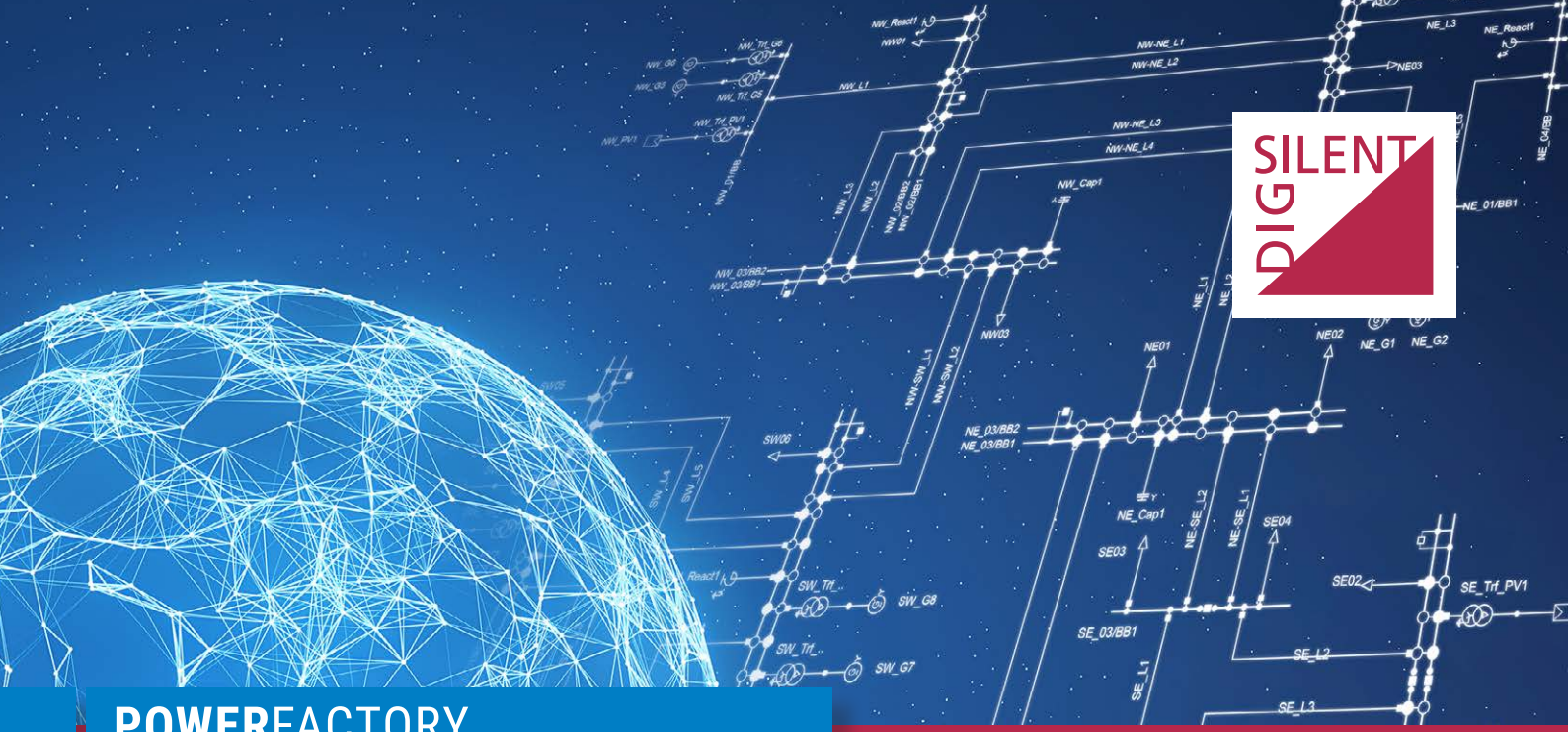

POWERFACTORY

PowerFactory 2021

Technical Reference

NSE KOMBISAVE

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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Contents

Disclaimer

DIgSILENT protection device models are developed using publicly accessible information, such as user manuals, and are not validated or tested by the respective manufacturers.

