Wide Spectrum Power Meter for Comprehensive Device Assessment

DC/0.5Hz to 1MHz broad-band POWER HiTESTER measures up to 6 systems simultaneously.

The POWER HiTESTER 3193-10 is a multi-function power meter for use with single phase power lines to 3-phase, 4-wire circuits. Accommodating up to 6 units, it is not only capable of measuring up to 6 single phase systems, but can simultaneously measure the input and output of a 3-phase inverter and provide effective power measurements. Additionally, it supports harmonic analysis and flicker measurement (optional), features which are essential for overall device assessment. Standard features include a GP-IB and RS-232C interface, making it easy to feed data to a personal computer for processing and analysis. This unit is ideal for those requiring greater efficiency in electrical device assessment.

AC/DC CURRENT SENSOR
- Rated at 1000A rms
- Wide bandwidth
- Super high precision

Printer is optional unit
Harmonic and Flicker Analysis

Harmonic and flicker analysis are possible when using the optional HARMONIC / FLICKER MEASUREMENTS UNIT 9605.

A Variety of Interfaces for Differing Needs

★ Connecting to a PC

The RS-232C and GP-IB interface, provided as standard features, make it possible to connect the power meter directly to a PC, allowing efficient measurement, management and analysis of data.

★ Connecting to a Recorder

With 8 selectable D/A outputs and voltage, current and power analog/monitor output (current and voltage only) as standard features, the HiTESTER allows recording of changes and transient fluctuations in waveforms using a recording unit.

★ Connecting to a Printer

Data can be output to the optional PRINTER UNIT 9604.

Features

■ Wide range of measurement functions

Capable of measuring voltage, current, active/reactive/apparent power, power factor, phase, frequency, and current, and of integrating power according to polarity, the 3193-10 also provides wave peak and efficiency measurements that are essential to device assessment.

■ Measure Motor Output

With the optional EXTERNAL SIGNAL INPUT UNIT 9603, the HiTESTER can take analog input from torque and revolution measurements and use that information to calculate motor output.

■ Measurement for Minute Stand-by Power also Available (by special-order)

The 9600 and 9601 input units have 10-times improved current sensitivity, and currents starting from the 20.000mA range can be measured. (Please inquire for further information.)

■ High Visibility Color LCD

Featuring a wide viewing angle, the color LCD displays a variety of items simultaneously, making it ideal for quickly grasping power usage on the system being measured. Expanded display is possible for any four selected items.

■ Harmonic and Flicker Analysis

Harmonic and flicker analysis are possible when using the optional HARMONIC / FLICKER MEASUREMENTS UNIT 9605.

■ High Basic Accuracy of ±0.2%

Measurements of even greater precision can be obtained using the optional 9600 to 9602 input unit, which provides a basic accuracy of ±0.1% rdg. ±0.1% f.s. (With the 9602, the accuracy of the clamp-on sensor is a factor affecting total accuracy during power measurement.)

■ A Variety of Interfaces for Differing Needs

★ Connecting to a PC

The RS-232C and GP-IB interface, provided as standard features, make it possible to connect the power meter directly to a PC, allowing efficient measurement, management and analysis of data.

★ Connecting to a Recorder

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★ Connecting to a Printer

Data can be output to the optional PRINTER UNIT 9604.

Print type : Thermal line dot printing
Paper width : 72mm
Main functions : printing of items measured, hard copy output of displayed screens, printout of meter settings, printout of various times (such as interval time, timer time, and realtime control time). Printouts are performed either automatically, upon input of an external control signal, or synchronized with an integrator.
Choose from a variety of input units according to application

Three types of input units are available, including the 9602 AC/DC Clamp Input Unit, which can be used with current levels exceeding 50A under live circuit conditions, as well as the 9600 and 9601 which accept direct input of up to 1000V/50A.

