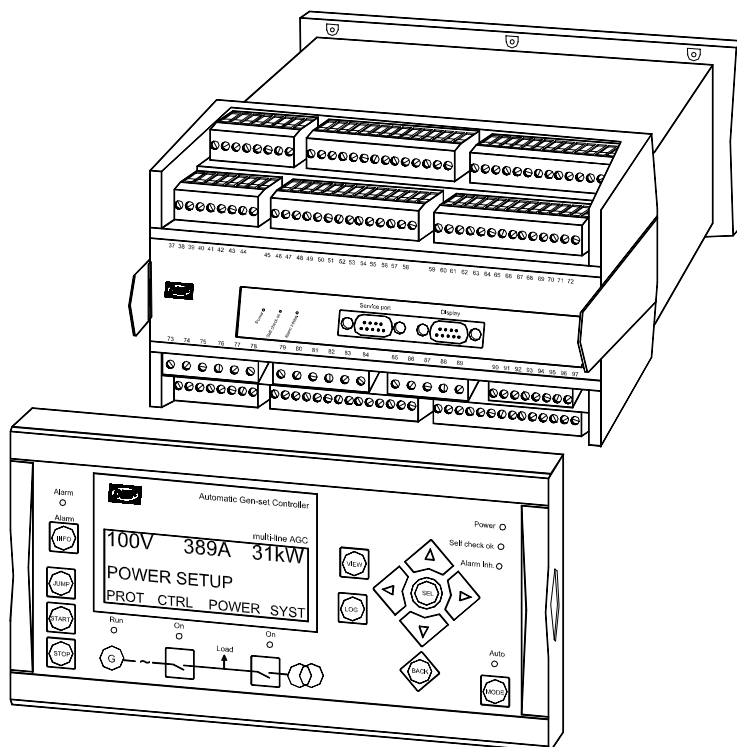


## Description of option Option A and B



### multi-line 2 PPU/GPU/GPC – version 2 4189340266B



- *Mains protections*
- *Busbar / mains voltage and frequency protections*
- *Generator voltage and frequency protections*



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This manual is valid for standard multi-line 2 PPU/GPU/GPC units with application software version 2.20.0 or later.

## 1 Warnings and legal information

This manual gives guidelines to the use and installation of the DEIF multi-line 2 units. It is, however, not a complete installation instruction. Therefore, even if terminal numbers may be shown in the drawings, the drawings are to be used as guidance only.

**Installing and operating the multi-line 2 units implies work with dangerous currents and voltages, and therefore only qualified personnel should do it.**

During the installation care must be taken to protect the terminals against static discharges. Once the units are installed and connected, these precautions are no longer necessary.

**DEIF takes no responsibility for operation or installation of the generator set. If there is any doubt about how to install or operate the system on which the multi-line 2 unit is measuring, the company responsible for the installation or the operation must be contacted.**

## 2 Options A, functions included

The A options are software options and therefore not related to any hardware apart from the standard installed hardware.

The A options are a mix of frequency, voltage, vector jump and df/dt protections as follows:

### 2.1 Option A1

- Over- and undervoltage, generator and busbar/mains
- Over- and underfrequency, generator and busbar/mains
- Vector jump
- Df/dt (ROCOF)

### 2.2 Option A2

- Over- and undervoltage, generator and busbar/mains
- Over- and underfrequency, generator and busbar/mains
- Df/dt (ROCOF)

### 2.3 Option A3

- Over- and undervoltage, generator and busbar/mains
- Over- and underfrequency, generator and busbar/mains
- Vector jump

## 3 Options B, functions included

The B options are software options and therefore not related to any hardware apart from the standard installed hardware.

