MULTI-LINE 2
DESCRIPTION OF OPTIONS

Option A4
Loss of mains protection package

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1. Delimitation

1.1 Scope of option A4

This description of options covers the following products:

<table>
<thead>
<tr>
<th>Product</th>
<th>SW Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGC-3</td>
<td>3.4.x.x or later</td>
</tr>
<tr>
<td>AGC-4</td>
<td>4.0.x.x or later</td>
</tr>
<tr>
<td>AGC 200 series</td>
<td>3.5.x.x or later</td>
</tr>
<tr>
<td>APU 200 series</td>
<td>3.53.x or later</td>
</tr>
<tr>
<td>GPC/GPU Hydro</td>
<td>3.0.x.x or later</td>
</tr>
<tr>
<td>GPU/PPU</td>
<td>3.0.x.x or later</td>
</tr>
</tbody>
</table>
2. General information

2.1 Warnings, legal information and safety

2.1.1 Warnings and notes
Throughout this document, a number of warnings and notes with helpful user information will be presented. To ensure that these are noticed, they will be highlighted as follows in order to separate them from the general text.

**Warnings**

⚠️ Warnings indicate a potentially dangerous situation, which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

**Notes**

ℹ️ Notes provide general information, which will be helpful for the reader to bear in mind.

2.1.2 Legal information and disclaimer
DEIF takes no responsibility for installation or operation of the generator set. If there is any doubt about how to install or operate the engine/generator controlled by the Multi-line 2 unit, the company responsible for the installation or the operation of the set must be contacted.

⚠️ The Multi-line 2 unit is not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

**Disclaimer**
DEIF A/S reserves the right to change any of the contents of this document without prior notice.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.

2.1.3 Safety issues
Installing and operating the Multi-line 2 unit may imply work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

⚠️ Be aware of the hazardous live currents and voltages. Do not touch any AC measurement inputs as this could lead to injury or death.

2.1.4 Electrostatic discharge awareness
Sufficient care must be taken to protect the terminals against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.
2.1.5 Factory settings
The Multi-line 2 unit is delivered from factory with certain factory settings. These are based on average values and are not necessarily the correct settings for matching the engine/generator set in question. Precautions must be taken to check the settings before running the engine/generator set.
3. Description of option

3.1 Option A4

Option A4 is a software option and therefore not related to any hardware apart from the standard installed hardware.

This protection prevents motor malfunctioning due to insufficient or unbalanced supply voltage. The protection is used when the generator is running in parallel with the mains.

3.2 ANSI numbers

<table>
<thead>
<tr>
<th>Protection</th>
<th>ANSI no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive sequence voltage</td>
<td>47 U1, 27 pos</td>
</tr>
</tbody>
</table>
4. Functional description

4.1 Voltage vector system

The measurements of the busbar/mains voltages are split up in three theoretical systems:

- The positive sequence system with a positive direction of rotation
- The negative sequence system with a negative direction of rotation
- The zero sequence system with a positive direction of rotation

As a result of the generator’s power production to the consumers, the positive sequence system represents the fault-free part of the voltages and currents. The negative sequence system, which rotates in the opposite direction of the generator, is used by the protection’s negative sequence current and negative sequence voltage to prevent the generator from overheating. The zero sequence system is used for detection of earth faults.

**Description of the approach**

Positive, negative and zero sequence values are calculated based on estimated phase current/phase voltage phasors. The RMS value of the phase quantity expresses the absolute value of the phasors, and an evaluation of zero crossings delivers expressions for the angles between the phasors.

4.2 Positive sequence voltage

The positive sequence voltage detects voltage state on the positive sequence voltage part of the 3-phase voltage vector diagram of the busbar/mains.

The positive sequence voltage low calculation takes place in the zero crossing of all three phases to make the protection as fast as possible.
5. Parameters

5.1 Further information

The option A4 relates to the parameter 1440.

For further information, please see the separate parameter list for the Multi-line unit in question:

<table>
<thead>
<tr>
<th>Model</th>
<th>Document number</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGC-3</td>
<td>Document number 4189340705</td>
</tr>
<tr>
<td>AGC-4</td>
<td>Document number 4189340688</td>
</tr>
<tr>
<td>AGC 200</td>
<td>Document number 4189340605</td>
</tr>
<tr>
<td>GPC-3/GPU-3 Hydro</td>
<td>Document number 4189340580</td>
</tr>
<tr>
<td>GPU-3/PPU-3</td>
<td>Document number 4189340581</td>
</tr>
</tbody>
</table>
6. Response time

The time delay for the positive sequence alarm can be adjusted. It is adjusted in periods, not seconds.

The response times specified below are measured with a 2-period delay.

<table>
<thead>
<tr>
<th>Fault:</th>
<th>Delay:</th>
<th>Response time</th>
<th>Recommended protection for fast trip</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-phase fault</td>
<td></td>
<td>&lt;50 ms</td>
<td>BB pos seq volt</td>
<td></td>
</tr>
<tr>
<td>1 phase missing</td>
<td></td>
<td>&lt;70 ms</td>
<td>BB U&lt;</td>
<td>Option A</td>
</tr>
<tr>
<td>2 phases missing</td>
<td></td>
<td>&lt;110 ms</td>
<td>BB U&lt;</td>
<td>Option A</td>
</tr>
<tr>
<td>3 phases missing</td>
<td></td>
<td>&lt;285 ms</td>
<td>df/dt or vector jump</td>
<td>Option A</td>
</tr>
</tbody>
</table>

The diagram shows that when the fault has been present for two periods, the relay will trip within the specified time.

**Response time is with 2 periods delay setting. The response time counts from the end of the delay.**