FUEL CELL IMPEDANCE METER KFM2005

The impedance measurement can be performed using AC impedance method
Impedance of cells of up to 20V can be measured in the range of 10 mHz to 10 kHz.
Two ranges of the constant current mode in 5A and 0.5A are available for the load rating
Load current setting resolutions of 0.1 mA (in 5 A range) and 0.01 mA (in 0.5 A range)
Capable of 0 V operating voltage, equipped built-in electronic load
with maximum power consumption of 60 W (applied to the single cell testing)
Application software included as a standard accessory
External control of the load current, various protection functions are equipped
Equipped with GPIB, RS232C and USB interfaces as standard

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The measruing instrument and the electronic load are integrated in one single device!

Possible to acquire the Tafel plot and the Cole-cole plot of the micro fuel cell (such as cellular phones, laptop computers, and electric power-assisted bicycles, etc.)

The impedance meter KFM2005 is designed for testing of the fuel cell with the small current (5 A or less), and not only the current-voltage characteristic test, the KFM2005 can easily measure the impedance of a fuel cell using the AC impedance method, and the Cole-Cole plot. Using the measurement data of the Cole-cole plot, it is possible to calculate the circuit constant of the approximate equivalent circuit of the fuel cell. The built-in DC load (60 W) is capable to operate from 0 V, and it can perform the test for the fuel cell up to 20 V and 5 A.

Fuel Cell Impedance meter
KFM2005

● Application software included as a standard accessory ● Equipped with GPIB, RS232C and USB interfaces as standard.

The impedance measurement using AC impedance method

● Frequency range: 10 mHz to 10 kHz
● Frequency resolution: 14 points/decade
● Impedance measurement range: 100 mΩ, 300 mΩ, 1 Ω, 3 Ω
● Measurement alternated current range: 16.5 mA range, 50 mA range
  The selected range of measurement AC current can be set for 10 % to 100 % of the rated value in 0.1 % step.
  The impedance measurement can be measured by the dummy rated voltage which varies automatically for the measured AC current to become at 5mVpp of the detected terminal voltage of the DUT.

The built-in DC load (60 W) is capable to operate from 0 V

● Not only for stack cell, it can also apply for single cell testing
● Operating mode: Constant Current
● Current range: 0.5 A range, 5 A range
● Current setting resolution: 0.01 mA(0.5 A range), 0.1 mA(5 A range)
● Input voltage range: 0 V to 20 V
● Maximum input power: 60 W

Useful application software is included

It is possible to start immediate testing for the measurement of Cole-Cole Plot, I-V characteristics, and Constant Current characteristics simply by entering the parameters and acquiring the test data easily.

[System Requirements] CPU: Pentium IV 1 GHz or higher/Memory: 512 MB or more/ Windows 2000 (SP4+Update Roll up1)Windows XP (SP2 or later with intel x86), Windows Vista (Intel x86, x64) /USB interface

Various controls by external control functions

The KFM2005 allows you to control not only from the panel or through the communication interface but also using external signals from the control terminal .

● Controlling the load current using an external voltage
  0.5 A range : 0 V to 10 V at 0 A to 0.5 A
  5 A range : 0 V to 10 V at 0 A to 5 A
● Turning the load current on/off
● Swithching the load current range
● Voltage monitor output : outputs 10 V at 20 V of the sensing input voltage
● Current monitor output : outputs 10 V at 5 A of the load current
● Alarm output : occurred when abnormal state is detected such as OHP, Over Load, OCP.
● Status output of the LOAD ON/OFF
  (output of the ON/OFF status of the load device)

External control by Interfaces

Equipped with GPIB, RS232C and USB interfaces as standard.

Various protection functions

The protection function of UVP / OVP / OPP / OHP / OCP / OPEN are equipped as standard
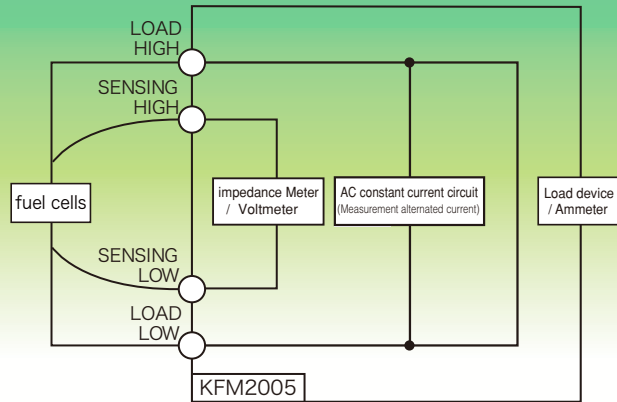
For the secondary or the primary battery testing

