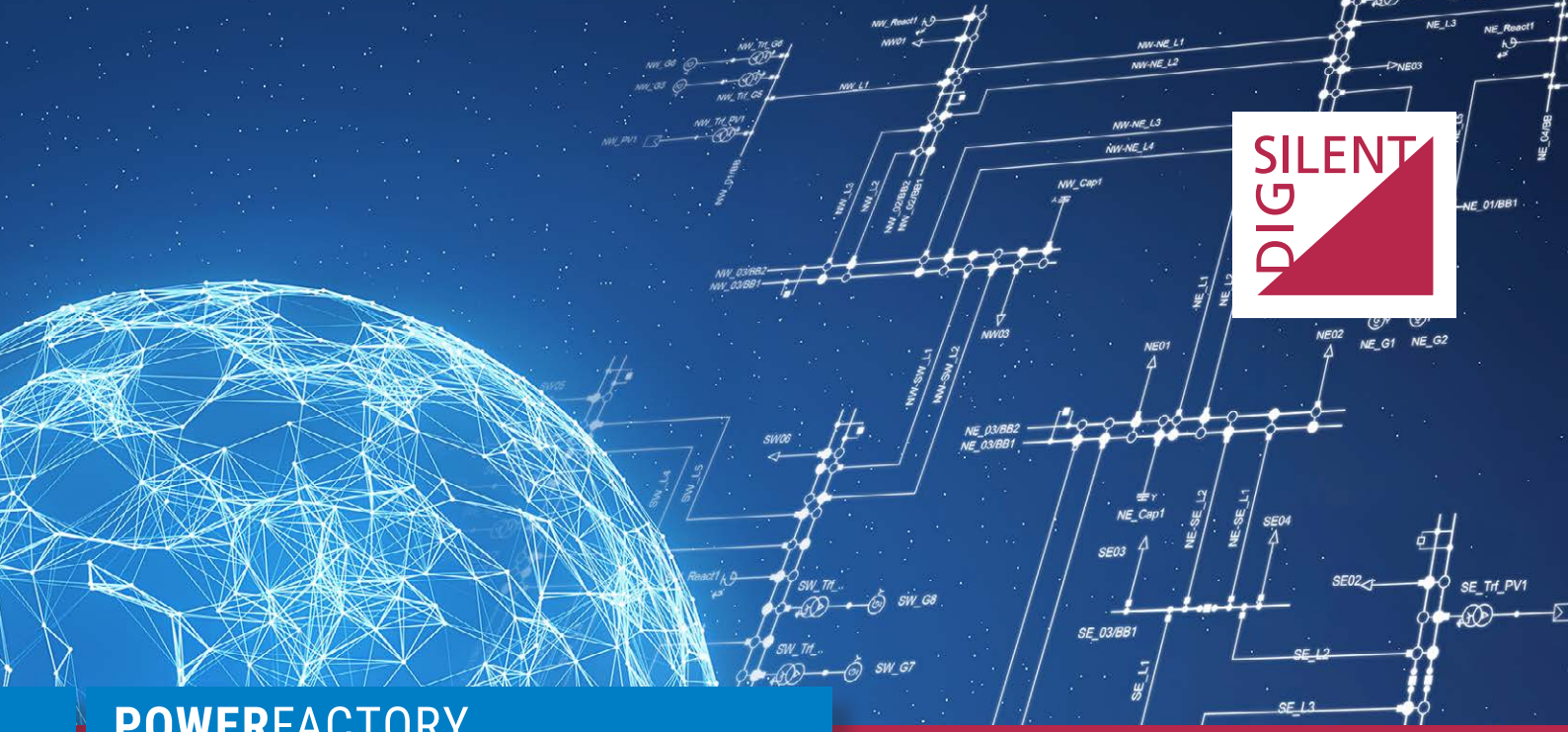

POWERFACTORY

PowerFactory 2021

Technical Reference

Areva P34x

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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November 15, 2019
PowerFactory 2021
Revision 924

Contents

1 Model information

Manufacturer Areva

Model P34x

Variants The Areva P34x PowerFactory relay models can be used to simulate the Areva P342, P343, P344, and P345 relay. However please consider that the models have been implemented with a reduced set of the features available in the relays.

2 General description

The MiCOM P342/3/4/5 generator protection relays have been designed for the protection of a wide range of generators. The MiCOM P342 is suitable for protection of small to medium size generators (1-10MVA) or can be used as back-up protection for larger generators. The MiCOM P343 is suitable for protection of medium to large size generators (>10MVA) or more important generators, providing generator differential, 100% stator earth fault via a 3rd harmonic measuring technique, pole slipping and unintentional energization at standstill protection in addition to the features of the P342. The P344 is similar to the P343 but includes a second neutral voltage input for earth fault/interturn protection. The MiCOM P345 is suitable for protection of large generators (>50MVA) providing 100% stator earth fault protection via a low frequency injection technique in addition to the features of the P344.

