DEIF A/S

Description of options

Options A and B, Loss of mains protection package Multi-line 2

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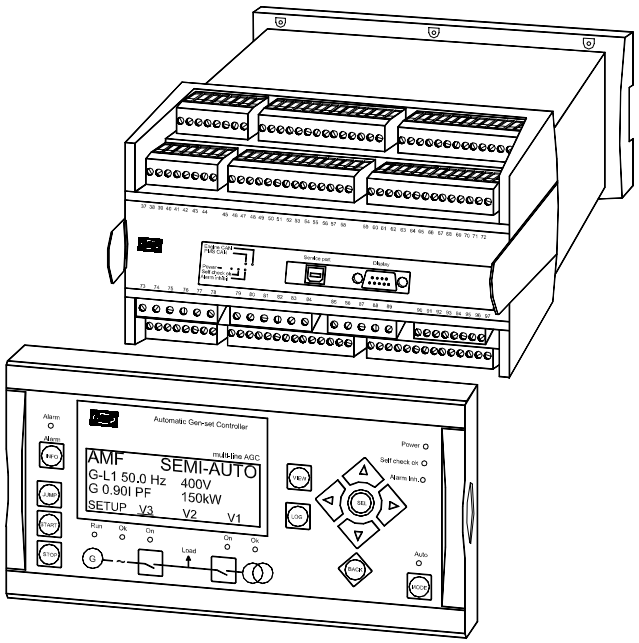
SW 3.0X.X



- *Description of options*
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1. Warnings and legal information

Legal information and responsibility

DEIF takes no responsibility for installation or operation of the generator set. If there is any doubt about how to install or operate the generator set controlled by the unit, the company responsible for the installation or the operation of the set must be contacted.

The units are not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

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.

Safety issues

Installing the unit implies 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.

Definitions

Throughout this document a number of notes and warnings will be presented. To ensure that these are noticed, they will be highlighted in order to separate them from the general text.

Notes

The notes provide general information which will be helpful for the reader to bear in mind.

Warning

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

2. Description of options

A options

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:

Option A1

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

Option A2

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

Option A3

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

B options

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:

Option B1

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

ANSI numbers

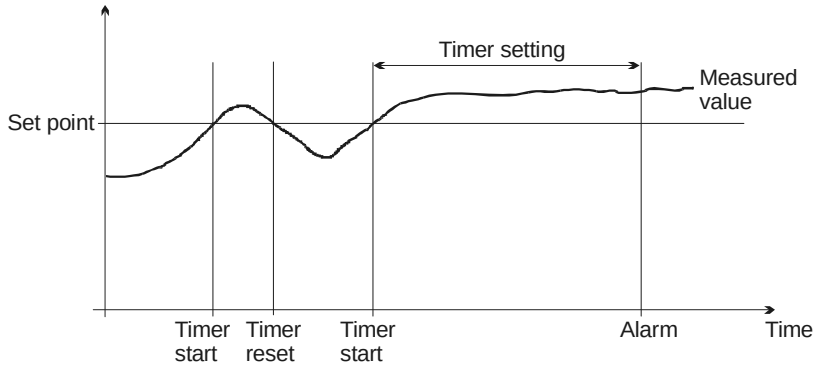
Protection	ANSI no.
Overvoltage, U>	59
Undervoltage, U<	27
Overfrequency, f>	81
Underfrequency, f<	81
Vector jump	78
df/dt (ROCOF)	81

3. Functional descriptions

Voltage and frequency

Voltage and frequency is set in % of nominal generator value. The delay settings are all of the definite time type, meaning that a set point and time is selected.

If the function is e.g. overvoltage, then 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, then the timer will be stopped and reset.

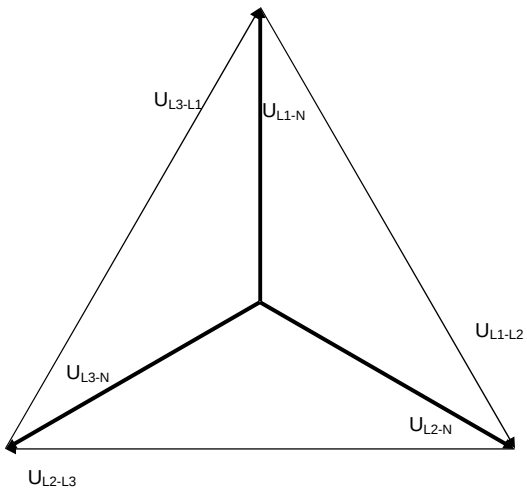


When the timer runs out, the output is activated. The total delay will be the delay setting + the reaction time.