1 Model information

Manufacturer NSE

Model KOMBISAVE

Variants The NSE KOMBISAVE consists of three PowerFactory relay models, one for each of the different variants of the KOMBISAVE family. Functions and model parameters are derived from [1].

Modelled Functionality

Functionality (ANSI)	KOMBISAVE RN	KOMBISAVE RQ	KOMBISAVE RF
50P		-	
50P, 51P	X	X	X
51BF, 51NBF	-	-	-
49 I & II	-	-	-
67			X
67N			-
32N			-
67NIEF			-
59G			-
59, 27			X
81O, 81U			X
37	-		
68	-	-	-
81LSH			-
21, 21N, 21P			X
46PD	-		-
85N	-	-	-
QU			-
47O			-
87T		X	
24		X	

2 General description

Each model consists of a main relay with several sub-functions.

KOMBISAVE RN

- Main relay : Measurement transformer slots, measurement processing, breaker logic
- Overcurrent : Overcurrent protection

KOMBISAVE RQ

- Main relay : Measurement transformer slots, measurement processing, breaker logic
- Overcurrent Side 1: Overcurrent protection for side 1
- Overcurrent Side 2: Overcurrent protection for side 2
- Differential: Differential protection and CT adaption

KOMBISAVE RF

- Main relay : Measurement transformer slots, measurement processing, breaker logic
- Distance: Distance protection
- Overcurrent: Overcurrent protection
- Voltage: Voltage protection
- Frequency: Frequency protection

3 Main relay

Measurement transformers

The *"CT"* and *"VT"* slots hold the assigned 3-phase measurement transformers. The *"CT IE"* and *"VT U0"* slots present in the KOMBISAVE RF model can be assigned to the corresponding zero sequence measurement transformers. If the relay is configured to use the calculated zero sequence values, the main CT and VT need to be assigned to theses slots as well.

Measurement units

The "Measurement" slots process the transformer input and hold the nominal current and voltage values.

KOMBISAVE RN

Address	Relay Setting	Model Unit	Model Parameter	Note
WaILSek	Rated secondary current for phase curr. transf.	Measurement	Nominal Current	

KOMBISAVE RQ

Address	Relay Setting	Model Unit	Model Parameter	Note
WaILSekS1	Rated secondary current for phase curr. transf. side 1	Measurement Side 1	Nominal Current	
WaILSekS2	Rated secondary current for phase curr. transf. side 2	Measurement Side 2	Nominal Current	

KOMBISAVE RF

Address	Relay Setting	Model Unit	Model Parameter	Note
WaILSek	Rated secondary current for phase curr. transf.	Measurement Measurement Delta	Nominal Current	
WaIESek	Rated secondary current for ground curr. transf.	Measurement IE U0	Nominal Current	see 1)
WaULSek	Rated secondary voltage phase voltage transf.	Measurement Measurement Delta	Nominal Voltage	
WaU0Sek	Rated secondary voltage displacement volt. transf.	Measurement IE U0	Nominal Voltage	see 1)

Note

1) Use the value for phase if the corresponding transformer is not connected

Breaker logics

The *"Trip Logic"* holds the breakers which are to be tripped.

4 Overcurrent

This sub-function models the overcurrent protection functionality. Depending on the variant used, the layout may vary.

Note

- Due to different settable current ranges, the definite time and inverse time characteristics are split into separate units; please use the *"DT"* units for the definite time characteristics and the *"IDMT"* units for inverse time characteristics; the unused unit in each pair should be set *"Out of service"*.
- (KOMBISAVE RF only) Due to the bi-directional operating mode, the non-direction, forward and reverse modes are also split into separate units; please use the unit without suffix for *"non-directional"*, the unit with *"fw"* for *"forward"* and the unit with *"rev"* for *"reverse"*; units for unused directions should be set *"Out of service"*

