HIOKI
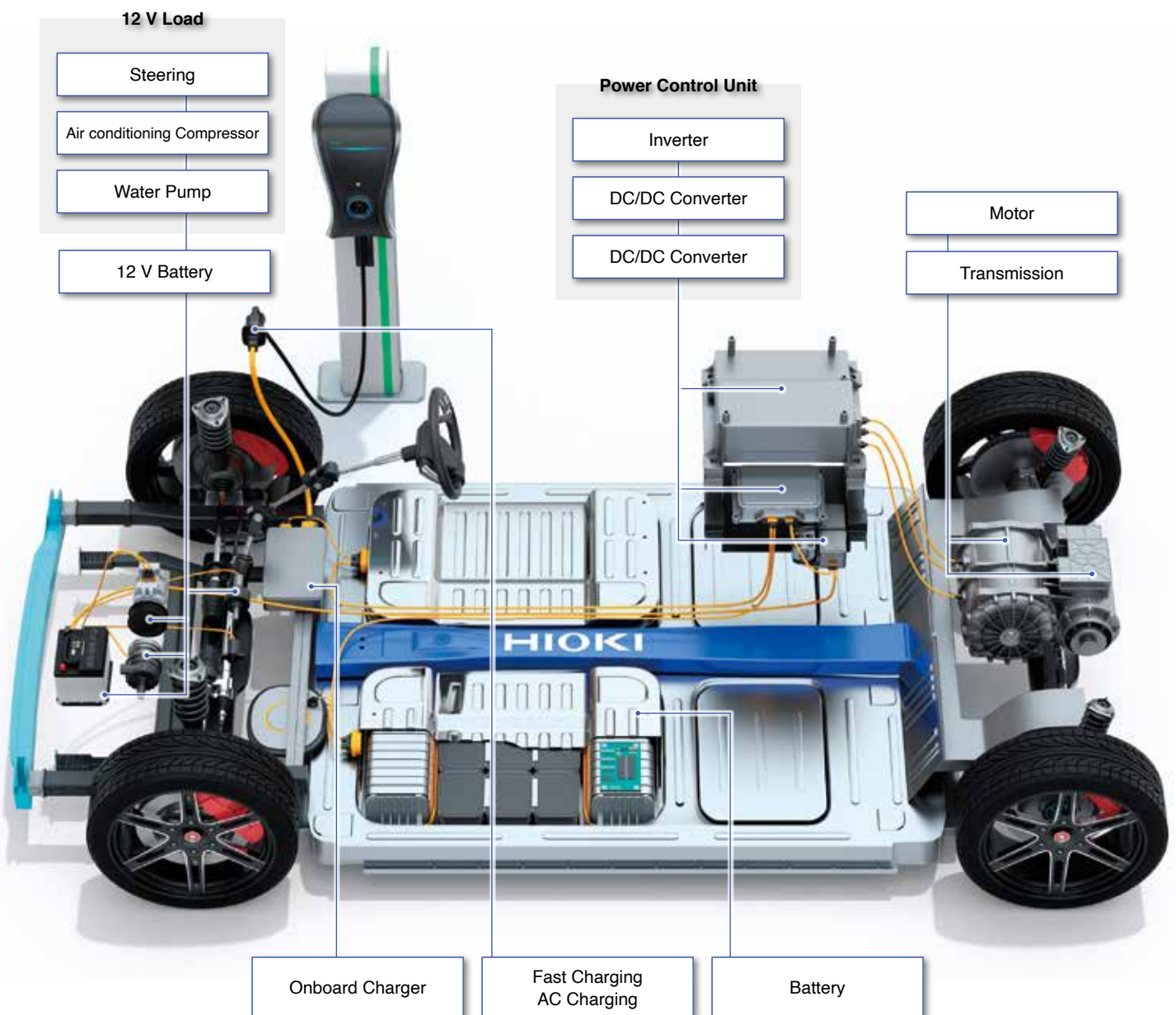
***Motor Measurement,
from Performance Analysis
to Quality Testing***

Measurement Application Profile

Improving Motor Performance and Quality High-Precision Measurement Solutions

Hioki offers a diverse array of motor measurement solutions that can be used in applications ranging from performance analysis to quality testing. The ability to assess and analyze using high-precision measurement technologies provides valuable assistance to engineers as they work to increase motor performance and quality.

12 V Load

- Steering
- Air conditioning Compressor
- Water Pump
- 12 V Battery

Power Control Unit

- Inverter
- DC/DC Converter
- DC/DC Converter

- Motor
- Transmission

Onboard Charger

Fast Charging
AC Charging

Battery

Design / Development

Production / Testing

4

Evaluating Inverter Motor Efficiency and Loss

Simultaneously measure inverter input and output power, and motor output.
Evaluate inverter, motor, and overall system efficiency and loss in an accurate and highly reproducible manner.
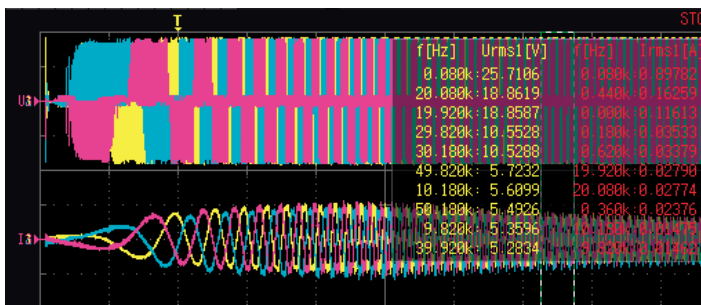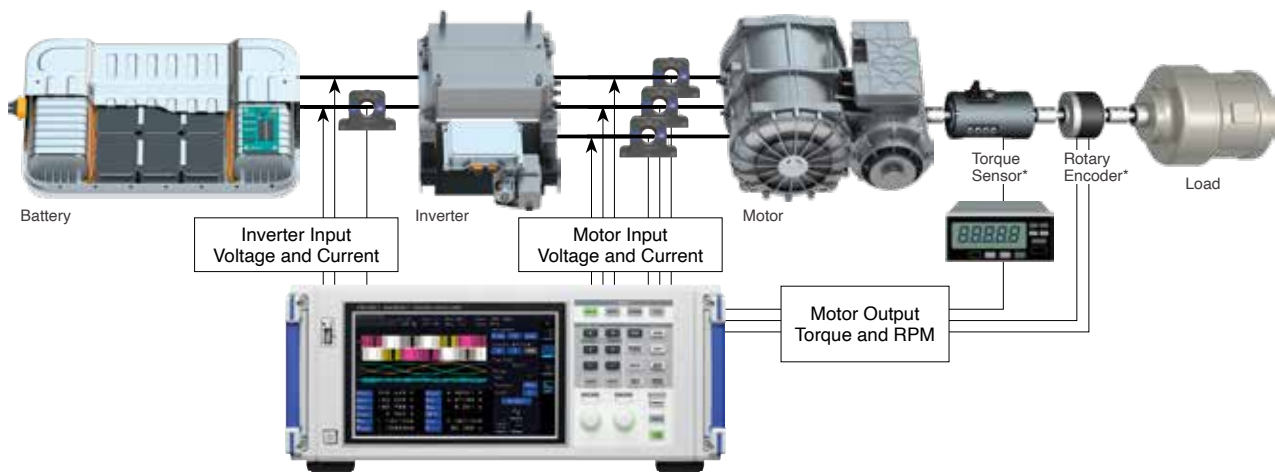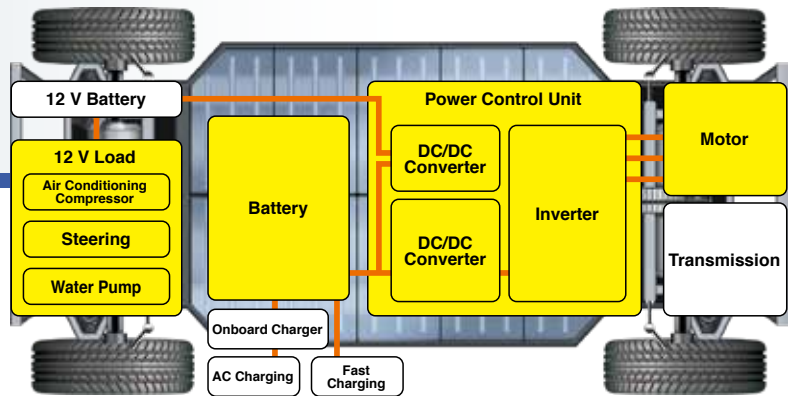
Analyzing Waveforms at Motor Start

Reliably capture and analyze instantaneous waveforms at the start of motor operation.
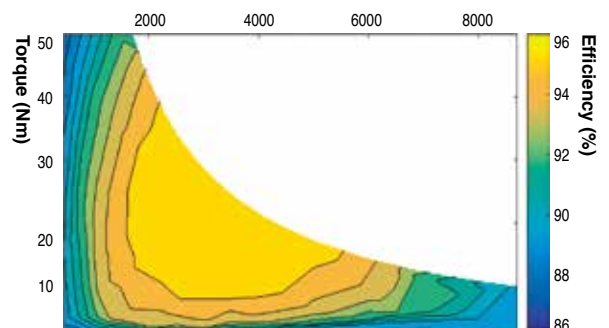
Efficiency/Loss Map

Created using measurement data and MATLAB.
(MATLAB is a registered trademark of MathWorks.)

