

KFM2030

FC Impedance Meter



Dimensions / Weight (approx.)

430(455)W × 88(105)H × 380(450)Dmm / 9.5kg

Accessories

Operation manual, Power cord, Sensing line, Load line, Application software (CD)

Options

■ Rack mount bracket
KRB100-TOS (JIS standard)/KRB2-TOS (EIA standard)

Application software

- Cole-cole plot
- Current-voltage characteristic measurement testing (I-V characteristics)
- CC mode testing (for aging)

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 | 165 mA range (60 mA AC rms): 30 mΩ, 100 mΩ, 300 mΩ, AUTO 500 mA range (180 mA AC rms): 10 mΩ, 30 mΩ, 100 mΩ, AUTO |
| Measurement alternate current | 60 mA rms (165 mA range), 180 mA rms (500 mA range), OFF |
| Measurement resolution | 10 mΩ range: 1 μΩ 30 mΩ, 100 mΩ range: 10 μΩ 300 mΩ range: 100 μΩ |
| Measurement value display | Four types of measurement value can be chosen for display freely from R, X, Z , θ, voltage, and current. |
| Measurement accuracy | 10 mHz to 900 Hz R, X: ±2% of range*2 1 kHz to 4 kHz R, X: ±3% of range*2 5 kHz to 10 kHz R, X: ±4% of range*2 |
| 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*3 + 6 digits) 20 V range ±(0.7% of rdg*3 + 8 digits) |
| Current measurement resolution | 1 mA |
| Current measurement accuracy | ±2% for 30 A |
| Monitor output | Voltage monitor: Outputs 10 V for sensing input voltage of 20 V. Voltage monitor accuracy: ±0.05 V Current monitor: Outputs 10 V for load current of 30 A. Current monitor accuracy: ±0.2 V |
| Electronic load | |
| Operation mode | Constant current |
| Range | Two ranges - 5 A and 30 A |
| Maximum load current | 30 A |
| Input voltage range | 0 V to 20 V |
| Maximum input power | 60 W |
| Current setting accuracy | ±(0.5% of set*4 + 10 mA) |
| External control*5 | 5 A range: 0 A to 5 A for 0 V to 10 V 30 A range: 0 A to 30 A for 0 V to 10 V |

Fuel cell characteristic, variation, and service life testing can be done with ease!

The impedance meter KFM2030 is intended to enable the impedance characteristics of a fuel cell to be measured easily through the use of the AC impedance measurement method.

Using the application software that comes with it, the meter can obtain impedance values at different frequencies by means of AC impedance measurement and display the obtained values in a Cole-Cole plot. With a low-power DC load (60 W) built in it, KFM2030 supports fuel cell load testing at up to 20 V, at up to 30 A.

Features

- Impedance of cells of up to 20V can be measured in the range of 10 mHz to 10 kHz. (The cell voltage can be read back as well in the 0 V-20 V range.)
- Two constant current modes ranges for the load rating: 30 A and 5 A Load current setting resolutions of 1 mA (30 A range) and 0.1 mA (5 A range) are available, with maximum power consumption of 60 W.
- Undervoltage protection, overvoltage protection, overpower protection, overheat protection, overcurrent protection, and line cut detection are supported.
- The backlit LCD offers enhanced visibility.
- Four types of measurement value can be chosen for display freely from R, X, |Z|, θ, V, and I.
- Equipped with GPIB, RS-232C and USB interfaces as standard.
- Impedance measurements can be made in the range of 10 mHz to 10 kHz as well on both primary and secondary cells.

| | |
|--|---|
| Display(240 dots × 64 dots LCD with cold-cathode ray tube backlighting) | |
| Impedance measurement part | 10 mΩ → XX.XXX mΩ, 30 mΩ/100 mΩ → XXX.XX mΩ 300 mΩ → XXX.X mΩ |
| DC voltage measurement part | 0.0000 V to 2.0000 V and 2.000 V to 20.000 V |
| Average setting | |
| The integral average (1 to 32) and the moving average (1 to 256) may be used in combination. | |
| Power | |
| Allowable power voltage range | 90 VAC to 132 VAC, 180 VAC to 250 VAC |
| Power frequency range | 45 Hz to 65 Hz |
| Maximum power consumption | 600 VA or less |
| Dielectric resistance | 50 MΩ or more (500 VDC) [between AC line and chassis] |
| Withstand voltage | 1500 VAC/minute [between AC line and chassis] |

*1: Values up to four times the range can be measured. Note that, in cases where the drift or ripple of the fuel cell is large or there is much noise, a value lower than the range may be regarded as exceeding the range.