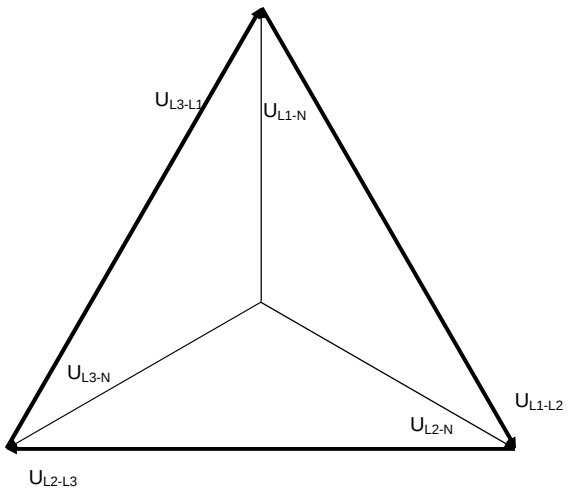
Phase-neutral voltage trip

If the voltage alarms are to work based on phase-neutral measurements, please adjust menus 1200 and 1340 accordingly. Depending on the selections, either phase-phase voltages or phase-neutral voltages will be used for the alarm monitoring.

Phase-neutral



Phase-phase



As indicated in the vector diagram there is a difference in voltage values at an error situation for the phase-neutral voltage and the phase-phase voltage.

The table shows the actual measurements at a 10% undervoltage situation in a 400/230 volt system.

	Phase-neutral	Phase-phase
Nominal voltage	**400/230**	**400/230**
Voltage, 10% error	380/**207**	**360**/185

The alarm will occur at two different voltage levels, even though the alarm set point is 10% in both cases.

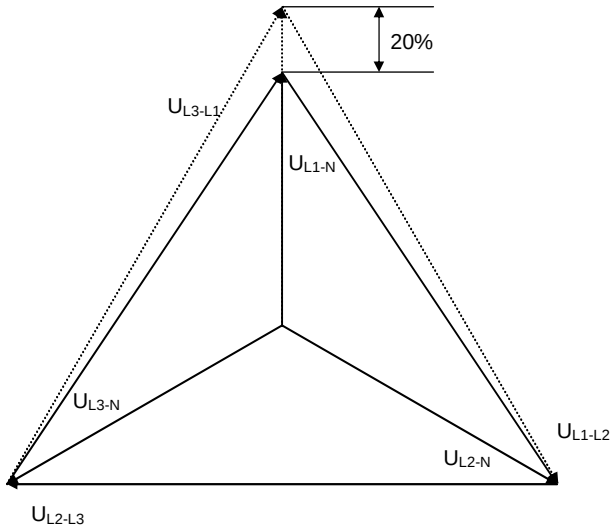
Example
The below 400V AC system shows that the phase-neutral voltage must change 20%, when the phase-phase voltage changes 40 volts (10%).

Example:
U_{NOM} = 400/230V AC

Error situation:
U_{L1L2} = 360V AC
U_{L3L1} = 360V AC

U_{L1-N} = 185V AC

ΔU_{PH-N} = 20%



Phase-neutral or phase-phase: Both the generator protections and the busbar/mains protections use the selected voltage.

Vector jump and df/dt protections

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

Measurement

Both the df/dt and vector jump protections are based on 3 individual single phase measurements (individual monitoring of phases L1, L2 and L3). Therefore, the relay will trip if a df/dt and/or vector jump occurs in one of the 3 phases.

Principle

The vector jump and df/dt protections are intended for detection of a mains failure and subsequent opening of the mains breaker. The reasons are:

1) In case of mains failure the generator will run 'stand-alone' on the grid, attempting to supply power to all consumers. Naturally, this is not possible because of the mains failure, and an overload/overcurrent situation is likely to be the end result, as the mains consumption normally exceeds the generator capacity.

