

## Voltage Drop

Voltage drop is the drop in device voltage, when wiring devices with electric wires, which takes place when voltage decreases in the wires due to the resistance of the wiring itself.

Voltage drop is affected by the power and power factor of the load, the alternate-current resistance of the line, and inductance. If we call the receiving end voltage  $E_r$ , the current  $I$ , the current power factor angle  $\theta$ , the line resistance  $R$ , the line reactance  $X$ , and the line length  $\ell$ , the transmission end voltage  $E_s$  is, from figure A,

$$E_s = \sqrt{(E_r \cos\theta + RI\ell)^2 + (E_r \sin\theta + XI\ell)^2}$$

Similarly, the above equation can easily show

$$E_s = E_r + I(R\cos\theta + X\sin\theta)\ell$$

so the line voltage drop is

$$E_s - E_r = I(R\cos\theta + X\sin\theta)\ell$$

For the above equation, when we can ignore the circuit reactance and assume that the power factor is 1, the following simplified equation is often used to derive an approximate value.

For single-phase 2-wire type (Figure B)

$$e = E_s - E_r = R \cdot I \cdot \ell \times 2$$

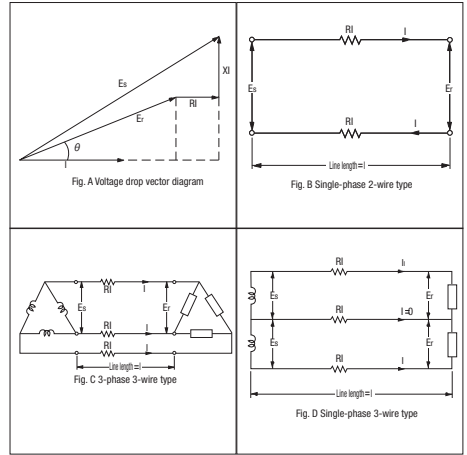
For 3-phase 3-wire type (Figure C)

$$e = E_s - E_r = R \cdot I \cdot \ell \times \sqrt{3}$$

For single-phase 3-wire type, calculation assumes that the load is balanced and there is no current flowing through the neutral wire (Figure D).

$$e' = E_s - E_r = R \cdot I \cdot \ell$$

Note that  $e'$  shows the voltage drop between the neutral wire and the outer wire or 1 wire of each phase.



## How to read the Properties Radar Chart

Some references have been changed from this catalog on.

\* The levels noted in the radar chart are reference values, not guaranteed values.

Heat-resistant	<p>Vinyl is generally rated at 60°C. Heat resistance can be derived from special vinyl or special materials.</p> <ol style="list-style-type: none"> <li>1 60 degrees</li> <li>2 80 degrees or less</li> <li>3 105 degrees or less</li> <li>4 Less than 151 degrees</li> <li>5 151 degrees or more</li> </ol>
Oil Resistance	<p>Like rubber, vinyl usually does not swell even if oiled, but it hardens and loses flexibility. While it depends on the type of oil, resistance to oil can be increased by using special vinyl or materials. (Levels 1 ~ 5 are not guarantees of resistance to oils and greases.)</p> <ol style="list-style-type: none"> <li>1 No oil-resistant characteristics</li> <li>2 Resistant to ASTM Testing Oils No.1</li> <li>3 Resistant to ASTM Testing Oils No.2</li> <li>4 Almost no change with regard to major cutting oils</li> <li>5 Resistant to almost all oils (take care regarding highly volatile oils such as fuel oil)</li> </ol>
Noise Resistance	<p>Noise countermeasures are generally accomplished with increased performance through twisted pairs and shielding.</p> <ol style="list-style-type: none"> <li>1 No noise countermeasures</li> <li>2 Twisted pair cable</li> <li>3 Shielded cable</li> <li>4 Twisted pair + shielded cable</li> <li>5 Excellent noise performance</li> </ol>
Twisting Resistance	<p>Performance required in areas where wires must twist.</p> <ol style="list-style-type: none"> <li>1 No twisting resistance</li> <li>2 Twistable when cable is dragged</li> <li>3 Twistable to some extent to less than 90 degrees</li> <li>4 Twistable to some extent to 90 degrees or so</li> <li>5 Usable even in machines which require violent repeated twisting</li> </ol>
Vibration-resistant	<p>Performance required in areas like vibrating parts of motors and electric tools.</p> <ol style="list-style-type: none"> <li>1 No vibration resistance</li> <li>2 Supports some degree of vibration</li> <li>3 Non-bent wiring to vibrating parts is possible</li> <li>4 Non-bent wiring to vibrating parts is entirely acceptable</li> <li>5 Usable with vibrating parts even if bent</li> </ol>
Flexible	<p>Performance value compared in flexibility tests.</p> <ol style="list-style-type: none"> <li>1 No flexibility</li> <li>2 Usable with minimal flexibility required</li> <li>3 Usable for left-right bending of 45 degrees or so</li> <li>4 Usable for left-right bending of 90 degrees or so</li> <li>5 No flexibility problems, including vibration</li> </ol>
Carrier-tested Cable	<p>Performance required for cable carrier use. For long-term stable use, when wiring to cable carrier, see <a href="#">▶P:1683 "3. Wiring for cable carrier"</a>. (Levels 1 ~ 5 are not guaranteed values. They are actual measurement values, or estimates from design specifications etc.)</p> <ol style="list-style-type: none"> <li>1 Not for cable carrier use</li> <li>2 Usable depending on conditions</li> <li>3 Cable carrier test less than 5 million times (take care when using)</li> <li>4 Cable carrier test less than 10 million times</li> <li>5 Cable carrier test 10 million times or more</li> </ol>
Compliant to Environmental Resistant Material	<p>Results of evaluation responding to cable contents for 24 types of chemicals. Almost all cables are evaluated at levels 4 or 5.</p> <ol style="list-style-type: none"> <li>1 Contains, or is under investigation concerning, the 24 environmentally damaging chemicals investigated</li> <li>2 Contains, or is under investigation concerning, materials other than lead</li> <li>3 Contains, or is under investigation concerning, materials other than lead and hexavalent chromium</li> <li>4 Does not contain hexavalent chromium/lead/mercury/cadmium/PBB/PBDE (European RoHS compliant)</li> <li>5 European RoHS compliant as well as investigated or under investigation for other substances</li> </ol>