*2: range: Measurement range

*3: rdg: Reading of input voltage

*4: set: Value set for input current

*5: The set full scale can be fine-tuned.

KFM2150 system

FC Impedance Measurement System



Only FC impedance meter KFM2150 cannot be operated. KFM2150 system needs to be combined with PLZ-4W series and calibrated.

KFM2150 SYSTEM 1000-01
(The upper unit is an FC impedance meter KFM2150, and the lower one is an electronic load unit PLZ1004W.)

Dimensions / Weight (approx.)

KFM2150 : 430(455)W × 88(105)H × 270(330)Dmm / 6kg

PLZ-4W Series : Refer to page 46 to 47.

● Bench top type(List of mass amount only)

KFM2150 SYSTEM 165-01A : 13.5kg

KFM2150 SYSTEM 660-01A : 22kg

KFM2150 SYSTEM 1320-02A : 38kg

KFM2150 SYSTEM 1000-01 : 21kg

KFM2150 SYSTEM 3000-02 : 45kg

● Rack mount type

KFM2150 SYSTEM 1980-03A : (570)W×(1430)H×(875)Dmm / 170kg

KFM2150 SYSTEM 2640-04A : (570)W×(1430)H×(875)Dmm / 185kg

KFM2150 SYSTEM 3300-05A : (570)W×(1430)H×(875)Dmm / 200kg

KFM2150 SYSTEM 5000-03 : (570)W×(1430)H×(1025)Dmm / 190kg

KFM2150 SYSTEM 7000-04 : (570)W×(1430)H×(1025)Dmm / 215kg

KFM2150 SYSTEM 9000-05 : (570)W×(1430)H×(1025)Dmm / 240kg

Specifications

| Model | Units configuring the system | | | Rating | | |
|-------------------------|------------------------------|---|-----------------|-------------------|---------|-------|
| | FC Impedance meter | Electronic load unit Operation mode : CC+CV mode | Type | Operating voltage | Current | Power |
| | | | | V | A | W |
| KFM2150 SYSTEM 165-01A | KFM2150 | PLZ164WA (1 unit) | Bench top type | 0 to 150 | 33 | 165 |
| KFM2150 SYSTEM 660-01A | KFM2150 | PLZ664WA (1 unit) | Bench top type | 0 to 150 | 132 | 660 |
| KFM2150 SYSTEM 1320-02A | KFM2150 | PLZ664WA (2 units) | Bench top type | 0 to 150 | 264 | 1320 |
| KFM2150 SYSTEM 1980-03A | KFM2150 | PLZ664WA (3 units) | Rack mount type | 0 to 150 | 396 | 1980 |
| KFM2150 SYSTEM 2640-04A | KFM2150 | PLZ664WA (4 units) | Rack mount type | 0 to 150 | 528 | 2640 |
| KFM2150 SYSTEM 3300-05A | KFM2150 | PLZ664WA (5 units) | Rack mount type | 0 to 150 | 660 | 3300 |
| KFM2150 SYSTEM 1000-01 | KFM2150 | PLZ1004W (1 unit) | Bench top type | 1.5 to 150 | 200 | 1000 |
| KFM2150 SYSTEM 3000-02 | KFM2150 | PLZ1004W (1 unit)+PLZ2004WB (1 unit) | Bench top type | 1.5 to 150 | 600 | 3000 |
| KFM2150 SYSTEM 5000-03 | KFM2150 | PLZ1004W (1 unit)+PLZ2004WB (2 units) | Rack mount type | 1.5 to 150 | 1000 | 5000 |
| KFM2150 SYSTEM 7000-04 | KFM2150 | PLZ1004W (1 unit)+PLZ2004WB (3 units) | Rack mount type | 1.5 to 150 | 1400 | 7000 |
| KFM2150 SYSTEM 9000-05 | KFM2150 | PLZ1004W (1 unit)+PLZ2004WB (4 units) | Rack mount type | 1.5 to 150 | 1800 | 9000 |