The B options are a mix of frequency and voltage protections as follows:

### 3.1 Option B1

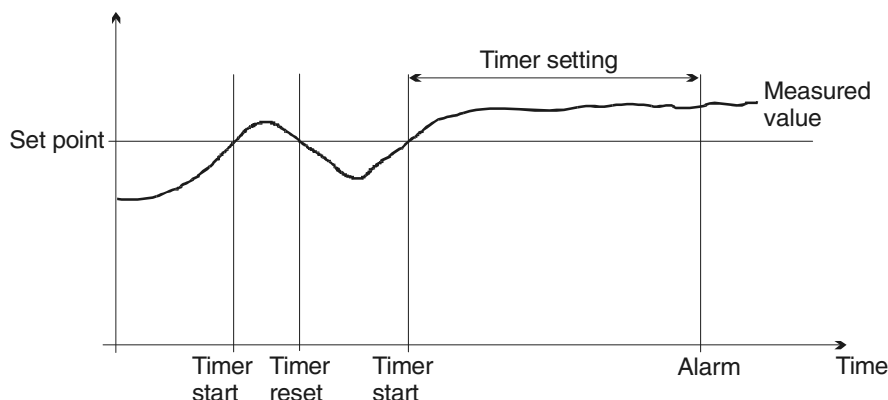
- Over- and undervoltage, generator and busbar/mains
- Over- and underfrequency, generator and busbar/mains

## 4 Function descriptions

### 4.1 Voltage and frequency protections

The voltage and frequency protections are all of the definite time type, i.e. a set point and time is selected.

If the function is e.g. overvoltage, the timer will be activated if the set point is exceeded. If the voltage value goes below the set point value before the timer runs out, the timer will be stopped and reset.



When the timer runs out, the output is activated.

### 4.2 Vector jump and df/dt protections

The functions are intended for detection of a mains failure and subsequent opening of the mains breaker. The reasons are:

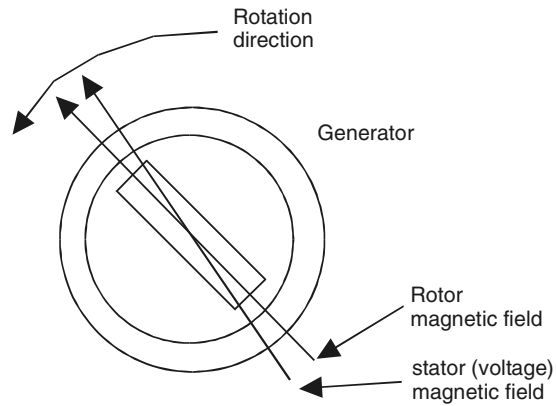
- 1) The generator will, in case of mains failure, be running "stand-alone" on the grid, attempting to supply power to all the consumers. Naturally this is not possible and an overload/overcurrent situation is likely to be the result, as the mains consumption normally exceeds the generator capacity.
- 2) Mains transformer protection systems are constructed with a so-called "fast re-closing" feature. This means that if a failure occurs (e.g. a short circuit), the transformer protection system will open the transformer breaker, but after a while (the time is country dependent, in Denmark we use 300 ms) the breaker will be re-closed, just to check if it was a short-time failure (2 overhead wires meeting shortly, a lightning strike, a branch falling down from a tree or the like). If the failure is still there, the breaker will be re-opened and remain there.

The above re-closing combined with the high overload on the generator means that the generator and mains will be paralleled again without synchronisation, and that will most likely damage the gen-set.

Ordinary protections will not see the above mains failure before it is too late (300 ms). Therefore vector jump and/or df/dt is used. These functions can detect the mains failure and open the breaker before re-closing occurs.

