Utilizing Vehicle On-Board CAN Data to Simplify WLTP Energy Consumption Evaluations

Content

Introduction

As electric vehicles (EVs) gain prominence in the drive toward decarbonization, accurate measurement of electric range and energy consumption become essential for compliance with international standards like WLTP (Worldwide harmonized Light duty driving Test Procedure) and SAE J1634 (Battery Electric Vehicle Energy Consumption and Range Test Procedure, including EPA cycles). These standards allow multiple methods for measuring voltage and current, including direct instrumentation or vehicle on-board data. However, modern EV designs often make battery terminals inaccessible, complicating direct voltage measurements, while high-density component packaging hinders current probing. This leads to varied testing patterns across vehicle models, potentially increasing equipment costs and procedural complexity.

Using on-board data via controller area network (CAN) offers a practical alternative, provided accuracy is verified per regulatory requirements. Hioki's solutions enable seamless integration of real measurements and CAN data, allowing technicians to handle all test patterns with a single instrument. This approach streamlines workflows, reduces setup time, and ensures reliable results, benefiting R&D engineers and certification teams by minimizing errors and enhancing efficiency in EV development and quality assurance.

Standards for EV Range and Energy Consumption Testing

International standards WLTP and SAE J1634 outline acceptable methods for

calculating one-charge driving range (km) and energy consumption (Wh/km) based on voltage and current measurements.

For WLTP:

Parameter	Methods
Current	Method 1: Measure with an instrument meeting accuracy requirements. Method 2: Use vehicle on-board current data. However, the manufacturer must prove the on-board data's accuracy to the certification authority.
Voltage	Method 1: Measure with an instrument meeting accuracy requirements. Method 2: Use vehicle on-board voltage data. However, the manufacturer must prove the on-board data's accuracy to the certification authority.

For SAE J1634:

Parameter	Methods
Current	Method 1: Measure with an instrument meeting accuracy requirements.
Voltage	Method 1: Measure with an instrument meeting accuracy requirements. Method 2: Use vehicle on-board voltage data. However, discharge energy calculated from on-board data must match that measured by a power analyzer or similar.

Challenges in EV Testing

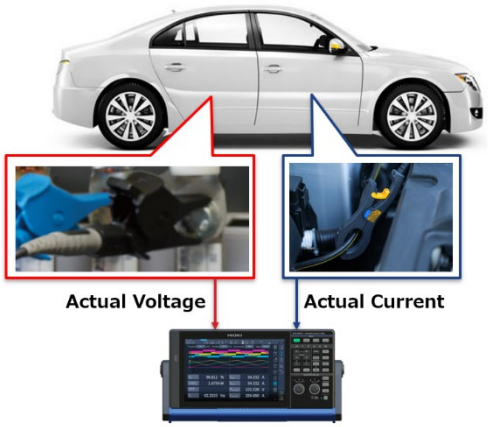
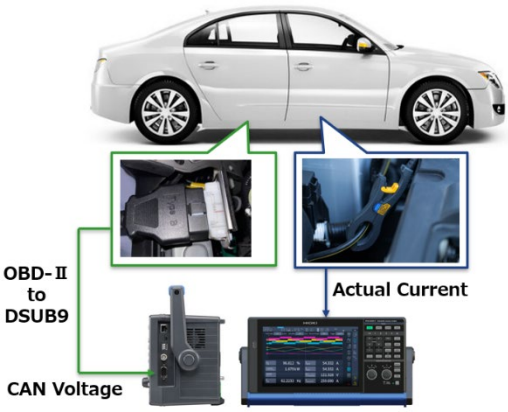
Current EV structures restrict easy access to battery terminals, making voltage measurement difficult. Furthermore, due to the packaging of multiple components and the increasing density of mounted components, current measurement has also

become difficult. Consequently, there is a shift toward using vehicle on-board data in WLTP and SAE J1634 range tests instead of direct measurements. Yet, certification requires meeting specific criteria, limiting universal application. This results in multiple patterns—direct measurement, on-board data, or combinations—varying by vehicle model. Employing different equipment for each pattern raises equipment costs and complicates test procedures.

Solutions from Hioki

Hioki's PW4001 power analyzer features CAN input functionality, supporting both direct measurements and vehicle on-board data (CAN) for range and energy consumption tests. One unit covers all patterns, eliminating the need for multiple devices and simplifying operations.