| Model | Constant current mode | | | Ammeter | | | Constant voltage mode | | Voltmeter | | |
|-------------------------|-------------------------------------|--------------|----------------|------------------|------------------|------------------|-------------------------------------|---------------|------------------|------------------|------------------|
| | Allowable range (A)/Resolution (mA) | | | Accuracy*1 | | | Allowable range (V)/Resolution (mV) | | Accuracy*2 | | |
| | Range H | Range M | Range L | Range H (A) | Range M (A) | Range L (A) | 15 V range | 150 V range | 10 V range (V) | 100 V range (V) | 150 V range (V) |
| KFM2150 SYSTEM 165-01A | 0 to 33/1 | 0 to 3.3/0.1 | 0 to 0.33/0.01 | 0.0000 to 33.000 | 0.0000 to 3.3000 | 0.0000 to 0.3300 | 0 to 15.75/1 | 0 to 157.5/10 | 0.0000 to 9.9999 | 10.000 to 99.999 | 100.00 to 150.00 |
| KFM2150 SYSTEM 660-01A | 0 to 132/10 | 0 to 13.2/1 | 0 to 1.32/0.1 | 0.0000 to 132.00 | 0.0000 to 13.200 | 0.0000 to 1.3200 | | | | | |
| KFM2150 SYSTEM 1320-02A | 0 to 264/20 | 0 to 26.4/2 | 0 to 2.64/0.2 | 0.0000 to 264.00 | 0.0000 to 26.400 | 0.0000 to 2.6400 | | | | | |
| KFM2150 SYSTEM 1980-03A | 0 to 396/30 | 0 to 39.6/3 | 0 to 3.96/0.3 | 0.0000 to 396.00 | 0.0000 to 39.600 | 0.0000 to 3.9600 | | | | | |
| KFM2150 SYSTEM 2640-04A | 0 to 528/40 | 0 to 52.8/4 | 0 to 5.28/0.4 | 0.0000 to 528.00 | 0.0000 to 52.800 | 0.0000 to 5.2800 | | | | | |
| KFM2150 SYSTEM 3300-05A | 0 to 660/50 | 0 to 66/5 | 0 to 6.6/0.5 | 0.0000 to 660.00 | 0.0000 to 66.000 | 0.0000 to 6.6000 | | | | | |
| KFM2150 SYSTEM 1000-01 | 0 to 200/10 | 0 to 20.0/1 | 0 to 2.00/0.1 | 0.0000 to 200.00 | 0.0000 to 20.000 | 0.0000 to 2.0000 | 0 to 15.75/1 | 0 to 157.5/10 | 0.0000 to 9.9999 | 10.000 to 99.999 | 100.00 to 150.00 |
| KFM2150 SYSTEM 3000-02 | 0 to 600/30 | 0 to 60.0/3 | 0 to 6.00/0.3 | 0.0000 to 600.00 | 0.0000 to 60.000 | 0.0000 to 6.0000 | | | | | |
| KFM2150 SYSTEM 5000-03 | 0 to 1000/50 | 0 to 100.0/5 | 0 to 10.00/0.5 | 0.0000 to 1000.0 | 0.0000 to 100.00 | 0.0000 to 10.000 | | | | | |
| KFM2150 SYSTEM 7000-04 | 0 to 1400/70 | 0 to 140.0/7 | 0 to 14.00/0.7 | 0.0000 to 1400.0 | 0.0000 to 140.00 | 0.0000 to 14.000 | | | | | |
| KFM2150 SYSTEM 9000-05 | 0 to 1800/90 | 0 to 180.0/9 | 0 to 18.00/0.9 | 0.0000 to 1800.0 | 0.0000 to 180.00 | 0.0000 to 18.000 | | | | | |

*1 : Range H, M, L : ± (0.3% of rdng + 0.3% of f.s), where f.s: full scale of the H range
Range L : ± (0.3% of rdng + 0.3% of f.s), where f.s: full scale of the L range

[Note] rdng: Stands for reading.

rng: Stands for range value.

*2 : All ranges : ± (0.1% of rdng + 0.1% of rng)

f.s: Stands for full scale.

Impedance measurement system that supports stack fuel cells

The KFM2150 system is a fuel cell impedance measurement system configured with an FC impedance meter KFM2150 and an electronic load PLZ-4W series. Combination of KFM2150 and PLZ-4WA series (0V input type) supports impedance measurement for single cell of fuel cell.

In addition to impedance measurement with AC impedance method, KFM2150 system provides IR measurement with current interrupt method. Application software enables test for each characteristic of fuel cell such as I-V characteristics, Constant Current characteristics, Current Interrupt method and Cole-Cole plot by the AC impedance method. Moreover, each test can be performed in a specified order.

