Electrical equipment such as power transmission and distribution equipment critical for social infrastructures and factories that operate 24 hours a day is demanded of high reliability even when used under severe conditions. Recent years have seen attempts to diagnose the accurate remaining lifespan during periodic inspections, and realize use of such equipment beyond the design life-cycle through implementation of appropriate maintenance. In addition, equipment diagnostic techniques as means of preventive maintenance have also become essential to prevent the sudden breakdown of electrical equipment. To meet the expectations for these electrical equipment diagnoses, Soken Electric Co., Ltd. has developed Digital Partial Discharge Analyzer DAC-PD-9 that incorporates the very latest digital technology.

Covering widely required tests by IEC standards, DAC-PD-9 is an analyzer with a wide-band amplifier. The set incorporates the same conventional testing functions as low-frequency (narrowband), wide-band and tuned measuring instruments do. Moreover, it is also capable of ultra wide-band measurements (up to 40 MHz). DAC-PD-9 allows a selection of optimum frequency bands suitable for any type of test specimens to enable quantitative and reproducible partial discharge measurements. In addition, the set can sample in time-series all data to enable statistical and quantitative measurements.

Test Specimen
- HV Transformer
- Power Cable
- Generator, Motor, Coil
- Capacitor, Bushing
- Circuit Breaker, Switch
DAC-PD-9
PARTIAL DISCHARGE ANALYZER

Features

- Digital technology enables determination of the true polarity of partial discharges.
- All parameters such as cumulative frequency and net peak are displayed in real time.
- Discharge pulses of positive and negative electrodes can be counted simultaneously.
- Center frequencies and frequency bandwidths can be freely selected for measurement.
- The large-capacity memory enables long-term data storage.

Variable Measuring Frequency

The evaluation of partial discharge largely depends on selection of frequency bands. Taking into account the propagation characteristics and electrical structure of test specimen, and paying attention to the noise environment and data reproducibility, the optimal frequency band should be selected.

- **Frequency Band:**
  - Low Band: 20kHz - 400kHz
  - MID Band: 400kHz - 4MHz
  - HIGH Band: 4MHz - 40MHz

- **Center Frequency:** 40kHz - 40MHz

- **Frequency Band Range**
  - LOW Band: 30kHz, 50kHz, 100kHz, 300kHz
  - MID Band: 300kHz, 500kHz, 1MHz, 3MHz
  - HIGH Band: 300kHz, 500kHz, 1MHz, 3MHz

Partial Discharge Analyzing Software

Data such as Q, Phase and Time obtained by DAC-PD-9 can be saved in PC with USB interface to analyze and evaluate.

Polarity Judgment

Auto-Judging in polarity of partial discharge waves in a wide band.

Numerical Evaluation of Partial Discharges by a digital sampling

- **Average discharge current I**
  
  The average discharge current is expressed in coulombs per second (C/s) or in amperes (A).

  \[ I = \frac{1}{T_{\text{ref}}} (|q_1| + |q_2| + \cdots + |q_i|) \]

- **Discharge power P**
  
  Where an \( u_i \) is instantaneous value of the test voltage at the instant occurrence of the individual apparent charges magnitude as \( q_i \).
  
  The discharge power is expressed in watts (W) and becomes the cause of the electric power loss of the sample.

  \[ P = \frac{1}{T_{\text{ref}}} (q_1^* u_1 + q_2^* u_2 + \cdots + q_i^* u_i) \]

- **Quadratic rate D**
  
  The quadratic rate is expressed in (coulombs)² per second (C²/s), and the partial discharge magnitudes will be accentuated and displayed.

  \[ D = \frac{1}{T_{\text{ref}}} (q_1^2 + q_2^2 + \cdots + q_i^2) \]
- TFT liquid crystal and touch keys enable simple, visual operation.
- Compact (W320 x D350 x H150mm) and lightweight (10 kg).
- Interface with USB and LAN.
- The analyzer can be used by itself for measurement independent of a PC.
- Measured data is stored in USB memory.

**Analysis**

Partial Discharges can be displayed visibly in 2D or 3D graphics for analysis.