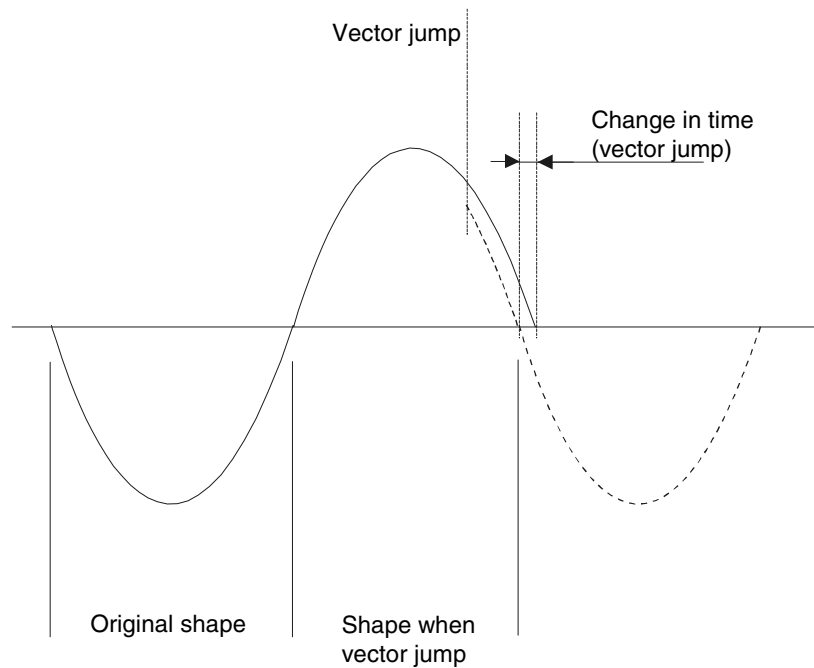
### 4.2.1 Vector jump

Vector jump is based on the fact that the stator magnetic field, and as a result, the 3 phase voltage coming out of a generator, is lagging a little behind the rotor (in time and position) magnetic field.



If a mains failure occurs, the time lagging of the stator magnetic field (and the output voltage) will change (jump) and that is called the vector jump.

Shown as a sine wave:

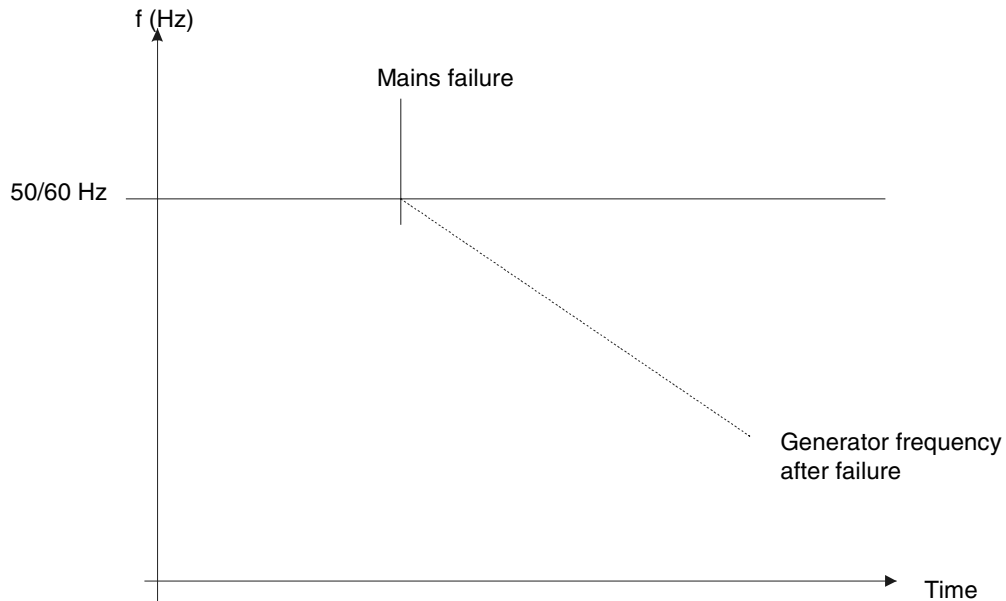


So, by comparing the half-sine curve time duration with the previous ones, a sudden change in time can be detected. This is the vector jump.

The vector jump setting is made in electrical degrees.

### 4.2.2 $df/dt$ (ROCOF)

The  $df/dt$  (ROCOF: Rate Of Change Of Frequency, change of frequency over time) function is based on the fact that the generator, if overloaded, will lose speed dramatically.



So, a dramatic drop of frequency over time is a mains failure.