KOMBISAVE RN

Address	Relay Setting	Model Unit	Model Parameter	Note
IL>ANR	Threshold independent IL>	IL> DT	Pickup Current	
tIL>	Delay nondirectional IL>	IL> DT	Time Setting	
IL>AMZ	Threshold inverse IL>	IL> IDMT	Current Setting	
IL>AMZt	Time factor nondirectional IL>	IL> IDMT	Time Dial	
IL>AMZv	Maximum delay IL>	IL> IDMT	Max. Time	
IL>>ANR	Threshold independent IL>>	IL>> DT	Pickup Current	
tIL>>	Delay nondirectional IL>>	IL>> DT	Time Setting	
IL>>AMZ	Threshold inverse IL>>	IL>> IDMT	Current Setting	
IL>>AMZt	Time factor nondirectional IL>>	IL>> IDMT	Time Dial	
IL>>AMZv	Maximum delay IL>>	IL>> IDMT	Max. Time	

KOMBISAVE RQ

Side 1

All units are stored inside the *"Overcurrent Side 1"* sub-function.

Address	Relay Setting	Model Unit	Model Parameter	Note
IL>ANRS1	Threshold independent IL>	IL> DT	Pickup Current	
tIL>S1	Delay nondirectional IL>	IL> DT	Time Setting	
IL>AMZS1	Threshold inverse IL>	IL> IDMT	Current Setting	
IL>AMZtS1	Time factor nondirectional IL>	IL> IDMT	Time Dial	
IL>AMZvS1	Maximum delay IL>	IL> IDMT	Max. Time	
IL>>ANRS1	Threshold independent IL>>	IL>> DT	Pickup Current	
tIL>>S1	Delay nondirectional IL>>	IL>> DT	Time Setting	
IL>>AMZS1	Threshold inverse IL>>	IL>> IDMT	Current Setting	
IL>>AMZtS1	Time factor nondirectional IL>>	IL>> IDMT	Time Dial	
IL>>AMZvS1	Maximum delay IL>>	IL>> IDMT	Max. Time	

Side 2

All units are stored inside the *"Overcurrent Side 2"* sub-function.

Address	Relay Setting	Model Unit	Model Parameter	Note
IL>ANRS2	Threshold independent IL>	IL> DT	Pickup Current	
tIL>S2	Delay nondirectional IL>	IL> DT	Time Setting	
IL>AMZS2	Threshold inverse IL>	IL> IDMT	Current Setting	
IL>AMZtS2	Time factor nondirectional IL>	IL> IDMT	Time Dial	
IL>AMZvS2	Maximum delay IL>	IL> IDMT	Max. Time	
IL>>ANRS2	Threshold independent IL>>	IL>> DT	Pickup Current	
tIL>>S2	Delay nondirectional IL>>	IL>> DT	Time Setting	
IL>>AMZS2	Threshold inverse IL>>	IL>> IDMT	Current Setting	
IL>>AMZtS2	Time factor nondirectional IL>>	IL>> IDMT	Time Dial	
IL>>AMZvS2	Maximum delay IL>>	IL>> IDMT	Max. Time	

KOMBISAVE RF

Address	Relay Setting	Model Unit	Model Parameter	Note
IL>ANR	Threshold independent IL>	IL> DT IL> DT fw IL> DT rev	Pickup Current	
tIL>	Delay nondirectional IL>	IL> DT	Time Setting	
tIL>vw	Delay forward IL>	IL> DT fw	Time Setting	
tIL>rw	Delay reverse IL>	IL> DT rev	Time Setting	
IL>AMZ	Threshold inverse IL>	IL> IDMT IL> IDMT fw IL> IDMT rev	Current Setting	
IL>AMZt	Time factor nondirectional IL>	IL> IDMT	Time Dial	
IL>AMZtvw	Time factor forward IL>	IL> IDMT fw	Time Dial	
IL>AMZtrw	Time factor reverse IL>	IL> IDMT rev	Time Dial	
IL>AMZv	Maximum delay IL>	IL> IDMT IL> IDMT fw IL> IDMT rev	Max. Time	
IL>>ANR	Threshold independent IL>>	IL>> DT IL>> DT fw IL>> DT rev	Pickup Current	
tIL>>	Delay nondirectional IL>>	IL>> DT	Time Setting	
tIL>>vw	Delay forward IL>>	IL>> DT fw	Time Setting	
tIL>>rw	Delay reverse IL>>	IL>> DT rev	Time Setting	
IL>>AMZ	Threshold inverse IL>>	IL>> IDMT IL>> IDMT fw IL>> IDMT rev	Current Setting	
IL>>AMZt	Time factor nondirectional IL>>	IL>> IDMT	Time Dial	
IL>>AMZtvw	Time factor forward IL>>	IL>> IDMT fw	Time Dial	
IL>>AMZtrw	Time factor reverse IL>>	IL>> IDMT rev	Time Dial	
IL>>AMZv	Maximum delay IL>>	IL>> IDMT IL>> IDMT fw IL>> IDMT rev	Max. Time	

5 Distance

This sub-function models the distance protection functionality available in the KOMBISAVE RF.