The Areva P34x PowerFactory relay models consist of a main relay and six sub relays:

- Areva P34x overcurrent elements (F50/51).
- Areva P34x voltage elements (F27/59).
- Areva P34x frequency (F81).
- Areva P34x power (F32).
- Areva P34x differential and REF.
- Areva P34x impedance.

Two model versions are available, one for each available rated voltage; the two versions are identical except for the voltage setting ranges. The model versions are:

- Areva P34x 100/120 V
- Areva P34x 380/480 V

The Areva P34x PowerFactory relay models have been implemented trying to simulate the most commonly used protective functions. The main relay model contains the measurement and acquisition units,the output logic and all other sub relays. The model implementation has been based on the information available in the relay manual [1].

3 Supported features

3.1 Measurement and acquisition

The currents are converted by one three phase current transformer (”Ct” block), and two single phase current transformers (”SEF Ct” and ”Earthing system Ct(REF)” block); the voltage are converted by two three phase voltage transformers (”Vt” and ”Vt Open Delta” block). One additional three phase current transformer (”Diff Ct” block) represents the remote current transformer which defines the zone protected by the differential element.

Six measurement units (”Measurement”, ”Meas Neutral I”, ”Earthing Measurement REF”, ”Remote Measurement”, ”Measurement VT open Delta” and ”Measurement Seq” block) are fed by these CTs and these VTs.

3.1.1 Available Units

- Two three phase current transformers (”Ct” and ”Diff Ct” block).
- Two three phase voltage transformers (”Vt” and ”Vt Open Delta” block).
- Two single phase current transformers (”SEF Ct” and ”Earthing system Ct(REF)” block).
- One three phase measurement element calculating both the current and voltage values (”Measurement” block).
- One three phase measurement element calculating the current values at the remote location(”Remote Measurement” block).
- One single phase measurement element calculating the voltage converted by the open delta Vt (”Measurement VT open Delta” block).
- One three phase measurement element calculating the current and the voltage sequence vectors (”Measurement Seq” block).
- Two single phase measurement elements (”Meas Neutral I” and ”Earthing Measurement REF” block)

3.1.2 Functionality

The input current and voltage values are sampled at 24 samples/cycle. The average values are processed by a DFT filter, operating over a cycle, which then calculates the voltage and current values used by the protective elements.

3.1.3 Data input

The nominal current and the nominal voltage values MUST be entered in any measurement block.

3.2 Overcurrent subrelay

The *Overcurrent* sub relay simulates one thermal image element, four directional phase overcurrent elements, one *voltage restraint* or *voltage controlled* phase overcurrent element, two ground overcurrent elements, one sensitive ground directional overcurrent element, one negative sequence thermal image element and four negative sequence directional overcurrent element.

3.2.1 Available Units

- One thermal replica element (”Thermal replica” block).
- Two phase fault inverse characteristic elements with directional feature (”I>1” and ”I>2” block).
- Two phase fault definite time elements with directional feature (”I>3” and ”I>4” block).
- One phase directional element (”Phase directional angle” block).
- One voltage restrained/controlled phase overcurrent element (”V dep OC I>” and ”V restraint” block).
- One earth fault inverse characteristic element (”IN>1” block).
- One earth fault definite time element (”IN>2” block).
- One sensitive earth fault directional inverse characteristic element (”ISEF>1” block).
- Two SEF directional elements with additional configuration logic(”SEF directional angle” and ”SEF wattmetric directional angle”, ”VPol Measured or Derived” block).
- Four negative sequence definite time elements with directional feature (”I2>1”, ”I2>2”, ”I2>3” and ”I2>4” block).
- One negative sequence thermal element (”I2Therm>1” block).
- One negative sequence directional element (”I2 directional angle” block).

3.2.2 Functionality

The *voltage restrain* of the ”V dep OC I>” phase overcurrent element can be enabled in the ”Logic” tab page of the ”V restraint” block setting equal to 1 the *VrestraintedON* parameter; the voltage restrain characteristic can be configures setting the *KIMSET*, the *V1mSET*, and the *V1mSET* parameter.
The *voltage control* can be enabled in the ”Logic” tab page of the ”V restraint” block setting equal to 1 the *VcontrolledON* parameter.

The SEF ground overcurrent element(”ISEF>1” block) can use as directional logic the zero sequence current and voltage phasor angle comparison (”SEF directional angle” block) or the product of the zero sequence current and of the zero sequence voltage (”SEF wattmetric directional angle” block). Please note that only one directional block can be enabled at the time. Which Polarizing value (the value derived from the phase voltages or the value measured by the open delta VT) is used can be set in the ”logic” tab page of the ”VPol Measured or Derived” block setting equal to 1 the *MEASURED* or the *DERIVED* parameter.