Features

- Capable of measuring impedance in the frequency range from 10 mHz to 20 kHz.
- Parallel operation by same model of PLZ-4W series enhances current capacity and power capacity.
- Power capacity:
1000 W, 200 A, load input terminal: 1.5 V to 150 V (KFM2150 system 1000-01)
660 W, 132 A, load input terminal: 0 V to 150 V (KFM2150 system 660-01A)
- Measuring AC current can be set from 0.1% to 10% (0.1% unit) of DC load current.
- Capable of IR measurement with the current interrupt method.
- Capable of varying DC load current while keeping measuring AC current setting (%).
- Equipped with low voltage protection
- External interface equipped as standard (RS-232C, GPIB, USB)

Accessories

Operation manual, Power cord, Sensing wire, Flat cable, Application software (CD-ROM), RS-232C cable, Cables for parallel connection (2 pcs. per set./KFM2150 SYSTEM 1320-02A, KFM2150 SYSTEM 3000-02 only)

Common Specifications

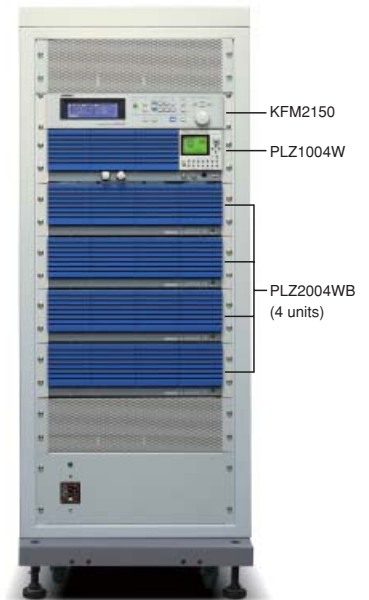
| | | |
|------------------------------------|-----------------------------|--|
| Impedance measurement function | Input voltage range | Bench top type: 90 VAC to 250 V, single phase Rack mount type: 180 VAC to 250 V, single phase |
| AC impedance method | Input frequency range | 47 Hz to 63 Hz |
| Frequency range | Power consumption | 550VA (SYSTEM165-01A) 1600VA (SYSTEM660-01A) 3100VA (SYSTEM1320-02A) 260VA (SYSTEM1000-01) 460VA (SYSTEM3000-02) 4600VA (SYSTEM1980-03A) 6100 VA (SYSTEM2640-04A) 7600 VA (SYSTEM3300-05A) 660 VA (SYSTEM5000-03) 860 VA (SYSTEM7000-04) 1060 VA (SYSTEM9000-05) |
| Frequency resolution | | |
| Measurement range | | |
| Measurement items | | |
| Current interrupt method | | |
| Measurement range | | |
| Measurement item | | |
| External control interface | | |
| Average setting | | |
| Protection function | | |
| Low-voltage protection (UVP) | | |
| Load protection | | |

FCTester (Application software)

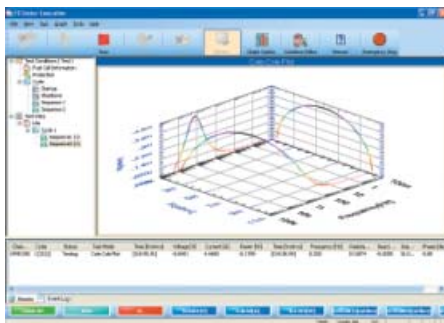
With the FC Tester, KFM system will be controlled by a PC and it offers the test for each characteristic of the fuel cell such as I-V characteristics, constant current characteristics, current interrupt method and Cole-Cole plot by the AC impedance method. In addition, each test can be performed in a specified order. Furthermore, it offers the sequential measurement of each cell's impedance by switching them off with the FC Scanner KFM2151.

Features

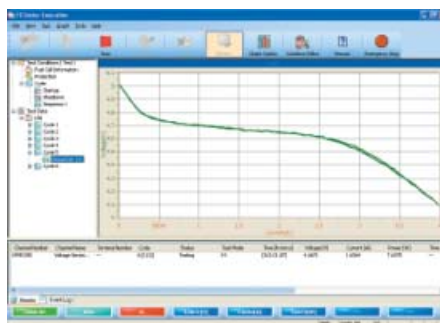
- Fuel cell-friendly start-up and shut-down sequences are equipped.
- Test modes such as I-V characteristics, constant current characteristics, current interrupt method, and Cole-Cole plot by the AC impedance method are equipped.
- Capable of performing cycle test for fuel cell with a combination of sequence functions.
- 2D/3D real-time graph function is equipped.
- Capable of outputting the test data by CSV file (text format).
- Capable of observing the voltage and the current waveform of when performing the current interrupt method.
- A panel control function that is operable by PC equivalent to KFM2150's panel operation is equipped.
- Capable of performing the impedance measurement of each cell with a combination with the FC Scanner (KFM2151).
- FC Tester consists of 3 programs, Configuration Tool, Condition Editor and Executive.