Starting

The *"Starting"* unit models the fault detection and measurement loop selection of the distance protection.

Note The actual model used is that of a Siemens 7SA511. While it is quite similar to the starting unit used by the NSE KOMBISAVE , there are some important differences:

- The earth fault stabilisation is much stronger, as it uses $I'_e = I_e * (1 + K * I_{ph,max})$ instead of $I'_e = I_e * (1 + K * (I_{set} - I_{ph,max}))$
- The maximum load of the impedance starting polygon is a straight resistive blinder, instead of a circular impedance characteristic
- There is no possibility to enter a different reactive reach for the PH-E starting polygon

Address	Relay Setting	Model Unit	Model Parameter	Note
DISANR	Starting procedure	Starting	Type of Starting	
SP	Neutral point	Starting	System Grounding	
DISIIph	Current starting threshold current	Starting	Iph>>	see 1)
DISUIANRPRG	V-I starting starting program - FLE	Starting	Prog. U/I	see 3)
DISUIANRPRG	V-I starting starting program - FLL	Starting	Prog. U/I	see 4)
DISUIIph>	V-I starting threshold I>	Starting	Iph>	
DISUIIph>>	V-I starting threshold I>>	Starting	Iph>>	see 2)
DISUIUphe>	V-I starting threshold UphE>	Starting	Uphe(I>)	convert to sec.V
DISUIUphe>>	V-I starting threshold UphE>>	Starting	Uphe(I>>)	convert to sec.V
DISUIUphph>	V-I starting threshold Uphph>	Starting	Uphph(I>)	convert to sec.V
DISUIUphph>>	V-I starting threshold Uphph>>	Starting	Uphph(I>)	convert to sec.V
DISZIph	Imped. start. threshold current	Starting	Minimum Iph>	
DISZLLRmax	Imped. start. LL limit value resistance	Starting	Resistance RA2, Ph-Ph	see 5)
DISZLLXmax	Imped. start. LL limit value reactance	Starting	Reactance Forward Reactance Reverse	see 5)
DISZLLZLast	Imped. start. LL maximum load	Starting	Resistance RA1, Ph-Ph	see 5)
DISZLLPhiLast	Imped. start. LL load angle	Starting	Angle PHIA, Ph-Ph	

Address	Relay Setting	Model Unit	Model Parameter	Note
DISZLERmax	Imped. start. LE limit value resistance	Starting	Resistance RA2, Ph-E	see 5)
DISZLEXmax	Imped. start. LE limit value reactance			
DISZLEZLast	Imped. start. LE maximum load	Starting	Resistance RA1, Ph-E	see 5)
DISZLEPhiLast	Imped. start. LE load angle	Starting	Angle PHIA, Ph-E	
DISIEph	Ground current starting	Starting	Ie>	
DISIESTAB	Ground current stabilization	Starting	Stabilisation Slope	convert to %
DISU0>wSET	Threshold V0	Starting	Ue	convert to sec.V
DISU0>nwSET	Threshold V0	Starting	Ueiso	convert to sec.V
DISphpheANR	Handling double ground short circuit	Starting	Ph-Ph-E Faults	
DISZyklANR	Handling double ground fault	Starting	Phase preference for Ph-Ph-E Faults	

Note

1) Use if starting procedure is not U/I
2) Use if starting procedure is U/I
3) Use if system is not solidly grounded
4) Use if system is solidly grounded

Polarisation

The *"Polarisation"* unit models the impedance calculation and voltage memory for the distance protection.

Note Currently only the complex compensation factor input mode is supported.