POWER ANALYZER
PW6001

AC/DC CURRENT SENSOR
CT6875, CT6876

PW6001
· Power measurement (6 channels with 1 instrument or up to 12 channels by connecting 2 instruments)
· Basic accuracy (power) of ±0.05%
· Waveform analysis without an oscilloscope; triggers specifically designed for motor analysis

CT6875, CT6876
· 500 A AC/DC, DC to 2 MHz (CT6875)
· 1000 A AC/DC, DC to 1.5 MHz (CT6876)
· Basic accuracy (power) of ±0.048%

* Please prepare the torque sensor and rotary encoder separately.

Inverter Motor ECU Measurement and Calibration

Make quick work of PCU calibration by taking advantage of PW6001 and INCA[1] link functionality so that you can use the PW6001 to perform accurate power and motive power measurement. You can simultaneously monitor CAN bus data and ECU RAM values.
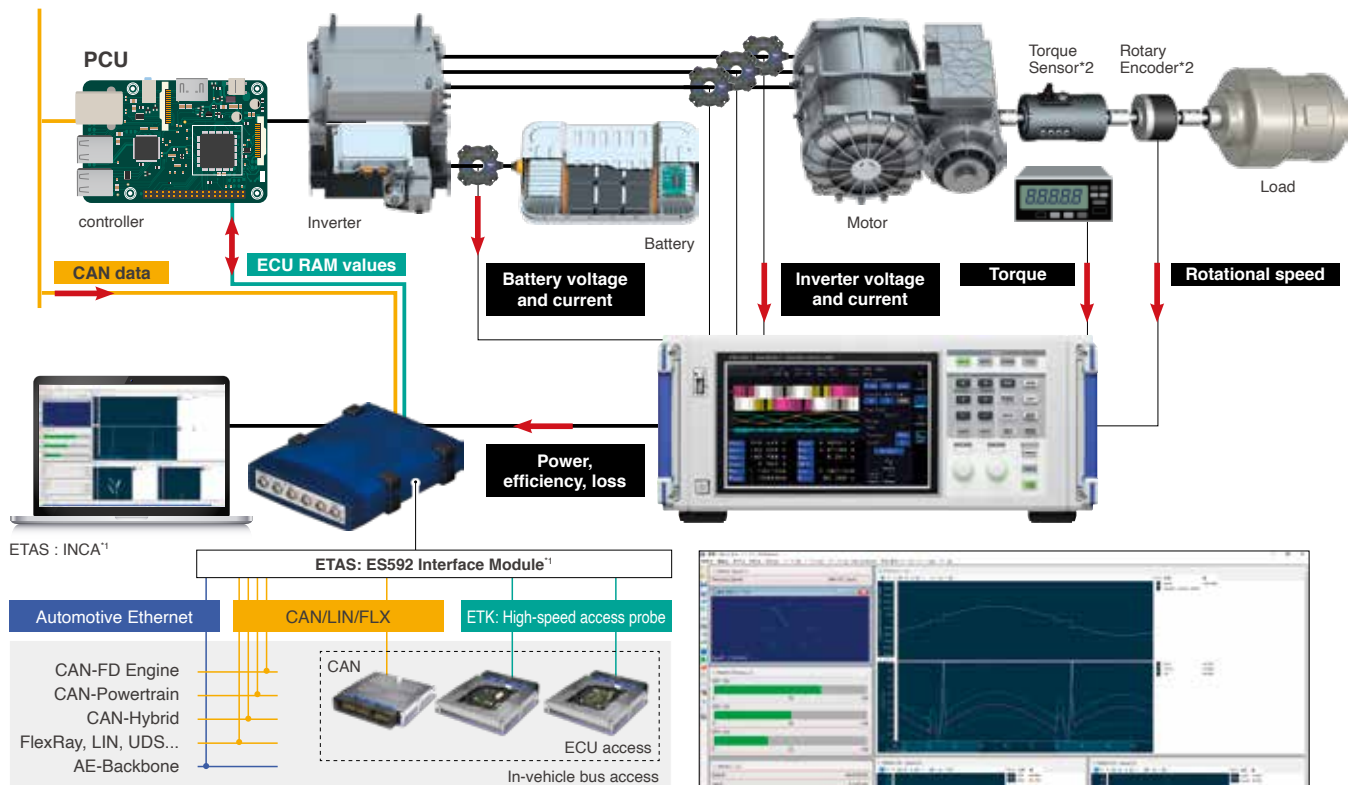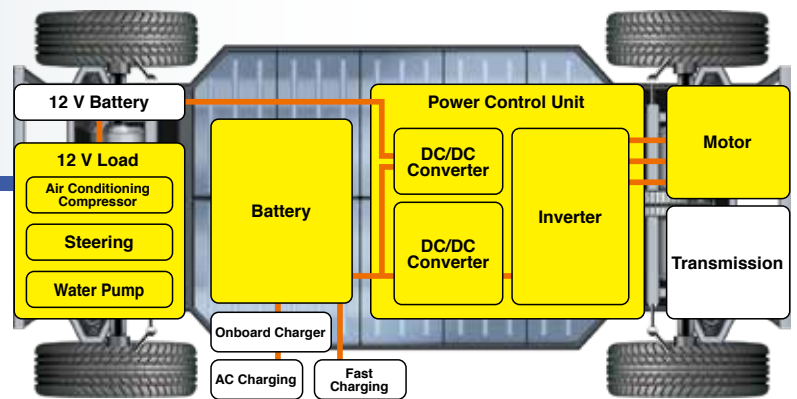
Increase efficiency of measurement experiments and calibration INCA measurement, calibration, and diagnosis tool[1]

- Parameters can be rewritten during PCU operation
- High-speed monitoring of ECU RAM
- Aggregate data from multiple measurement system and buses into one intensive software

Example display from INCA (ETAS)

Comparison of measured values from a connected Power Analyzer PW6001, against CAN data and ECU RAM values

POWER ANALYZER
PW6001

AC/DC CURRENT SENSOR
CT6904, 6904-60

PW6001
- Power measurement (6 channels with 1 instrument or up to 12 channels by connecting 2 instruments)
- Basic accuracy (power) of ±0.05%
- Waveform analysis without an oscilloscope; triggers specifically designed for motor analysis

CT6904, CT6904-60
- 500 A AC/DC, DC to 4 MHz (CT6904)
- 800 A AC/DC, DC to 4 MHz (CT6904-60)
- Basic accuracy (power) of ±0.048%

ETAS [1] Inquiries concerning ETAS tools should be directed to www.etas.com.

[2] Please prepare the torque sensor and rotary encoder separately.

Identifying PMSM Motor Parameters

Identify more accurate motor control motor control by using motor parameters measured under actual operating conditions in upstream design processes.

PMSM
Permanent magnet synchronous motors (PMSMs) have been attracting attention in recent years as a type of 3-phase AC motor that can deliver low energy loss and significantly reduced power consumption.

12 V Battery		Power Control Unit	Motor
12 V Load	Battery	DC/DC Converter	
Air Conditioning Compressor		Inverter	
Steering		DC/DC Converter	Transmission
Water Pump			
Onboard Charger			
AC Charging	Fast Charging		

Battery — Inverter — Motor — Torque Sensor* — Rotary Encoder* — Load

Inverter Input Voltage and Current

Motor Input Voltage and Current

Torque
A-phase Pulse
Z-phase Pulse

Identifying Advanced Motor Control

In order to identify advanced motor control, it is necessary to take into account the current dependence of the d-axis and q-axis inductance Ld and Lq, which in the past were treated as constants.
The PW6001 can carry out d-axis and q-axis vector analysis of voltage and current during motor operation. Since that data can be used to calculate Ld and Lq in real time, it is possible to measure the current saturation characteristics of motor parameters.

$$L_d = \frac{v_q - Ke \cdot \omega - R \cdot i_q}{\omega \cdot i_d} \qquad L_q = \frac{R \cdot i_d - v_d}{\omega \cdot i_q}$$

q axis

$R \cdot i_d - \omega \cdot L_q \cdot i_q$

$\omega \cdot L_d \cdot i_d$

$R \cdot i_q$

$i1$ i_q

θi

$Ke \cdot \omega$

v_1
(v_d, v_q)

θv

i_d

d axis
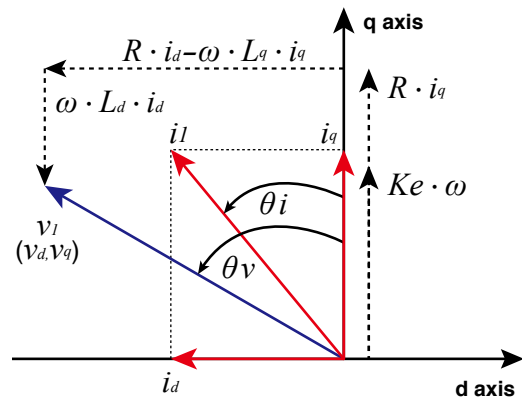
POWER ANALYZER
PW6001

AC/DC CURRENT SENSOR
CT6875, CT6876

PW6001
· Provides electrical angle measurement functionality that is needed to analyze vector control.
· Can display voltage and current vectors based on the d- and q-axes.
· Provides user-defined numerical calculation functionality that is useful when measuring motor parameters.

CT6875, CT6876
· 500 A AC/DC, DC to 2 MHz (CT6875)
· 1000A AC/DC, DC to 1.5MHz (CT6876)
· Basic accuracy (power) of ±0.048%

*Please prepare the torque sensor and rotary encoder separately.

Test Automobile Fuel Economy

Taking fuel economy measurements that comply with WLTP international standards requires the precise measurement of current integration and power integration for the recharging/discharging of each battery in the system. High accuracy clamp current sensors, the excellent DC accuracy of the PW3390, and the ability to integrate current and power at 50 ms intervals are extremely effective in meeting this application.

