FUEL CELL IMPEDANCE METER KFM2005

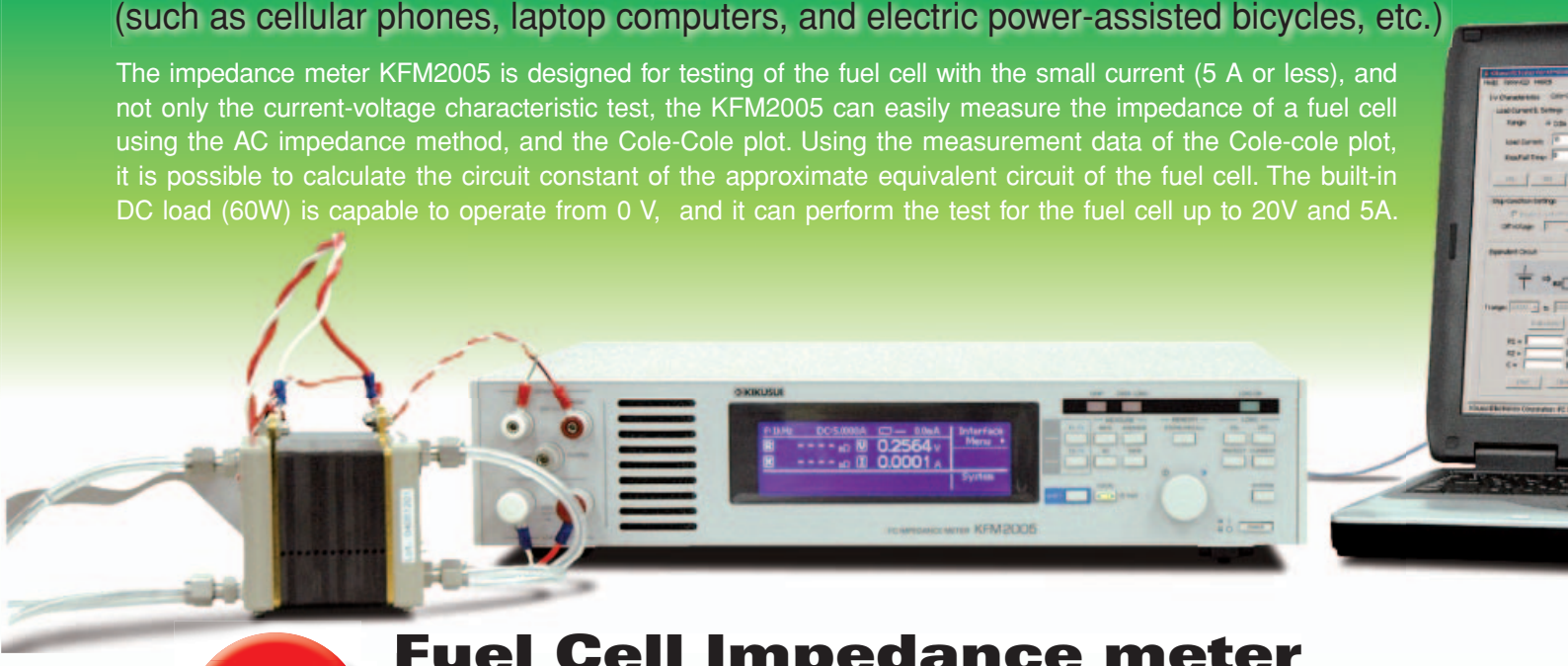
The impedance measurement can be performed using AC impedance method
Impedance of cells of up to 20V can be measured in the range of 10 mHz to 10 kHz.
Two ranges of the constant current mode in 5A and 0.5A are available for the load rating
Load current setting resolutions of 0.1 mA (in 5 A range) and 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, RS-232C and USB interfaces as standard

KIKUSUI

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 (60W) is capable to operate from 0 V, and it can perform the test for the fuel cell up to 20V and 5A.



NEW

Fuel Cell Impedance meter
KFM2005

- Application software included as a standard accessory
- Equipped with GPIB, RS-232C and USB interfaces as standard.

