

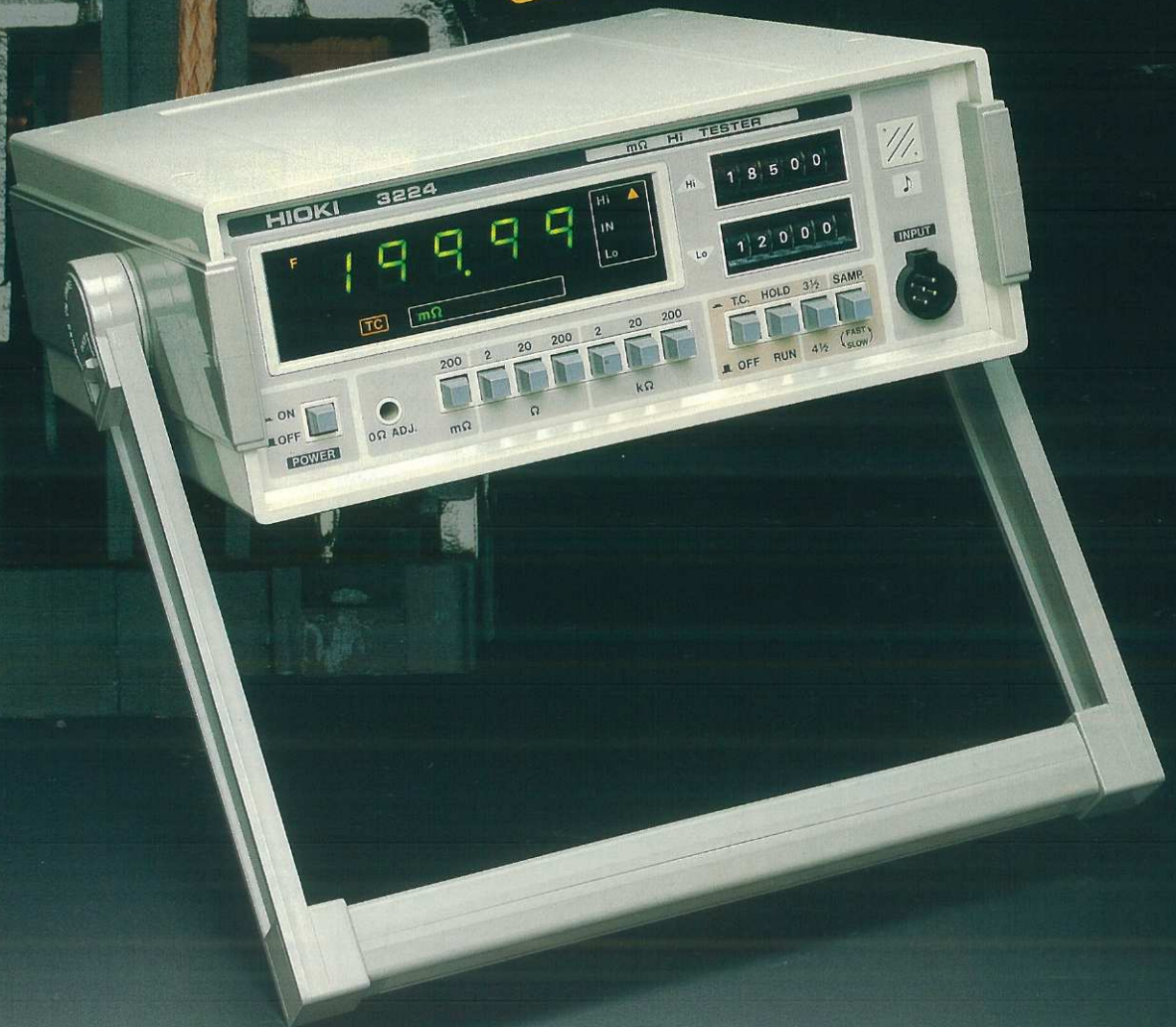
DIGITAL mΩ METER

HIOKI

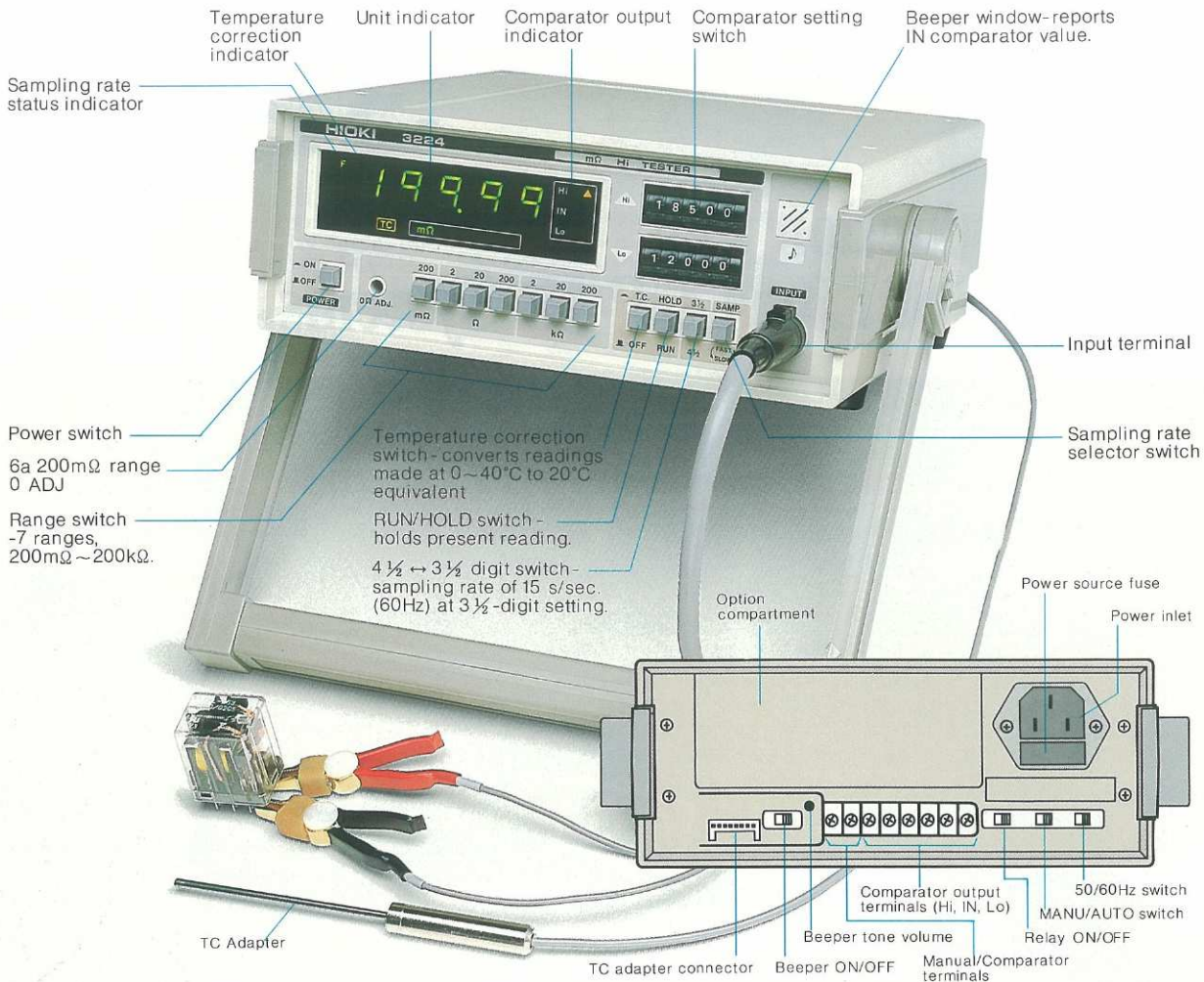
mΩ Hi TESTER

3224

Ideal for Production and
Quality-Control Lines, GP-IB Systems.



Comparator built-in. Measurement data



Measures contact resistance of relays, switches, connectors, etc.



Measures coil resistance of motors, transformers, relays, etc.



Measures fixed resistors up to 200kΩ



Measurement data compared.