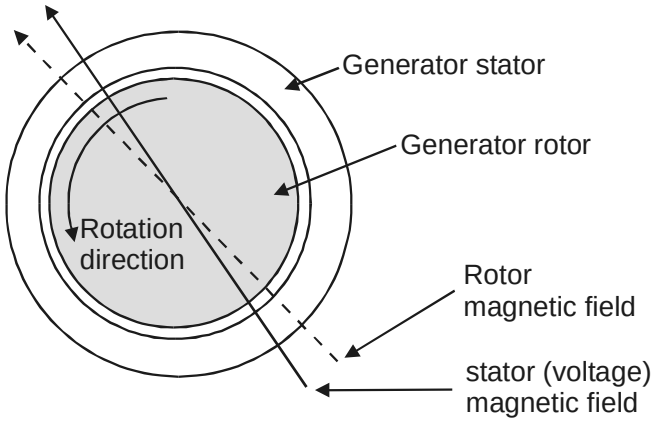
2) Mains transformer protection systems are constructed with a so-called 'fast re-closing' feature. This means that if a failure occurs (e.g. a short circuit), then the transformer protection system will open the transformer breaker. But after a while (the actual time period depends on the specific country (e.g. 330 ms in Denmark)), the breaker will be re-closed to check whether it was a short-time failure, e.g. 2 overhead wires meeting shortly, a lightning strike, a branch falling down from a tree, etc. If the failure is still present, then the breaker will be reopened and remain there.

This re-closing combined with the high overload on the generator means that the generator and the mains will be paralleled again without synchronisation, an operation which will most likely damage the entire gen-set.

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

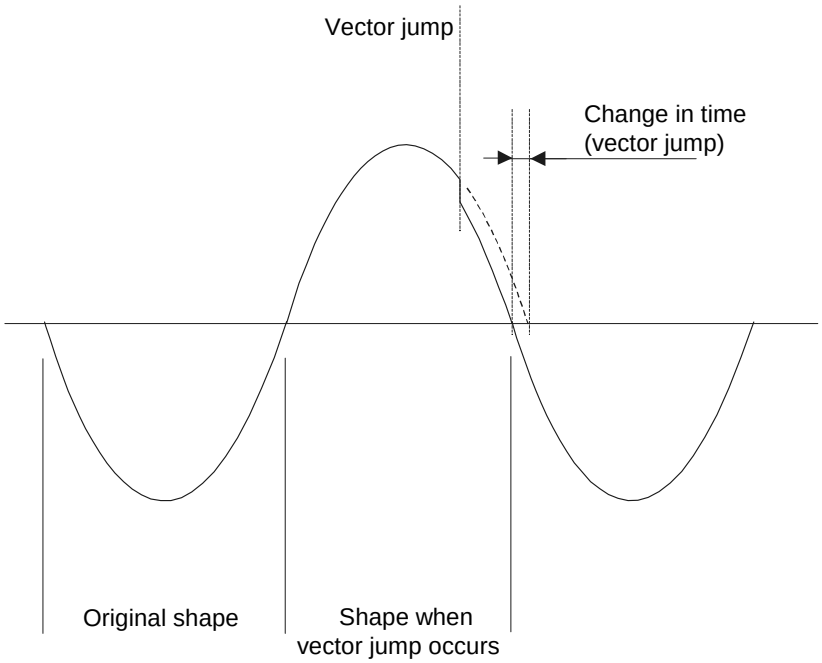
Vector jump

Vector jump is based on the fact that the stator magnetic field – and as a result, the 3-phase voltage from a generator – lack a little behind the rotor magnetic field (in time and position).



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

A vector jump illustrated in a sine wave:

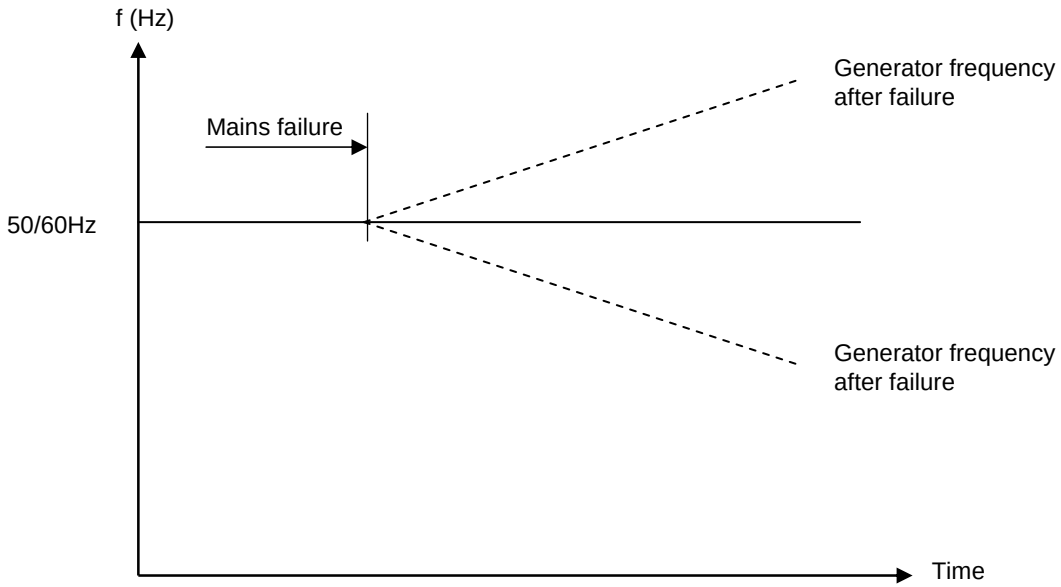


Again, comparing the half-sine curve time duration with the previous ones, a sudden change in time can be detected. This is the vector jump.

The vector jump setting is made in electrical degrees. The vector jump has no delay setting, since it reacts instantaneously. The delay will be the reaction time.

df/dt (ROCOF)

The df/dt function is based on the fact that the generator, if overloaded, will loose speed dramatically. Alternatively, it will speed up dramatically if a lot of load is dropped instantly.



So, a dramatic drop/increase of frequency over time is a mains failure. The df/dt setting is made in Hz/sec.

The delay is set in periods, i.e. if the setting is set to '6per' (factory setting), the time delay will be 120 ms (50Hz) or 100 ms (60Hz). The total delay will be the delay setting + reaction time.

Adjustments

Load jumps

Vector jump and df/dt protections are generally very reliable when used for generator protection to avoid asynchronous reconnection of the generator to the mains after a mains failure.

Nevertheless, the protections may fail to react if no or a very small load change takes place upon mains failure. This can happen when the generator is used in a peak lopping or Combined Heat and Power (CHP) system, where the power flow to the mains is very low.

In general, the system load change necessary to activate the vector jump or the df/dt protections is between 15-20% of the plant's rated power. Attempting to increase the sensitivity of the protection by lowering the set point value may result in false trips, because even the mains grid is not completely stable.

Distant mains breaker decoupling

If a mains failure occurs in a system where a generator is running as a peak lopping/automatic mains failure generator, and if the loss of mains protections are used to decouple a mains breaker, care must be taken to prevent the generator breaker short circuit from tripping the generator breaker before the mains breaker is tripped.

This may happen if the mains failure is a distant one, because it will leave so many remaining consumers connected to the gen-set that they will appear to be a short circuit when compared to the generator nominal current.

Compare the reaction + delay time of the vector jump/df/dt protection to the delay time of the generator breaker short circuit protection to determine whether this is a problem.

4. Parameter list

For further information about the structure of the parameter descriptions, please see the Designer's Reference Handbook.

Loss of mains protections (option A)

1420 df/dt (ROCOF)

No.	Setting		Min. setting	Max. setting	Factory setting
1421	df/dt (ROCOF)	Set point +/-	0.1Hz/s	10.0Hz/s	5.0Hz/s
1422	df/dt (ROCOF)	Delay	1 per	20 per	6 per
1423	df/dt (ROCOF)	Relay output A	Not used	Option dependent	Not used
1424	df/dt (ROCOF)	Relay output B	Not used		Not used
1425	df/dt (ROCOF)	Enable	OFF	ON	OFF
1426	df/dt (ROCOF)	Fail class	Alarm (1)	Trip MB (6)	Trip MB (6)

This protection is included in option A1 and A2.