Power Control Unit diagram: 12 V Battery, 12 V Load (Air Conditioning Compressor, Steering, Water Pump), Battery, DC/DC Converter, DC/DC Converter, Inverter, Motor, Transmission, Onboard Charger, AC Charging, Fast Charging

Inverter, Car charger, Battery, Motor, Auxiliary battery, Charging facility

Test Cycle Example

LOW PHASE, MEDIUM PHASE, HIGH PHASE, Extra HIGH PHASE

Example of DC Power Fluctuation

Discharge power Wh(+), Recharge power Wh(-)

High Accuracy Sensor, Clamp Type Sensitivity Fluctuation due to Temperature

CT6846-05 (1000 A), CT6845-05 (500 A); CT6844-05 (500 A); CT6843-05 (200 A); CT6841-05 (20 A); Legacy models 9279 (500 A), 9278 (200 A), 9277 (20 A)

Current and Power Integration Function by Polarity

DC integration measurement integrates the recharging power and discharging power by polarity for every sample at 500 kS/s, and measures positive-direction power magnitude, negative-direction power magnitude, and the sum of positive- and negative-direction power magnitude during the integration period. Accurate measurement of recharging power and discharging power is possible even if there is rapid repetition of battery recharging/discharging.

Optimal Current Sensors for Automotive Testing

Easily connect high accuracy clamp-type sensors without cutting the cables. Sensors operate over a temperature range of -40°C to 85°C (-40°F to 185°F), characteristics that enable highly accurate measurements even inside the engine room of a car.

Equipment Used

POWER ANALYZER PW3390

AC/DC CURRENT PROBE CT684X Series

PW3390
• Basic accuracy (power) of ±0.04% rdg±0.05% f.s

CT684X Series
• 20A AC/DC, DC to 1MHz (CT6841-05)
• 200A AC/DC, DC to 500kHz (CT6843-05)
• 500A AC/DC, DC to 200kHz (CT6844-05)
• 500A AC/DC, DC to 100kHz (CT6845-05)
• 1000A AC/DC, DC to 20kHz (CT6846-05)

Measuring Motor Temperature

Apply thermocouples to the motor frame and winding to record temperature variations. Display and record differences in temperature relative to the measurement environment as a waveform in real time.
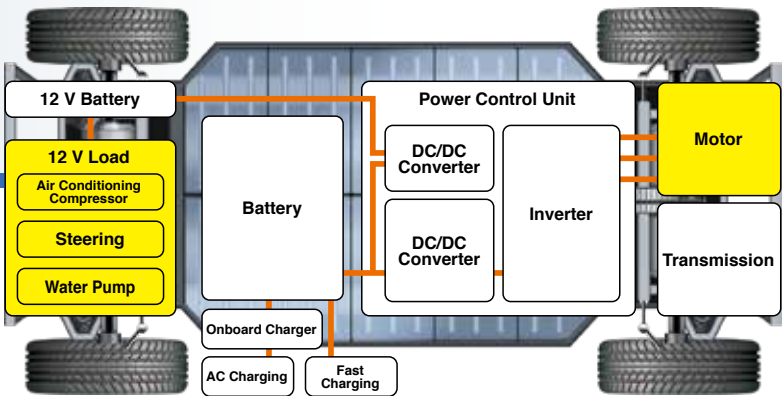
Accommodates up to four units

Voltage: from 1 ms sampling
Temperature: from 10 ms sampling
Strain: from 1 ms sampling
Humidity: from 10 ms sampling
Resistance: from 10 ms sampling

U8550

Ambient Temperature

Winding Temperature

LR8450
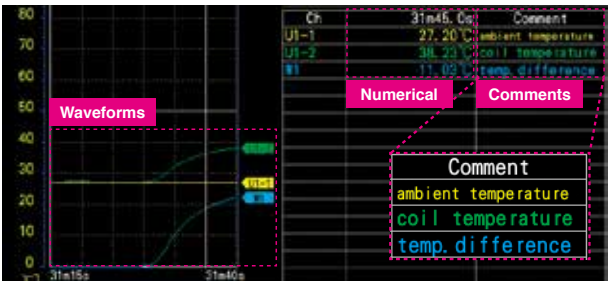
Display Waveforms, Values, and Comments on The Screen

The instrument can simultaneously display waveforms and numerical values. Recorded data can be identified easily since user-entered comments can be displayed along with the data.
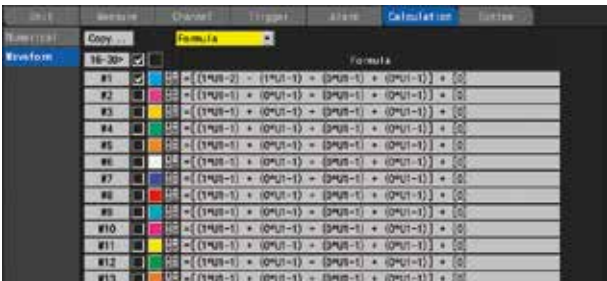
Record The Differences Between The Ambient Temperature and The Winding Temperature

By configuring calculation formulas with the waveform calculation function, you can record the differences between temperature measurements along with the measurement results.

MEMORY HiLOGGER LR8450

VOLTAGE/TEMP UNIT U8550

LR8450
The instrument accommodates various measurement units.
These units can measure not only temperature,
but also voltage and strain at a 1 ms sampling period.

LR8450-01 (wireless LAN model)
The LR8450-01 can accommodate wireless units such as the LR8530 Wireless Voltage/Temp Unit, eliminating the need to wire together the instrument and unit.

EV and EV Motor Evaluation Using CAN/CAN FD

Accurately assess behavior during HILS testing and vehicle evaluation by simultaneously measuring control and sensor data on the CAN bus and actual analog values.

12 V Battery

Power Control Unit

12 V Load
- Air Conditioning Compressor
- Steering
- Water Pump

Battery

DC/DC Converter

DC/DC Converter

Inverter

Motor

Transmission

Onboard Charger

AC Charging

Fast Charging

ECU · GPS · Radar · ECU · Onboard camera · Instrument panel · Brakes · Steering angle · Wheel speed · ECU · ESP · Engine · Wheel speed · Water temperature gauge · G sensor · Throttle · ECU · Air-conditioning control · ECU · Radar · TCS · Wheel speed · ECU

Connect using a sub-harness or SP7001/SP7002

SP7001/SP7002
Evaluate vehicles with peace of mind by detecting signals from outside wire insulation.

USB

- Simple USB connection
- Capture all data on the CAN bus during measurement
- Load DBC files with the MR6000
- CAN trigger function
  Data frames
  Remote frames
  Error frames

Steering wheel angle

Steering wheel rotation speed

Brake pressure

Parking brake on/off
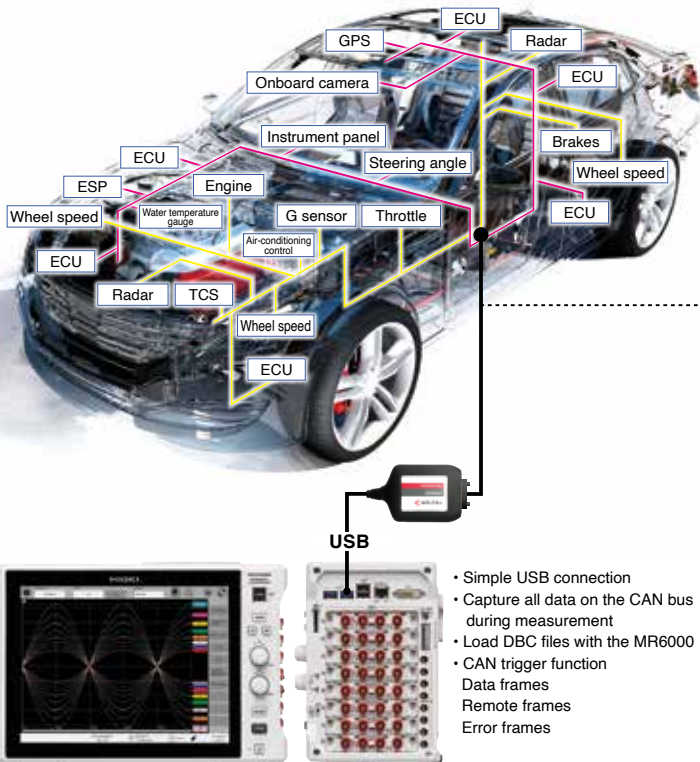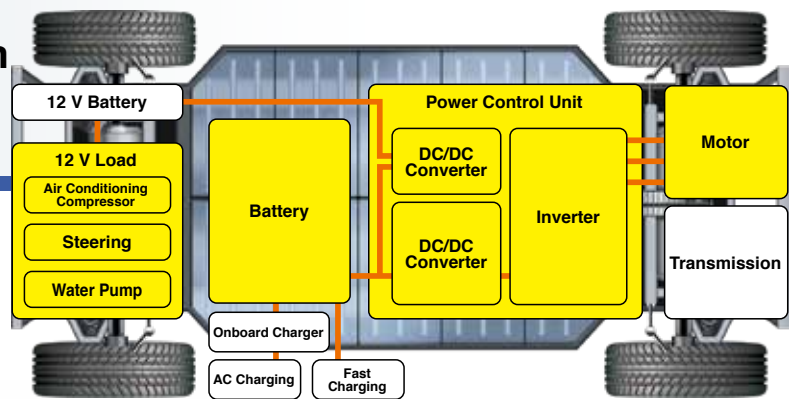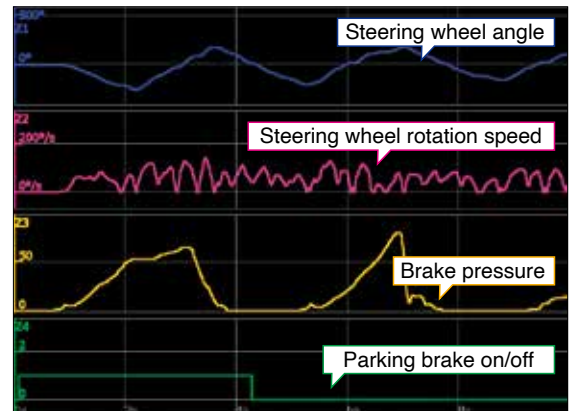
Choose signals to display after measurement

Vehicle evaluation

When dealing with parameters that are difficult to measure in assembled vehicles, you can use data on the CAN bus to assess vehicle condition and status. Use the Non-Contact CAN Sensor SP7001/SP7002 to monitor a CAN bus without the need for bothersome preparations like fabricating sub-harnesses or modifying cables. Simply remove the sensors when you're finished, without any effect on the vehicle.

