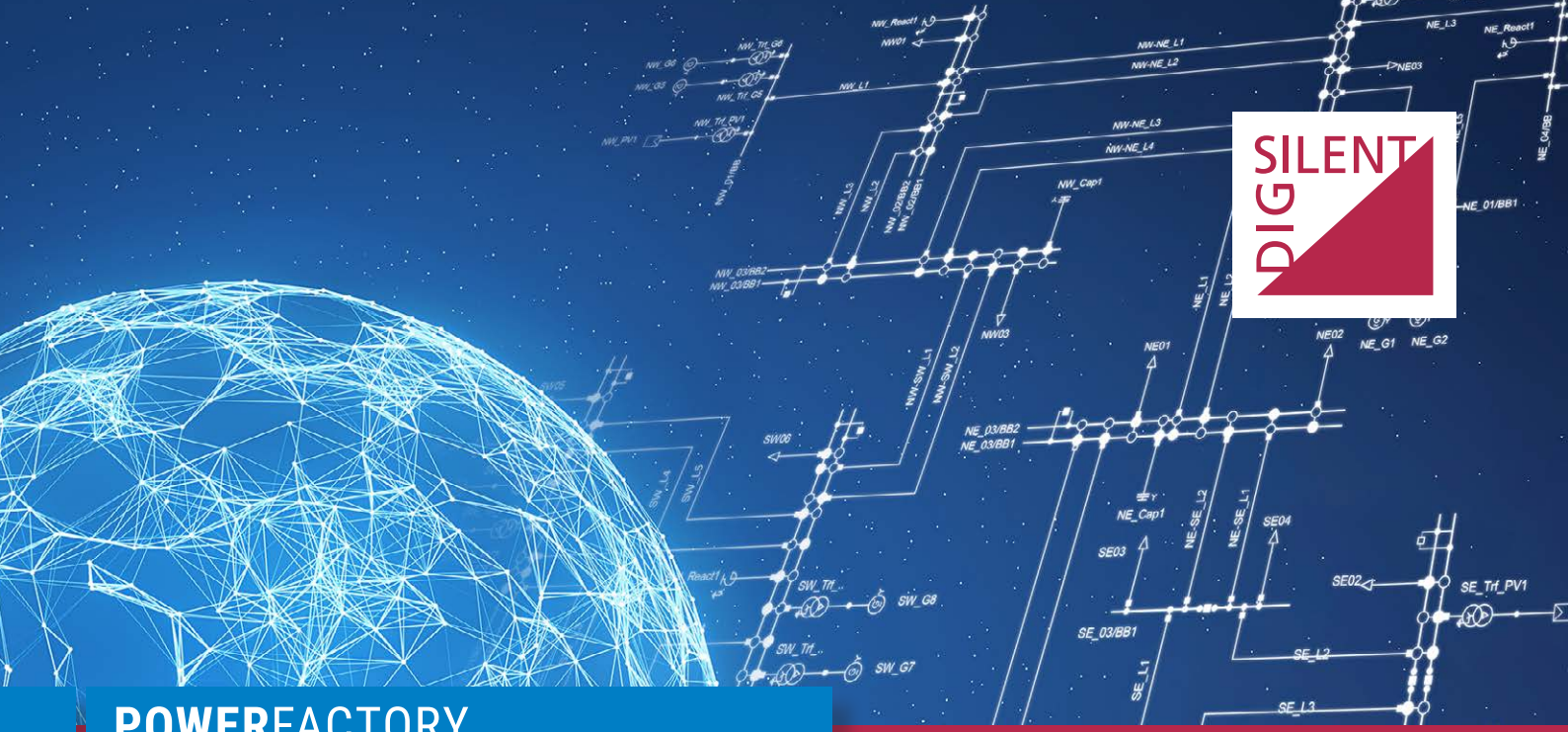

POWERFACTORY

PowerFactory 2021

Technical Reference

GE UR G30

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

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Contents

1 Model information

Manufacturer GE

Model UR G30

Variants The GE UR G30 PowerFactory relay model can be used to model the different firmware versions of the GE UR G30 relay up to revision 5.9.

2 General description

The GE UR G30 is a generator protection relay with additional differential, frequency, over flux, voltage and overcurrent protective elements. The GE UR G30 PowerFactory relay model has been implemented trying to simulate the protective functions more commonly used.

The GE UR G30 PowerFactory relay model consists of a main relay model and the following sub relays:

- Overcurrent(F50-F51-F46)
- Voltage(F27-F59)
- Frequency(F81)
- Differential(F87)
- Loss of excitation(F40)

The main relay 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 voltage and the current are measured by four current transformers (”Ct”, ”Mutual Ct”, ”Neutral Ct1” and ”Neutral Ct2” blocks) and one voltage transformer (”Vt” block). Two additional current transformers are used by the differential element: the ”Remote Ct1” and the ”Remote Ct2” block represent the CTs located at the other line terminals.