The impedance can be measured in the range of 10 mHz to 10 kHz.
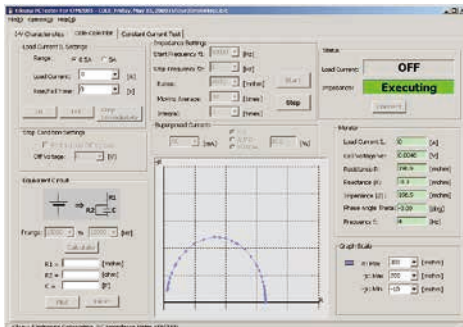
FC Impedance Meter
KFM2005

● KFM2005 Configuration

The KFM2005 is equipped with the required element of testing fuel cells on a single unit. It consists of an electric load device, voltmeter, ammeter, and impedance meter.


*The picture shown as an example of connecting the PC and the Fuel Cell, the PC and the Fuel Cell are not included in the package of the KFM2005.

The data acquisition of each characteristic test is possible by the application software included as a standard accessory. Each test data can be created in the text file in the TAB (Tab separated value) format.

● Cole-Cole plot

The impedance measurement is used by the AC impedance measurement method. The AC impedance measurement method applies alternate current-induced vibration to the DUT (fuel cell), calculates the complex impedance from the amplitude of the resulting voltage and current and the phase difference, and then plots the impedance in a complex coordinate system.
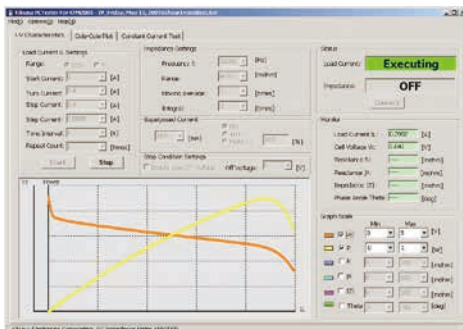
● Current-voltage characteristic measurement testing (I-V characteristics)

Measures the cell voltage (contact point of the sensing terminal) to the load current, and displays the Tafel plot.

The maximum resolution can be adjusted in 0.1 mA steps in the range of 0 A to 5 A. The software reads voltages with the specified resolution. The measurement can be repeated any number of times including infinitely. Even while the load current is passing through, it is also possible to measure the internal resistance (the impedance value of the single frequency measured by the AC impedance measurement method).
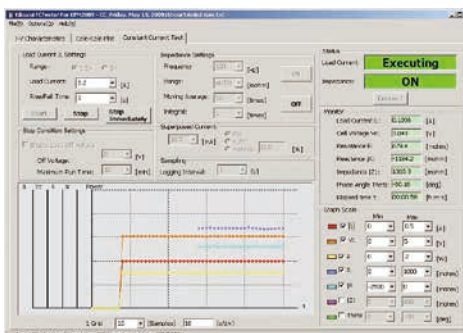
● Constant Current characteristic (for aging test)

The rise or fall time can be set to a maximum of 999 seconds.
Measures the change of cell voltage at constant load current.
The logging interval can be extended from 1 s to 86,400 s.
Even while the load current is passing through, it is also possible to measure the internal resistance (the impedance value of the single frequency measured by the AC impedance measurement method).

■ Specifications

Impedance Measurement Section

Measurement frequency	10 mHz to 10 kHz
Frequency resolution	1.00, 1.26, 1.58, 2.00, 2.51, 3.00, 3.16, 4.00, 5.00, 6.00, 6.30, 7.00, 8.00, 9.00 sequence with a resolution of 14 points/decade
Measurement range *1	16.5 mA range: 300 mΩ, 1 Ω, 3 Ω, or AUTO
	50 mA range: 100 mΩ, 300 mΩ, 1 Ω, or AUTO
Measurement alternated current	16.5 mA range: 6 mArms ±10 % *2
	50 mA range: 18 mArms ±10 % *2
	OFF: Mechanically opens the AC current source
Measured value display	100 mΩ range: 0.0 mΩ to 999.9 mΩ,
	1.000 Ω to approx. 4.000 Ω
	300 mΩ range: 0.0 mΩ to 999.9 mΩ,
	1.000 Ω to approx. 12.000 Ω
	1 Ω range: 0.0 mΩ to 999.9 mΩ,
	1.000 Ω to approx. 16.000 Ω
	3 Ω range: 0.000 Ω to approx. 16.000 Ω
	The unit is fixed at "Ω".
	All ranges: -180.00 deg to 180.00 deg
Measured value display	Select and display 4 items among R, X, |Z|, θ, voltage, and current
Measurement accuracy *2, *3	R and X from 10 mHz to 900 Hz:
	± (2 % of |Z| rdng + 0.5 % of range + 1 mΩ/Variable ratio) *4
	R and X from 1 kHz to 4 kHz:
	± (3 % of |Z| rdng + 0.5 % of range + 1.5 mΩ/Variable ratio) *4
	R and X from 5 kHz to 10 kHz:
	± (4 % of |Z| rdng + 0.5 % of range + 2 mΩ/Variable ratio) *4