The  $df/dt$  setting is made in Hz/sec.

## 5 Settings PPU/GPC/GPU

### 5.1 Loss of mains protections (option A)

The loss of mains protection includes df/dt (Rate Of Change Of Frequency, ROCOF) and/or vector jump protection. The protection is used when the generator is paralleling with the mains.

Both df/dt and vector jump are based on 3 individual single phase measurements (individual monitoring of phase L1 and L2 and L3), i.e. if a df/dt and/or vector jump occurs in one of the 3 phases, no matter which, the relay will trip.

#### 5.1.1 df/dt (ROCOF) (option A1/A2)

**NOTE:** Time delay is in periods (per).

No.	Setting	Min. setting	Max. setting	Factory setting
1350	df/dt (ROCOF) Selection display	-	-	-
1351	df/dt (ROCOF) Set point +/-	0.1 Hz/s	10.0 Hz/s	5.0 Hz/s
1352	df/dt (ROCOF) Timer	1 per	20 per	6 per
1353	df/dt (ROCOF) Relay output A	R0 (none)	R0 (none)	R0 (none)
1354	df/dt (ROCOF) Relay output B	R0 (none)	R0 (none)	R0 (none)
1355	df/dt (ROCOF) Enable	OFF	ON	OFF

#### 5.1.2 Vector jump (option A1/A3)

No.	Setting	Min. setting	Max. setting	Factory setting
1360	Vector jump Selection display	-	-	-
1361	Vector jump Set point	0.0 deg.	90.0 deg.	10.0 deg.
1362	Vector jump Relay output A	R0 (none)	R0 (none)	R0 (none)
1363	Vector jump Relay output B	R0 (none)	R0 (none)	R0 (none)
1364	Vector jump Enable	OFF	ON	OFF

### 5.2 Voltage protections

#### 5.2.1 Selection of phase-phase or phase-neutral measurement

The voltage protection functions are as default set to be based on phase-phase measurements, but can be selected to be phase-neutral based.

No.	Setting	Min. setting	Max. setting	Factory setting
4960	Voltage trip Selection display	-	-	-
4961	Voltage trip Set point	Phase-phase	Phase-neutral	Phase-phase

#### 5.2.2 Bus voltage protection (option A or B)

Voltage selections relate to nominal phase-phase or phase-neutral voltage, according to selection.

No.	Setting	Min. setting	Max. setting	Factory setting
1180	Bus high volt. 1 Selection display	-	-	-
1181	Bus high volt. 1 Set point	90.0%	120.0%	103.0%
1182	Bus high volt. 1 Timer	0.00 s	99.99 s	10.00 s
1183	Bus high volt. 1 Relay output A	R0 (none)	R0 (none)	R0 (none)
1184	Bus high volt. 1 Relay output B	R0 (none)	R0 (none)	R0 (none)
1185	Bus high volt. 1 Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1190	Bus high volt. 2	Selection display	-	-	-
1191	Bus high volt. 2	Set point	90.0%	120.0%	105.0%
1192	Bus high volt. 2	Timer	0.00 s	99.99 s	5.00 s
1193	Bus high volt. 2	Relay output A	R0 (none)	R0 (none)	R0 (none)
1194	Bus high volt. 2	Relay output B	R0 (none)	R0 (none)	R0 (none)
1195	Bus high volt. 2	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1200	Bus low volt. 1	Selection display	-	-	-
1201	Bus low volt. 1	Set point	80.0%	100.0%	97.0%
1202	Bus low volt. 1	Timer	0.00 s	99.99 s	10.00 s
1203	Bus low volt. 1	Relay output A	R0 (none)	R0 (none)	R0 (none)
1204	Bus low volt. 1	Relay output B	R0 (none)	R0 (none)	R0 (none)
1205	Bus low volt. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1210	Bus low volt. 2	Selection display	-	-	-
1211	Bus low volt. 2	Set point	50.0%	100.0%	95.0%
1212	Bus low volt. 2	Timer	0.00 s	99.99 s	5.00 s
1213	Bus low volt. 2	Relay output A	R0 (none)	R0 (none)	R0 (none)
1214	Bus low volt. 2	Relay output B	R0 (none)	R0 (none)	R0 (none)
1215	Bus low volt. 2	Enable	OFF	ON	OFF

### 5.2.3 Generator voltage protection (option A or B)

Voltage selections relate to nominal phase-phase or phase-neutral voltage, according to selection.