KFM2150 SYSTEM 9000-05



▲ Cole-Cole plot



▲ I-V characteristics

KFM2151

FC Scanner



Dimensions / Weight (approx.)

430(435)W × 44(60)H × 270(285)Dmm / 3.5kg

Accessories

Operation manual, Power cord, Metal fitting (4pcs.), Metal fitting screws (4pcs.), KFM2150 connection cable (1m), Screwless terminal connector (8 poles, 8pcs.), Screwless terminal connector (2 poles, 2pcs.)

Specifications

| | |
|--|---|
| SENSING terminal | |
| Number of inputs..... | 32 ch/unit (expandable to 160 ch with 5 units) |
| Rated input voltage..... | ±150 V (±200 Vpeak maximum) |
| Interface | |
| Remote control..... | RS-232C |
| For connecting the FC Impedance Meter .. | Dedicated interface |
| For channel expansion..... | Dedicated interface |
| Voltage measurement section | |
| Number of channels..... | 32. A SENSING terminal can be assigned to each channel. |
| Range..... | 2 V, 20 V, 200 V, and auto range |
| Scanning speed..... | 32 channels/s |
| OVP..... | -2 V to 200 V. Can be set for each channel. Resolution: 0.01 V |
| UVP..... | -2 V to 200 V. Can be set for each channel. Resolution: 0.01 V |
| Voltmeter..... | Maximum display: 19999 Accuracy: ±(0.1 % of rdng*1 + 0.1 % of rng*2) |

32ch voltage scanner that is compatible with stack fuel cells.

A combination with KFM2150 allows the impedance measurement as well!

FC Scanner KFM2151 is a 32ch scanner that meets the needs of monitoring each cell while assessing the stack fuel cell. It is capable of up to 160ch in a parallel connection so that the scanner is compatible with various sizes of stacks. In order to remove the burden of connecting the lines, the scanner has a function to change the allocated terminal of the channel without reconnecting them when performing voltage and impedance measurement of arbitrary cells. It also features the 32 channels/sec. of the scanning speed that is sufficient enough for the practical use as the voltage monitoring function.

Features

- Capable of impedance measurement that is up to 150V of input voltage when connected to KFM2150 with the dedicated cable.
- Capable of 32ch/unit input, and it is expandable to 160ch in a parallel connection.
- Capable of voltage and impedance measurement of arbitrary cells in a single connection due to the function that allows the ability to change the allocated terminal of the channel.
- Capable of setting OVP and UVP to each channel.
- Capable of voltage monitoring with the 32 channels/sec. of the scanning speed.
Capable of an individual operation as a voltage monitoring.

| | |
|---|--|
| Impedance measurement switching section | |
| Number of channels..... | 32. A SENSING terminal can be assigned to each channel. |
| Output terminal..... | Number of outputs: 1 ch Output voltage: Input voltage × 1/10 Accuracy: ±1 %: For DC |
| Scanning..... | Auto or manual |
| Frequency characteristics..... | 126 Hz or less: 2% (value to be added to the measurement accuracy of the KFM2150*3) 158 Hz to 3 kHz: 2% 3.16 kHz to 9 kHz: 3 % 10 kHz to 20 kHz: 5 % |
| Input voltage range..... | AC100V to 240V(AC90V to 250V), single phase |
| Input frequency range..... | 47Hz to 63Hz |
| Maximum power consumption..... | 30 VAmx |
| Insulation resistance..... | 500 VDC, 30 MΩ or more (Between the primary circuit and chassis) |
| Withstand voltage..... | No abnormalities at 1500 VAC for 1 minute (Between the primary circuit and chassis) |

*1: rdng: Indicates the read value.

*2: rng: Indicates the range.

*3: The basic measurement accuracy when combined with the KFM2150 FC Impedance Meter is obtained by adding a percentage indicated for a specific frequency range to the percentage of the |Z| reading on the KFM2150. ±((percentage of the |Z| reading) + 3 mΩ) for the 10 mΩ range.

● Configuration example of the impedance measurement system of KFM2150/KFM2151/PLZ-4W series (electronic loads devices)