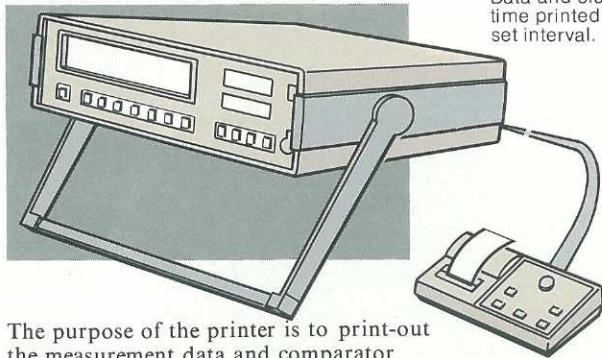
GP-IB system compatibility (3224-01 option)



Data print-out capability (3224-02 option)

Print out measurement data, comparator results.

3224-02: mΩ Hi TESTER with printer



The purpose of the printer is to print-out the measurement data and comparator results produced by the 3224 mΩ Hi TESTER. The printer is also capable of arranging input data in histogram form for quick visual confirmation of variations between test samples. In the histogram mode, a graph is made dividing the test samples into approximately 10 rankings between minimum and maximum value (automatic), or a center-value and rank width can be entered for use in constructing the graph.

(AUTO mode)
Data and elapsed time printed out at set interval.

(Automatic Graph Construction)
Test samples divided into approximately 10 rankings between minimum and maximum value.

Comparator results

```
00:00 161.18 RH
00:05 166.89 RH
00:10 146.86 RI
00:15 137.51 RL
00:20 123.61 QL
END
MIN= 123.61 Ω
(00:00:20)
MAX= 166.89 Ω
(00:00:05)
```

```
GRAPH  #=5
1.0000|
1.0060|}
1.0040|}
1.0020|}
1.0000|}
0.9980|}
0.9960|}
0.9940|}
0.9920|}
0.9900|}
```

(MANU mode)
Samples numbered (1~1000) and printed out manually.

Previous sample data cancelled.

3 CANCEL

No. of samples
20: No. of entries
18: No. of effective entries.

(OVER excluded.)
Average min, max, and standard deviation of effective entries.

```
No.
1 151.10 Ω
2 145.13 Ω
3 089.73 Ω
3 CANCEL
3 151.52 Ω
4 141.61 Ω
5 147.94 Ω
6 OVER Ω
7 146.44 Ω
8 OVER Ω
9 140.10 Ω
10 151.41 Ω
17 148.75 Ω
18 149.70 Ω
19 150.96 Ω
20 156.25 Ω
END
N = 20 (* 18)
x̄ = 148.563 Ω
MIN= 140.10 Ω
(No. 9)
*MAX= 156.25 Ω
(No. 20)
σn = 5.43629 Ω
```


compared. Device selection capability.

Ideally suited for use on production and quality-control lines, the HIOKI 3224 mΩ Hi TESTER features seven ranges between 200mΩ and 200kΩ. With maximum resolution of 10μΩ and 4-terminal measurement capability, the 3224 promises extremely accurate measurement results for a wide range of materials. Sampling rates of 2.5, 7.5, and 15* samples-per-second are selectable, and a temperature correction function automatically converts readings to their 20°C equivalent. The instrument comes standard with a comparator function, with printer and GP-IB models available as options.

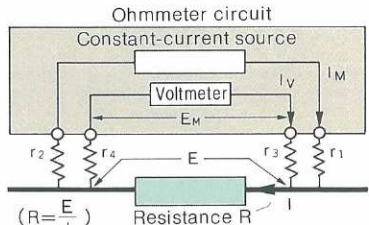
* 3½-digit display for 15 samples-per-second.

Features

- 10μΩ resolution (4½-digit display)
- High-speed sampling.
- 4½ ↔ 3½-digit switchable display.
- Comparator function.
- Comparator AUTO/MANU switch function.
- Reading HOLD function.
- 3224-01 GP-IB
- 3224-02 Printer

4-terminal resistance measurements

Since lead and contact resistance are added as factors in standard 2-terminal measurements, this method is not suited for low ohms measurements. Although test lead construction and measurement setup becomes somewhat more complicated, these factors can be cancelled with the 4-terminal method giving an accurate resistance measurement of the device being tested. (See example test circuit below)



($r_1 \sim r_4$ represent test lead and contact resistance values.)
 Assuming that $I_V \ll I_M$, then I is approximately equal to I_M . And since I_V is approximately zero, then $E_M = E + I_V(r_3 + r_4) \approx E$. Therefore, from $R_M = \frac{E_M}{I_M}$, the ohmmeter reading R_M becomes $R_M \approx \frac{E}{I} = R$.