- 9600 · · · DC/0.5Hz to 1MHz wide band
- 9601 · · · 5Hz to 100kHz, for AC only
- 9602 · · · DC/0.5Hz to 200kHz clamp input

Choose from a variety sensors including AC Clamp On Sensors 9272-10 and 9290-10, AC/DC CURRENT PROBEs CT6841, CT6843 and 9279, and super high-precision AC/DC Sensors CT6865, 9709, CT6862 and CT6863.

Simultaneous Measurement of Multiple Systems

Since all units are mutually isolated, the primary and secondary sides of devices or disparate power lines can be measured simultaneously. Simultaneous measurement of single phase 6 wire or 3 phase 2 wire systems which previously required multiple units, can now be handled with one. What’s more, measurements of all devices can be taken at the same instant, providing a powerful tool for integrated, all-round device assessment.

Feed-through current sensors

<table>
<thead>
<tr>
<th>CT6865</th>
<th>CT6863</th>
<th>CT6862</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC/DC 1000A</td>
<td>AC/DC 200A</td>
<td>AC/DC 50A</td>
</tr>
</tbody>
</table>

Clamp-on sensors

<table>
<thead>
<tr>
<th>CT6846</th>
<th>CT6843</th>
<th>CT6841</th>
<th>9272-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC/DC 1000A</td>
<td>AC/DC 200A</td>
<td>AC/DC 20A</td>
<td>AC 20/200A</td>
</tr>
</tbody>
</table>

9600 Frequency characteristics (at 15W [15V x 1A] range, response slow)

Effect of common mode voltage
The Power Analysis Station

Applications of 3193-10

Example of Application With Power Converter
Measure mixed AC and DC components with a single unit.

Example of Assessment Trial of EV (Electric Vehicle)
Separate charge/generation integration capability. Measurement under live circuit conditions. (Clamp input)

Even Supports Harmonic / Flicker analysis when using the optional 9605 HARMONIC / FLICKER MEASUREMENTS UNIT.

Graph Display of Harmonics
Voltage, current and power can be analyzed and displayed by bargraphs of harmonic amplitude, content and phase angle. Voltage, current and power can be displayed simultaneously for a single channel, or a single parameter can be displayed simultaneously for each of three channels.

List Display of Harmonics
The harmonic list display shows the amplitude, proportion, phase angle and distortion for each harmonic of voltage, current and power. Displaying only proportion, or two parameters simultaneously, such as amplitude and phase angle, is selectable.

Flicker Measurement Display
Displays data during measurement in real-time. Display can also be switched to D measurement and "Pst" value.

Waveform Display
The waveform display shows one cycle of the voltage and current waveforms. RMS and peak values can be displayed along with voltage and current waveforms, or voltage and current waveforms for up to three channels can be displayed at the same time.

Vector Display of Harmonics
The harmonic vector display shows the voltage, current and phase angle for each harmonic, making clear the voltage-current phase relationship.

Monitor Display
The relative "d" voltage change ΔV/V and the instantaneous flicker value "S(t)" can be displayed in a time series, so past variations are clearly displayed.
**9605 Specifications (optional)**

<table>
<thead>
<tr>
<th>Installation</th>
<th>Installs in the 3193-10 main unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement lines</td>
<td>Single-phase 2- and 3-wire, three-phase 4-wire</td>
</tr>
<tr>
<td>No. of channels</td>
<td>Up to 6 channels within channels 1 to 6, depending on 3193-10 wiring mode</td>
</tr>
<tr>
<td>Output functions</td>
<td>RS-232C, GPIB, printer</td>
</tr>
</tbody>
</table>

**Harmonic Waveform Analysis Functions**

- Measurement range: Fundamental frequency: 1 to 440 Hz, PLL system (5 to 440 Hz), external clock system (1 to 5 Hz)
- Orders analyzed: Up to 50th harmonic (with 1 to 250 Hz fundamental)
- Window width: 16 cycles (for 40 to 70 Hz fundamental)
- Windowing type: Rectangular tiling (no gap between or overlap of windows)
- Amount of data analyzed: 512 points (for 40 to 70 Hz fundamental)
- Measurement items: Harmonic level, percentage and phase angle of each order of harmonic waveform for each of voltage, current and power. Total up to 50th harmonic (of 40 to 70 Hz fundamental) for voltage, current and power. Total harmonic distortion for voltage and current (THD-F and THD-R)