**Clamp-type High Frequency CT**

- Measuring Frequency Band: 10kHz - 100MHz
- Max. Current: 39.3A
- Aperture: 31Φ

**Calibrator DAC-CP-2**

- Output Voltage: 5V, 50V
- Lamp Time: <20nS
- Generating Pulses: 0~10000pC
- Repetition Frequency: 50Hz
- Power Source: Battery 7.2V
- Size: W170 x H60 x D110(mm)
- Weight: 800g, approx.

**Detector DAC-PDE-2**

- Applicable Frequency Band: 10kHz - 4MHz
- Max. Applicable Current:
  - Balance Circuit: 5A
  - Un-balance Circuit: 1A
- Size: W170 x H70 x D110(mm)
- Weight: 1kg, approx.

**Detector and Divider DAC-PDE-6**

- Applicable Frequency Band: 10kHz - 400kHz
- Max. Applicable Current:
  - Balance Circuit: 5A
  - Un-balance Circuit: 50mA
- Test Frequency: 50/60Hz
- Test Voltage Dividing Capacitor: 2μF
- Size: W180 x H100 x D120(mm)
- Weight: 2.3kg, approx.

**Coupling Capacitor**

<table>
<thead>
<tr>
<th></th>
<th>DAC-LCC-15</th>
<th>DAC-LCC-30</th>
<th>DAC-LCC-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Voltage(kV)</td>
<td>15</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Rated Current(A)</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Capacitance(pF)</td>
<td>1000</td>
<td>1000</td>
<td>600</td>
</tr>
<tr>
<td>Height(mm)</td>
<td>512</td>
<td>702</td>
<td>912</td>
</tr>
<tr>
<td>Weight(kg)</td>
<td>8</td>
<td>13</td>
<td>15</td>
</tr>
</tbody>
</table>
### DAC-PD-9
**PARTIAL DISCHARGE ANALYZER**

#### Specifications

**Partial Discharge Measuring Unit**
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measuring Range</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Partial Discharge</td>
<td>1-100000pC</td>
<td></td>
</tr>
<tr>
<td>Phase Resolution</td>
<td>1 deg.</td>
<td></td>
</tr>
<tr>
<td>Evaluated Inception Frequency</td>
<td>10 - 400pps</td>
<td></td>
</tr>
<tr>
<td>Allowable Repetition Frequency Rate</td>
<td>0 - 9999pps</td>
<td></td>
</tr>
<tr>
<td>Polarity</td>
<td>Auto Judgement</td>
<td></td>
</tr>
<tr>
<td>Frequency Range</td>
<td>Center Frequency</td>
<td>40kHz - 40MHz</td>
</tr>
<tr>
<td>Low Band: 20kHz-400kHz</td>
<td>Frequency Range Width</td>
<td>LOW: 30kHz, 50kHz, 100kHz, 300kHz</td>
</tr>
<tr>
<td>MID Band: 400kHz-4MHz</td>
<td>MID: 300kHz, 500kHz, 1MHz, 3MHz</td>
<td></td>
</tr>
<tr>
<td>HIGH Band: 4MHz-40MHz</td>
<td>HIGH: 300kHz, 500kHz, 1MHz, 3MHz</td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>LOW: -40dB to 74dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MID: -40dB to 74dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIGH: -40dB to 104dB</td>
<td></td>
</tr>
</tbody>
</table>

**Input Characteristic**
- Input Impedance: 50Ω
- Input Voltage Range: 0 - 2 Vp-p

**Memory**
- Voltage Detection (Torigger source)
  - Input Characteristic: Input Impedance 1MΩ
  - Input Voltage Range: 0 - 20Vrms
  - Input Frequency Range: 50/60Hz

**Interface/Power Source**
- Interface: USB 2.0/1.1 or equivalent B type, LAN
- External Memory Function: USB 32GB or more
- Size and Weight: W320×D350×H150(mm) Approx. 10kg
- Power Source: AC100V-240V ±10% 50/60Hz
- Ambient Temperature/Humidity: 0 - 40℃ / 20 - 85%(No Dew)

**Partial Discharge Analysing Software**
- System Requirements: OS Windows XP, 7

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### Connection Diagram

**●GST (Grounded Specimen Test)**

- Test Source
- Blocking Coil
- Specimen
- DAC-PD-9
- Grounding

**●UST (Un-grounded Specimen Test)**

- Test Source
- Blocking Coil
- Specimen
- DAC-PD-9
- Grounding