BATTERY STORAGE SYSTEMS

Commissioning and maintenance

Test and logger solutions for the installation and maintenance of battery energy storage systems running on CAN networks

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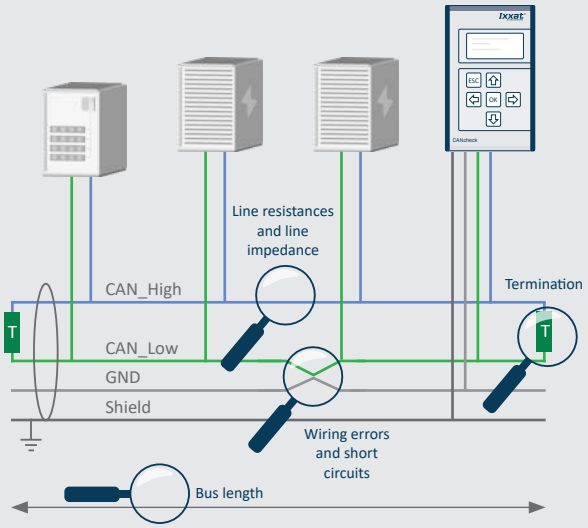
Components in battery energy storage systems (BESS) are networked with each other using a variety of different topologies, and sometimes over long distances. When using CAN (Controller Area Network), a large number of aspects have to be taken into account in order to establish robust communication and trouble-free operation. In addition, valuable system data is generated during operation, which, if used correctly, enables predictive maintenance and in-depth system analysis.

This white paper presents solutions for a simple, physical and signaling analysis of CAN installations to ensure interference-resistant communication. It also shows cost-effective approaches to implement predictive maintenance solutions using data logging and access to data from a remote location.

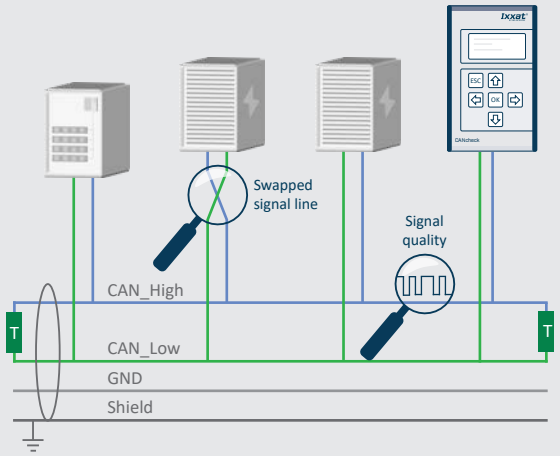
TOOL-SUPPORTED WIRING AND SIGNAL TEST

TEST POINTS OF PHYSICAL WIRING

The error-free function of the CAN system in BESS applications depends first and foremost on the correct wiring of the components (line, topology, etc.), compliance with the maximum bus length and correct termination. When wiring, there must be no electrical connection between the lines, line resistance (70 mΩ/m) and line impedance (120 Ω) must be within the permitted range of values, and the resistance between the line shield and ground needs to be within the specified range. Due to the topology and arbitration mechanisms of CAN, other possible sources of error must be excluded in addition to the wiring. To avoid signal reflections, the CAN bus must be terminated at both ends with a 120 Ω resistor.



Step-by-step and menu-guided analysis of the wiring in the switched-off state using Ixxat CANcheck.



Menu-guided analysis of signal levels in operation and node assignment based on identifiers.

TEST POINTS FOR COMMUNICATION AND SIGNAL TESTS

In addition to physical tests, a signal test helps to identify further possible network problems. An obvious error, for example, can be the swapping of the signal lines (CAN high and CAN low), which leads to communication problems with the affected node. In addition, care must be taken to ensure that the transmitted signals are of sufficiently good quality. For this purpose, the signal level and the common mode voltage of the transmitted messages are measured. According to the standard, the dominant signal level must be in a range between 1.5 and 3 V. For the common mode voltage, V_{CANL} must be greater than -2 V and V_{CANH} must be less than 7 V. Errors due to signal quality can cause sporadic problems that result in high troubleshooting and repair costs in the field.

With the hand-held Ixxat CANcheck installation tester from HMS, the BESS CAN network can be tested both physically and signal-wise.