Three selectable sampling rates

A Fast/Slow switch allows sampling rates to be switched from 2.5 samples-per-second (normal setting) to 7.5 s/sec (60Hz), or 15 s/sec (3½-digit display, 60Hz).

4½ ↔ 3½-Digit switching function

Switching the display to 3½-digits enables the high-speed (15 s/sec, 60Hz) sampling rate.

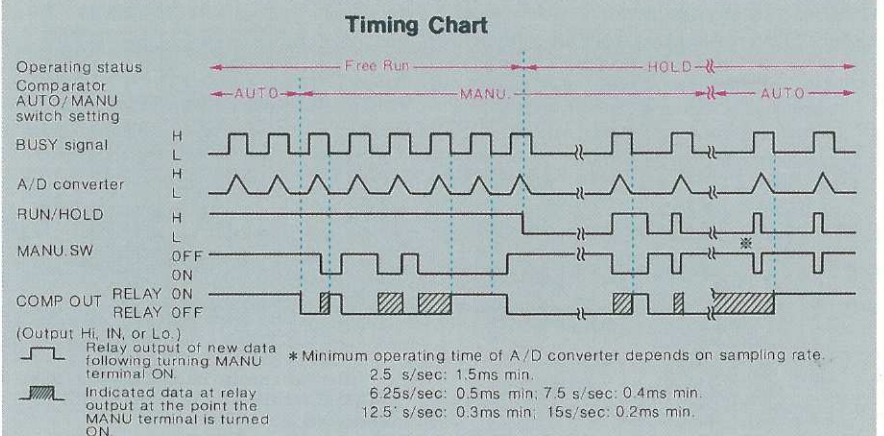
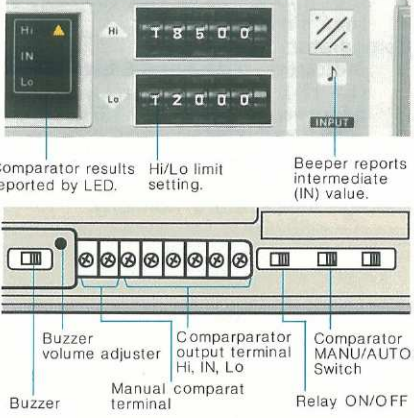
Comparator function

High limit (Hi) and low limit (Lo) settings are independent. Comparator results are reported by Hi, IN, and Lo LEDs, beeper tone, and relay output.

- The beeper sounds for an IN value. It also has a tone volume, and can be turned ON and OFF.
- Make-contact relays are independent for Hi, IN, and Lo output. ON/OFF switch provided. (OFF setting disables all output.)
- AUTO/MANU switch provided.
 - AUTO setting: Comparator operates continually.
 - MANU setting: Closure of switch (e.g., foot-switch, etc.) connected to MANU comparator output terminal activates comparator operation.

The timing diagram below illustrates the operating status of the comparator.

If the HOLD function is used, the comparator will be triggered simultaneously with the measurement START trigger. If only the HOLD function is used (AUTO/MANU switch in AUTO), each time the MANU switch is turned ON, the comparator result will be held.



Copper wire resistance readings temperature corrected

When measuring the resistivity of copper wire, resistance readings are corrected to indicate their 20°C equivalent. Accurate linear characteristics are assured by the use of a platinum thermoresistance element type temperature sensor.

The temperature sensor is connected to the instrument by cable, and can thus be placed next to the measurement sample for maximum accuracy.

Note 1: The temperature sensor should not make contact with the measurement sample. Its intended purpose is only to sense ambient temperature.

Note 2: The measurement sample and temperature sensor must be adjusted to ambient temperature.

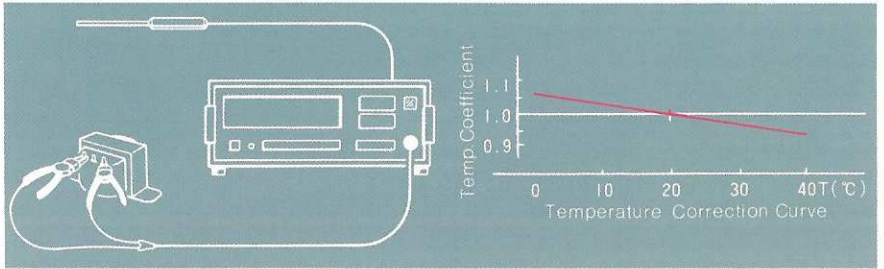
The measurement should be setup and left to warm-up prior to making the measurement.