The impedance measurement using AC impedance method

- Frequency range: 10mHz to 10kHz
- Frequency resolution: 14 points/decade
- Impedance measurement range: 100mΩ, 300mΩ, 1Ω, 3Ω
- 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 (60W) 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: 0.5A range, 5A range
- Current setting resolution: 0.01mA(0.5A range), 0.1mA(5A range)
- Input voltage range: 0V ～ 20V
- Maximum input power: 60W

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 1GHz or higher/Memory: 512MB 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, RS-232C and USB interfaces as standard.

Various protection functions

The protection function of UVP / OVP / OPP / OHP / OCP / OPEN are equipped as standard

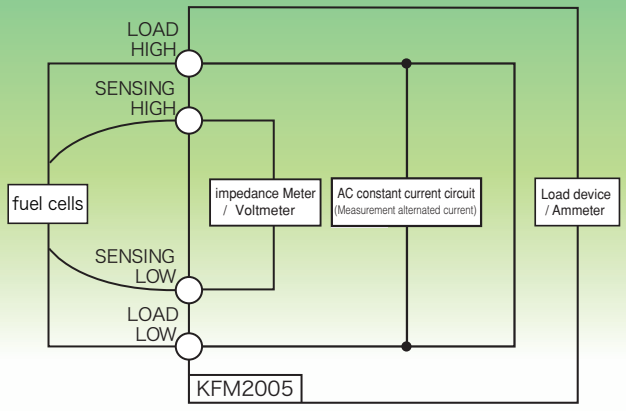
For the secondary or the primary battery testing

The impedance can be measured in the range of 10 mHz to 10 kHz.

FC Impedance Meter KFM2005

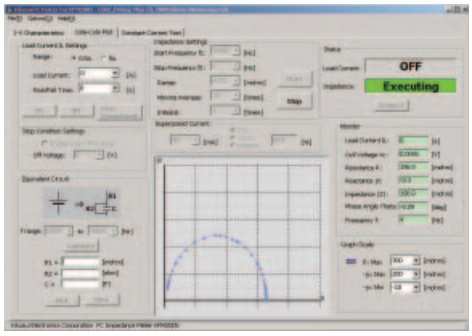
● KFM2005 Configuration

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.



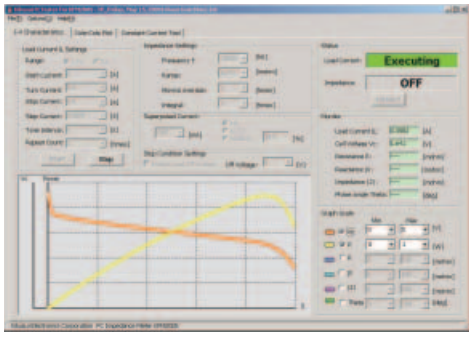
*The picture shown as an example of connecting the PC and the Fuel Cell, the PC and the Fuel Cell are not included in the package of the KFM2005.

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 5A. 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 part

Measurement frequency ..... 10 mHz to 10 kHz

Frequency resolution..... 14 points/decade - 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

Measurement range *1 ..... 16.5mA range：300mΩ, 1Ω, 3Ω/ AUTO,
50mA range：100Ωm, 300Ωm, 1Ω/ AUTO

Measurement alternated current..... 16 mArms ±10 % (16.5 mA range) ,
18 mArms ±10 % (50 mA range) Mechanically opens the AC current source

Measurement value display ..... 100mΩ range：0.0mΩ to 999.9mΩ , 1,000Ω to approx.4,000Ω
300mΩ range：0.0mΩ to 999.9mΩ, 1,000Ω to approx.12,000Ω
1Ω range：0.0mΩ to 999.9mΩ , 1,000Ω to approx. 16,000Ω
3Ω range：0.000Ω to approx.16,000Ω
All range：-180.00 deg to 180.00deg

Measurement display items ..... Four types of measurement value can be chosen for display freely from R, X, | Z | , *q*, voltage, and current.