Equipment Used

U8978 · U8977 · 8970 · U8969

9322 · CT6843-05 · L9197

MR6000/MR6000-01 · SP7001-90/SP7002-90

*1 Torque sensor (strain gage-type converter)
(For more information about the sensor, please contact the sensor manufacturer.)
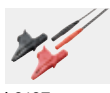
- MEMORY HiCORDER MR6000/MR6000-01
- NON-CONTACT CAN SENSOR SP7001-90/SP7002-90
- 4CH ANALOG UNIT U8978
- DIFFERENTIAL PROBE 9322
- 3CH CURRENT UNIT U8977
- AC/DC CURRENT PROBE CT6843-05
- FREQ UNIT 8970
- CONNECTION CORD L9197
- STRAIN UNIT U8969
- Torque sensor*1

Measuring Dynamic Motor Characteristics

Record inverter output voltage and current, torque, and RPM from motor start to stop. Calculate inverter output power, motor power, and motor efficiency using waveform calculations.

Power Control Unit

- 12 V Battery
- 12 V Load
  - Air Conditioning Compressor
  - Steering
  - Water Pump
- Battery
- DC/DC Converter
- DC/DC Converter
- Inverter
- Motor
- Transmission
- Onboard Charger
- AC Charging
- Fast Charging

Inverter

- Output Voltage
- Output Current
- Torque
- RPM

Motor

— Motor efficiency — Rotation
— Motor power — Torque
— Inverter output

Output Voltage		Output Current	
U8978	9322	U8977	CT6841-05

Torque		RPM	
U8969	Torque Sensor*1	8970	L9197

Stop · Start · Increasing RPM · Decreasing RPM · Stop

Motor efficiency
Torque
Inverter output power
Motor power

RPM   RPM

Calculate Inverter Output Power, Motor Power, and Motor Efficiency Using Waveform Calculations

Calculate motor power, motor efficiency, and inverter output power after measurement using high-speed waveform calculations and display the results using the instrument's X-Y display function. The ability to use the X-Y display for waveform calculation results as well as input signals from measurement units means you can perform a broad range of analyses. Additionally, X-Y analysis can be performed at user-specified areas of the recorded fluctuating waveform, since you can choose waveform areas for generating an X-Y display.

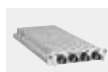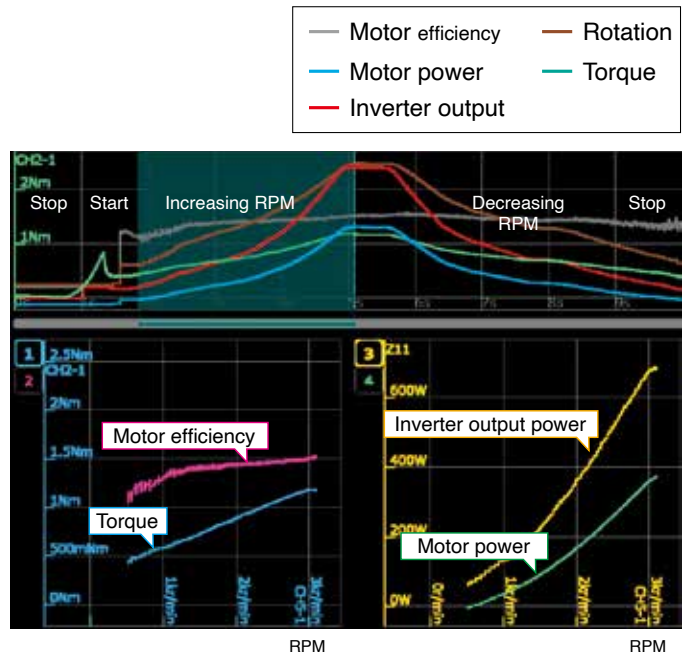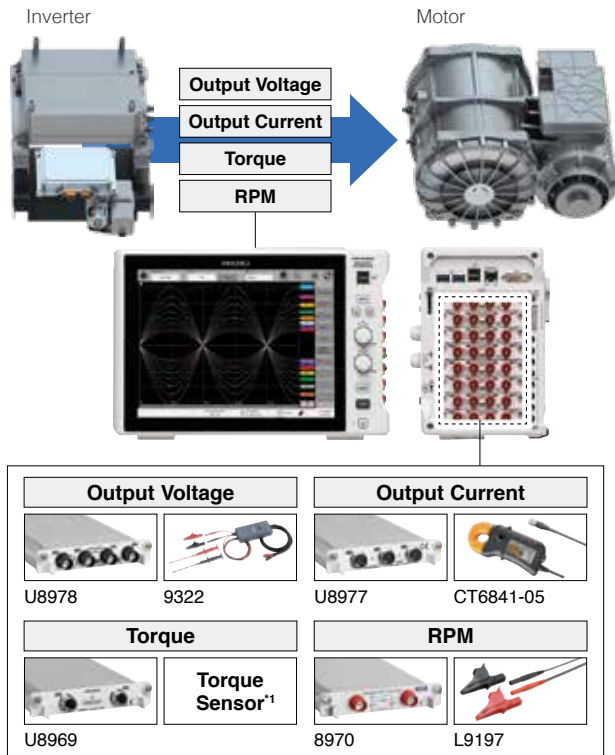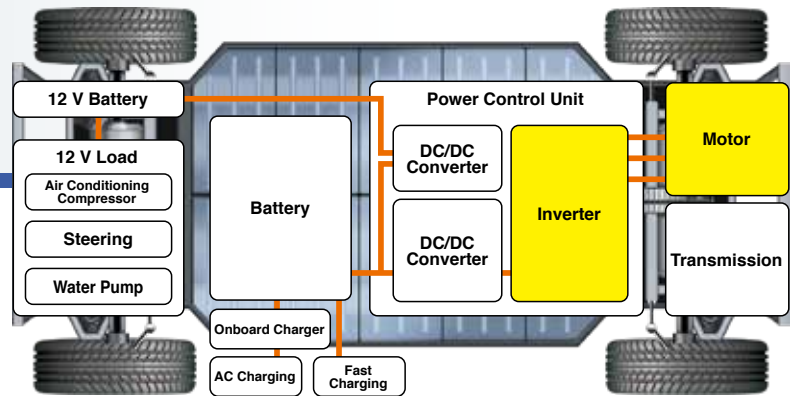### Equipment Used
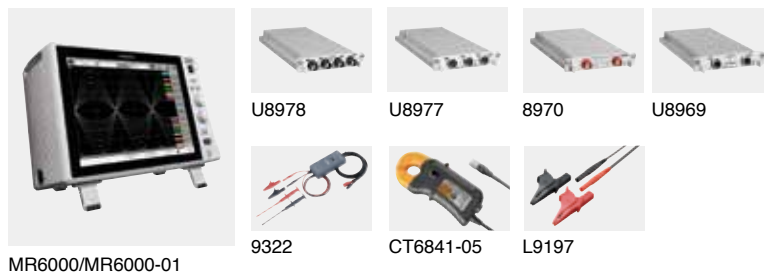
MR6000/MR6000-01

U8978   U8977   8970   U8969

9322   CT6841-05   L9197

- MEMORY HiCORDER MR6000/MR6000-01
- 4CH ANALOG UNIT U8978
- DIFFERENTIAL PROBE 9322
- 3CH CURRENT UNIT U8977
- AC/DC CURRENT PROBE CT6841-05
- FREQ UNIT 8970
- CONNECTION CORD L9197
- STRAIN UNIT U8969
- Torque sensor*1