**Flicker Measurement Function**

- Measurement range: Fundamental frequency: 45 to 66 Hz, PLL synchronization system
- Analysis items: dc (relative constant voltage change), d max (max. relative constant voltage change), d(t)500ms (relative voltage change per time), P0.1/ P1s/ P3s/ P10s and 30s (cumulative probability), Pst (short-term flicker value), Ph (long-term flicker value)
- Screen displays: Measured value, CPF, Pst list, Monitor

**Other Analysis Functions**

**Integration According to Polarity**

Positive, negative, and total current and power can be integrated simultaneously for all channels. This makes it possible to grasp the income and outflow of power at a glance.

**Peak Measurements Function**

Voltage and current wave peaks can be measured. The Peak Hold function can be used to find peak values and effective maximums for motor rush current waves.

**Wave Monitor Output**

With the voltage and current ranges, waveforms are output as a 5V full scale values, allowing waveforms to be monitored using devices such as recorders or synchroscopes.

**Analog and D/A Output**

Analog (voltage, current, and effective power) and D/A outputs (any selected eight items) are output as a 5V range full scale value. (Except for the 1000V range), 100ms response time can be obtained by using the FAST setting.

- **3 Types of Averaging Functions**
  Select from time average, moving average and exponential average.

- **3ch Frequency Measurement Function**
  With the frequency ranges, LPF and HPF can be used in combination, allowing measurement of fundamental waveforms and carrier waveforms of inverters.

- **Efficiency Calculation Function**
  Three efficiency calculations can be obtained simultaneously from measured voltage values.

**Multi-Channel Recorders**

**MEMORY HiCORDER MR8847A**

- The Ideal Recorder for Field Use, Easy Portability and Sturdy Construction
  - 20M-Sampling/s
  - Max. 16 ch + logic 16 ch
  - 32M to 256M-Word Memory (2ch)

**MEMORY HiCORDER MR8875**

- Smart Design - Smart Engineering
  - 500k-Sampling/s
  - Max. 16ch+Logic 8ch
  - Memory 8M-word by each input unit, total 32M-words
Optional Input Unit Specifications

AC/DIRECT INPUT UNIT 9600

<table>
<thead>
<tr>
<th>Measurement range</th>
<th>Voltage</th>
<th>Current</th>
<th>Active power</th>
<th>Voltage</th>
<th>Current</th>
<th>Active power</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0000/15.000/30.000</td>
<td>20.000/50.000 mA</td>
<td></td>
<td></td>
<td>6.0000/15.000/30.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0000/15.000/30.000</td>
<td>1.0000/2.0000/5.0000</td>
<td></td>
<td></td>
<td>6.0000/15.000/30.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0000/15.000/30.000 A</td>
<td>10.000/20.000/50.000 A</td>
<td></td>
<td></td>
<td>6.0000/15.000/30.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AC/CLAMP INPUT UNIT 9602

<table>
<thead>
<tr>
<th>Measurement range</th>
<th>Voltage</th>
<th>Current</th>
<th>Active power</th>
<th>Voltage</th>
<th>Current</th>
<th>Active power</th>
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</thead>
<tbody>
<tr>
<td>Depends on combination of voltage and current ranges</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Max.operating input (AC)

- 1000Vrms/1500 V peak
- 65Ams/100 A peak

Max.operating input (DC)

- Depends on clamp-on sensor

Crest factor

- Lower of either (measured range X 6) / measured value or maximum permissible rated peak / measured value

Input resistance

- 2MΩ±5%

Accuracy

- (Accuracy assured at 23°C±5°C (73°F±9°F) at 80% R.H., power factor = 1, sine wave input, in-phase voltage 0, after DMAG)