The negative sequence thermal element (”I2Therm>1” block) operates with independent trip and reset characteristics and supports the maximum and the minimum thermal limit.

The inverse time elements are supporting the following inverse time and definite time trip characteristics (the IEEE/ANSI characteristics are also associate to an inverse time reset characteristic):

- Definite Time (associated to the ”Definite time reset” reset characteristic)
- IEC S Inverse
- IEC V Inverse
- IEC E Inverse
- IEEE M inverse (associated to the ”IEEE M inverse reset” reset characteristic)
- IEEE V inverse (associated to the ”IEEE V inverse reset” reset characteristic)
- IEEE E inverse (associated to the ”IEEE E inverse reset” reset characteristic)
- UK Long time inverse
- US CO-8 Inverse (associated to the ”US CO-8 Inverse reset” reset characteristic)
- US CO-2 Short Time inverse (associated to the ”US CO-2 Short time inverse reset” reset characteristic)
- RI (phase and earth stages only)
- IDG (earth stages only)

The inverse time element trip characteristic equations comply with the IEC 60255-3 and the ANSI standards.

3.2.3 Data input

The relationships between the relay settings and the model parameters can be found in the following table (the relay model parameter names are listed between brackets):

Address	Relay Setting	Model block	Model setting	Note
	I> 1 Function	I> 1	Out of Service (outserv)	outserv=1 when the relay setting is *Disabled*
		I> 1	Characteristic (pcharac)	Set the characteristic when emph-Function is not *Disabled*
	I> 1 Direction	I> 1	Tripping Direction (idir)	
	I> 1 Current Set	I> 1	Current setting (Ipset)	
	I> 1 Time Delay	I> 1	Time Dial (Tpset)	Used in the relay by the DT characteristic
	I> 1 TMS	I> 1	Time Dial (Tpset)	Used in the relay by the IEC characteristics
	I> 1 Time Dial	I> 1	Time Dial (Tpset)	Used in the relay by the IEEE/US characteristic
	I> 1 K (RI)	I> 1	Time Dial (Tpset)	Used in the relay by the RI characteristic
	I> 1 tRESET	I> 1	Reset Delay (ResetT)	Activate the reset feature with the ”Reset Characteristic” check box
	I> 2 Function	I> 2	Out of Service (outserv)	outserv=1 when the relay setting is *Disabled*
		I> 2	Characteristic (pcharac)	
	I> 2 Direction	I> 2	Tripping Direction (idir)	
	I> 2 Current Set	I> 2	Current setting (Ipset)	

Address	Relay Setting	Model block	Model setting	Note
	I> 2 Time Delay	I> 2	Time Dial (Tpset)	Used in the relay by the DT characteristic
	I> 2 TMS	I> 2	Time Dial (Tpset)	Used in the relay by the IEC characteristics
	I> 2 Time Dial	I> 2	Time Dial (Tpset)	Used in the relay by the IEEE/US characteristic
	I> 2 tRESET	I> 2	Reset Delay (ResetT)	Activate the reset feature with the ”Reset Characteristic” check box
	I> 3 Status	I> 3	Out of Service (outserv)	
	I> 3 Direction	I> 3	Tripping Direction (idir)	
	I> 3 Current Set	I> 3	Pickup Current (Ipset)	
	I> 3 Time Delay	I> 3	Time Setting (Tset)	
	I> 4 Status	I> 4	Out of Service (outserv)	
	I> 4 Direction	I> 4	Tripping Direction (idir)	
	I> 4 Current Set	I> 4	Pickup Current (Ipset)	
	I> 4 Time Delay	I> 4	Time Setting (Tset)	
	I> Char Angle	Phase directional angle	Max. Torque Angle (mtau)	in the *Voltage Polarizing* tab page
	V Dep OC Backup Function	V restraint	VrestraintedON VcontrolledON	In the ”Logic” tab page
	V Dep OC Char	V dep OC I>	Characteristic (pcharac)	
	V Dep OC I> Set	V dep OC I>	Current setting (Ipsetr)	
	V Dep OC T Dial	V dep OC I>	Time Dial (Tpset)	Used in the relay by the IEEE/US characteristic
	V Dep OC Reset	V dep OC I>	Reset Delay (ResetT)	Activate the reset feature with the ”Reset Characteristic” check box
	V Dep OC Delay	V dep OC I>	Time Dial (Tpset)	Used in the relay by the DT characteristic
	V Dep OC TMS	V dep OC I>	Time Dial (Tpset)	Used in the relay by the IEC characteristics
	V Dep OC K(RI)	V dep OC I>	Time Dial (Tpset)	Used in the relay by the RI characteristic
	V Dep OC tRESET	V dep OC I>	Reset Delay (ResetT)	Activate the reset feature with the ”Reset Characteristic” check box
	IN1> 1 Status	IN> 1	Out of Service (outserv)	
	IN1> 1 Function	IN> 1	Characteristic (pcharac)	
	IN1> 1 Current Set	IN> 1	Current setting (Ipset)	
	IN1>1 IDG Is	IN> 1	Current setting (Ipset)	Set Ipset = Is*IN>
	IN1> 1 Time Delay	IN> 1	Time Dial (Tpset)	Used in the relay by the DT characteristic
	IN1> 1 TMS	IN> 1	Time Dial (Tpset)	Used in the relay by the IEC characteristics
	IN1> 1 Time Dial	IN> 1	Time Dial (Tpset)	Used in the relay by the IEEE/US characteristic
	IN1> 1 K (RI)	IN> 1	Time Dial (Tpset)	Used in the relay by the RI curve
	IN1> 1 IDG Time	IN> 1	Min. Time (udeftimin)	Used in the relay by the IDG characteristic
	IN1> 1 tRESET	IN> 1	Reset Delay (ResetT)	Activate the reset feature with the ”Reset Characteristic” check box
	IN> 2 Status	IN> 2	Out of Service (outserv)	
	IN> 2 Current	IN> 2	Pickup Current (Ipset)	
	IN> 2 Time Delay	IN> 2	Time Setting (Tset)	Used in the relay by the DT characteristic
	SEF/REF Options	SEF directional angle	Out of Service (outserv)	outserv = 0 when *SEF* in the relay
		SEF wattmetric directional angle	Out of Service (outserv)	outserv = 0 when *Wattmetric* in the relay
		SEF directional angle	I, cos(phi) (icosphi)	icosphi = 1 when *SEF cos (PHI)* in the relay

