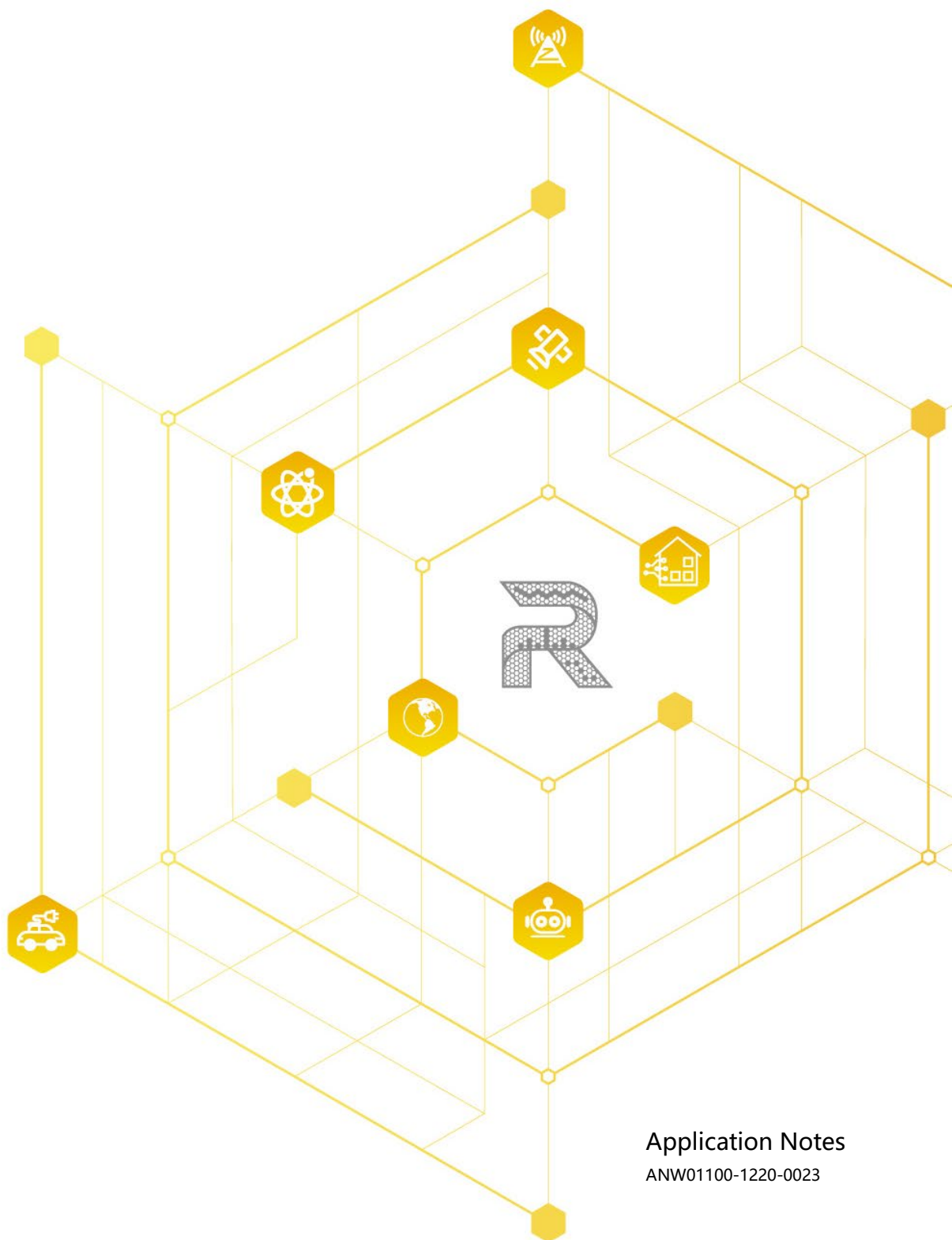




RIGOL

Test Solution for On-board Charger (OBC) in New Energy Vehicles



Application Notes
ANW01100-1220-0023

Introduction

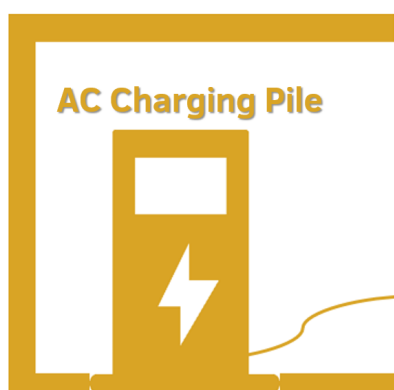
With the booming development of the new energy industry, new energy vehicles (NEVs) have become a major trend in the automotive sector. As a core component of the three electric systems in new energy vehicles, the on-board power supply converts the AC mains power to the battery pack, and the DC output of the battery pack is converted to auxiliary DC power. The performance and efficiency of the on-board power supply directly impact the real-time endurance of the battery pack, making its testing particularly important.

In this case, the client needed to perform a comprehensive test on an automotive on-board charger (OBC). Based on the client's test scenarios and actual test requirements, RIGOL provided essential instrument support for the testing solution.