- DC ±0.1% rdg. ±0.2% f.s.
- 0.5 to 1 Hz ±0.5% rdg. ±0.5% f.s.
- 1 to 10 Hz ±0.2% rdg. ±0.2% f.s.
- 10 to 45 Hz ±0.1% rdg. ±0.2% f.s.
- 45 to 66 Hz ±0.1% rdg. ±0.1% f.s.
- 66 Hz to 10 kHz ±0.1% rdg. ±0.2% f.s.
- 10 kHz to 50 kHz ±0.3% rdg. ±0.3% f.s.
- Less than 5 A ±0.5% rdg. ±0.5% f.s.
- Greater than 5 A ±0.5% rdg. ±0.5% f.s.

Note 1: Assured accuracy ranges for different response settings are as follows: FAST (0.1 sec) to DC and greater than 50 Hz, MID (0.8 sec) to DC and greater than 10 Hz, SLOW (5.0 sec) to DC or greater than 0.5 Hz.

Note 2: The “s” before each power factor or phase operation indicates the lead or lag of current phase in relation to voltage. The “-” sign means current phase leads voltage and when there is no symbol, it lags. “su” is “-” when the sum of reactive power is negative and “+” (but unsigned) when it is positive.

AC DIRECT INPUT UNIT 9601

<table>
<thead>
<tr>
<th>Measurement range</th>
<th>Voltage</th>
<th>Current</th>
<th>Active power</th>
<th>Voltage</th>
<th>Current</th>
<th>Active power</th>
</tr>
</thead>
<tbody>
<tr>
<td>60.000/15.000/30.000</td>
<td>20.000/50.000 mA</td>
<td></td>
<td></td>
<td>60.000/15.000/30.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60.000/15.000/30.000</td>
<td>1.0000/2.0000/5.0000</td>
<td></td>
<td></td>
<td>1.0000/2.0000/5.0000</td>
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<td>60.000/15.000/30.000 A</td>
<td>10.000/20.000/50.000 A</td>
<td></td>
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<td>10.000/20.000/50.000 A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Assured Accuracy Range for Input Frequency of the 9600

9601 and 9602 each have assured ranges for input frequency.

Note 1: Assured accuracy ranges for different response settings are as follows: FAST (0.1 sec) to DC and greater than 50 Hz, MID (0.8 sec) to DC and greater than 10 Hz, SLOW (5.0 sec) to DC or greater than 0.5 Hz.

Note 2: Assured accuracy ranges for combined mode measurement are 10 Hz or greater for the AC mode, and DC only for the AC+DC mode or DC mode.

Calculation algorithm

(Indicated only for single phase, 2 wire and 3 phase. 3 wire (3V3A). Two additional calculation algorithms can be selected for apparent/reactive power)

Note 1: The above calculation algorithm is for a single phase, 2 wire input to ch 1, and 3 phase, 3 wire input to ch 1/2/3 (3 voltage, 3 current).

Note 2: The “*” before each power factor or phase operation indicates the lead or lag of current phase in relation to voltage. The “-” sign means current phase leads voltage and when there is no symbol, it lags. “su” is “-” when the sum of reactive power is negative and “+” (but unsigned) when it is positive.
### Basic specifications

**Measurement line**: Single phase 2 wire, single phase 3 wire, 3 phase 3 wire (3V3A is possible), 3 phase 4 wire

**Measurement item**: When using 9600, 9601, 9602 (optional)

- Voltage, current, voltage/current peak, effective/reactive/apparent power, power factor, phase, frequency, current/power integration, lead/lag, efficiency.

**When using the 9603 (optional)**

- Voltage, torque, r/min, frequency, motor output.

**When using the 9605 (optional)**

- Harmonic, waveform, voltage fluctuation, fluxometer measurement function.

**Display indication range**

- At the lowest range in the DC mode of Models 9600 & 9602 0.2% to ±13%
- At the lower range in the AC mode of Models 9600 & 9602 0.5% to ±13%
- At the 200V range of Model 9601 0.5% to ±13%
- At 0.1% to ±13% of all other ranges.