*1 Torque sensor (strain gage-type converter) (For more information about the sensor, please contact the sensor manufacturer.)
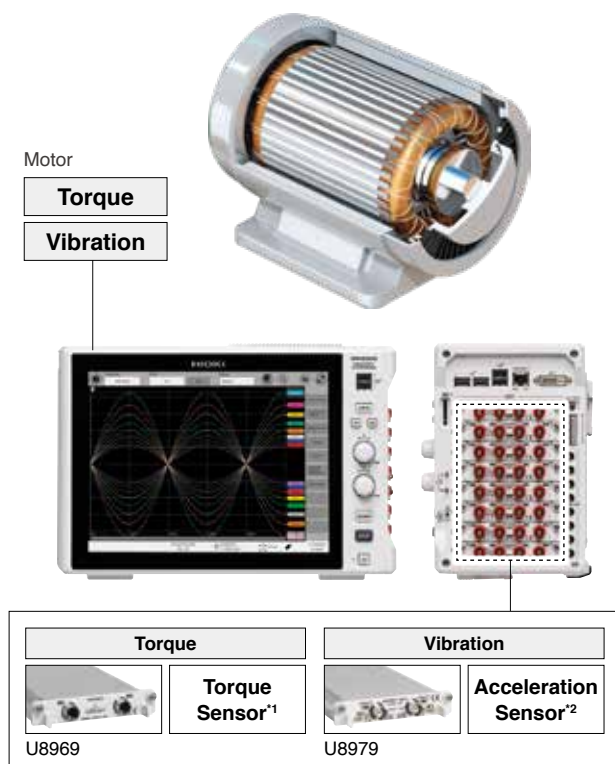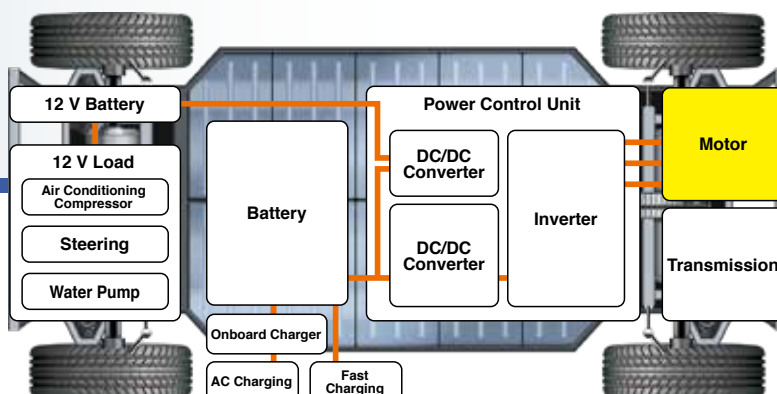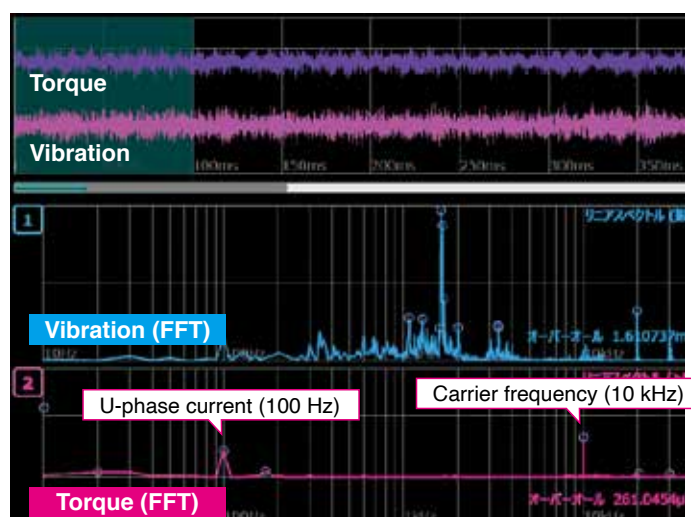
Measuring Motor Torque Vibrations

Measure torque and vibration, and analyze behavior during motor operation. Discover resonance phenomena and other unpredicted frequency components by using FFT calculations to perform a frequency analysis.

| 12 V Battery |
| 12 V Load |
| Air Conditioning Compressor |
| Steering |
| Water Pump |
| Onboard Charger |
| AC Charging | Fast Charging |

| Power Control Unit |
| DC/DC Converter |
| DC/DC Converter |
| Battery |
| Inverter |
| Motor |
| Transmission |

Motor
Torque
Vibration

Torque		Vibration	
	Torque Sensor[*1]		**Acceleration Sensor**[*2]
U8969		U8979	

Record Torque and Vibration.

Torque
Vibration

100ms   150ms   200ms   250ms   300ms   350ms

Vibration (FFT)

U-phase current (100 Hz)   Carrier frequency (10 kHz)

Torque (FFT)

Perform Frequency Analysis Using FFT Calculations.

The MR6000/MR6000-01's FFT calculation functionality can be used to perform frequency analysis of torque and vibration signals. The MR6000/MR6000-01's FFT calculation functionality can analyze 8 phenomena simultaneous per measurement. By performing FFT analysis of signals input to different channels, it is possible to analyze frequency components occurring at the same time on different channels.

Equipment Used

U8969   U8979

MR6000/MR6000-01

· MEMORY HiCORDER MR6000/MR6000-01
· STRAIN UNIT U8969
· Torque sensor[*1]
· CHARGE UNIT U8979
· Acceleration sensor[*2]

The torque sensor (strain gage-type converter) is connected to the Strain Unit U8969 to measure torque. An acceleration sensor affixed to the chassis, on which the motor is mounted, is connected to the Charge Unit U8979 to measure vibrations being transferred to the chassis.

[*1] Torque sensor (strain gage-type converter) (For more information about the sensor, please contact the sensor manufacturer.)
[*2] Charge output type with built-in pre amp (For more information about the sensor, please contact the sensor manufacturer.)

Measuring Resolver Rotation Angles

A resolver is used as a sensor to accurately measure the angular position of the motor. Resolvers are used in harsh environments such as industrial motors, servers, and electric vehicles (EVs) because they can operate under demanding conditions for extended period of time. In order to increase EV range, it's necessary to control motors with a high degree of precision so as to boost their energy efficiency.

Excitation Signal		Output Signal	
U8978	Sensor	U8978	Sensor
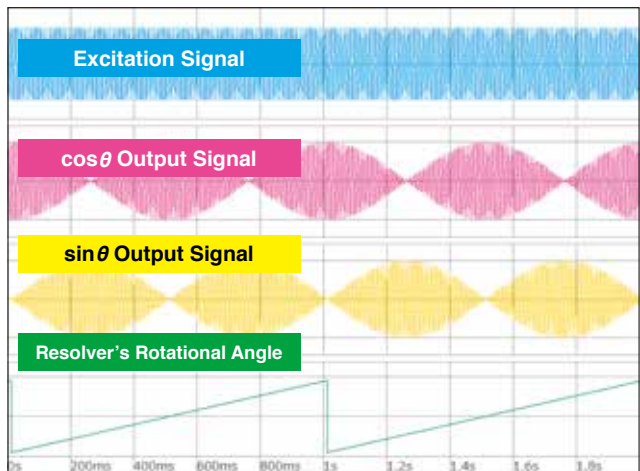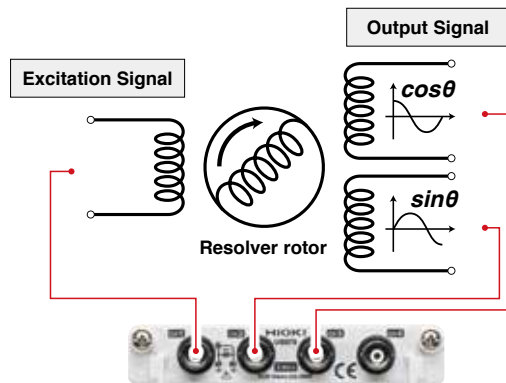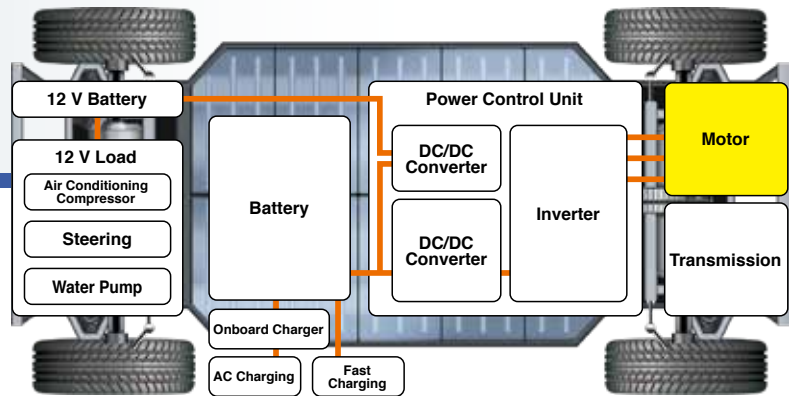
Calculate The Resolver's Rotational Angle Using Waveform Calculations.

The resolver's excitation signal and output signal are input to the 4ch Analog Unit U8978. Since setups that would have required two slots with previous models can be accommodated with a single slot, there's capacity left over to measure temperature, control signals, torque, and current signals at the same time. The instrument's waveform calculation function is used to calculate the resolver's rotational angle. Motor control sequences can be adjusted by analyzing the relationship between the resolver rotation angle and other signals.
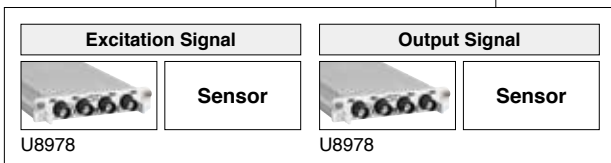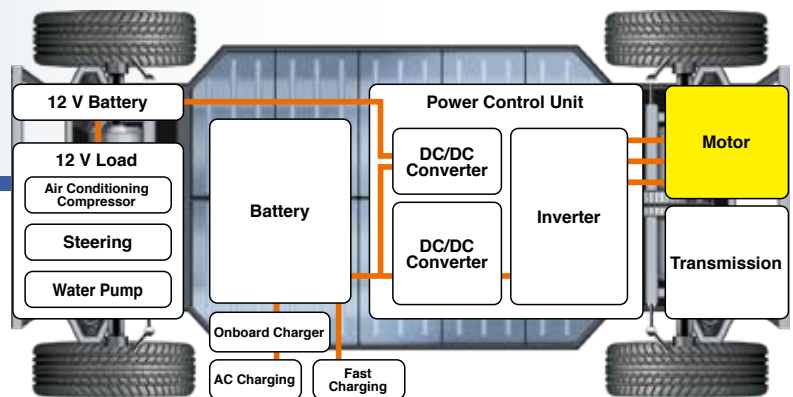
U8978

· MEMORY HiCORDER
  MR6000/MR6000-01
· 4CH ANALOG UNIT U8978

MR6000/MR6000-01

The 4ch Analog Unit U8978 can be used to measure a resolver's excitation signal and output signal ($\sin\theta$ and $\cos\theta$) with a single unit slot. Additionally, the MR6000/MR6000-01's high-speed waveform calculation function can be used to display the rotational angle.