No.	Setting		Min. setting	Max. setting	Factory setting
1100	Gen. high volt. 1	Selection display	-	-	-
1101	Gen. high volt. 1	Set point	90.0%	120.0%	103.0%
1102	Gen. high volt. 1	Timer	0.1 s	100.0 s	10.0 s
1103	Gen. high volt. 1	Relay output A	R0 (none)	R0 (none)	R0 (none)
1104	Gen. high volt. 1	Relay output B	R0 (none)	R0 (none)	R0 (none)
1105	Gen. high volt. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1110	Gen. high volt. 2	Selection display	-	-	-
1111	Gen. high volt. 2	Set point	90.0%	120.0%	105.0%
1112	Gen. high volt. 2	Timer	0.1 s	100.0 s	5.0 s
1113	Gen. high volt. 2	Relay output A	R0 (none)	R0 (none)	R0 (none)
1114	Gen. high volt. 2	Relay output B	R0 (none)	R0 (none)	R0 (none)
1115	Gen. high volt. 2	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1120	Gen. low volt. 1	Selection display	-	-	-
1121	Gen. low volt. 1	Set point	80.0%	100.0%	97.0%
1122	Gen. low volt. 1	Timer	0.1 s	100.0 s	10.0 s
1123	Gen. low volt. 1	Relay output A	R0 (none)	R0 (none)	R0 (none)
1124	Gen. low volt. 1	Relay output B	R0 (none)	R0 (none)	R0 (none)
1125	Gen. low volt. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1130	Gen. low volt. 2	Selection display	-	-	-
1131	Gen. low volt. 2	Set point	50.0%	100.0%	95.0%
1132	Gen. low volt. 2	Timer	0.1 s	100.0 s	5.0 s
1133	Gen. low volt. 2	Relay output A	R0 (none)	R0 (none)	R0 (none)
1134	Gen. low volt. 2	Relay output B	R0 (none)	R0 (none)	R0 (none)
1135	Gen. low volt. 2	Enable	OFF	ON	OFF

### 5.3 Frequency protections

#### 5.3.1 Bus frequency protection (option A or B)

Frequency settings relate to nominal frequency setting.

No.	Setting		Min. setting	Max. setting	Factory setting
1220	Bus high freq. 1	Selection display	-	-	-
1221	Bus high freq. 1	Set point	90.0%	120.0%	103.0%
1222	Bus high freq. 1	Timer	0.00 s	99.99 s	10.00 s
1223	Bus high freq. 1	Relay output A	R0 (none)	R0 (none)	R0 (none)
1224	Bus high freq. 1	Relay output B	R0 (none)	R0 (none)	R0 (none)
1225	Bus high freq. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1230	Bus high freq. 2	Selection display	-	-	-
1231	Bus high freq. 2	Set point	90.0%	120.0%	105.0%
1232	Bus high freq. 2	Timer	0.00 s	99.99 s	5.00 s
1233	Bus high freq. 2	Relay output A	R0 (none)	R0 (none)	R0 (none)
1234	Bus high freq. 2	Relay output B	R0 (none)	R0 (none)	R0 (none)
1235	Bus high freq. 2	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1240	Bus low freq. 1	Selection display	-	-	-
1241	Bus low freq. 1	Set point	80.0%	100.0%	97.0%
1242	Bus low freq. 1	Timer	0.00 s	99.99 s	10.00 s
1243	Bus low freq. 1	Relay output A	R0 (none)	R0 (none)	R0 (none)
1244	Bus low freq. 1	Relay output B	R0 (none)	R0 (none)	R0 (none)
1245	Bus low freq. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1250	Bus low freq. 2	Selection display	-	-	-
1251	Bus low freq. 2	Set point	80.0%	100.0%	95.0%
1252	Bus low freq. 2	Timer	0.00 s	99.99 s	5.00 s
1253	Bus low freq. 2	Relay output A	R0 (none)	R0 (none)	R0 (none)
1254	Bus low freq. 2	Relay output B	R0 (none)	R0 (none)	R0 (none)
1255	Bus low freq. 2	Enable	OFF	ON	OFF