This is achieved using individual tests or by an automated test sequence, which performs the defined tests in sequence and displays the test results clearly. For example, CANcheck checks the presence of the required termination resistors and their value, checks the system for short circuits, measures the length of the lines (see table) and the line impedance. As part of the system tests during operation, all message identifiers are determined and checked. Messages that have poor signal quality are detected and displayed. In addition, all transmitted messages are checked for protocol errors. The corresponding subscriber can easily be traced via the message identifiers. In addition to signal quality, a high bus load (too many messages per time unit) can lead to sporadic problems. For this reason, CANcheck calculates the bus load of the system and displays it as a percentage value. Experience shows that the bus load should be approximately 40% or below.

Bit rate (Kbps)	Maximum bus length (m)
500	110
250	280
125	620
100	790
50	1640

Table: Approximation values for bit rates and the resulting maximum bus lengths.

Cable typ	Bus length (m)
AWG22 0,25 mm²	100
AWG20 0,50 mm²	250
AWG18 0,75 mm²	500

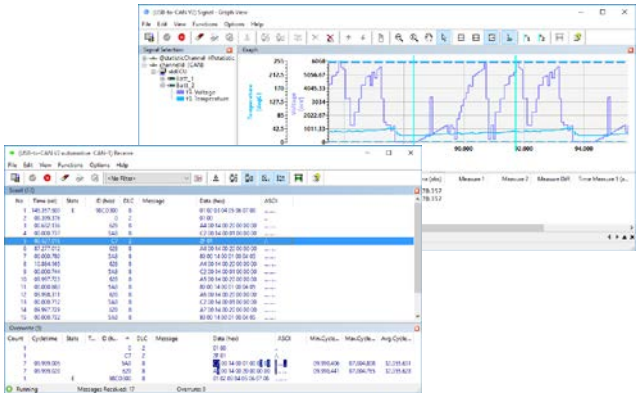
Table: Recommended line types for different bus lengths.

COMMUNICATION TEST AND VERIFICATION OF MESSAGE CONTENT

With technically flawless communication on the bus, a big step has already been taken. However, problems can occur in message communication between nodes for a variety of reasons, which require further analysis of the message format and message content. CAN message analysis can be used to monitor and check communication between nodes and to evaluate and assess the signals and commands transmitted via CAN.

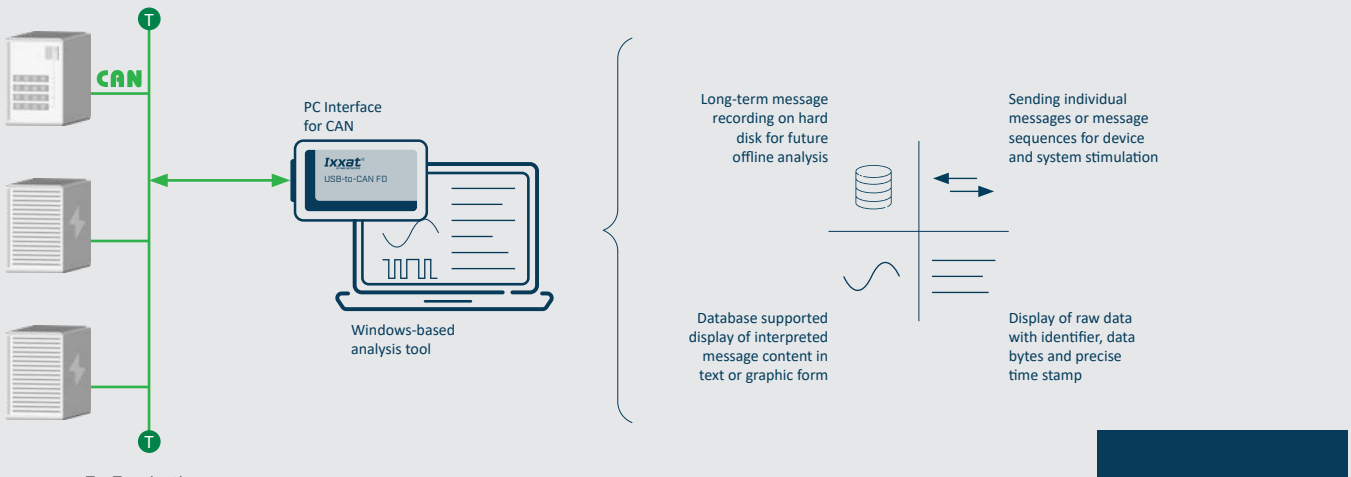
For larger amounts of data, a database-based breakdown and interpretation of the transmitted signals and commands is required for the best possible evaluation. These can then be displayed in plain text (temperature, voltage, etc.) or graphically. Protocol errors, device errors and errors in the transmitted data can thus be easily detected.

