Packed with Features to Ensure Accuracy in Battery Measurements

- Circuit design friendly for impedance measurements that minimize errors between channels (Effect: 0.01% f.s.)*
- For OCV measurement, internal resistance measurement, and external potential measurement of battery cells
- Measure battery modules up to 60 V DC
- Switch between voltmeter and battery tester while testing
- Built-in short-circuit protection fuse for each channel

* For BT4560 100 mΩ range, R measurements, and a measurement frequency of 1 kHz
Multi-channel Battery Testing

Combine the SW1001 or SW1002 with a battery testing instrument to measure a battery cell’s OCV (open circuit voltage), internal resistance, reaction resistance at low frequency, Cole-Cole plot, and external potential on multiple channels.

**OCV Measurements**
- High-precision OCV measurements
  - PRECISION DC VOLTMETER DM7276

**Internal Resistance Measurements**
- 1 kHz high-speed, high-precision internal resistance measurements
  - Module weld resistance measurements
  - BATTERY TESTER BT3562

**Impedance Measurements**
- Reaction resistance and electrolyte resistance measurements
  - Cole-Cole plots
  - BATTERY IMPEDANCE METER BT4560
  - CHEMICAL IMPEDANCE ANALYZER IM3590

**External Potential Measurement**
- Highly reliable measurement of external potential between electrode and case, using the contact check function
  - PRECISION DC VOLTMETER DM7276
Connect Up to Two Measuring Instruments with Different Functions

Switch between two types of measuring instruments to perform a variety of measurements.*

<table>
<thead>
<tr>
<th>Configuration Example</th>
<th>Switch between PRECISION DC VOLTMETER DM7276 and BATTERY IMPEDANCE METER BT4560</th>
</tr>
</thead>
</table>

**Example:**

- **DM7276**
  - Cell OCV measurements
  - External potential measurements between electrode and case

- **BT4560**
  - Cell internal resistance measurements
  - Cole-Cole plot measurements

*One 2-wire module and one 4-wire module or 4-terminal (BNC) module can be used together (see page 7). Only one channel can be measured at a time. Two modules cannot be used at the same time to measure multiple channels.

Battery Measurement Supported by Exclusive PC Application

Use the free, downloadable PC application to perform various measurements easily.*

**OCV Measurement function**

Enjoy basic functions as well as a newly added dedicated OCV measurement function. This allows you to measure initial voltage, voltage drops, voltage drop rate (mV/day), and the latest voltage drop rate (mV/hour) in addition to OCV measurement values. A judgment function is also included, making it easy to determine which battery cell is experiencing aging defects.

**Logging function**

Use in combination with supported measurement instruments to perform logging measurements (Interval setting: 1 second to 60 minutes) for up to 264 channels. The judgment function makes it easy to determine which channel on which an abnormality occurred.

**Multi-channel Cole-Cole plot measurements**

Use in combination with the BT4560 or the IM3590 to perform multi-channel Cole-Cole plot measurements. Allows testing to be performed efficiently for R&D and quality assurance.

---

LabVIEW® Compatibility

Build a measurement system with your LabVIEW® software and our LabVIEW® driver.*

Download the LabVIEW® driver from the HIOKI website at www.hioki.com.

*LabVIEW® is a trademark of National Instruments Corporation.

---

**Supported measuring instruments:** DM7275, DM7276, BT3562, BT3563, BT3561, BT4560, IM3590, RM3545, RM3544-01

**Save measurement data in CSV file format.**

**Create save files for each channel.**

**RS-232C/USB/LAN supported (matching the communication function of the connected device).**

---

**HIOKI products compatible with LabVIEW drivers**

<table>
<thead>
<tr>
<th>HIOKI products compatible with LabVIEW drivers (As of October 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW1001, SW1002</td>
</tr>
<tr>
<td>BT3562, BT3563</td>
</tr>
<tr>
<td>BT4560</td>
</tr>
<tr>
<td>RM3545</td>
</tr>
</tbody>
</table>

*LabVIEW® is a trademark of National Instruments Corporation.
Circuit Design for Impedance Measurements

The effect on the detection signal is reduced by canceling the magnetic flux of the AC measurement current and separating the source from the sense.

### Issue

**Effect of magnetic flux on 4-terminal measurement**

1. The magnetic flux generated by the measurement current generates induced voltage in the voltage terminal.
2. The magnetic flux generated by the eddy current generates induced voltage in the voltage terminal.
3. Magnetic flux from outside (Interference when using multiple modules simultaneously)

With the 4-terminal method, magnetic flux is generated from the AC measurement current. Further, the magnetic flux generates an eddy current in the surrounding metal, and the magnetic flux from that eddy current affects the detection signal, resulting in errors in measurement values.