**All range is zero suppressed at less than lower % value.**

**Display resolution**

- 9999 count (except with integration), 999999 count (with integration)

**Rectification method**

- Switchable between RMS (true root mean square value) and MAX (average rectified RMS indication). When combined mode DC is selected, its not possible to switch between them.

**Display update rate**

- 8 times/sec.

**Combined mode**

- DC: AC + DC, AC (AC only when used in combination with 9601 or 9602 + AC clamp-on sensor)

**Analogue output**

- Voltage / current / active power

**DC±5V f.s. (1000V range is ±3333 V f.s.)**

**Display**

- Voltage / current: 1Vrms f.s. (1000V range is 0.6667 Vrms f.s.)

**Number of channels**

- Max. 3ch (selection of voltage or current for arbitrary channel)

**Effective input range**

- 0.2 Hz to 2 MHz

**Measurement range**

- See Page 5 specifications for individual input units

**[Integration measurement]**

**Number of measurements**

- 64 times/sec

**Measurement range**

- 0.0009999999 TAh / TWh (integration time up to 10,000 hours)

**[Power factor/Phase angle measurement]**

**Measurement range**

- ±1.0000 (lead) to 0.0000, ±1.0000 (lag)

**[Frequency measurement]**

**Number of channels**

- Max. 3ch (selection of voltage or current for arbitrary channel)

**Effective input range**

- 0.5 Hz to 2 MHz

**Measurement range**

- Auto / 50Hz / 500Hz / 5 kHz / 2 MHz

### Measurement accuracy

(Accuracy guaranteed for 6 months, Post-adjustment accuracy guaranteed for 6 months)

**V, A, W**

- Per accuracy table on page 5

**Apparent / reactive power**

- ±1% dgt. with respect to measurement from measured value (U, I, P)

**Integration**

- ±1% dgt. with respect to measurement from measured values (L, P)

**Power factor**

- Max. ±3% dgt. with respect to measured values from measurements (L, P)

**Phase angle**

- ±0.1% ±1% dgt. ±10% (±10% to ±25%)

**Frequency**

- ±1% dgt. with respect to values calculated from measurements (U, I, P)

**Wave peak**

- ±1% (±0.5Hz to 1kHz), ±2% (±1kHz to 10kHz), ±10% (±1kHz to 100kHz)

### General Specifications

**Location for use**

- Indoors, altitude to 2000 m, Pollution levels 2

**Ambient storage humidity**

- -10°C to 40°C, 60% relative humidity (40% relative humidity, 12°C, ±85% relative humidity)

**Maximum rated voltage/earth**

- Single phase 2 wire, single phase 3 wire, 3 phase 3 wire, 3 phase 4 wire, 3 phase 4 wire

**Withstand voltage**

- 600V measurement category II (expected transient overvoltage 600V)

**Power supply**

- AC100V/120V 50/60Hz (switched automatically), 50/60Hz

**Maximum rated power**

- 150VA max

**Dimensions, mass**

- Approx 430 W 14.57 (H) x 5.91 (W) x 370 (D), Approx 13 kg

**Accessories**

- Power cord 1, ground adapter (3P to 2P), 1, connector 1

**Power cord**

- 150 V A max.

**Certifications**

- Safety EN 61010

- EMC EN 61326

- En 61000-3-2

- En 61000-3-1

**Motor output (Pm) measured**

- 9600 (optional) external input unit required

**Display indication range**

- 0.1% to ±13% of 9603 voltage range (polarity not indicated)

**[Efficiency measurement]**

**Calculable factors**

- Maximum of 3 formats

**Calculatied items**

- P for each input unit, Power when combined with 9603

**Measurements with 9605 not allowed**

**[D/A output]**

- Number of channels: 8ch

- Output impedance: 100Ω±5%

- Output items: Outputs 8 arbitrarily selected items

- Output voltage: ±0.0000 to ±0.0000

- Output update rate: 16 times/sec

**[Interface]**

**GP-IB**

- RS-232C

- Start-stop synchronous, with baud rate of 2400 or 9600 bits/sec

**[External Control]**

**Functions**

- Integration start / stop control, Integration data reset, External A/D (For display update when power meter display is in hold mode), Manual print control