Customer Case: On-board Charger (OBC) Testing

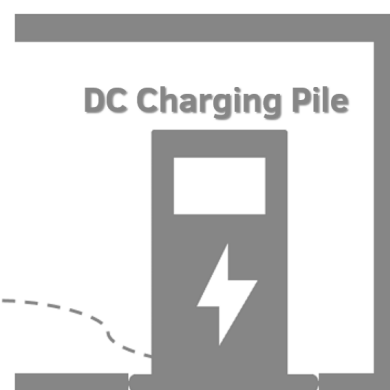
The on-board charger (OBC) is a charger fixed in NEVs, with the capability to safely and automatically fully charge the power battery of a new energy vehicle. Due to the high cost and limited large-scale application of DC fast chargers, AC charging has become one of the mainstream charging methods for electric vehicles. NEVs using AC charging piles require on-board chargers to automatically adjust the charging current and voltage according to the data provided by the battery management system (BMS), converting the AC power from the charging pile into DC power.

AC Charging (Slow Charging)



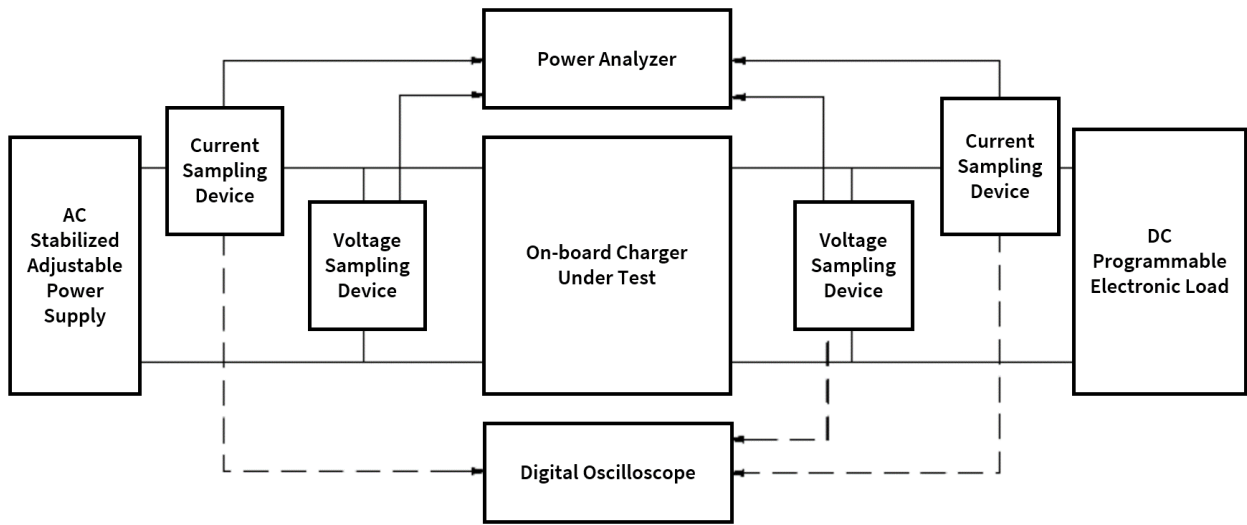
When using an AC charging pile, an on-board charger is required.