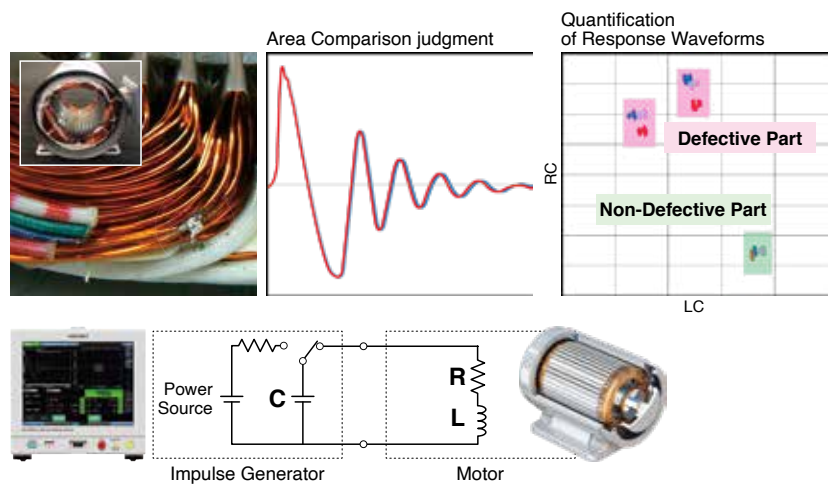# Performing Layer Short Testing of Motor Windings

Detect insulation failures (layer shorts) and deterioration in motor windings. Generate pass/fail judgments with greater precision than conventional approaches by quantifying response waveforms.

12 V Battery		Power Control Unit		Motor
12 V Load	Battery	DC/DC Converter	Inverter	
Air Conditioning Compressor		DC/DC Converter		Transmission
Steering				
Water Pump				
Onboard Charger				
AC Charging	Fast Charging			

Capture Minuscule Variations That Do Not Appear in Response Waveforms

Detect minuscule defects that do not appear in response waveforms more effectively than conventional area comparison judgment (AREA, DIFF AREA) by quantifying response waveforms.
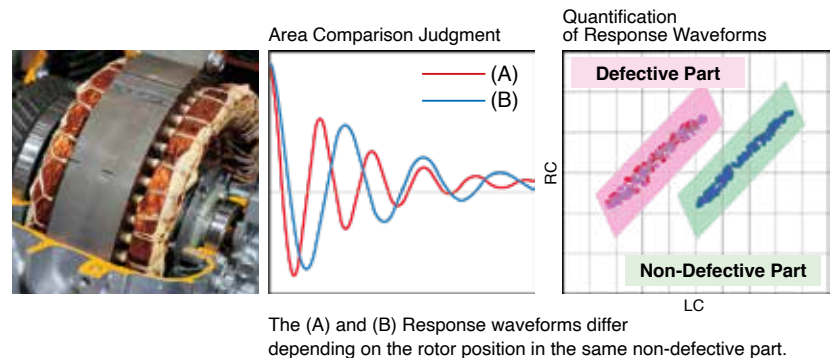
Since minuscule defects such as 1-turn shorts differ only slightly from the response waveform for a non-defective part, it's difficult to detect them using area comparison.

Area Comparison judgment

Quantification of Response Waveforms

Defective Part

Non-Defective Part

Power Source

C

R
L

Impulse Generator   Motor

Carry Out Tests with The Rotor Installed

Changes in response waveforms caused by rotor position can also be quantified. Pass/fail judgments can then be generated by configuring non-defective and defective part areas.
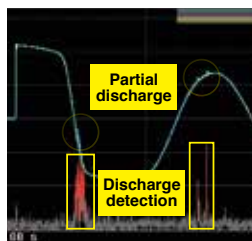
Since the response waveform varies with rotor position in conventional area comparison judgment, it is not possible to make pass/fail judgments for the motor.

Area Comparison Judgment
— (A)
— (B)

Quantification of Response Waveforms

Defective Part

Non-Defective Part

The (A) and (B) Response waveforms differ depending on the rotor position in the same non-defective part.

Partial discharge

Discharge detection

IMPULSE WINDING TESTER ST4030A

Discharge Detection Function ST9000

- High-precision waveform detection: 200 MHz, 12-bit resolution
- Quantification of response waveforms (using a patent held by Toenec Corporation)
- Detection of discharges obscured by noise (option)

**Production/Testing**

Performing Motor Winding Maintenance

Perform impulse testing and use the results in motor winding maintenance and trend management.
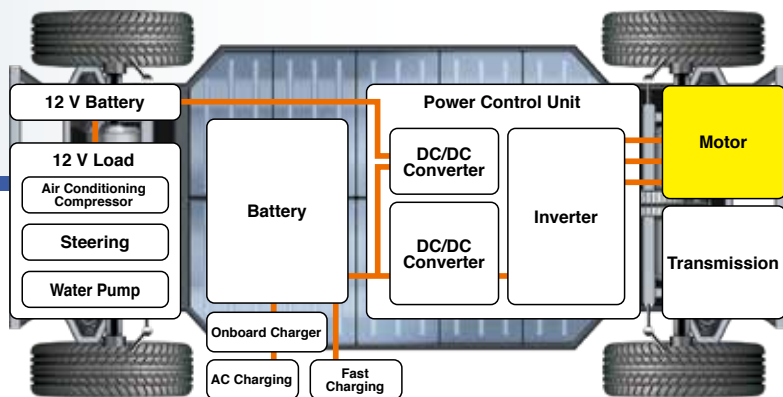
Check for Insulation Defects and Deterioration Even If No Non-Defective Part is Available

On a standard, properly configured 3-phase motor, the phases (U, V, and W) are balanced. Consequently, the response waveforms obtained when an impulse voltage is applied between phases (U-V, V-W, W-U) will be almost identical.
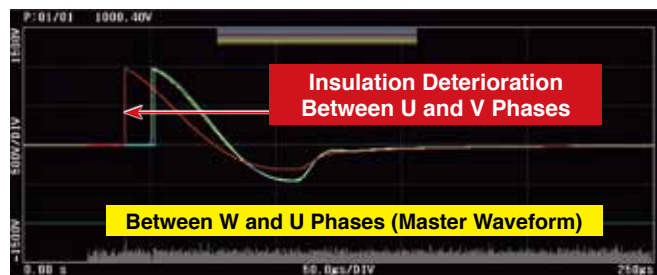
By tentatively identifying the response waveform obtained from one phase as the waveform for a non-defective part and comparing it to the response waveforms from the other phases, you can detect insulation failures and deterioration.
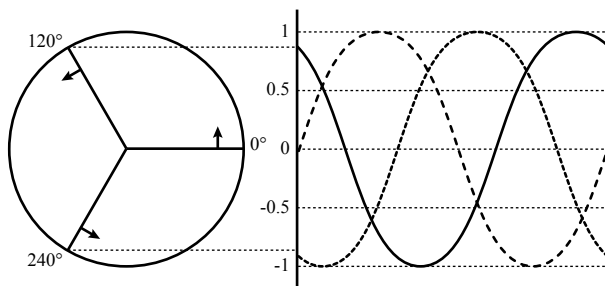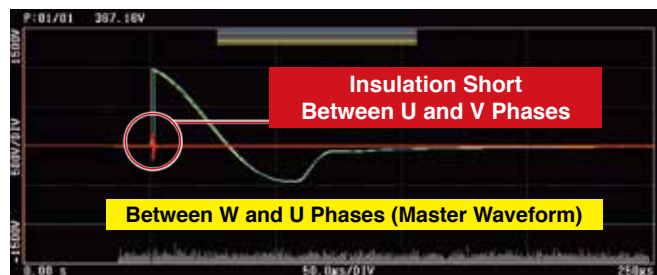

Properly Configured 3-phase Motor
Phases (U, V, W) are Balanced.
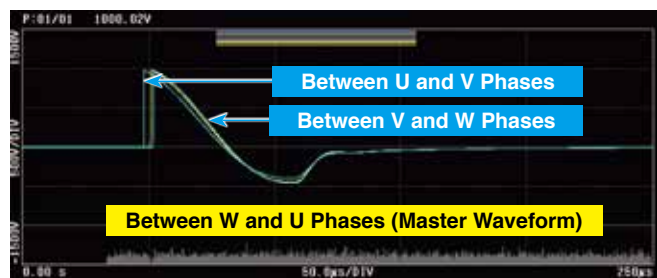
Non-Defective Product Response Waveform

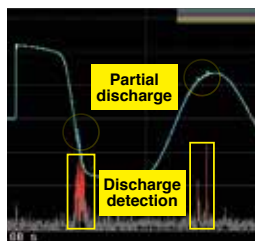Example of Response Waveform Exhibiting Insulation Deterioration