1430 Vector jump

No.	Setting		Min. setting	Max. setting	Factory setting
1431	Vector jump	Set point	1.0 deg.	90.0 deg.	10.0 deg.
1432	Vector jump	Relay output A	Not used	Option dependent	Not used
1433	Vector jump	Relay output B	Not used		Not used
1434	Vector jump	Enable	OFF	ON	OFF
1435	Vector jump	Fail class	Alarm (1)	Trip MB (6)	Trip MB (6)

This protection is included in option A1 and A3.

Both df/dt and vector jump have a fixed time delay of 1 second after the mains breaker has closed.

Voltage protections (option A and B)

1200 G voltage trip

No.	Setting		Min. setting	Max. setting	Factory setting
1201	G voltage trip	Set point	Phase-phase	Phase-neutral	Phase-phase

1340 BB voltage trip

No.	Setting		Min. setting	Max. setting	Factory setting
1341	BB voltage trip	Set point	Phase-phase	Phase-neutral	Phase-phase

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

When phase-phase tripping is selected, the voltage alarms relate to the nominal voltage.

When phase-neutral tripping is selected, the voltage alarms relate to the nominal voltage divided by √3.

1150 G U> 1

No.	Setting			Min. setting	Max. setting	Factory setting
1151	G U>	1	Set point	100.0%	120.0%	103.0%
1152	G U>	1	Delay	0.1 s	100.0 s	10.0 s
1153	G U>	1	Relay output A	Not used	Option dependent	Not used
1154	G U>	1	Relay output B	Not used		Not used
1155	G U>	1	Enable	OFF	ON	OFF
1156	G U>	1	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1160 G U> 2

No.	Setting			Min. setting	Max. setting	Factory setting
1161	G U>	2	Set point	100.0%	120.0%	105.0%
1162	G U>	2	Delay	0.1 s	100.0 s	5.0 s
1163	G U>	2	Relay output A	Not used	Option dependent	Not used
1164	G U>	2	Relay output B	Not used		Not used
1165	G U>	2	Enable	OFF	ON	OFF
1166	G U>	2	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1170 G U< 1

No.	Setting			Min. setting	Max. setting	Factory setting
1171	G U<	1	Set point	80.0%	100.0%	97.0%
1172	G U<	1	Delay	0.1 s	100.0 s	10.0 s
1173	G U<	1	Relay output A	Not used	Option dependent	Not used
1174	G U<	1	Relay output B	Not used		Not used
1175	G U<	1	Enable	OFF	ON	OFF
1176	G U<	1	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1180 G U< 2

No.	Setting			Min. setting	Max. setting	Factory setting
1181	G U<	2	Set point	50.0%	100.0%	95.0%
1182	G U<	2	Delay	0.1 s	100.0 s	5.0 s
1183	G U<	2	Relay output A	Not used	Option dependent	Not used
1184	G U<	2	Relay output B	Not used		Not used
1185	G U<	2	Enable	OFF	ON	OFF
1186	G U<	2	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1190 G U< 3

No.	Setting			Min. setting	Max. setting	Factory setting
1191	G U<	3	Set point	50.0%	100.0%	95.0%
1192	G U<	3	Delay	0.1 s	100.0 s	5.0 s
1193	G U<	3	Relay output A	Not used	Option dependent	Not used
1194	G U<	3	Relay output B	Not used		Not used
1195	G U<	3	Enable	OFF	ON	OFF
1196	G U<	3	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1270 BB U> 1

No.	Setting			Min. setting	Max. setting	Factory setting
1271	BB U>	1	Set point	100.0%	120.0%	103.0%
1272	BB U>	1	Delay	0.10 s	99.99 s	10.00 s
1273	BB U>	1	Relay output A	Not used	Option dependent	Not used
1274	BB U>	1	Relay output B	Not used		Not used
1275	BB U>	1	Enable	OFF	ON	OFF
1276	BB U>	1	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1280 BB U> 2

No.	Setting			Min. setting	Max. setting	Factory setting
1281	BB U>	2	Set point	100.0%	120.0%	105.0%
1282	BB U>	2	Delay	0.00 s	99.99 s	5.00 s
1283	BB U>	2	Relay output A	Not used	Option dependent	Not used
1284	BB U>	2	Relay output B	Not used		Not used
1285	BB U>	2	Enable	OFF	ON	OFF
1286	BB U>	2	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1290 BB U> 3