Supported measurement methods:

Measured voltage × measured current (Traditional approach)  	CAN voltage × measured current (Uses on-board voltage with probe-based current) 

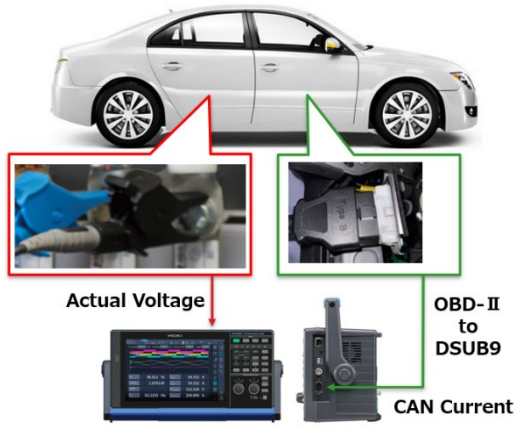
Measured voltage × CAN current (Combines probe-based voltage with on-board current)	CAN voltage × CAN current (Fully leverages on-board data for non-invasive testing)
	

Fig. 1. Measurement Methods Supported by Hioki's solution

This versatility reduces equipment investment and streamlines test setups, allowing engineers to focus on data analysis rather than hardware reconfiguration.

Two CAN Measurement Methods: DBC-Based and DIAG Measurement

On-board data acquisition via CAN primarily falls into two categories: DBC-based CAN measurement and diagnostic (DIAG) measurement.

- **DBC-based CAN measurement**
  CAN data varies by vehicle model and manufacturer in terms of IDs and definitions, typically requiring a CAN database (DBC). This is DBC-based measurement. Vehicles may output CAN signals automatically or require

queries from the instrument.

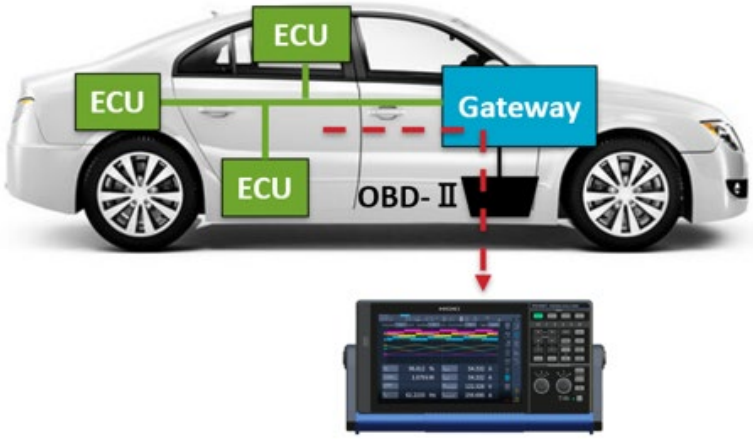


Fig. 2. CAN Measurement Diagram When CAN Data is Automatically Output

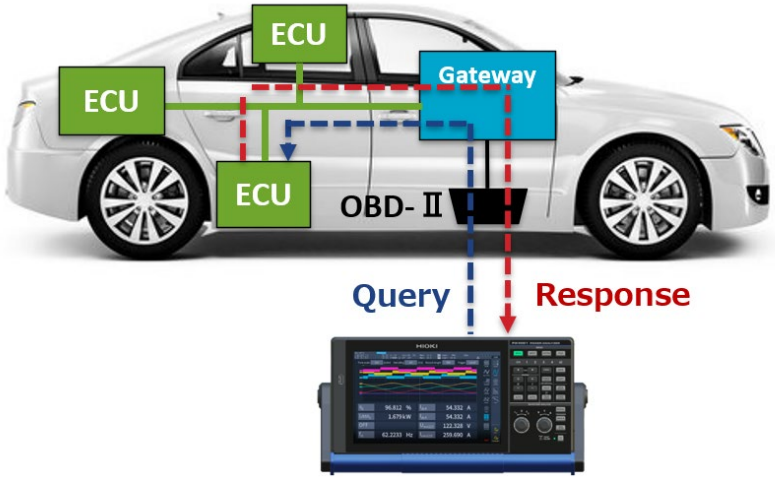


Fig. 3. CAN Measurement Diagram When a Query is Required

For measurement, it is necessary to register database information into the PW4001. This can be done by either directly inputting the information into the PW4001 or sending it via dedicated software on a PC.