The Ixxat canAnalyser enables both message analysis and stimulation of nodes by sending messages. Via a CAN interface, e.g. USB-to-CAN compact, the tool can be connected to the CAN network to be tested via a notebook or desktop PC.



Display of received messages in raw data format with identifier and data field (left) and interpreted (right).

The data transmitted in the BESS network is shown online in raw format (identifier and data bytes) or interpreted by means of a database and displayed as signal values. In addition to online analysis, the canAnalyser also allows long-term recording of data with the aid of powerful filter and trigger functions. These data can be evaluated offline using canAnalyser, which is extremely useful especially in case of sporadically occurring errors. In order to test BESS device functions, Ixxat canAnalyser can also send messages for device stimulation.



Connection of a PC-based analysis tool to the CAN network of the BESS application, for online and offline analysis of the transmitted commands and signals.

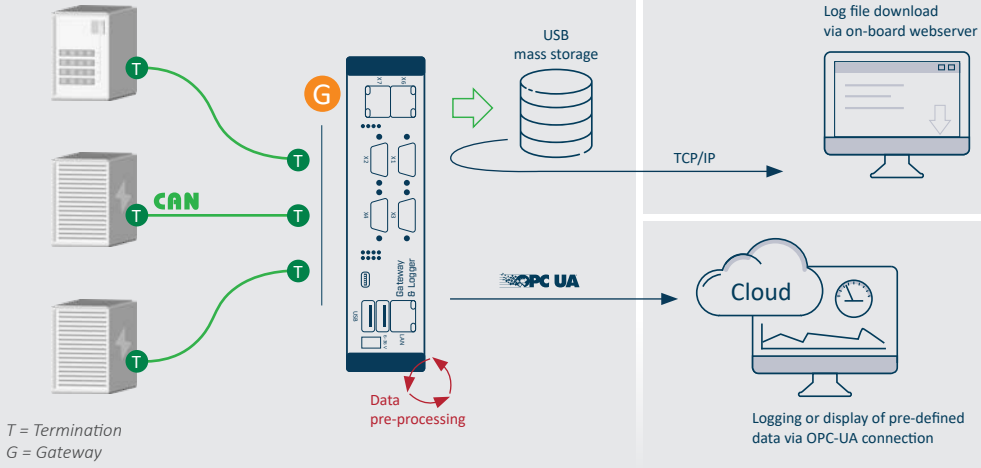
DATA LOGGING AND REMOTE ACCESS TO RECORDED DATA

Selective long-term recording of data supported by powerful filter and trigger functions enables the storage of signal values and limit-violation events, which are, among other things, required for targeted and predictive maintenance of BESS systems. This often requires comprehensive solutions that also enable a connection to the cloud and thus remote access to the data.

With the Ixxat CANnector, HMS offers a logger/bridge/cloud solution that combines several functions in one extremely cost-effective device. With its up to eight galvanically isolated CAN interfaces, the CANnector couples different CAN segments of the BESS application easily and securely and also offers powerful filter and mapping functions for this purpose. The data of all connected bus systems can be saved in various formats to a USB-connected storage medium using powerful trigger and filter functions. Configuration is achieved using drag & drop within an intuitive configuration tool.

The stored data can be accessed either locally or remotely, e.g. by file download via the integrated web server. Via OPC-UA, pre-selected data can be sent directly to the cloud, ideal for remote logging and monitoring of individual signals.

By adding user code, programmed in C, the three basic functions of the CANnector can be extended with the addition of customer-specific signal and data manipulation functions. An integrated development tool and remote debugging function are available for this purpose.



Cost-effective multifunctional use of the Ixxat CANnector, for star networking of BESS nodes, for recording of data and for transmission of pre-selected information to the cloud.

Products from HMS for CAN network testing and message analysis in battery energy storage systems

CANcheck

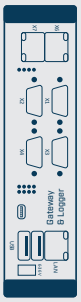
- Hand-held installation tester
- Enables menu-driven physical tests and communication tests
- Easy to use, even by service technicians without CAN experience

USB-to-CAN compact

- CAN PC interface for mobile and desktop-based use
- Suitable for analysis, configuration and control applications
- Driver support for Windows and Linux

canAnalyser

- Windows-based analysis tool for CAN
- Enables message analysis, message transmission and data interpretation
- Data logging with powerful trigger and filter functions
- Online and offline analysis



CANnector

- Multifunctional device with gateway, logging, and cloud functionality
- Simple drag-and-drop configuration, without programming
- Integrated web server for remote control and log file downloads
- Expandable through C user code