GP-IB Capability (3224-01)

The 3224-01 comes with a GP-IB interface installed. Measurement data and comparator results can be output to a controller in a data acquisition system. The measurement signal system of the basic instrument is electrically isolated from the GP-IB signal system.

Print-out capability (3224-02)

The 3224-02 has a built-in printer. In addition to print-out of measurement data and comparator results, the printer also has calculation capability.



1. General Specifications

Measurement method: 4-terminal.
Instrument operation: Dual integrator type.
Display: 4½-digit LED (19999), or 3½-digit (1999).

Annunciators: mΩ, Ω, kΩ, F, **TC**, **GP-IB** (3224-01 only), and comparator results.
Input overload: Display flashes.

Sampling rate: Slow, 2.5 samples-per-second. Fast, 6.25 (50Hz), 7.5 (60Hz) samples-per-second.
3½-digit display, 12.5(50Hz), 15(60Hz) samples-per-second.
("F" appears in display for rates other than slow.)

Comparator: Three level (Hi, IN, Lo). LED indicators, relay output, beeper tone (for IN). (Beeper and relay output can be turned ON/OFF.) AUTO/MANU switch provided.

Operating temperature/humidity: 0~40°C / <80% RH (no condensation)
Storage temperature/humidity: -10~50°C / <80% RH (no condensation)

Dielectric strength: 500V (DC or AC peak) between case and AC power source line.

Power supply : AC 100V, 120V, 220V, 240V (specify at order)

Power consumption: Less than 8.5W (approx). (Main unit only.)

Dimensions/weight: 80H×218W×240D (mm)/2.1kg (approx)

Accessories provided:

- 9097 4-terminal test lead set
- 9099 Clip type test lead set
- T.C. adapter; power cord; 3A spare (power-source) fuse, 1; 1A spare (constant-current protection) fuse, 1.

2. Measurement Range

Conditions: 23°C ±5°C, <80% RH (no condensation)

Period of guaranteed accuracy: Six months

● 2-1. 4½-digit (SLOW sampling rate)

| Range | 200mΩ | 2Ω | 20Ω | 200Ω | 2kΩ | 20kΩ | 200kΩ |
|-------------------------|----------------------------|------------------|-----|-------|------------------|------|-------|
| Resolution | 10μΩ | 100μΩ | 1mΩ | 10mΩ | 100mΩ | 1Ω | 10Ω |
| Measurement current | 100mA | 10mA | 1mA | 10μA | | | |
| Max. test voltage | 20mV | 200mV | 2V | 200mV | 2V | | |
| Accuracy | *** | ±0.08%rdg. ±dgt. | | | ±0.1%rdg. ±3dgt. | | |
| Temperature coefficient | (±0.01%rdg. ±0.5dgt.) / °C | | | | | | |
| Open-terminal voltage | 5.0V Max. | | | | | | |
| | 2dgt. | | | | | | |

* Accuracy for 20mΩ range applicable following 0 ADJ.
** For FAST sampling rates, add digits to digit error.
*** ±0.1%rdg. ±8dgt.

● 2-2 3½-digit

| Range | 200mΩ | 2Ω | 20Ω | 200Ω | 2kΩ | 20kΩ | 200kΩ |
|-------------------------|----------------------------|------------------|------|-------|-----|------|-------|
| Resolution | 100μΩ | 1mΩ | 10mΩ | 100mΩ | 1Ω | 10Ω | 100Ω |
| Measurement current | 100mA | 10mA | 1mA | 10μA | | | |
| Max. test voltage | 20mV | 200mV | 2V | 200mV | 2V | | |
| Accuracy | ** | ±0.1%rdg. ±1dgt. | | | | | |
| Temperature coefficient | (±0.01%rdg. ±0.1dgt.) / °C | | | | | | |
| Open-terminal voltage | 5.0V Max. | | | | | | |
| | 1dgt. | | | | | | |

* Accuracy for 20mΩ range applicable following 0 ADJ.
** ±0.1%rdg. ±3dgt.