#### 5.3.2 Generator frequency protection (option A or B)

No.	Setting		Min. setting	Max. setting	Factory setting
1140	Gen. high freq. 1	Selection display	-	-	-
1141	Gen. high freq. 1	Set point	90.0%	120.0%	103.0%
1142	Gen. high freq. 1	Timer	0.2 s	100.0 s	10.0 s
1143	Gen. high freq. 1	Relay output A	R0 (none)	R0 (none)	R0 (none)
1144	Gen. high freq. 1	Relay output B	R0 (none)	R0 (none)	R0 (none)
1145	Gen. high freq. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1150	Gen. high freq. 2	Selection display	-	-	-
1151	Gen. high freq. 2	Set point	90.0%	120.0%	105.0%
1152	Gen. high freq. 2	Timer	0.2 s	100.0 s	5.0 s
1153	Gen. high freq. 2	Relay output A	R0 (none)	R0 (none)	R0 (none)
1154	Gen. high freq. 2	Relay output B	R0 (none)	R0 (none)	R0 (none)
1155	Gen. high freq. 2	Enable	OFF	ON	OFF



## DESCRIPTION OF OPTION A AND B

### *multi-line 2*

4189340266B

No.	Setting		Min. setting	Max. setting	Factory setting
1160	Gen. low freq. 1	Selection display	-	-	-
1161	Gen. low freq. 1	Set point	80.0%	100.0%	97.0%
1162	Gen. low freq. 1	Timer	0.2 s	100.0 s	10.0 s
1163	Gen. low freq. 1	Relay output A	R0 (none)	R0 (none)	R0 (none)
1164	Gen. low freq. 1	Relay output B	R0 (none)	R0 (none)	R0 (none)
1165	Gen. low freq. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1170	Gen. low freq. 2	Selection display	-	-	-
1171	Gen. low freq. 2	Set point	80.0%	100.0%	95.0%
1172	Gen. low freq. 2	Timer	0.2 s	100.0 s	5.0 s
1173	Gen. low freq. 2	Relay output A	R0 (none)	R0 (none)	R0 (none)
1174	Gen. low freq. 2	Relay output B	R0 (none)	R0 (none)	R0 (none)
1175	Gen. low freq. 2	Enable	OFF	ON	OFF

## 6 Inhibit inputs, relay outputs

### 6.1 Inhibit relations, voltages and frequencies

The inhibit input of the standard multi-line (binary input 1, terminals 23) will inhibit all the following alarms:

- Over- and undervoltage, busbar/mains
- Over- and underfrequency, busbar/mains
- Undervoltage, generator
- Underfrequency, generator

Using the PC utility software, the inhibit function can be programmed. Please refer to the main Designer's Reference Handbook of multi-line 2.

### 6.2 Inhibit relations, vector jump and df/dt

Via the PC utility software, inhibiting (blocking) loss of mains functions can be chosen. There are 2 solutions:

- A fixed time delay of 1 second after the breaker closes till the vector jump and df/dt protections are activated
- A binary input (block loss of mains, terminal 27) can be used to disable the protections

The block loss of mains input will, if activated, cause the alarm inhibit LED on the display to flash.