### Circuit Design for Problem Solving

**Multiplexer module circuitry that is not easily affected by eddy currents and noise**

Sense and Source are separated to eliminate any effect on each other.

The Sense loop area is minimized to reduce the effect of external noise.

### Error in Measurement Values between Channels/Slots Due to Use of Switching System

**Example of measurement with BT3562**

- Measurement conditions: 3 mΩ range, 0 Ω measurement, after zero adjustment by direct connection

**Example of measurement with BT4560**

- Measurement conditions: RX function, 3 mΩ range, 1 kHz, 0 Ω measurement, after zero adjustment by direct connection

From the measurement results...

Little error between when a switch is used or not used.
Little error between channels.
Little error between slots.

Reliable measurement with little effect from eddy currents
Note: TERMINAL2 (4-Terminal banana) and TERMINAL3 (BNC) are shared internally. Do not connect more than one measuring instrument at the same time.

This module supports 2-wire/4-wire configurations. Channel switching can be performed in 11 ms (excluding communication, command processing time, and contact bounce).

Choose from Two Types of Multiplexer Modules

MULTIPLEXER MODULE SW9001
This module supports 2-wire/4-wire configurations. Channel switching can be performed in 11 ms (excluding communication, command processing time, and contact bounce).

MULTIPLEXER MODULE SW9002
This module supports 4-terminal pair configuration for use in combination with BT4560 and IM3590. 2-wire measurement is also possible (Sense only). Channel switching can be performed in 11 ms (excluding communication, command processing time, and contact bounce).

Examples of Switching Measurement Time *(Use in combination with SW1002 to measure the actual time for scan measurements.)* Communication with SW1002 via USB.

<table>
<thead>
<tr>
<th>Module</th>
<th>Measuring Instrument</th>
<th>Function</th>
<th>Measurement Speed</th>
<th>No. of Channels</th>
<th>Delay Time</th>
<th>Scan Time (All Channels)</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW9001</td>
<td>DM7276</td>
<td>V</td>
<td>0.02 PLC</td>
<td>22</td>
<td>0 ms</td>
<td>0.45 s (Approx. 20 ms/CH)</td>
<td>Communication with DM7276 via USB Contact check OFF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FAST</td>
<td>22</td>
<td>0 ms</td>
<td>0.85 s (Approx. 39 ms/CH)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BT3562</td>
<td>V</td>
<td>EX. FAST</td>
<td>11</td>
<td>10 ms</td>
<td>0.45 s (Approx. 41 ms/CH)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MEDIUM</td>
<td>11</td>
<td>10 ms</td>
<td>1.1 s (Approx. 100 ms/CH)</td>
<td></td>
</tr>
<tr>
<td>SW9002</td>
<td>BT4560</td>
<td>RX</td>
<td>FAST</td>
<td>6</td>
<td>0 ms</td>
<td>1.0 s (Approx. 167 ms/CH)</td>
<td>Communication with BT4560 via USB (9600 bps) Measurement frequency: 1 kHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MEDIUM</td>
<td>6</td>
<td>0 ms</td>
<td>1.2 s (Approx. 200 ms/CH)</td>
<td></td>
</tr>
</tbody>
</table>

Note: This is a conceptual diagram of the wiring of a module. For more information about the wiring of an actual module, refer to the instruction manual.
Control Interface/Useful Functions

Channel switching is controlled by the communication interface. LAN/USB/RS-232C interfaces are supported.

Rear Interfaces

Communication I/F: LAN/USB/RS-232C (HOST)
Transmission of communication commands to measurement instruments: RS-232C (INSTRUMENT)
For scanner control: EXT. I/O

Communication Command Transmission Function Reduces the Number of PC Ports Needed

Normally, PC control requires two ports: one communication port for switching and one for the measuring instrument.
By using the communication command transmission function on the SW1001 and SW1002, the switch mainframe can transfer control commands from the PC to the measuring instrument (and responses can be received from the device). This allows you to reduce the number of communication ports used on the measuring instrument. *2
*2 The measuring instrument is connected with the RS-232C. Only one instrument is supported (one port).

Scan Function

This function switches between channels in order based on the scan list registered in advance.
The switch mainframe and the EXT. I/O of the measuring instrument are connected. With the scan function, channel switching and trigger measurement can be synced for continuous scanning. *3

*3 To obtain the measurement value, use the data output function or the memory function on the measuring instruments.