Example of Response Waveform Exhibiting Insulation Short

Equipment Used


IMPULSE WINDING TESTER
ST4030A

Discharge Detection Function
ST9000

· High-precision waveform detection: 200 MHz, 12-bit resolution
· Quantification of response waveforms
 (using a patent held by Toenec Corporation)
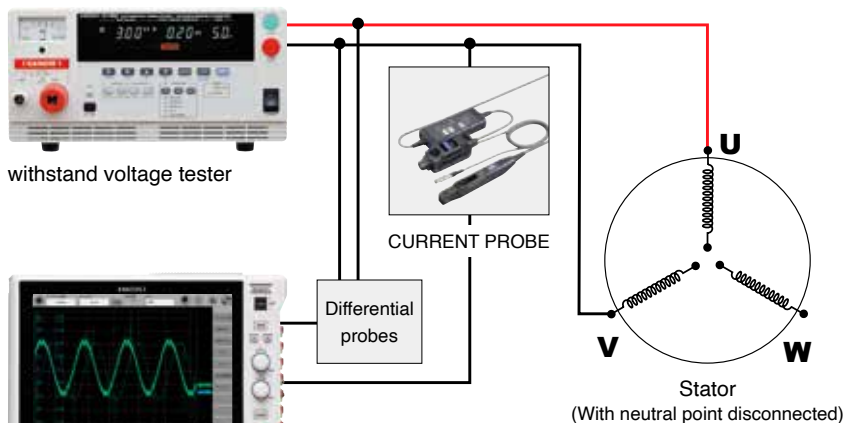· Detection of discharges obscured by noise (option)

Observation of Partial Discharges During Breakdown Voltage Testing

Detect partial discharges by observing current and voltage waveforms during breakdown voltage testing. By checking for partial discharges, which can lead to insulation breakdown, you can ascertain whether a coil contains any latent defects.
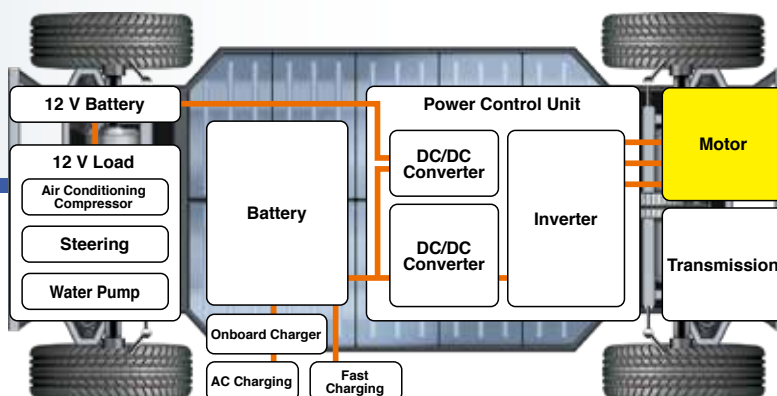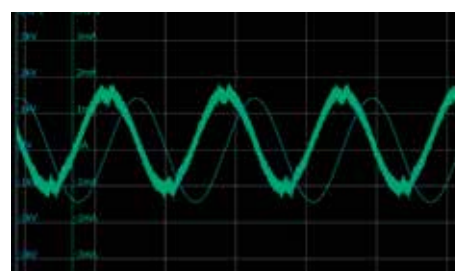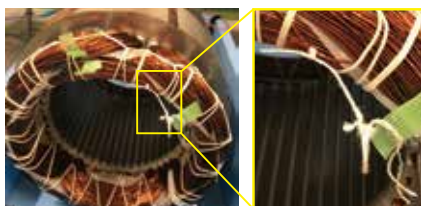
Observation of partial discharges while using a hipot tester as a voltage source

Apply a high voltage after connecting the tester's positive terminal to a stator's U-phase and its negative terminal to the stator's V-phase while the stator's neutral point remains unconnected. Then compare variations in the voltage at which partial discharges begin in a stators with good insulation and in a stator whose U- and V-phase coils are in contact.

withstand voltage tester

CURRENT PROBE

Differential probes

Waveform observation

U

V   W

Stator
(With neutral point disconnected)

Pseudo-defect

Current and voltage waveforms when 1.0 kV AC is applied to a non-defective stator

Partial discharges occur

Current and voltage waveforms when 1.5 kV AC is applied to a non-defective stator

Partial discharges occur

Current and voltage waveforms when 1.0 kV AC is applied to a stator with a pseudo-defect

Equipment Used

AUTOMATIC INSULATION/ WITHSTANDING HiTESTER 3153

MEMORY HiCORDER MR6000

CURRENT PROBE CT6711

3153
· Test voltage: 60 Hz AC
  Increasing from 1000 V in 100 V increments

MR6000
· Sampling speed: 200 MS/s
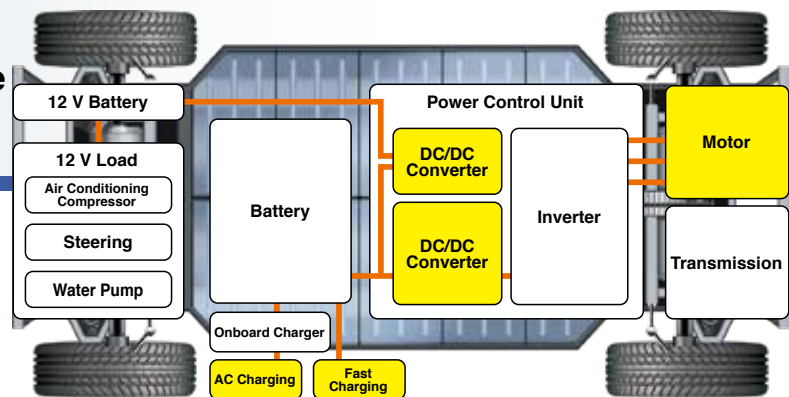· Storage time: 2.5 s
· Coupling method: AC coupling

CT6711
· Range: 0.5 A
· Output rage: 10 V/A
· Frequency band: DC to 120 MHz

Measuring Motor and Winding Insulation Resistance and Withstand Voltage

Carry out insulation resistance and withstand voltage testing. Ensure a high level of safety by testing the state of insulation as part of shipping inspections.


For Use in Shipping Inspections Measure Insulation Resistance and Withstand Voltage

Insulation deterioration leads to the risk of electric shock and ground faults. The condition of insulation is tested during shipping inspections to ensure product safety.
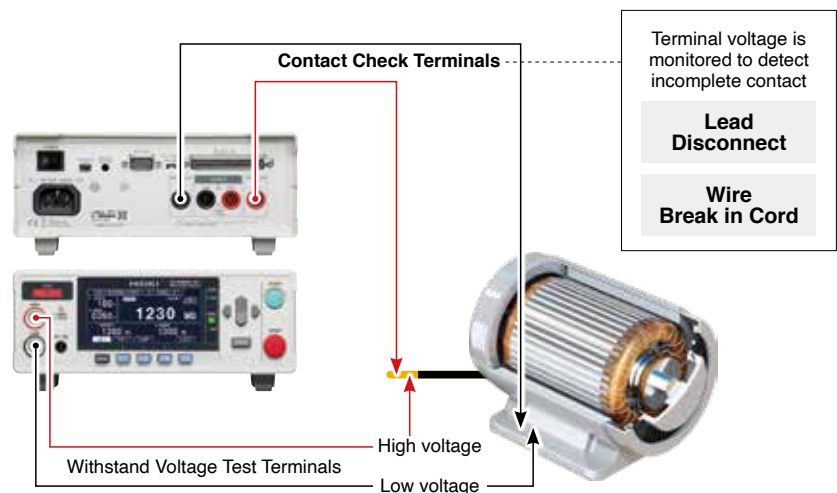
Results of Insulation Deterioration

Risk of Electric Shock

Risk of Ground Faults

Withstand Voltage Test Terminals
High Voltage
Low Voltage
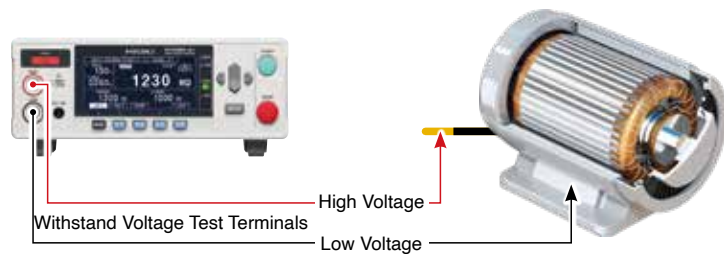
Contact Check Function to Ensure Reliable Testing

Incomplete probe contact and wire breaks in cables can prevent proper contact with the device under test. In such cases, defective parts can be misidentified as non-defective. Contact check functionality provides an effective means of ensuring test integrity.

Contact Check Terminals

Terminal voltage is monitored to detect incomplete contact

Lead Disconnect

Wire Break in Cord

Withstand Voltage Test Terminals
High voltage
Low voltage

INSULATION TESTER ST5520

AUTOMATIC INSULATION/ WITHSTANDING HiTESTER 3153

Contact checks can be performed continuously without affecting measured values.