Address	Relay Setting	Model block	Model setting	Note
	ISEF> 1 Function	ISEF> 1	Characteristic (pcharac)	
	ISEF> 1 Direction	ISEF> 1	Tripping Direction (idir)	
	ISEF> 1 Current	ISEF> 1	Current setting (Ipset)	
	ISEF> 1 Delay	ISEF> 1	Time Dial (Tpset)	
	ISEF> Char Angle	SEF directional angle	Max. Torque Angle (mtau)	in the *Voltage Polarizing* tab page
		SEF power directional angle	Max. Torque Angle (mtau)	in the *Voltage Polarizing* tab page
	ISEF> VNpol Input	VPol Measured or Derived	*MEASURED*, *DERIVED*	In the ”Logic” tab page
	ISEF> VN pol Set	SEF directional angle	Polarizing Voltage (upolur)	in the *Voltage Polarizing* tab page
		SEF power directional angle	Polarizing Voltage (upolur)	in the *Voltage Polarizing* tab page
	I2> 1 Status	I2> 1	Out of Service (outserv)	
	I2> 1 Direction	I2> 1	Tripping Direction (idir)	
	I2> 1 Current Set	I2> 1	Pickup Current (Ipset)	
	I2> 1 Time Delay	I2> 1	Time Setting (Tset)	
	I2> 2 Status	I2> 2	Out of Service (outserv)	
	I2> 2 Direction	I2> 2	Tripping Direction (idir)	
	I2> 2 Current Set	I2> 2	Pickup Current (Ipset)	
	I2> 2 Time Delay	I2> 2	Time Setting (Tset)	
	I2> 3 Status	I2> 3	Out of Service (outserv)	
	I2> 3 Direction	I2> 3	Tripping Direction (idir)	
	I2> 3 Current Set	I2> 3	Pickup Current (Ipset)	
	I2> 3 Time Delay	I2> 3	Time Setting (Tset)	
	I2> 4 Status	I2> 4	Out of Service (outserv)	
	I2> 4 Direction	I2> 4	Tripping Direction (idir)	
	I2> 4 Current Set	I2> 4	Pickup Current (Ipset)	
	I2> 4 Time Delay	I2> 4	Time Setting (Tset)	
	I2> V2pol Set	I2 directional angle	Polarizing Voltage (upolur)	in the *Voltage Polarizing* tab page
	I2> Char Angle	I2 directional angle	Max. Torque Angle (mtau)	in the *Voltage Polarizing* tab page
	IThermal	Thermal replica	Out of Service (outserv)	
	Thermal I>	Thermal replica	Current setting (Ipset)	
	T-heating	Thermal replica	Time Dial (Tpset)	
	T-cooling	Thermal replica	Reset Time (ResetT)	
	I2therm>2 Trip	I2Therm>>1	Out of Service (outserv)	
	I2therm>2 Set	I2Therm>>1	Current setting (Ipset)	
	I2therm>2 k	I2Therm>>1	Time Dial (Tpset)	
	I2therm>2 kRESET	I2Therm>>1	Reset Time (ResetT)	
	I2therm>2 tMAX	I2Therm>>1	Max. Time(udeftmax)	
	I2therm>2 tMIN	I2Therm>>1	Min. Time (udeftimin)	

3.3 Voltage(F27/59) subrelay

The *Voltage(F27/59)* subrelay simulates inverse characteristic/definite time neutral overvoltage elements, three phase over/undervoltage elements, and negative sequence definite time overvoltage elements.