No.	Setting			Min. setting	Max. setting	Factory setting
1291	BB U>	3	Set point	100.0%	120.0%	105.0%
1292	BB U>	3	Delay	0.00 s	99.99 s	5.00 s
1293	BB U>	3	Relay output A	Not used	Option dependent	Not used
1294	BB U>	3	Relay output B	Not used		Not used
1295	BB U>	3	Enable	OFF	ON	OFF
1296	BB U>	3	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1300 BB U< 1

No.	Setting			Min. setting	Max. setting	Factory setting
1301	BB U<	1	Set point	50.0%	100.0%	97.0%
1302	BB U<	1	Delay	0.00 s	99.99 s	10.00 s
1303	BB U<	1	Relay output A	Not used	Option dependent	Not used
1304	BB U<	1	Relay output B	Not used		Not used
1305	BB U<	1	Enable	OFF	ON	OFF
1306	BB U<	1	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1310 BB U< 2

No.	Setting			Min. setting	Max. setting	Factory setting
1311	BB U<	2	Set point	50.0%	100.0%	95.0%
1312	BB U<	2	Delay	0.00 s	99.99 s	5.00 s
1313	BB U<	2	Relay output A	Not used	Option dependent	Not used
1314	BB U<	2	Relay output B	Not used		Not used
1315	BB U<	2	Enable	OFF	ON	OFF
1316	BB U<	2	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1320 BB U< 3

No.	Setting			Min. setting	Max. setting	Factory setting
1321	BB U<	3	Set point	50.0%	100.0%	97.0%
1322	BB U<	3	Delay	0.00 s	99.99 s	510.00 s
1323	BB U<	3	Relay output A	Not used	Option dependent	Not used
1324	BB U<	3	Relay output B	Not used		Not used
1325	BB U<	3	Enable	OFF	ON	OFF
1326	BB U<	3	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1330 BB U< 4

No.	Setting			Min. setting	Max. setting	Factory setting
1331	BB U<	4	Set point	50.0%	100.0%	95.0%
1332	BB U<	4	Delay	0.00 s	99.99 s	5.00 s
1333	BB U<	4	Relay output A	Not used	Option dependent	Not used
1334	BB U<	4	Relay output B	Not used		Not used
1335	BB U<	4	Enable	OFF	ON	OFF
1336	BB U<	4	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

If using option G5, the busbar protections become mains protections and BB is replaced with M in the protection menus.

Frequency protections (option A and B)

Frequency settings relate to the nominal frequency setting.

1210 G f> 1

No.	Setting			Min. setting	Max. setting	Factory setting
1211	G f>	1	Set point	100.0%	120.0%	103.0%
1212	G f>	1	Delay	0.2 s	100.0 s	10.0 s
1213	G f>	1	Relay output A	Not used	Option dependent	Not used
1214	G f>	1	Relay output B	Not used		Not used
1215	G f>	1	Enable	OFF	ON	OFF
1216	G f>	1	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1220 G f> 2

No.	Setting			Min. setting	Max. setting	Factory setting
1221	G f>	2	Set point	100.0%	120.0%	105.0%
1222	G f>	2	Delay	0.2 s	100.0 s	5.0 s
1223	G f>	2	Relay output A	Not used	Option dependent	Not used
1224	G f>	2	Relay output B	Not used		Not used
1225	G f>	2	Enable	OFF	ON	OFF
1226	G f>	2	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1230 G f> 3

No.	Setting			Min. setting	Max. setting	Factory setting
1231	G f>	3	Set point	100.0%	120.0%	105.0%
1232	G f>	3	Delay	0.2 s	100.0 s	5.0 s
1233	G f>	3	Relay output A	Not used	Option dependent	Not used
1234	G f>	3	Relay output B	Not used		Not used
1235	G f>	3	Enable	OFF	ON	OFF
1236	G f>	3	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1240 G f< 1

No.	Setting			Min. setting	Max. setting	Factory setting
1241	G f<	1	Set point	80.0%	100.0%	97.0%
1242	G f<	1	Delay	0.2 s	100.0 s	10.0 s
1243	G f<	1	Relay output A	Not used	Option dependent	Not used
1244	G f<	1	Relay output B	Not used		Not used
1245	G f<	1	Enable	OFF	ON	OFF
1246	G f<	1	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1250 G f< 2