DC Voltage and Current Measurement Section

Voltage range	Auto switching between 2 V and 20 V
Voltage measurement resolution	2 V range: 100 µV
	20 V range: 1 mV
Voltage measurement accuracy *2	2 V range: ±(0.2 % of rdng *5 + 6 digit)
	20 V range: ±(0.7 % of rdng *5 + 8 digit)
Current measurement resolution	100 µA
Current measurement accuracy *2	±1 % with respect to 5 A
Monitor output	Voltage monitor: Outputs 10 V with respect to a sensing input voltage of 20 V
	Voltage monitor accuracy: ±0.05 V
	Current monitor: Outputs 10 V with respect to a load current of 5 A
	Current monitor accuracy: ±0.2 V

Electronic Load Section

Operation mode	Constant current
Range	0.5 A or 5 A
Maximum load current	5 A
Input voltage range	0 V to 20 V
Maximum input power	60 W
Current setting resolution	0.5 A range: 0.01 mA
	5 A range: 0.1 mA
Current setting accuracy *2	0.5 A range: ±(0.5 % of set *6 +0.5 mA)
	5 A range: ±(0.5 % of set *6 +2.5 mA)
External control *7	0.5 A range: 0 A to 0.5 A with respect to 0 V to 10 V
	5 A range: 0 A to 5 A with respect to 0 V to 10 V

[Rear panel]

Protection Function

Overvoltage protection (OVP)	Cuts off the load when a voltage greater than or equal to 21 V is applied to the sensing terminal
Undervoltage protection (UVP)	Cuts off the load if the sensing terminal falls below the preset voltage. Setting range: -2 V to 20 V
	Mask Time: 0 s to 10 s (in 1 second)
Overheat protection (OHP)	Cuts off the load when the load device reaches an abnormal temperature. OHP LED lights.
Overload protection (OPP)	CP (constant power) trips and OVER LOAD LED lights with a power greater than or equal to 63 W
Overcurrent protection (OCP)	Cuts off the load when a load current greater than or equal to 5.25 A flows.
Disconnection detection (OPEN)	Cuts off the load when the load cable is not wired or is loose

Communication Interface

RS232C, GPIB, USB

General

Display	240 × 64 dot LCD, with CCFL backlight, contrast adjustable
Installation location	2000 m or less
Storage temperature range	-10 °C to 60 °C (14 °F to 140 °F)
Storage humidity range	90 % rh or less (no condensation)
Operating temperature range	0 °C to 40 °C (32 °F to 104 °F)
Operating humidity range	20 % to 85 % rh or less (no condensation)
Line voltage range	90 VAC to 132 VAC, 180 VAC to 250 VAC
Line frequency range	45 Hz to 65 Hz
Maximum power consumption	600 VA
Dimensions	430(16.93)W × 88(3.46)H × 380(14.96)Dmm(inch)
Weight	9.5 kg (20.9 lb)

Accessories

Power cord: 1, Spare fuse: 1 *8 (250 VAC, 6.3 A), Sensing wire: 1 (AWG24, 2-core shielded wire 1.8 m), Load wire: 1 pair (AWG18 red and white twisted pair 1.5 m), CD-ROM: 1, User's manual: 1

Options

Rack mountbracket KRB2-TOS, KRB100-TOS

*1. Can measure up to approximately 4 times the range. When varying the superimposed current, it extends the range of measuring value depends on the variable ratio. If you vary the superimposed current down to 10 %, it enables to extend approximately 10 times of the range for the measuring value (maximum up to approximately 40 times). The maximum display for the range of each impedance measurement value display will be changed depending on the variable ratio of the superimposed current. However, under the environment when the drift or the ripple of the fuel cell were large or the considerable noise were generated, it may become over range by the value smaller than the specified value. Maximum capable measurement value is approximately 16 Ω

*2. At 15 °C to 35 °C

*3. After 32 counts of the moving average count

*4. range: Measurement rangeVariable ratio: 1 to 0.1 of the super imposed current |Z| rdng: |Z| reading

*5. rdng: Input voltage reading

*6. set: Input current setting

*7. The full scale of the setting can be fine tuned.

*8. Contained in the AC LINE connector.

[Dimensions]