Address	Relay Setting	Model Unit	Model Parameter	Note
FEKL	Grounding factor absolute value	Polarisation	Earth Factor: k0	
FEKLPhi	Grounding factor angle	Polarisation	Earth Factor: Angle	
tWaUAkku	Voltage memory duration of action	Polarisation	Memory Time	convert to cycles
DISULL<Umin	Line without voltage	Polarisation	Memory use threshold Memory reset threshold	

Zones

The units *"Z1 LL"* - *"Z7 LL"* and *"Z1 LE"* - *"Z7 LE"* and their respective timers model the tripping characteristics of the distance protection.

Note

- In the absence of automatic reclosure and signal transmission, the overreaching zone *"Z1B"* is not modelled
- The tripping direction of the *"Directional LE"* and *"Directional LL"* must remain set to *"Forward"* for correct functionality of the end timers

Address	Relay Setting	Model Unit	Model Parameter	Note
DISPhiPoly	Polygon slant	ZX LL ZX LE	Relay Angle	X=1..7
DISAZ1	Zone 1 effective	Z1 LL Z1 LE	Out of service	
DISAZ1RTG	Direction	Z1 LL Z1 LE	Tripping Direction	
DISAZ1RZ	LL resistance	Z1 LL	+X Reach	
DISAZ1XZ	LL reactance	Z1 LL	+R Resistance	
DISAZ1REZ	LE resistance	Z1 LE	+X Reach	see 1)
DISAZ1XEZ	LE reactance	Z1 LE	+R Resistance	
DISAZ1t1pol	Delay LE fault trip	T1 LE	Time Setting	
DISAZ1tMehr	Delay LL fault trip	T1 LL	Time Setting	
DISAZ2	Zone 2 effective	Z2 LL Z2 LE	Out of service	
DISAZ2RTG	Direction	Z2 LL Z2 LE	Tripping Direction	
DISAZ2RZ	LL resistance	Z2 LL	+X Reach	
DISAZ2XZ	LL reactance	Z2 LL	+R Resistance	
DISAZ2REZ	LE resistance	Z2 LE	+X Reach	see 1)
DISAZ2XEZ	LE reactance	Z2 LE	+R Resistance	
DISAZ2t2pol	Delay LE fault trip	T2 LE	Time Setting	
DISAZ2tMehr	Delay LL fault trip	T2 LL	Time Setting	
DISAZ3	Zone 3 effective	Z3 LL Z3 LE	Out of service	
DISAZ3RTG	Direction	Z3 LL Z3 LE	Tripping Direction	
DISAZ3RZ	LL resistance	Z3 LL	+X Reach	
DISAZ3XZ	LL reactance	Z3 LL	+R Resistance	
DISAZ3REZ	LE resistance	Z3 LE	+X Reach	see 1)
DISAZ3XEZ	LE reactance	Z3 LE	+R Resistance	
DISAZ3t3pol	Delay LE fault trip	T3 LE	Time Setting	
DISAZ3tMehr	Delay LL fault trip	T3 LL	Time Setting	
DISAZ4	Zone 4 effective	Z4 LL Z4 LE	Out of service	
DISAZ4RTG	Direction	Z4 LL Z4 LE	Tripping Direction	
DISAZ4RZ	LL resistance	Z4 LL	+X Reach	