2-3. Maximum allowable input voltage

20mΩ range only:

2-4. Temperature correction function

Effective range: 0~40°C

Temperature sensor: Platinum thermoresistance element

Dielectric strength: 100V (DC or AC peak) between temperature sensor and (-) voltage terminal.

Accuracy (temperature sensor): Add the below values to accuracy values in 2-1 and 2-2.

| Temperature range | Accuracy |
|-------------------|------------|
| 0°C ~ 15°C | ±0.35%rdg. |
| 15°C ~ 25°C | ±0.25%rdg. |
| 25°C ~ 40°C | ±0.35%rdg. |

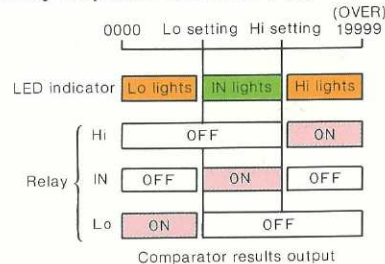
Temperature coefficient (adapter unit): Add ±150ppm to temperature coefficients in 2-1 and 2-2.

2-5. Comparator output terminals

Comparator output: Separate Hi, IN, and Lo relays (make-contact)

Relay contact capacity: AC 250V, 3A; DC 30V, 3A (resistive load)

Relay response time: 0.5s (approx)



Note: In 3½-digit operation, LSD ignored.

Printer Specifications (3224-02)

Printer: Thermal type character printer
Recording chart: 38mm(W)×8.5m(L)
(Approx. 2200 lines)

Printer life: 500,000 lines

Printer modes: TIME and NUMBER (No.), switchable

TIME mode: Automatic print-out at set time interval.

Print intervals:

- 1, 2, 5, 10, 15, 30(sec)
- 1, 2, 3, 5, 6, 10, 15, 30(min)
- 1 (hour)

Interval can be changed after start.

NUMBER mode: Manual print-out

Data No: 1~1000

Comparator results: Print-out of H (High), I (Intermediate), and L (Low).

Data processing

| | No. | | TIME |
|---------------------------------------|---------|---------|------|
| | N ≤ 100 | N > 100 | |
| N = (data No.) | ○ | ○ | ○ |
| \bar{x} = (average value) | ○ | ○ | ○ |
| MIN. = (minimum value) | ○ | ○ | ○ |
| MAX. = (maximum value) | ○ | ○ | ○ |
| σ_n = (standard deviation) | ○ | ○ | |
| σ_{n-1} = (standard deviation) | ○ | ○ | |
| GRAPH = (Graph mode) | ○ | | |

Cancel function: Immediately previous data entry can be cancelled.

Graph mode:

Automatic graph mode

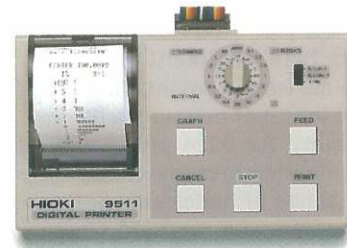
Graph produced of 10 rankings (approx) dividing values equally between MIN. and MAX. value.

Manual graph mode

Graph produced by entering center-value and ranking width.

Center-value setting: Upper-order

3½-digits
Rank width setting: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20% ... ±5 ranks
0.1, 0.2, 0.5, 1, 2, 5, 10% ... ±10 ranks
Option unit and decimal point settable.
Ext. control terminal provided (PRINT, STOP).
Instrument connector cable: 1m

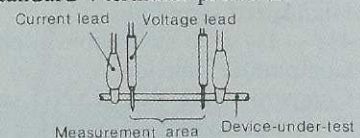


Available test leads

9097 4-terminal lead set (provided)



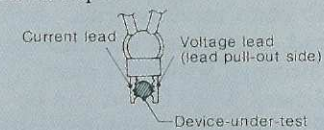
Standard 4-terminal probe set



9099 Clip type lead set (provided)



Kelvin clip set



9098 Pin type lead set (optional)



One-touch measurements



| Standard Packing (double carton box) | Sets | N.W. | G.W. | M ³ |
|--------------------------------------|------|------|------|----------------|
| | 3 | 8kg | 10kg | 0.10 |

Optional Accessory
9222 Recording Chart

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