DC Charging (Fast Charging)



When using a DC charging pile, no on-board charger is required.

The national standard GB/T 40432-2021 defines the basic test schematic for OBC charging tests, setting clear requirements for technical parameters including input voltage, current, and output voltage, covering output voltage, operating efficiency, power factor, harmonics, output ripple, output voltage, and output current, etc.



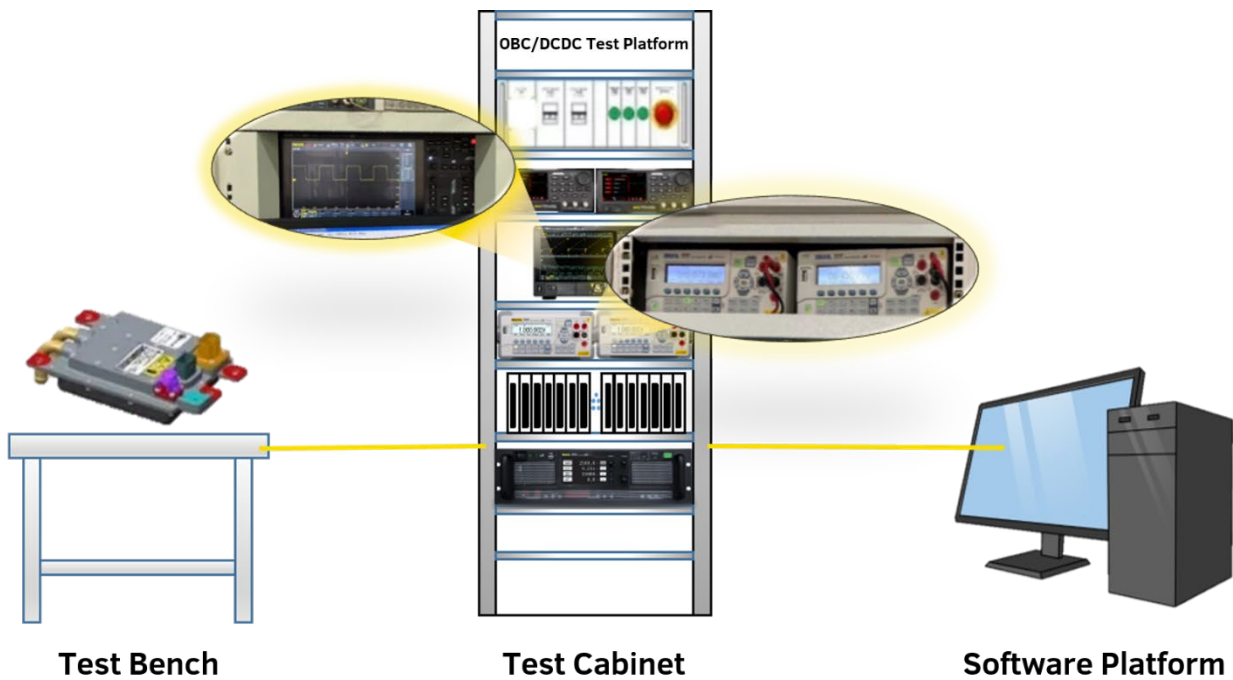
▲ Basic Schematic for Charging Test

This OBC testing performed a series of automated tests to verify product functionality and meet testing requirements. The test items included the following 15 projects:

No.	Test Item	No.	Test Item
1	Low Voltage Power-on Test	9	DCDC Startup Test
2	Signal and Wake-up Test	10	Calibration Test
3	Normal Startup Test	11	Post-Calibration Verification Test
4	Calibration Test	12	Output Short Circuit Test
5	Post-Calibration Verification Test	13	Output Ripple and Efficiency Test
6	High Voltage Performance Test	14	Write Logistics Information
7	Input Undervoltage Test	15	Module and Check
8	Input Overvoltage Test		

▲ Test Item List

To conduct these tests, it was necessary to configure power supplies including DC and AC sources, as well as measurement instruments such as oscilloscopes, multimeters, and signal generators. RIGOL provided corresponding instrument support for different test items.