#### **NOTE:**

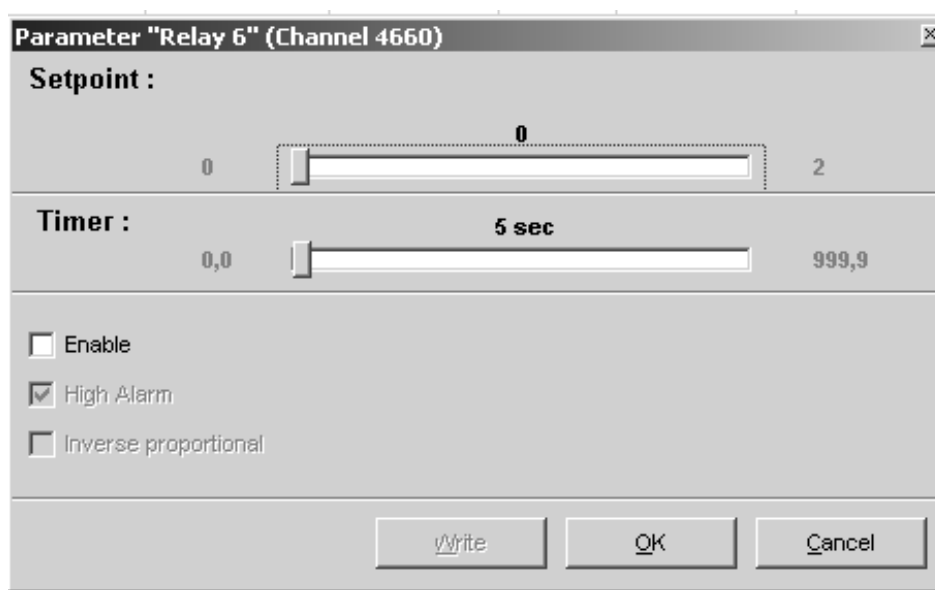
If the 1 second time delay of the breaker close signal cannot be accepted, the block loss of mains input can be used. There is no time delay connected to this.

### 6.3 Relay function selections

The relays can be configured in the three different ways described below. In the display menu structure this setup can be found under "System".

Relay function	PC utility software set point	Description
Alarm	0	When an alarm activates the relay, it is activated as long as the alarm is present and unacknowledged
Alarm + sync. block	1	When an alarm activates the relay, it is activated as long as the alarm is present and unacknowledged. Also it is not possible to synchronise the generator breaker as long as the alarm is active
Limit	2	When an alarm activates the relay, no alarm message is displayed. After the condition activating this relay has returned to normal, the relay will deactivate when the Timer setting ("Off Delay") has expired

In the PC utility software, it looks like this:



The availability of relays is related to hardware choice. Please refer to the description of hardware options. Therefore, the following is just an example.

No.	Setting		First/min. setting	Second setting	Third/max. setting	Factory setting
xxx	Relay x	Selection display	-		-	-
xxx	Relay x	Function	Alarm	Alarm + sync. block	Limit	Alarm
xxx	Relay x	Off delay	0.0 s		999.9 s	5.0 s

## 7 Technical data

### 7.1 Time delays

The total trip time for all functions is the result of response time + adjusted time delay as selected in the settings.

This means that e.g. a busbar undervoltage at 50 Hz with a timer setting of 1.00 sec. has a total resulting trip time of  $0.050 + 1.000 = 1.050$  sec.

#### 7.1.1 Response times

A response time is defined as the time duration from an event occurs until the multi-line unit has detected it and started the delay timer.

The following response times are maximum response times. Shorter response times may be seen:

Protection	Response times	
	50 Hz	60 Hz
Vector jump	30 ms	30 ms
df/dt (ROCOF)	125 ms*	100 ms*
Busbar over (high) voltage	50 ms	40 ms
Busbar under (low) voltage	50 ms	40 ms
Generator over (high) voltage	180 ms	200 ms
Generator under (low) voltage	180 ms	200 ms
Busbar over (high) frequency	50 ms	40 ms
Busbar under (low) frequency	50 ms	40 ms
Generator over (high) frequency	250 ms	225 ms
Generator under (low) frequency	250 ms	225 ms

\* df/dt response time with 4 periods setting.

For further technical data, please refer to the Designer's Reference Handbook.

Errors and changes excepted