Digital multimeters (DMMs) employ an A/D converter with a dual-integration system, which determines the measurement value by converting the input voltage into time using an integration AD converter. The interval to perform an integral action periodically is referred to as the integral action time.

Measurement Accuracy
With DMMs, the measurement accuracy is generally expressed as: ±% of reading + digits. ("Reading" refers to the reading value, and is abbreviated as "rdg"; "digits" refers to the number displayed in the smallest decimal place, and is abbreviated as "dig"). This expresses the range of values that a DMM may measure or represent for a given actual value.

Root Mean Square Value
The value most directly related to the energy of a given waveform. Refers to the square root of a value found by averaging the squares of instantaneous values of a waveform over a single cycle. (See Table 1, Figures 1 and 2.)

Mean Value
Refers to the average of the sum of instantaneous values, determined for a current half-wave. It is equivalent to calculating the surface area of a waveform.

Form Factor
Ratio of RMS value with respect to average value. Form factor = RMS value/mean value (See Figures 1 and 2.)

Crest Factor
Ratio of maximum value to RMS value. Crest factor = maximum value/RMS value(See Figures 1 and 2.)

Peak-to-Peak (P-P) value
Refers to the distance between the smallest and largest amplitudes in a waveform (see Figure 1).

Figure 1. RMS and Mean Values of Sine Wave

<table>
<thead>
<tr>
<th>Waveform</th>
<th>RMS value</th>
<th>Mean value</th>
<th>Crest factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sine wave</td>
<td>(E = \sqrt{\frac{1}{T} \int_0^T E , dt}) (energy)</td>
<td>(E_{\text{mean}} = \frac{1}{T} \int_0^T E , dt) (surface area)</td>
<td>(CF = \frac{E_{\text{crest}}}{E_{\text{rms}}})</td>
</tr>
<tr>
<td>Half rectification wave</td>
<td>(E_{\text{rms}} = \frac{E_{\text{crest}}}{\sqrt{2}})</td>
<td>(E_{\text{mean}} = \frac{1}{2} \cdot 0.7071 \cdot E_{\text{crest}})</td>
<td>2</td>
</tr>
<tr>
<td>Full rectification wave</td>
<td>(E_{\text{rms}} = \frac{E_{\text{crest}}}{\sqrt{2}})</td>
<td>(E_{\text{mean}} = \frac{1}{2} \cdot 0.637 \cdot E_{\text{crest}})</td>
<td>1.11</td>
</tr>
<tr>
<td>Triangular wave</td>
<td>(E_{\text{rms}} = \frac{E_{\text{crest}}}{\sqrt{3}})</td>
<td>(E_{\text{mean}} = \frac{1}{2} \cdot 0.577 \cdot E_{\text{crest}})</td>
<td>1.15</td>
</tr>
<tr>
<td>Square wave</td>
<td>(E_{\text{rms}} = \frac{E_{\text{crest}}}{\sqrt{2}})</td>
<td>(E_{\text{mean}} = \frac{1}{2} \cdot 0.5 \cdot E_{\text{crest}})</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Glossary

CE Mark
The products of Yokogawa M&C Corporation are subjected to design and evaluation testing to ensure compliance with the safety and EMC standards in accordance with the directives issued by the EC.

Electromagnetic Compatibility (EMC)
The parameters EMI and EMS are referred to as electromagnetic compatibility as they relate to compatibility within an electromagnetic environment.

Safety Standards
These standards lay out safety requirements that are to be met by a product with the objective of the preservation of human life and property. The applicable international standard is IEC 61010, and while a product must conform to this standard, there are also domestic standards laid out by individual countries. With these safety regulations, the range of use of a measurement device is specified by categorization in overvoltage categories I through IV to ensure the safety of the user. The designations "CAT II, 1000 V" or "CAT III, 600 V" at the input terminals of a measurement device, for example, indicates the applicable category and the maximum voltage for the device in terms of safety.

Frequency Characteristic
Refers to a characteristic that shows variations in input, measurement, or response with frequency. When measuring alternating current signals, a measured signal does not have a simple frequency, but often includes various frequencies ranging from lower frequencies to higher harmonics. To measure such signals more accurately, it is preferable to use a measurement device that has a broader frequency characteristic range.

Input Impedance
To prevent the measured object from being influenced during voltage measurement, you should use a measurement device with an extremely high input impedance.

Decibel
A unit used for describing the change in electrical signal amplitude or noise level, or transmission systems in wired devices, etc. This parameter is also used to represent the level differences in voltage, current or related values, but is generally restricted to cases characterized by the relationship: \((I_1/I_2)^2 = (V_1/V_2)^2\). In the abbreviation "dB," "d" (deci) denotes 1/10, and "B" (Bell) denotes logarithm.

Table 1. RMS Value, Average Value, Waveform Factor and Crest Factor for a Typical Periodic Waveform

<table>
<thead>
<tr>
<th>Waveform</th>
<th>RMS value</th>
<th>Mean value</th>
<th>Crest factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sine wave</td>
<td>(E_{\text{rms}})</td>
<td>(E_{\text{mean}})</td>
<td>(CF)</td>
</tr>
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<td>(E_{\text{mean}})</td>
<td>1.15</td>
</tr>
<tr>
<td>Square</td>
<td>(E_{\text{rms}})</td>
<td>(E_{\text{mean}})</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Overvoltage categories (CAT)
In order to ensure the safety of the user, IEC 60664 defines the ranges of use of measuring instruments by classifying power levels into overvoltage categories I through IV. This is because the excessive impulse or surge levels induced in a power line vary depending on the location of measurement (category). Categories with higher numerals designate locations that include larger surge voltages. Instruments that are designed for category III can thus withstand higher surge voltages than instruments designed for category II.

Overvoltage category I (CAT I):
Secondary circuits connected to an outlet via a power transformer.

Overvoltage category II (CAT II):
Primary circuits of a device connected to an outlet with a power cord.

Overvoltage category III (CAT III):
Primary circuits of a device to which power is directly supplied from the power distribution panel, and circuits from the distribution panel to outlets.

Overvoltage category IV (CAT IV):
All service line entrance circuits through the power distribution panel.