ST5520
・ 25 V to 1000 V DC, 0.002 MΩ to 9990 MΩ

3153
・ AC withstand voltage testing: 0.2 kV to 5 kV AC, 100 mA
・ Insulation resistance testing: 50 V to 1200 V DC, 0.100 MΩ to 9999 MΩ

Measuring Winding Resistance

Check for wire breaks by measuring winding resistance with a high level of precision.
Check for incorrect wire thickness and turn count by using a high-precision resistance meter to make the measurements.
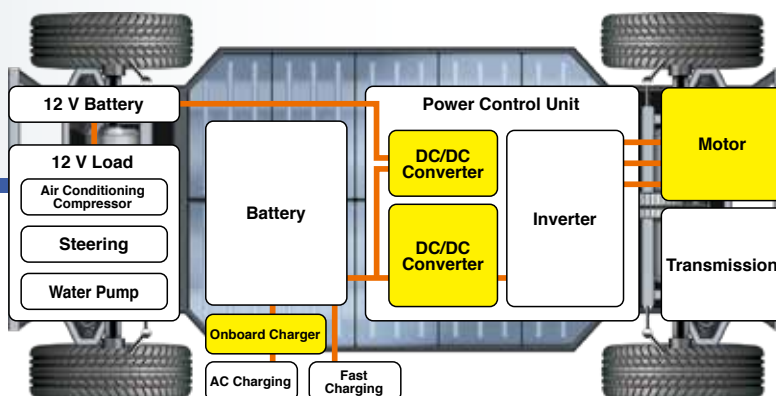
Testing Winding Quality with Resistance Measurement

To operate a motor efficiently, it's necessary to apply a large current.
To accommodate such currents, thick windings with low resistance are essential.
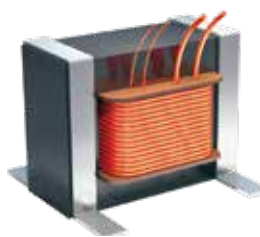
What can resistance values tell us?

Incorrect Wire Thickness

Incorrect Number of Turns

Winding Shorts

Motor Windings   **Transformer Winding**   **Coil Winding**

Performance Required for Resistance Measurement

Winding resistance, which is continually falling as technology progresses, can be accurately measured using a resistance meter.
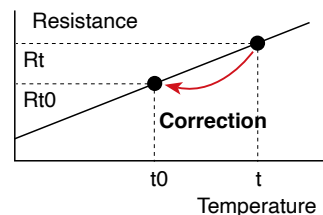
Required Performance

Low-Resistance Measurement	When measuring large windings, where low resistance values are increasingly becoming the norm, values must be managed on the order of 10 μΩ.
Ambient Temperature Correction	It's essential to perform temperature correction since wire resistance values vary with temperature.

Equipment Used

RESISTANCE METER
RM3545

MULTIPLEXER UNIT
Z3003

RESISTANCE METER
RM3548

RM3545
· High-precision resistance meter with a resolution of 0.01 μΩ
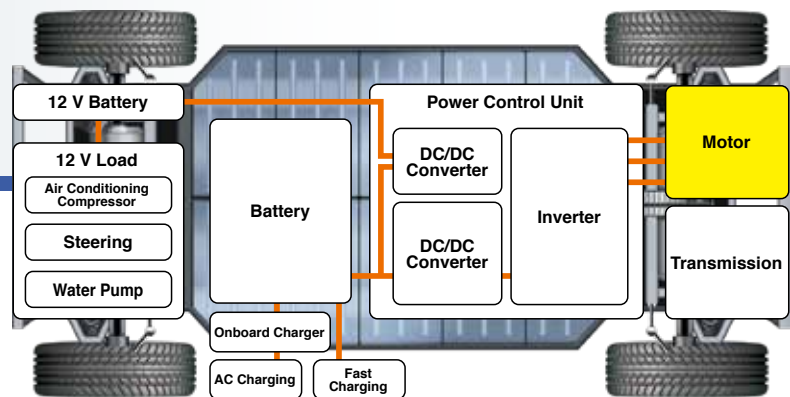· The RM3545-02 features an available internal multiplexer that efficiently measures resistance at multiple points.

RM3548
· Temperature correction functionality and interval measurement are convenient in temperature rise testing of motors and transformers.
· The portable form factor is ideal for measuring large motors and transformers.

Measuring Motor Coil Inductance

Measure winding inductance. Check phase balance, motor dynamic performance, RPM variations, and compatibility of the driver and motor.

12 V Battery	**Power Control Unit**
12 V Load	
Air Conditioning Compressor	**DC/DC Converter**
Steering	**Battery**
Water Pump	**DC/DC Converter**
	Inverter
	Motor
Onboard Charger	**Transmission**
AC Charging	Fast Charging

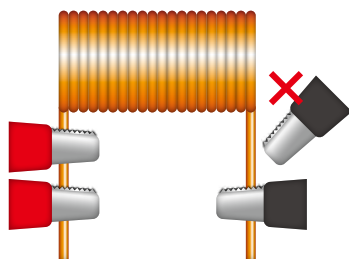## Using Winding Inductance to Test Motor Performance

What can inductance tell us?
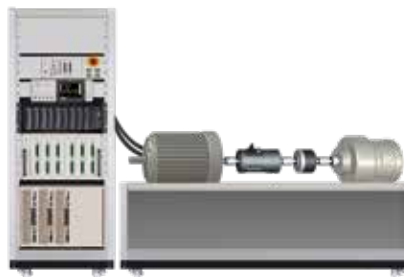
Phase Balance

Motor Operating Performance

RPM Variations
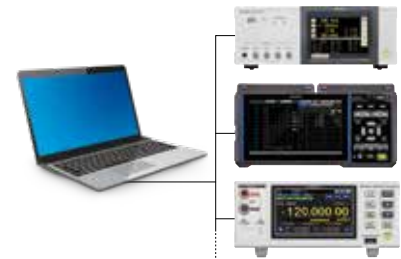
Compatibility of Drivers and Motors

Contact Check

Preventing erroneous measurement to ensure reliable testing

Cable Length: 4 m

Accuracy is guaranteed for measurement cables up to 4 m in length. Compatible with large equipment designed for use with motors

Labview Driver Available

Use in combination with other instruments.

• DC and 4Hz to 8MHz (up to 10MHz special order available) measurement frequency
• Manage winding inductance values using the judgment function.

LCR METER
IM3536

Measuring Motor Weld Resistance

Test weld quality (check for weld defects) in rectangular wire stators using a DC resistance meter with high resolution and measurement accuracy.

12 V Battery		Power Control Unit		Motor
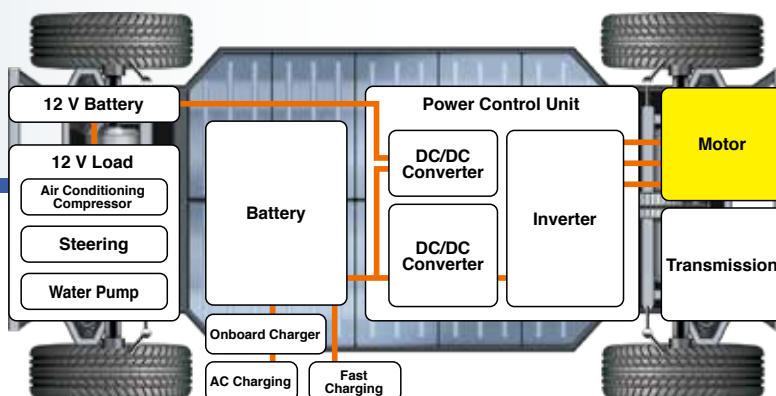
Rectangular Wire Stators

Rectangular copper wire that has been bent is affixed to the stator core, and rectangular wires from the same phase are welded together by a robot. Incomplete bonds can lead to latent defects due to insufficient weld penetration, cracking, and pinhole formation.
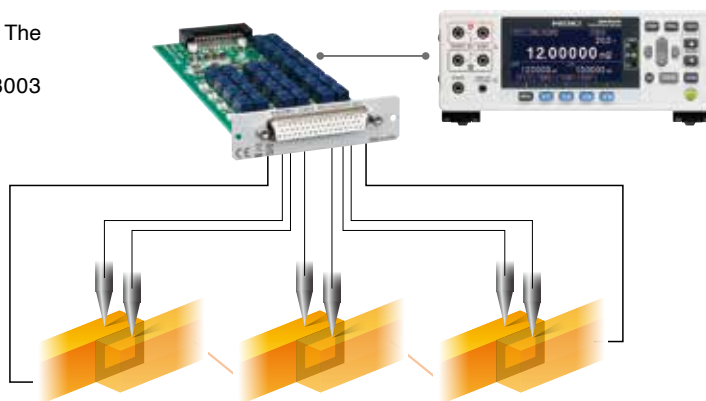

Rectangular Wire Stator

Weld Status

Good Weld

Defective Weld

Blow Hole (pinhole)
Insufficient Weld Penetration (thickness)
Cracking

Testing Weld Quality with DC Resistance Measurement

Probes for detecting voltage contact both side of welding point. The RM3545 can measure resistance of welding.
You can easily built measurement system by use the Z3003 multiplexer unit with the RM3545.

Since the Resistance Meter RM3545 can measure resistance at a resolution of 10 nΩ in the 10 mΩ range, the weld state can be judged on the basis of DC resistance values.

*Use the Temperature Sensor Z2001
 with the RM3545's temperature correction function.

World-class Accuracy and Digit Count
• Measurement basic accuracy of 0.006%
• Display count of 6 digits

Accurate Measurement of Super-low Resistance Values Allows quantification of the status of rectangular wire welds, playing a positive role when testing in the field.

RESISTANCE METER
RM3545-02

MULTIPLEXER UNIT
Z3003

HIOKI

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All information correct as of July 5, 2021. All specifications are subject to change without notice.   solution_motor_appli_E5-17B   Printed in Japan