3.3.1 Available Units

- Six inverse time neutral voltage displacements elements (”VN> 1”, ”VN> 2”, ”VN> 3”, ”VN> 4”, ”VN> 5”, and ”VN> 6” block).
- One inverse time phase overvoltage element (”V> 1”block).
- One definite time phase overvoltage element (”V> 2” block).
- One inverse time phase undervoltage element (”V< 1” block).
- One definite time phase undervoltage element (”V< 2” block).
- One definite time negative sequence overvoltage element (”V2> ” block).

3.3.2 Functionality

The inverse time elements can be configured to use an IDMT characteristic or a definite time characteristic.
The phase overvoltage (”V> 1” and ”V> 2” block) and undervoltage (”V< 1” and ”V< 2” block) elements are fed by the phase to neutral voltages. The ”VN> 1”, and the ”VN> 2” block monitor the zero sequence voltage calculated from the 3 phase to neutral voltages. The ”VN> 3”,”VN> 4”,”VN> 5”, and”VN> 6” block are fed by the voltage provided by the open delta transformer. Only the *any phase* undervoltage mode is modeled.

3.3.3 Data input

The relationships between the relay settings and the model parameters can be found in the following table (the relay model parameter names are listed between brackets):

Address	Relay Setting	Model block	Model setting	Note
	VN> y[1] Status	VN> y[1]	Out of Service (outserv)	
	VN> y[1] Function	VN> y[1]	Characteristic (pcharac)	
	VN> y[1] Voltage Set	VN> y[1]	Input Setting (Ipsetr)	
	VN> y[1] Time Delay	VN> y[1]	Time Dial (Tpset)	Active in the relay with the DT characteristic
	VN> y[1] TMS	VN> y[1]	Time Dial (Tpset)	Active in the relay with the inverse characteristic
	V< 1 Function	V< 1	Out of Service (outserv)	Set *outserv*=1 when relay setting is *Disabled*
		V< 1	Characteristic (pcharac)	
	V< 1 Voltage Set	V< 1	Input Setting (Ipsetr)	
	V< 1 Time Delay	V< 1	Time Dial (Tpset)	Active in the relay with the DT characteristic
	V< 1 TMS	V< 1	Time Dial (Tpset)	Active in the relay with the inverse characteristic

[1] y = 1,2,3,4,5,6

Address	Relay Setting	Model block	Model setting	Note
	V< 2 Status	V< 2	Out of Service (outserv)	
	V< 2 Voltage Set	V< 2	Pickup Voltage (Usetr)	
	V< 2 Time Delay	V< 2	Time Delay (Tdel)	
	V> 1 Function	V> 1	Out of Service (outserv)	Set *outserv*=1 when relay setting is *Disabled*
		V> 1	Characteristic (pcharac)	
	V> 1 Voltage Set	V> 1	Input Setting (Ipsetr)	
	V> 1 Time Delay	V> 1	Time Dial (Tpset)	Active in the relay with the DT characteristic
	V> 1 TMS	V> 1	Time Dial (Tpset)	Active in the relay with the inverse characteristic
	V> 2 Status	V> 2	Out of Service (outserv)	
	V> 2 Voltage Set	V> 2	Pickup Voltage (Usetr)	
	V> 2 Time Delay	V> 2	Time Delay (Tdel)	
	V2> Status	V2>	Out of Service (outserv)	
	V2> Voltage Set	V2>	Pickup Voltage (Usetr)	
	V2> Time Delay	V2>	Time Delay (Tdel)	

3.4 Frequency (F81) subrelay

The *Frequency (F81)* subrelay simulates the overfrequency , the underfrequency, and the overfluxing protective elements.

3.4.1 Available Units

- Four definite time under frequency elements (”F< 1”, ”F< 2”, ”F< 3”, and ”F< 4” block).
- Two definite time over frequency elements (”F> 1” and ”F> 2” block).
- Four definite/inverse time over flux elements (”V/Hz> 1”, ”V/Hz> 2”, ”V/Hz> 3”, and ”V/Hz> 4” block).
- One frequency calculation element (”Meas Freq” block).
- One flux calculation element (”V/Hz calculator” block).