Address	Relay Setting	Model Unit	Model Parameter	Note
DISAZ4XZ	LL reactance	Z4 LL	+R Resistance	
DISAZ4REZ	LE resistance	Z4 LE	+X Reach	see 1)
DISAZ4XEZ	LE reactance	Z4 LE	+R Resistance	
DISAZ4t4pol	Delay LE fault trip	T4 LE	Time Setting	
DISAZ4tMehr	Delay LL fault trip	T4 LL	Time Setting	
DISAZ5	Zone 5 effective	Z5 LL Z5 LE	Out of service	
DISAZ5RTG	Direction	Z5 LL Z5 LE	Tripping Direction	
DISAZ5RZ	LL resistance	Z5 LL	+X Reach	
DISAZ5XZ	LL reactance	Z5 LL	+R Resistance	
DISAZ5REZ	LE resistance	Z5 LE	+X Reach	see 1)
DISAZ5XEZ	LE reactance	Z5 LE	+R Resistance	
DISAZ5t5pol	Delay LE fault trip	T5 LE	Time Setting	
DISAZ5tMehr	Delay LL fault trip	T5 LL	Time Setting	
DISAZ6	Zone 6 effective	Z6 LL Z6 LE	Out of service	
DISAZ6RTG	Direction	Z6 LL Z6 LE	Tripping Direction	
DISAZ6RZ	LL resistance	Z6 LL	+X Reach	
DISAZ6XZ	LL reactance	Z6 LL	+R Resistance	
DISAZ6REZ	LE resistance	Z6 LE	+X Reach	see 1)
DISAZ6XEZ	LE reactance	Z6 LE	+R Resistance	
DISAZ6t6pol	Delay LE fault trip	T6 LE	Time Setting	
DISAZ6tMehr	Delay LL fault trip	T6 LL	Time Setting	
DISAZ7	Zone 7 effective	Z7 LL Z7 LE	Out of service	
DISAZ7RTG	Direction	Z7 LL Z7 LE	Tripping Direction	
DISAZ7RZ	LL resistance	Z7 LL	+X Reach	
DISAZ7XZ	LL reactance	Z7 LL	+R Resistance	
DISAZ7REZ	LE resistance	Z7 LE	+X Reach	see 1)
DISAZ7XEZ	LE reactance	Z7 LE	+R Resistance	
DISAZ7t7pol	Delay LE fault trip	T7 LE	Time Setting	
DISAZ7tMehr	Delay LL fault trip	T7 LL	Time Setting	
DISEND	End time	T Directional T Non Directional	Out of service	
DISENDtvw	End time delay forward	T Directional	Time Setting	
DISENDt	End time delay nondirectional	T Non Directional	Time Setting	

Note

1) Use phase value if *"Extended phase-ground polygon"* is configured as *"Reactance XLE equal to XLL"*

6 Differential

This sub-function models the differential protection functionality available in the KOMBISAVE RQ.

Note The compensation of transformer vector groups and different CT ratios is handled by the *"CT Adapation Side 1"* and *"CT Adapation Side 2"* units. Please enter the respective CT ratios, nominal voltages and vector groups into both units and add the phase shift to *"CT Adapation Side 2"*. Transformers with *"Z"* vector groups are not supported.

Address	Relay Setting	Model Unit	Model Parameter	Note
DIFF	Differential protection	Differential	Out of Service	
DIFFIdiff>	Starting value	Differential	Release Threshold Restraint 1st Slope Threshold	see 1)
DIFFIdiff>>	Starting without stabilization	Differential	Unrestrained Differential Threshold	
DIFFmDiff	Slope	Differential	Restraint 1st Slope Restraint 2nd Slope	
DIFFbStab	Additional stabilization	Differential	Restraint 2nd Slope Threshold	
tDIFF	Trip delay	Differential	Time Setting	
DIFFIRushMax	IRushMax	Differential	Disable Harm. Blocking	
DIFFInrushH21	Threshold for 2nd to 1st harmonic	Differential	2nd Harm. Blocking: Threshold	convert to %
DIFFUebererrH51	Threshold for 5th to 1st harmonic	Differential	5th Harm. Blocking: Threshold	convert to %
DIFFINE	Zero seq. elim. with earthing transf. in prot. zone	CT Adaption Side 1 CT Adaption Side 2	Remove Earth Current	

Note

1) calculate as $\frac{DIFFIdiff>}{DIFFmDiff}$

7 Voltage

This sub-function models the over-/undervoltage protection functionality available in the KOMBISAVE RF.

Note If a voltage unit is configured to issue a warning instead of a trip signal, the corresponding trip signal can be deactivated in the *"Logic"* unit on the *"DIP Settings tab"*.