Measurement accuracy *2 *3 ..... 10mHz to 900Hz of R,X
± (2% of | Z | reading +0.5% of range +1m / variable ratio)
1kHz to 4kHz of R,X
±(3% of | Z | reading +0.5% of range +1.5m/ variable ratio)
5kHz to 10kHz of R,X
± (4% of | Z | reading +0.5% of range +2m / variable ratio)

DC voltage/current measurement part

Voltage range --------- Automatic switch between two ranges: 2 V and 20 V

Voltage measurement resolution..... 2 V range: 100 μV, 20 V range: 1 mV

Voltage measurement accuracy..... 2 V range ±(0.2% of rdg *4 + 6 digits) ,
20 V range ±(0.7% of rdg *4 + 8 digits)

Current measurement resolution..... 100 μ A

Current measurement accuracy..... ± 1% of 5A （± 50mA）

Monitor output ..... Voltage monitor: Outputs 10 V for sensing input voltage of 20 V
(insulated output for the load) Voltage monitor accuracy: ± 0.05V
Voltage monitor accuracy Current monitor: Outputs 10 V for load current of 5 A.
Current monitor accuracy: ± 0.2V

Electronic load

Operation mode ..... Constant current

Range..... Two ranges - 0.5 A and 5 A

Maximum load current..... 5A

Input voltage range ..... 0 V to 20 V

Maximum input power..... 60W

Current setting accuracy ..... 0.5A range：± (0.5% of set *5 + 0.5 mA) ,
5A range：± (0.5% of set *5 + 2.5 mA)

External control *6 ..... 0.5A range：0 A to 0.5 A for 0 V to 10 V,
5A range：0 A to 5 A for 0 V to 10 V

Display

240 dots × 64 dots LCD with cold-cathode ray tube backlighting

External Control Interface

GPIB, RS-232C,USB

[Rear panel]

Average setting

The integral average (1 to 32) and the moving average (1 to 256) may be used in combination.

Protection functions

Overvoltage protection (OVP) .... The load is cut off if a voltage of 21 V or higher is applied to the sensing terminal.

Overpower protection (OPP) ..... Power of 63 W or higher activates the CP and lights the OVER LOAD LED.

Overheat protection (OHP) ..... The load is cut off if the temperature inside the load unit becomes abnormally high.

Overcurrent protection (OCP) ..... If a load current flows higher than 5.25 A, the LCD displays “ALM:OCP” and the load is cut off.

Undervoltage protection (UVP)..... The load is cut off if the voltage applied to the sensing terminal falls below the set voltage limit. This voltage limit can be set in the range of –2 V to 20 V.

Protection functions

External Control

Input ..... CC control, Load ON/OFF, Load range: 0/5 V

Output..... V monitor, I monitor, alarms, load status

Environment

Warm-up time..... 30 minutes or more

Installation altitude..... 2000 m or below

Storage temperature and humidity range..... –10°C to +60°C, 90% rh or below (no dew condensation allowed)

Operating temperature and humidity range.... 0℃ to + 40℃ , 20% to 85% rh or below (no dew condensation allowed)

Guaranteed temperature and humidity range..... +15℃ to + 35℃ , 20% to 85% rh or below (no dew condensation allowed)

Power

Allowable power voltage range..... AC90V to 132V , AC180V to 250V Single phase

Power frequency range ..... 45 Hz to 65 Hz

Maximum power consumption..... 600 VA or less

Dielectric resistance ..... 50 M or more (500 VDC) [between AC line and chassis]

Withstand voltage..... 1500 VAC/minute [between AC line and chassis]

Dimensions (maximum)..... 430 (455) W × 88 (105) H × 380 (450) D mm

Weight ..... Approx. 9.5 kg

Accessories

Power cord (100 VAC): 1 Sensing cable: 1 Load cable: 1 Operation manual: 1
Application software (CD): 1

Options

Rack mount bracket KRB100-TOS, KRB2-TOS

*1 Values up to four times the range can be measured. If the measurement current varies, the allowable measurement value can be extended in proportion of the varied ratio. It can be varied up to ten times if the measurement current is set to 10%. The maximum value can be set up to approx. 40 times of the range.

*2 | Z | reading：reading value of "Z"
range : measurement range
variable ratio : variable ratio of measurement current (1 to 0.1)

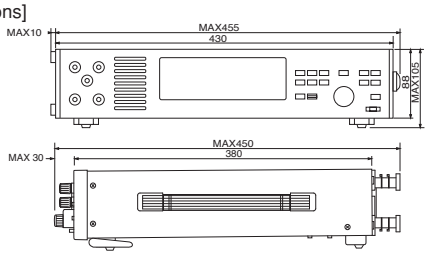
*3 after 32 times of moving average

*4 rdg: reading value of the input voltage

*5 set: setting value for the input current

*6 The set full scale can be fine-tuned.

[Dimensions]



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