**Control signal level**

- From 0 / 5V logic signal or short/open contact signal

**[Other functions]**

**Scaling**

- PT/CT ratio: Set ratio 0.0001 to 99999

**Averaging**

- Time average, set time (0.1sec to 10000 sec), set time (0.1sec to 10000 sec)

- Moving average (number of samples: 8/16/32/64)

**Exponential average (attenuation factor): 8/16/32/64

**Multilingual display**

- Japanese/English screen display switching

**Set time (all types)**

- Interval control time (10 sec to 100 hours) in 10 sec increments

**D/A output**

- When used with combination printer, auto select increments

**Monitor control time (1 min to 10000 hours) in 1 minute increments

**Realtime control time, 1 minute increments

**[Harmonic / Flicker measurement]**

**9605 (optional) required**

**Measurement item**

- See Page 4 specifications for 9605

**Motor output**

- ±10% dgt for calculations of each measured value

**Efficiency**

- Max. ±7% dgt with respect to values calculated from measurements of items substituted into algorithm

**Thermal coefficient**

- Of in-phase voltage

**Effect of in-phase voltage**

- Within ±0.03% f.s. / °C

**Effect of power factor**

- ±0.15% f.s. (power factor 0)

**Actual time**

- ±25ppm ±1% (0 to 40°C (37°F to 104°F))

**D/A output**

- Display accuracy - ±0.2% f.s

**Monitor output**

- Display accuracy - ±0.2% f.s (less than 100kHz)

- Display accuracy - ±3dB (100kHz to 1MHz)
Model: POWER HiTESTER 3193-10

Ordering information

Note: Main unit 3193-10 cannot operate alone - please purchase an input unit Model 9600 to 9605 for factory installation prior to shipment. All subsequent input unit replacements or expansions must be conducted at HIOKI for an additional service charge.

- Use the same input unit for a particular measurement line.
- Install units in succession starting from channel 1.
- For the 9603 only one unit can be installed.
- When the 9602 is selected, use an optional clamp-on sensor.

( ) : 9600, 9601, and 9602 can be selected.

<table>
<thead>
<tr>
<th>Pattern A</th>
<th>Pattern B</th>
<th>Pattern C</th>
<th>Pattern D</th>
<th>Pattern E</th>
<th>Pattern F</th>
<th>Pattern G</th>
</tr>
</thead>
<tbody>
<tr>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td></td>
</tr>
<tr>
<td>I ø 3 W /3 ø 5 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td></td>
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<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td></td>
</tr>
<tr>
<td>3V3A (3 ø 3 W) / 3 ø 4 W</td>
<td>I ø 2 W</td>
<td>1 ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td>I ø 2 W</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

- Voltage measurement
- Voltage measurement
- AC/DC DIRECT
- AC/DC DIRECT
- AC/DC CLAMP
- AC/DC CLAMP
- EXTERNAL SIGNAL INPUT UNIT 9603
- EXTERNAL SIGNAL INPUT UNIT 9603
- PRINTER UNIT 9604
- PRINTER UNIT 9604
- RECORDING PAPER 9232
- RECORDING PAPER 9232
- RS-232C CABLE L9438-50
- RS-232C CABLE L9438-50
- Conversion cable CT9902
- Conversion cable CT9902
- Voltage probes
- Voltage probes
- Magnetic adapter 9804-01
- Magnetic adapter 9804-01
- Magnetic adapter 9804-02
- Magnetic adapter 9804-02
- Magnet GRABBER CLIP 9243
- Magnet GRABBER CLIP 9243
- Magnet VOLTAGE CORD L9438-50
- Magnet VOLTAGE CORD L9438-50

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