3.4.2 Functionality

The frequency is calculated by the ”Meas Freq”block which uses by default the phase A-phase B voltage for its calculation (the parameter is user configurable). The calculated frequency value is then used by the overfrequency/underfrequency elements and by the ”V/Hz calculator” block to calculate the flux value.

3.4.3 Data input

The relationships between the relay settings and the model parameters can be found in the following table (the relay model parameter names are listed between brackets):

Address	Relay Setting	Model block	Model setting	Note
	F> z^2 Status	F> z^3	Out of Service (outserv)	
	F> z^3Setting	F> z^3	Frequency (Fset)	
	F> z^3Time Delay	F> z^3	Time Delay (Tdel)	
	F< x^2 Status	F< x^2	Out of Service (outserv)	
	F< x^2 Setting	F< x^2	Frequency (Fset)	
	F< x^2 Time Delay	F< x^2	Time Delay (Tdel)	
	V/Hz> x^3 Status	V/Hz> x^2	Out of Service (outserv)	
	V/Hz> x^2 Trip Func.	V/Hz> x^2	Characteristic (pcharac)	
	V/Hz> x^2 Trip Set	V/Hz> x^2	Input Setting (Ipsetr)	
	V/Hz> x^2 Trip TMS	V/Hz> x^2	Time Dial (Tpset)	Active in the relay with the DT characteristic
	V/Hz> x^2 Trip Delay	V/Hz> x^2	Time Dial (Tpset)	Active in the relay with the inverse characteristic

[2] z = 1,2
[3] x = 1,2,3,4

3.5 Power subrelay

The *Power* subrelay simulates the complete set of overpower, sensitive overpower, underpower, sensitive underpower, reverse power and sensitive reverse power elements which are available in the relay.

3.5.1 Available Units

- Two over power definite time elements (”P>1” and ”P>2” block).
- Two under power definite time elements (”P<1” and ”P<2” block).
- Two reverse power definite time elements (”-P>1” and ”-P>2” block).
- Two sensitive over power definite time elements (”Sen P>1” and ”Sen P>2” block).
- Two sensitive under power definite time elements (”Sens P<1” and ”Sens P<2” block).
- Two sensitive reverse power definite time elements (”Sens -P>1” and ”Sens -P>2” block).

3.5.2 Functionality

Two stages of power protection are present in the relay, these can be independently selected as either reverse power, over power, low forward power or disabled. Two additional stages of sensitive power protection are also available, they measure only A-phase active power,and can be independently selected as either reverse power, over power, low forward power or disabled.

In the relay model both the power elements and the sensitive power elements monitor the 3 phase power value; no compensation angle is available for the sensitive power elements. Separated blocks simulate the reverse power, the over power and the low forward power.
The forward active power and the reverse active power are calculated by the ”PQ calc” block which processes the 3 phase active and reactive power values calculated by the ”Power Calculator’ block.

3.5.3 Data input

The relationships between the relay settings and the model parameters can be found in the following table (the relay model parameter names are listed between brackets):

Address	Relay Setting	Model block	Model setting	Note
	Power1 Func	P>1	Out of Service (outserv)	outserv=1 when the relay setting is not *Over*
		P<1	Out of Service (outserv)	outserv=1 when the relay setting is not *Low Forward*
		-P>1	Out of Service (outserv)	outserv=1 when the relay setting is not *Reverse*
	-P>1 Setting	-P>1	Pickup Current (Ipset)	
	P<1 Setting	P<1	Pickup Current (Ipset)	
	P>1 Setting	P>1	Pickup Current (Ipset)	
	Power1 Delay	-P>1	Time Setting (Tset)	
		P<1	Time Setting (Tset)	
		P>1	Time Setting (Tset)	
	Power2 Func	P>2	Out of Service (outserv)	outserv=1 when the relay setting is not *Over*