Relay Open/Close Count Function

The number of times each relay opens/closes can be confirmed on the PC application. This allows you to estimate the service life of a relay.
Effects when Used in Combination with a Measurement Instrument

Combined measurement accuracy = Accuracy of measurement instrument + Combined effects

**SW9001 Connector signal table**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Shield</td>
<td>33</td>
<td>CH11 H</td>
</tr>
<tr>
<td>16</td>
<td>CH10 H</td>
<td>32</td>
<td>CH9 L</td>
</tr>
<tr>
<td>15</td>
<td>CH9 H</td>
<td>31</td>
<td>CH8 L</td>
</tr>
<tr>
<td>14</td>
<td>CH7 H</td>
<td>30</td>
<td>CH6 L</td>
</tr>
<tr>
<td>13</td>
<td>CH6 H</td>
<td>29</td>
<td>CH5 L</td>
</tr>
<tr>
<td>12</td>
<td>CH4 H</td>
<td>28</td>
<td>CH3 L</td>
</tr>
<tr>
<td>11</td>
<td>CH3 H</td>
<td>27</td>
<td>CH2 L</td>
</tr>
<tr>
<td>10</td>
<td>CH1 H</td>
<td>26</td>
<td>Shield</td>
</tr>
<tr>
<td>9</td>
<td>Shield</td>
<td>25</td>
<td>CH22 L</td>
</tr>
<tr>
<td>8</td>
<td>CH21 L</td>
<td>24</td>
<td>CH20 L</td>
</tr>
<tr>
<td>7</td>
<td>CH20 L</td>
<td>23</td>
<td>CH19 L</td>
</tr>
<tr>
<td>6</td>
<td>CH18 L</td>
<td>22</td>
<td>CH17 L</td>
</tr>
<tr>
<td>5</td>
<td>CH17 L</td>
<td>21</td>
<td>CH16 L</td>
</tr>
<tr>
<td>4</td>
<td>CH15 L</td>
<td>20</td>
<td>CH14 L</td>
</tr>
<tr>
<td>3</td>
<td>CH14 L</td>
<td>19</td>
<td>CH13 L</td>
</tr>
<tr>
<td>2</td>
<td>CH12 L</td>
<td>18</td>
<td>Shield</td>
</tr>
<tr>
<td>1</td>
<td>Shield</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

With a 4-wire system, channel n and channel n+11 are Source/Sense pairs.

**SW9002 Connector signal table**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Return CH6 L</td>
<td>37</td>
<td>Source CH6 L</td>
</tr>
<tr>
<td>18</td>
<td>Return CH5 L</td>
<td>36</td>
<td>Source CH5 L</td>
</tr>
<tr>
<td>17</td>
<td>Return CH4 L</td>
<td>35</td>
<td>Source CH4 L</td>
</tr>
<tr>
<td>16</td>
<td>Return CH3 L</td>
<td>34</td>
<td>Source CH3 L</td>
</tr>
<tr>
<td>15</td>
<td>Return CH2 L</td>
<td>33</td>
<td>Source CH2 L</td>
</tr>
<tr>
<td>14</td>
<td>Return CH1 L</td>
<td>32</td>
<td>Source CH1 L</td>
</tr>
<tr>
<td>13</td>
<td>Source CH1 L</td>
<td>31</td>
<td>Return CH1 H</td>
</tr>
<tr>
<td>12</td>
<td>Source CH2 H</td>
<td>30</td>
<td>Return CH2 H</td>
</tr>
<tr>
<td>11</td>
<td>Source CH3 H</td>
<td>29</td>
<td>Return CH3 H</td>
</tr>
<tr>
<td>10</td>
<td>Source CH4 H</td>
<td>28</td>
<td>Return CH4 H</td>
</tr>
<tr>
<td>9</td>
<td>Return CH5 H</td>
<td>27</td>
<td>Return CH5 H</td>
</tr>
<tr>
<td>8</td>
<td>Return CH6 H</td>
<td>26</td>
<td>Return CH6 H</td>
</tr>
<tr>
<td>7</td>
<td>Shield</td>
<td>25</td>
<td>Sense CH1 L</td>
</tr>
<tr>
<td>6</td>
<td>Sense CH1 H</td>
<td>24</td>
<td>Sense CH2 L</td>
</tr>
<tr>
<td>5</td>
<td>Sense CH2 H</td>
<td>23</td>
<td>Sense CH3 L</td>
</tr>
<tr>
<td>4</td>
<td>Sense CH3 H</td>
<td>22</td>
<td>Sense CH4 L</td>
</tr>
<tr>
<td>3</td>
<td>Sense CH4 H</td>
<td>21</td>
<td>Sense CH5 L</td>
</tr>
<tr>
<td>2</td>
<td>Sense CH5 L</td>
<td>20</td>
<td>Sense CH6 L</td>
</tr>
<tr>
<td>1</td>
<td>Sense CH6 H</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

When a 2-wire system is used, only Sense CH1 to CH6 are enabled.