Output Ripple Efficiency Test – DH04000 Series

In the output ripple efficiency test, the testing equipment is connected to the OBC's output port to record ripple characteristics of the output current, such as ripple amplitude, frequency, and waveform. The oscilloscope is required to perform ripple and timing tests, with a bandwidth over 70 MHz and 4 analog channels. By analyzing and evaluating the test data, it can be determined whether the OBC's output current ripple characteristics meet relevant standards and requirements.



Product:

- **RIGOL DH04000 Series High-Resolution Digital Oscilloscope**

Product Highlights:

- Analog bandwidth up to 800 MHz
- 12-bit vertical resolution for high measurement precision
- High sensitivity: 100 $\mu\text{V}/\text{div}$ vertical scale, capturing microvolt-level signals
- Ultra-low noise: minimum 18 μV_{rms} quantization noise, capturing pure and small signals
- Real-time sampling rate of 4 GSa/s
- Ultra acquire mode, waveform capture rate up to 1,500,000 wfms/s
- 10.1-inch HD touchscreen

Low-Voltage Power-on Test — DP2000 Series



This test mainly evaluates the low-voltage stability and power management capability when the OBC starts its charging system. A two-channel low-voltage auxiliary power supply with up to 30V/5A is required to simulate the vehicle battery voltage, typically within 8 V to 16 V.

Product:

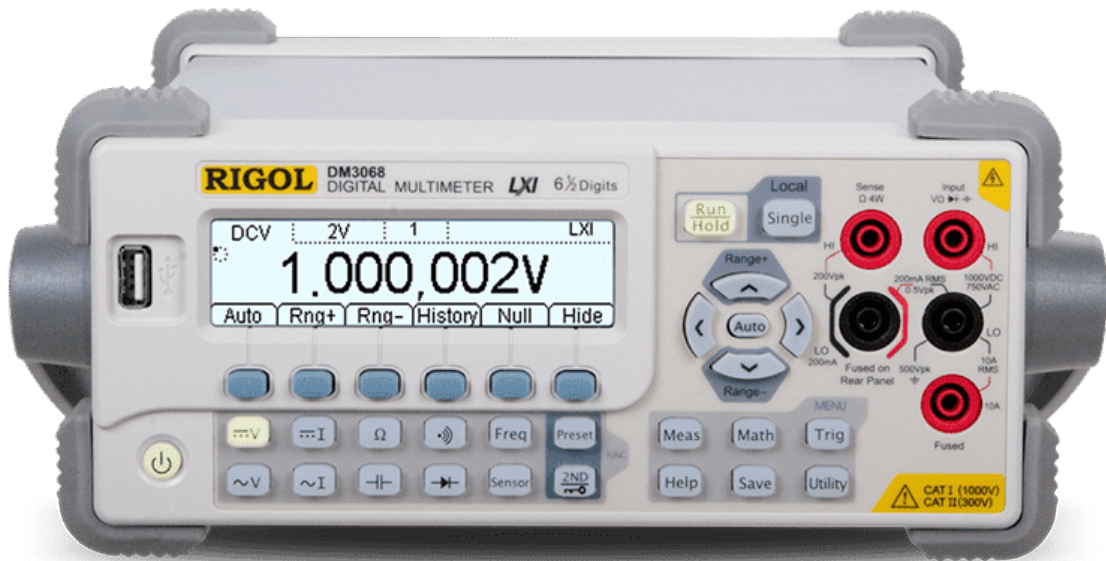
- **RIGOL DP2000 Series Programmable Linear DC Power Supply**

Product Highlights:

- 3 independent channels: 32V/3A || 32V/3A || 6V/5A(10A)
- High resolution for measurement of 1 μ A low current, yearly accuracy 0.25%+28 μ A
- High current sampling rate: 7.5 kSa/s
- Ripple and noise less than 350 μ Vrms/2 mVpp
- Minimum dwell time of 1 ms for waveform output sequences
- Multiple interfaces: LAN/USB/RS232/Digital IO, with 3 rear panel output terminals and sense terminals
- Compatible with standard SCPI command, system response time <10 ms

Signal and Wake-up Test – DM3068 and DG2000 Series

The signal test checks whether the OBC correctly responds to instructions or signals from the vehicle's information system. The wake-up test checks whether the OBC can be properly awakened from standby or sleep mode and start working. A signal generator with a bandwidth of 25 MHz and a sampling rate of 100 MSa/s is required to simulate the vehicle information system to issue wake-up instructions to the on-board charger. A 6.5-digit digital multimeter is used for measuring and recording voltage and current data to assess product performance.



Product:

- **RIGOL DM3068 6.5-Digit Digital Multimeter**

Product Highlights:

- Precision: 6.5 digits
- Sampling rate up to 10 k rdgs/s
- Rich measurement functions: AC/DC voltage and current, 2-wire/4-wire resistance, capacitance, frequency, and more
- Supports customized arbitrary sensor measurements and three temperature types: thermocouple, RTD, thermistor
- Powerful real-time analysis: statistics (max, min, average, standard deviation), P/F, dBm, dB, relative measurement, real-time trend and histogram displays
- SCPI is compatible with mainstream multimeter instruction sets



Product:

- **RIGOL DG2000 Series Function/Arbitrary Waveform Generator**

Product Highlights:

- Maximum output frequency 100/70/50 MHz
- Maximum sampling rate 250 MSa/s
- 16-bit vertical resolution
- Signal jitter as low as 200 ps
- Integrates functions of function generator, arbitrary waveform generator, noise generator, pulse generator, pattern generator, harmonic generator, analog/digital modulator, and frequency counter

DCDC Power-On Test — DP5000 Series

The DCDC converter is a critical component in electric vehicles, converting high-voltage DC power from the battery to the appropriate DC levels required by various vehicle electrical systems. During the DCDC power-on test, technicians must verify whether the converter can start up correctly and whether its output voltage and current meet specifications. This test requires an 8 kW programmable DC power supply to provide the DC input voltage.



Product:

RIGOL DP5000 Series Programmable Linear DC Power Supply

Product Highlights:

- 5 k/10 k/15 kW models available
- High-precision 5-digit display with resolution up to 0.1 mV/0.1 mA
- Wide output range with 3x expansion capability (full modular 3-phase input: 180V–460V AC)
- Supports over 100 units in parallel connection, with a max. power of 1.5 MW and a max. current of 54,000 A
- Standard interfaces: LXI, RS-422/RS-485, USB, GPIB, and Analog Programming interface used for industrial connectivity

RIGOL has long focused on electronic design, testing, production, and optimization, offering a wide range of solutions and products to meet customer needs. By continuously enhancing technical capabilities in hardware, algorithms, and software, RIGOL keeps closely aligned with customer demands and market trends, consistently exploring to broaden product application coverage across industries.



Looking ahead, the company will further focus on customer applications and strengthen its high-end product and solution deployment in cutting-edge technology fields like communications, new energy, and semiconductors. RIGOL aims to build comprehensive solutions from technology to products, from time-domain to frequency-domain, and from communications to new energy and semiconductors, helping customers tackle testing challenges and create core value.

Boost Smart World and Technology Innovation

Industrial Intelligent
Manufacturing



Semiconductors



Education &
Research



Communication

System Integration



New Energy



- 5G Cellular-5G/WIFI
- UWB/RFID/ ZIGBEE
- Digital Bus/Ethernet
- Optical Communication

- Digital/Analog/RF Chip
- Memory and MCU Chip
- Third-Generation Semiconductor
- Solar Photovoltaic Cells

- New Energy Automobile
- PV/Inverter
- Power Test
- Automotive Electronics

*Provide Testing and Measuring Products
and Solutions for Industry Customers*

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