Address	Relay Setting	Model block	Model setting	Note
		P<2	Out of Service (outserv)	outserv=1 when the relay setting is not *Low Forward*
		-P>2	Out of Service (outserv)	outserv=1 when the relay setting is not *Reverse*
	-P>2 Setting	-P>2	Pickup Current (Ipset)	
	P<2 Setting	P<2	Pickup Current (Ipset)	
	P>2 Setting	P>2	Pickup Current (Ipset)	
	Power2 Delay	-P>2	Time Setting (Tset)	
		P<2	Time Setting (Tset)	
		P>2	Time Setting (Tset)	
	Sen Power1 Func	Sen P>1	Out of Service (outserv)	outserv=1 when the relay setting is not *Over*
		Sens P<1	Out of Service (outserv)	outserv=1 when the relay setting is not *Low Forward*
		Sens -P>1	Out of Service (outserv)	outserv=1 when the relay setting is not *Reverse*
	Sen -P>1 Setting	Sens -P>1	Pickup Current (Ipset)	
	Sen P<1 Setting	Sens P<1	Pickup Current (Ipset)	
	Sen P>1 Setting	Sen P>1	Pickup Current (Ipset)	
	Sen Power1 Delay	Sens -P>1	Time Setting (Tset)	
		Sens P<1	Time Setting (Tset)	
		Sen P>1	Time Setting (Tset)	
	Sen Power2 Func	Sen P>2	Out of Service (outserv)	outserv=1 when the relay setting is not *Over*
		Sens P<2	Out of Service (outserv)	outserv=1 when the relay setting is not *Low Forward*
		Sens -P>2	Out of Service (outserv)	outserv=1 when the relay setting is not *Reverse*
	Sen -P>2 Setting	Sens -P>2	Pickup Current (Ipset)	
	Sen P<2 Setting	Sens P<2	Pickup Current (Ipset)	
	Sen P>2 Setting	Sen P>2	Pickup Current (Ipset)	
	Sen Power2 Delay	Sens -P>2	Time Setting (Tset)	
		Sens P<2	Time Setting (Tset)	
		Sen P>2	Time Setting (Tset)	

3.6 Differential and REF subrelay

The *Differential and REF subrelay* subrelay contains two restricted earth fault elements and one 3 phase differential element.

3.6.1 Available Units

- Two restricted earth fault elements (”Low impedance REF” and ”High impedance REF” block).
- Two restricted earth fault ancillary measurement element (”Diff Low Impedance RMS Measure” and ”Diff High Impedance RMS Measure” block).
- One 3 phase differential element (”Differential” block).
- One differential ancillary 3 phase measurement element (”Diff RMS Measure” block).

3.6.2 Functionality

The *Differential* subrelay implements a segregated 3 phase differential element with double slope bias restraint characteristic. The low impedance restricted earth fault (”Low impedance REF” block) element simulates a single input differential element with double slope bias restraint characteristic, the high impedance restricted earth fault (”High impedance REF” block) element models a single input differential element without any restraint.

3.6.3 Data input

The relationships between the relay settings and the model parameters can be found in the following table (the relay model parameter names are listed between brackets):

Address	Relay Setting	Model block	Model setting	Note
	GenDiff Function	Differential	Out of Service (outserv)	*Disabled* (outserv=1)and *Biased*(outserv=0) relay settings
	Gen Diff Is1	Differential	Differential Current base threshold (Idiff)	
	Gen Diff k1	Differential	Restrain Percentage 1 (Irestrpercent1)	
	Gen Diff Is2	Differential	Restraint Current 2nd threshold (Ipset2)	
	Gen Diff k2	Differential	Restrain Percentage 2 (Irestrpercent2)	
	RESTRICTED E/F IREF>k1	Low impedance REF	Restrain Percentage 1 (Irestrpercent1)	
	RESTRICTED E/F IREF>k2	Low impedance REF	Restrain Percentage 2 (Irestrpercent2)	
	RESTRICTED E/F IREF>Is1	Low impedance REF	Differential Current base threshold (Idiff)	
	RESTRICTED E/F IREF>Is2	Low impedance REF	Restraint Current 2nd threshold (Ipset2)	
	RESTRICTED E/F IREF> Is	Low impedance REF	Release Threshold (Idiff)	

3.7 Impedance subrelay

The *Impedance subrelay* subrelay simulate a set of polarizing elements, blinders and mho distance elements connected together to model the Areva P34x relay loss of field, underimpedance and pole slip functionalities.

3.7.1 Available Units

- Two under impedance elements (”Z< 1” and ”Z< 2” block).
- Two under impedance timers (”Z< 1TD”, ”Z< 2TD” block).
- Two loss of field elements (”Ffail1” and ”Ffail2” block).
- Two loss of field timers (”Ffail1TD” and ”Ffail2TD” block).
- One power swing detection element (”Pslip”, ”Pslip logic ”, ”PSlip Timer T1”, ”PSlip Timer T2”, ”Pslip lens”, ”Pslip blinder”, ”Pslip reactance line” block).
- Two polarizing elements (”Polarizing distance backup” and ”Polarizing field failure/pslip”block).

3.7.2 Functionality

Underimpedance elements The *Underimpedance elements* are modeled by two PowerFactory impedance elements which simulate two circles with center in the axis origin in the R-X diagram. The elements are fed by the ”Polarizing distance backup” element which calculates the phase-ground loop operating voltages and currents used to calculate the impedance value. A separate timer is associated to each impedance element.

Loss of field elements The *Loss of field elements* are modeled by two PowerFactory mho elements which simulate two offset mho with offset set along the negative part of the X axis in the R-X diagram. The elements are fed by the ”Polarizing field failure/pslip” block which calculates the single phase operating current and voltage and the polarizing voltage used by the mho vectorial calculation. A separate timer is associated to each mho element.