**List of possible combinations when using two measuring instruments together**

One 2-wire module + one 4-wire module, or one 2-wire module + one 4-terminal pair module can be used together.

**1st Module** | **2nd Module**
---|---
DM7275 or DM7276 | BT3562 or 3561

Combinations of two 2-wire modules, two 4-wire modules, or one 2-wire module + one 4-terminal pair module are not possible.

---

1. Measurement anomaly detection function not available in the 3000 Ω range of the BT3562 and BT3563.
2. The effect of voltage measurement includes the offset voltage of the basic specifications.
3. The effect when used in combination with the IM3590 is a reference value. It is not a guaranteed value.
**MULTIPLEXER MODULE SW9001 Specifications**

- **Wiring method**: 2-wire or 4-wire
- **No. of channels**: 22 channels (2-wire) / 11 channels (4-wire)
- **Channel switching time**: 11 ms (excluding measurement time)
- **Max. allowable voltage**: 60 V DC, 30 V AC rms, 42.4 V peak
- **Max. allowable current**: 1 A DC, 1 A AC rms
- **Max. allowable power**: 30 W (resistive load)
- **Max. allowable voltage to ground**: 60 V DC
- **Offset voltage**: 5 μV (TERMINAL 1, TERMINAL 2 Sense)
- **Initial path resistance**: Less than 1.5 Ω when using TERMINAL 1.
- **Initial contact resistance**: 1 GΩ or more between High-Low channels (at 60 V DC)
- **Contact life (reference value)**: No load: 50 million times
- **Dimensions and mass**: Approx. 25.5 mm (1.00 in) W x 110 mm (4.33 in) H x 257 mm (10.12 in) D, Approx. 230 g (8.1 oz)
- **Accessories**: Instruction manual x 1

*1 Product warranty period: 3 years (excluding relays and fuses)
*2 Cannot connect to battery packs in excess of 60 V DC.
*3 The offset value is within 1 minute of closing the channel. This value is also taken when the temperature of the usage environment is sufficiently stable.

---

**MULTIPLEXER MODULE SW9002 Specifications**

- **Wiring method**: 4-terminal pair (2-wire) or 2-wire
- **No. of channels**: 6 channels (4-terminal pair) / 6 channels (2-wire)
- **Channel switching time**: 1 ms (excluding measurement time)
- **Max. allowable voltage**: 60 V DC, 30 V AC rms, 42.4 V peak
- **Max. allowable current**: 1 A DC, 1 A AC rms
- **Max. allowable power**: 10 W (resistive load)
- **Max. allowable voltage to ground**: 60 V DC
- **Offset voltage**: 5 μV (TERMINAL 1, TERMINAL 2 Sense)
- **Initial path resistance**: Less than 1.0 Ω when using TERMINAL 2, 3
- **Initial contact resistance**: 1 GΩ or more between High-Low channels (at 60 V DC)
- **Contact life (reference value)**: No load: 50 million times
- **Dimensions and mass**: Approx. 25.5 mm (1.00 in) W x 110 mm (4.33 in) H x 257 mm (10.12 in) D, Approx. 190 g (6.7 oz)
- **Accessories**: Instruction manual x 1

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**Lineup**

**SWITCH MAINFRAME SW1001**

- **Model No. (Order Code)**: SW1001
- **Module not included with the switch mainframe. Modules must be purchased separately.**

**SWITCH MAINFRAME SW1002**

- **Model No. (Order Code)**: SW1002

**Optional Modules**

**MULTIPLEXER MODULE SW9001**

- **Model No. (Order Code)**: SW1002

**MULTIPLEXER MODULE SW9002**

- **Model No. (Order Code)**: SW1001

---

**Optional Connection Cables**

- **CONNECTION CABLE**
  - **SET L4930**: 1.2m (3.94 ft) length
- **CONNECTION CABLE**
  - **L2108 (4-terminal banana)**: 0.84m (2.76 ft) length
- **CONNECTION CABLE**
  - **L2004 (BNC)**: 0.91m (3.00 ft) length

**Optional Interface Cables**

- **RS-232C CABLE 9637**: 9 to 9-pin cross 1.8m (5.91 ft) length
- **LAN CABLE 9642**: 5m (16.41 ft) length
- **USB CABLE L1002 (A-B)**: 1m (3.28 ft) length

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All information correct as of Nov. 11, 2019. All specifications are subject to change without notice.