No.	Setting			Min. setting	Max. setting	Factory setting
1251	G f<	2	Set point	80.0%	100.0%	95.0%
1252	G f<	2	Delay	0.2 s	100.0 s	5.0 s
1253	G f<	2	Relay output A	Not used	Option dependent	Not used
1254	G f<	2	Relay output B	Not used		Not used
1255	G f<	2	Enable	OFF	ON	OFF
1256	G f<	2	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1260 G f< 3

No.	Setting			Min. setting	Max. setting	Factory setting
1261	G f<	3	Set point	80.0%	100.0%	95.0%
1262	G f<	3	Delay	0.2 s	100.0 s	5.0 s
1263	G f<	3	Relay output A	Not used	Option dependent	Not used
1264	G f<	3	Relay output B	Not used		Not used
1265	G f<	3	Enable	OFF	ON	OFF
1266	G f<	3	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1350 BB f> 1

No.	Setting			Min. setting	Max. setting	Factory setting
1351	BB f>	1	Set point	100.0%	120.0%	103.0%
1352	BB f>	1	Delay	0.00 s	99.99 s	10.00 s
1353	BB f>	1	Relay output A	Not used	Option dependent	Not used
1354	BB f>	1	Relay output B	Not used		Not used
1355	BB f>	1	Enable	OFF	ON	OFF
1356	BB f>	1	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1360 BB f> 2

No.	Setting			Min. setting	Max. setting	Factory setting
1361	BB f>	2	Set point	100.0%	120.0%	105.0%
1362	BB f>	2	Delay	0.00 s	99.99 s	5.00 s
1363	BB f>	2	Relay output A	Not used	Option dependent	Not used
1364	BB f>	2	Relay output B	Not used		Not used
1365	BB f>	2	Enable	OFF	ON	OFF
1366	BB f>	2	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1370 BB f> 3

No.	Setting			Min. setting	Max. setting	Factory setting
1371	BB f>	3	Set point	100.0%	120.0%	105.0%
1372	BB f>	3	Delay	0.00 s	99.99 s	5.00 s
1373	BB f>	3	Relay output A	Not used	Option dependent	Not used
1374	BB f>	3	Relay output B	Not used		Not used
1375	BB f>	3	Enable	OFF	ON	OFF
1376	BB f>	3	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1380 BB f< 1

No.	Setting			Min. setting	Max. setting	Factory setting
1381	BB f<	1	Set point	80.0%	100.0%	97.0%
1382	BB f<	1	Delay	0.00 s	99.99 s	10.00 s
1383	BB f<	1	Relay output A	Not used	Option dependent	Not used
1384	BB f<	1	Relay output B	Not used		Not used
1385	BB f<	1	Enable	OFF	ON	OFF
1386	BB f<	1	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1390 BB f< 2

No.	Setting			Min. setting	Max. setting	Factory setting
1391	BB f<	2	Set point	80.0%	100.0%	95.0%
1392	BB f<	2	Delay	0.00 s	99.99 s	5.00 s
1393	BB f<	2	Relay output A	Not used	Option dependent	Not used
1394	BB f<	2	Relay output B	Not used		Not used
1395	BB f<	2	Enable	OFF	ON	OFF
1396	BB f<	2	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1400 BB f< 3

No.	Setting			Min. setting	Max. setting	Factory setting
1401	BB f<	3	Set point	80.0%	100.0%	97.0%
1402	BB f<	3	Delay	0.00 s	99.99 s	5.00 s
1403	BB f<	3	Relay output A	Not used	Option dependent	Not used
1404	BB f<	3	Relay output B	Not used		Not used
1405	BB f<	3	Enable	OFF	ON	OFF
1406	BB f<	3	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

1410 BB f< 4

No.	Setting			Min. setting	Max. setting	Factory setting
1411	BB f<	4	Set point	80.0%	100.0%	95.0%
1412	BB f<	4	Delay	0.00 s	99.99 s	5.00 s
1413	BB f<	4	Relay output A	Not used	Option dependent	Not used
1414	BB f<	4	Relay output B	Not used		Not used
1415	BB f<	4	Enable	OFF	ON	OFF
1416	BB f<	4	Fail class	Alarm (1)	Trip MB (6)	Warning (2)

If using option G5, the busbar protections become mains protections and BB is replaced with M in the protection menus.