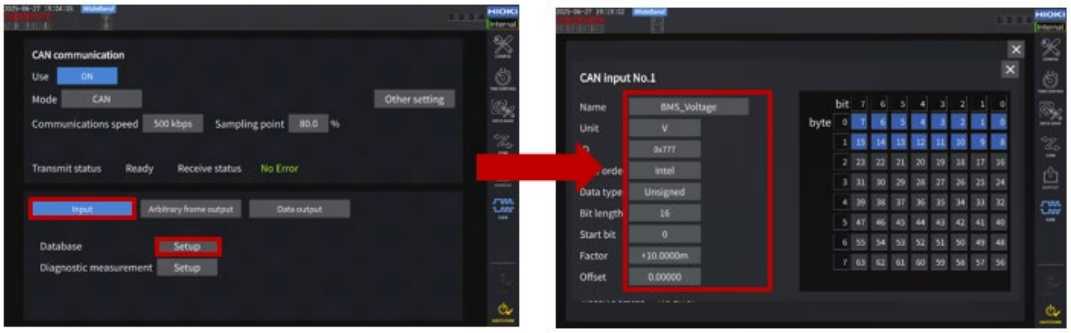


Fig. 4. Setup Method 1: Directly Inputting Database Information into the PW4001

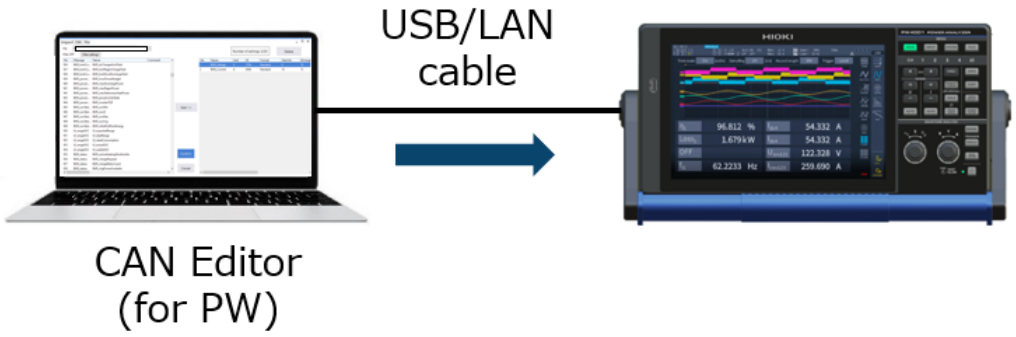


Fig. 5. Setup Method 2: Sending DBC File Information from a PC (Dedicated Software)

- **Diagnostic measurement (DIAG)**
  DIAG uses the vehicle's on-board diagnostics to acquire data, standardized by SAE J1979, often eliminating the need for custom databases. However, manufacturers define most output data arbitrarily, so not all specified items are available. Unique data requires definitions. Vehicle-specific details like ECU addresses and CAN formats must be input beforehand.

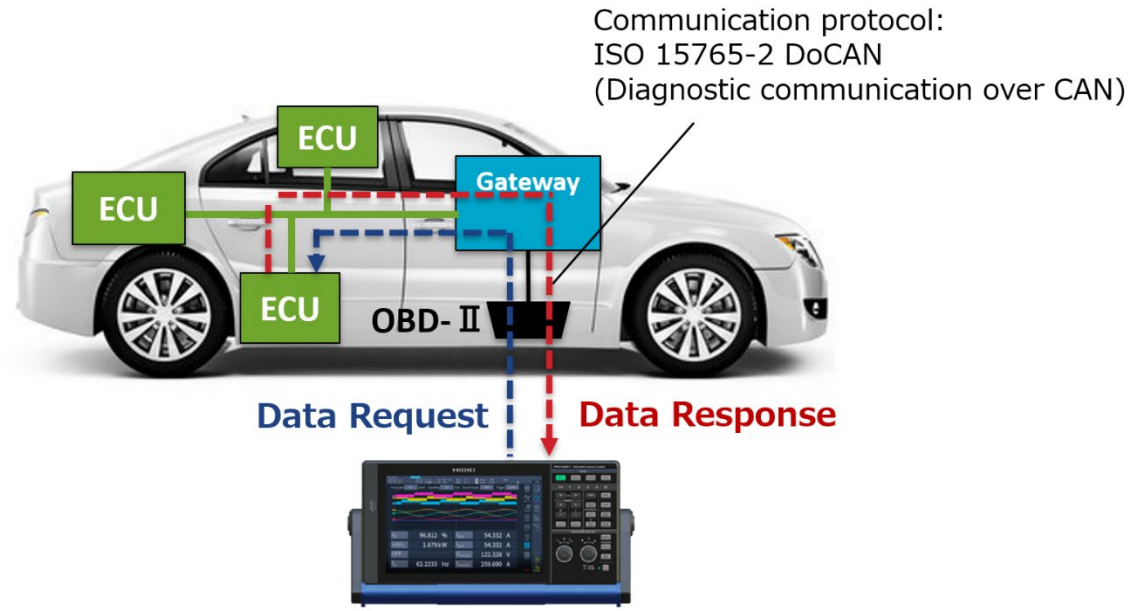


Fig. 6. DIAG Measurement Diagram

Following ISO15765-2 DoCAN (Diagnostic communication over CAN), data is obtained by sending a query to the vehicle.