Power swing detection elements The power swing detection area is modeled by one PowerFactory mho element and by two impedance blinders. The elements are fed by the ”Polarizing field failurepslip” block which calculates the single phase operating current and voltage and the polarizing voltage used by the mho vectorial calculation. The trip signals of the mho element and of the impedance blinders are combined by the ”Pslip logic” element which calculates the trip signal of *Zone 1* and of *Zone 2*. The ”PSlip Timer T1” and the ”PSlip Timer T2” timer add the delay setting associated to each zone. The delayed zone trip signals are them processed by the ”Pslip” which implements the power swing detection logic. The output signal is on when a power swing has been detected. The *Generating* and the *Motoring* mode is supported.

3.7.3 Data input

The relationships between the relay settings and the model parameters can be found in the following tables (the relay model parameter names are listed between brackets):

Address	Relay Setting	Model block	Model setting	Note
	Z< Stage 1	Z< 1	Out of Service (outserv)	
	Z< 1 Setting	Z< 1	Replica Impedance(ZmIn)	
	Z< 1 Time Delay	Z< 1TD	Time Setting (Tdelay)	
	Z< Stage 2	Z< 2	Out of Service (outserv)	
	Z< 2 Setting	Z< 2	Replica Impedance(ZmIn)	
	Z< 2 Time Delay	Z< 2TD	Time Setting (Tdelay)	
	FFail1 Status	Ffail1	Out of Service (outserv)	
	FFail1 -Xa1	Ffail1	Offset Impedance (Zoff)	
	FFail1 Xb1	Ffail1	Replica Impedance (ZmIn)	
	FFail1 TimeDelay	Ffail1TD	Time Setting (Tdelay)	
	FFail2 Status	Ffail2	Out of Service (outserv)	
	FFail2 -Xa2	Ffail2	Offset Impedance (Zoff)	
	FFail2 Xb2	Ffail2	Replica Impedance (ZmIn)	
	FFail2 TimeDelay	Ffail2TD	Time Setting (Tdelay)	
	Pslip Function	Pslip	Out of Service (outserv)	
	Pole Slip Mode	Pslip logic	*Generating*, *Motoring*	To define if equal to 1 or to 0 in the ”Logic” tab page
	Pslip Za Forward	Pslip lens	Replica Impedance(Zm)	
	Pslip Zb Reverse	Pslip lens	Offset Impedance (Zoff)	
	Lens Angle	Pslip lens	Character. Angle (alpha)	
	PSlip Timer T1	PSlip Timer T1	Time Setting (Tdelay)	
	PSlip Timer T2	PSlip Timer T2	Time Setting (Tdelay)	
	Blinder Angle	Pslip lens	Relay Angle (phi)	
		Pslip lens	Offset Angle (offang)	
		Pslip blinder	Relay Angle (phi)	
		Pslip reactance line	Relay Angle (phi)	

Please note the following rules:

- The ”offset angle” parameter of the ”Pslip lens” block must be set equal to ”relay angle” -180°.
- The ”pole slip mode” can be set in the ”Logic” tab page of the ”Pslip logic” block setting the ”Generating” and the ”Motoring” variable.

3.8 Output logic

The output logic is the interface between the relay and the power system.

3.8.1 Available Units and Signals

The trip logic is implemented by the ”Logic” following blocks located in the main relay.

The relay output signals are:

- *OUT1*
- *OUT2*
- *OUT3*
- *OUT4*
- *OUT5*
- *OUT6*
- *OUT7*
- *OUT8*
- *OUT9*
- *OUT10*
- *OUT11*

3.8.2 Functionality

The ”Logic” block operates the power breaker when a trip command has been issued by any protective element. The trip Logic can be configured in the ”Logic” tab page. As default configuration all relay output signals trips with the same logic. A three phases trip logic is implemented.

3.8.3 Data input

Please disable the ”Logic” block in the main relay to disable the relay model ability to open the power circuit.

4 Features not supported

The following features are not supported:

- Single phase trip.
- Check synchronization functions.
- Circuit breaker failure protection.
- 100% stator earth fault protection (3rd harmonic method) (27TN/59TN).
- 100% stator earth fault protection (low frequency injection method) (64S).
- Thermal element alarm thresholds.
- Dead machine.

5 References

[1] Areva T&D, Automation & Information Systems Business, Tour AREVA 1, place Jean Millier 92084 Paris - La Défense, 92084 France. *MiCOM P342, P343,P344, P345 Generator Protection Relays Software Version 0320 Hardware Suffix J (P342/3/4) Hardware Suffix K (P345) Technical Manual P34x/EN M/H65*, 2007.