Address	Relay Setting	Model Unit	Model Parameter	Note
Uph<	Undervoltage prot. 1 Vph<	Uph< LE Uph< LL	Out of Service	
Uph<SPA	Voltage evaluation Vph<	Uph< LE Uph< LL	Out of Service	see 1)
Uph<UMIN	Minimal voltage Vph<	Uph< min LE Uph< min LL	Pickup Voltage	
Uph<ANR	Threshold Vph<	Uph< LE Uph< LL	Pickup Voltage	see 2)
tUph<	Delay Vph<	Uph< LE Uph< LL	Time Delay	
Uph<<	Undervoltage prot. 2 Vph <<	Uph<< LE Uph<< LL	Out of Service	
Uph<< SPA	Voltage evaluation Vph <<	Uph<< LE Uph<< LL	Out of Service	see 1)
Uph<< UMIN	Minimal voltage Vph <<	Uph<< min LE Uph<< min LL	Pickup Voltage	
Uph<< ANR	Threshold Vph<<	Uph<< LE Uph<< LL	Pickup Voltage	
tUph<<	Delay Vph<<	Uph<< LE Uph<< LL	Time Delay	
Uph>	Overvoltage prot. 1 Vph>	Uph> LE Uph> LL	Out of Service	
Uph>SPA	Voltage evaluation Vph>	Uph> LE Uph> LL	Out of Service	see 1)
Uph>ANR	Threshold Vph>	Uph> LE Uph> LL	Pickup Voltage	
tUph>	Delay Vph>	Uph> LE Uph> LL	Time Delay	
Uph>>	Overvoltage prot. 2 Vph>>	Uph>> LE Uph>> LL	Out of Service	
Uph>>SPA	Voltage evaluation Vph>>	Uph>> LE Uph>> LL	Out of Service	see 1)
Uph>>ANR	Threshold Vph>>	Uph>> LE Uph>> LL	Pickup Voltage	
tUph>>	Delay Vph>>	Uph>> LE Uph>> LL	Time Delay	

Note

1) If *"Phase-Phase"* is configured, set the unit with the *"LE"* suffix out of service and vice versa

8 Frequency

This sub-function models the over-/underfrequency protection functionality available in the KOMBISAVE RF.

Note If a frequency unit is configured to issue a warning instead of a trip signal, the corresponding trip signal can be deactivated in the *"Logic"* unit on the *"DIP Settings tab"*.

Address	Relay Setting	Model Unit	Model Parameter	Note
f<	Underfrequency prot. 1 f<	f<	Out of Service	
f<Umin	Minimal voltage f<	f< Umin	Pickup Voltage	
f<ANR	Threshold f<	f<	Frequency	
tf<	Delay f<	f<	Time Delay	
f<<	Underfrequency prot. 2 f<<	f<<	Out of Service	
f<< Umin	Minimal voltage f<<	f<< Umin	Pickup Voltage	
f<< ANR	Threshold f<<	f<<	Frequency	
tf<<	Delay f<<	f<<	Time Delay	
f>	Overfrequency prot. 1 f>	f>	Out of Service	
f>Umin	Minimal voltage f>	f> Umin	Pickup Voltage	
f>ANR	Threshold f>	f>	Frequency	
tf>	Delay f>	f>	Time Delay	
f>>	Overfrequency prot. 2 f>>	f>>	Out of Service	
f>>Umin	Minimal voltage f>>	f>> Umin	Pickup Voltage	
f>>ANR	Threshold f>>	f>>	Frequency	
tf>>	Delay f>>	f>>	Time Delay	

9 Available Mapping Files

Note The firmware / hardware combination 1.x-1.x-1.x / 2.1x can be used to map *"SG-50"* devices.

Hardware Version	Firmware Version	Language	Multiple Setting Groups	Model
1.x-1.x-1.x	0.1x	de		KOMBISAVE RN
		en		KOMBISAVE RN
	1.0x	de		KOMBISAVE RN KOMBISAVE RF KOMBISAVE RQ
		en		KOMBISAVE RN KOMBISAVE RF KOMBISAVE RQ
	2.1x	de		KOMBISAVE RF
		en		KOMBISAVE RF
2.x-2.x-2.x	1.0x	de		KOMBISAVE RN KOMBISAVE RF KOMBISAVE RQ
		en		KOMBISAVE RN KOMBISAVE RF KOMBISAVE RQ

10 References

[1] NSE AG, Bremgarterstrasse 54, CH-5610 Wohlen. *SAVE-TECHNOLOGIE Funktionenhandbuch*. 05/2016.