Pre-set items include battery management system (BMS) parameters from SAE J1979 or J1979-2. Customize as needed for other or proprietary items.

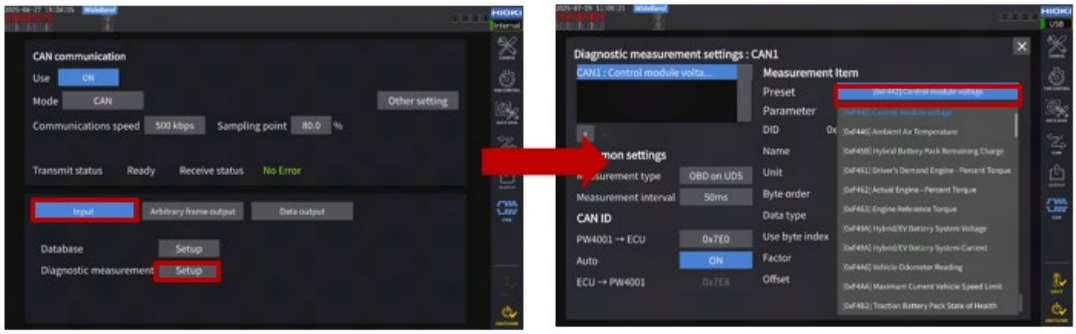


Fig. 7. Selecting Items to Retrieve from Presets

Real-Time Calculation of Power (W) and Energy (Wh)

The PW4001 freely combines direct values and CAN data for real-time power and energy calculations. Results can be sent to upper-level test systems via communication commands, XCP on Ethernet, or Modbus, just like standard measurements. Data updates at intervals of 50 ms, meeting WLTP and SAE J1634 requirements.

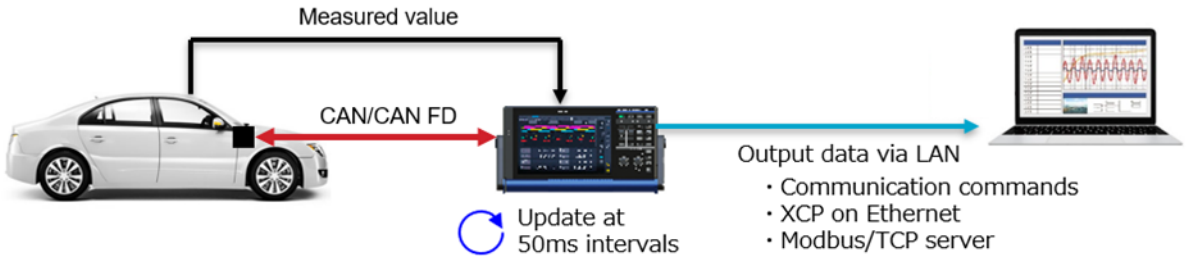


Fig. 8. 50 ms Interval Communication Meeting WLTP and SAE J1634 Requirements

Power (W) Energy (Wh)

Fig. 9. Calculation Example Using CAN Voltage and Measured Current

Fig. 10 Real-Time Monitoring of Calculation Results

This capability ensures precise, timely insights, enhancing test reliability and confidence in compliance verification.

Conclusion

In WLTP and SAE J1634 range and energy consumption tests, users may want to

use on-board data or data measured by power analyzers, creating multiple possible combinations of data sources. Hioki's PW4001 addresses this by supporting all combinations in one instrument, resolving issues of rising costs and procedural complexity. This makes measurement efficient and accurate while adapting to demands arising from diverse EV models in the market. In short, this proposal saves time and resources while maintaining high standards.

To explore how this solution can optimize your EV testing, consider the PW4001 for purchase or download the user's guide from the Hioki website. Contact us for detailed consultations and demonstrations tailored to your needs. Hioki delivers innovative tools for safer, more effective EV development.

Related Products

- PW4001
- CAN Editor (for PW) – Free download software

Contact Information

If you have any questions or need further information, please feel free to reach out to us using our inquiry form at the link below:

Contact Us

To learn more about our power analyzers, please visit the following page for detailed information:

Learn More About Hioki's Power Analyzers

We are always here to assist you with any questions or inquiries.