Nine measurement units (”Measurement”, ”Meas delta” , ”Measurement Seq”, ”Meas Neutral1 I”, ”Meas Neutral2 I” , ”Meas Mutual”, ”Measurement(remote 1)”, ”Measurement Seq Remote 1” and ”Measurement(remote 2)” block) are fed by these CTs and the VT.

3.1.1 Available Units

- Ct
- Mutual Ct
- Neutral Ct1
- Neutral Ct2
- Vt
- Remote Ct1
- Remote Ct2
- Measurement
- Meas delta
- Measurement Seq
- Meas Neutral1 I
- Meas Neutral2 I
- Meas Mutual
- Measurement(remote 1)
- Measurement Seq Remote 1
- Measurement(remote 2)

3.1.2 Functionality

The input signals are sampled at 16 samples/cycle; a DFT filter operating over a cycle calculates then 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 all the measurement units.

3.2 Overcurrent(F50-F51-F46) subrelay

3.2.1 Available Units

- One 3 phase inverse time directional overcurrent elements with voltage restraint (”Phase Toc 1” block, the relevant restraint blocks is ”V restraint Toc 1”)
- Two 3 phase definite time directional overcurrent elements (”Phase Ioc 1” and ”Phase Ioc 2” block)
- One 3phase directional elements (”DirPhase 1” block) which can be used to control the phase overcurrent blocks.
- Four neutral definite time directional overcurrent elements (”DirNeutral 1 Fwd” and ”DirNeutral 1 rev” are modelling the first neutral directional element, ”DirNeutral 2 Fwd” and ”DirNeutral 2 rev” are modelling the second neutral directional element)
- One neutral inverse time overcurrent elements (”Neutral Toc 1” block)
- Two neutral definite time elements (”Neutral Ioc 1” and ”Neutral Ioc 2” block).
- One ground inverse time overcurrent elements (”Ground Toc 1” block)
- One ground definite time overcurrent elements (”Ground Ioc 1” block)
- Four negative sequence directional elements (”DirNegSeq Fwd 1” and ”DirNegSeq 1 Rev” are modelling the first neutral directional element, ”DirNegSeq 2 Fwd” and ”DirNegSeq 2 Rev” are modelling the second neutral directional element).
- One negative sequence inverse time overcurrent elements (”Negative sequence Toc 1” block)
- Two negative sequence definite time overcurrent elements (”Negative sequence Ioc 1” and ”Negative sequence Ioc 2” block).
- Two generator unbalance elements (”Gen Unbal STG1” and ”Gen Unbal STG2” block). Please notice that the generator unbalance nominal current (”Gen Unbal Inom”) must be inserted in the ”Gen Umbal Inom” block (in the ”Logic” tab page)
- Two thermal image elements (”Thermal protection 1” and ”Thermal protection 2” block)
- One output block opening the associated breaker (”Output logic” block)

3.2.2 Functionality

The model contains all the overcurrent protective elements available in the relay but the input values are always phasors calculated by the measurement DFT filter. In the relay each directional element contains the settings for both the forward and the reverse direction trip: in the model it’s simulated using two directional blocks (i.e. the relay ”Neutral overcurrent directional OC1” is represented in the model by the ”DirNeutral 1 Fwd” and the ”DirNeutral 1 Rev” block). Each Ioc and Toc block can be set with a user configurable resetting time.

The inverse time overcurrent elements support the following trip characteristics:

- ”Definite time”
- ”IEEE Extremely Inverse”
- ”IEEE Very Inverse”

- ”IEEE Moderately Inverse”
- ”IEC Curve A”
- ”IEC Curve B”
- ”IEC Curve C”
- ”IEC short inverse”
- ”IAC Extremely Inverse”
- ”IAC Short Inverse”
- ”IAC Very Inverse”
- ”IAC Inverse”
- ”I2t”
- ”Recloser Curve” (31 curves)

The neutral and negative sequence directional elements can be set with a user configurable positive sequence current restraint. The negative sequence directional elements don’t support the ability to set the zero sequence current as operating current. The phase inverse elements can be used with a voltage restraint feature. The voltage restraint feature can be activated in the ”Logic” tab page of the ”V restraint Toc1” and of the ”V restraint Toc2” block. Set equal to one the ”VrestraintON” variable to enable the feature.

3.2.3 Data input

The relationships between the relay settings and the model parameters can be found in the following table:

Address	Relay Setting	Model block	Model setting	Note
	PHASE TOC1 FUNCTION	Phase Toc 1	Out of Service	
	PHASE TOC1 PIKCUP	Phase Toc 1	Current Setting	
	PHASE TOC1 CURVE	Phase Toc 1	Characteristic	
	PHASE TOC1 TD MULTIPLIER	Phase Toc 1	Time Dial	
	PHASE TOC1 RESET	Phase Toc 1	Reset Delay	
	PHASE TOC1 VOLTAGE RESTRAINT	V restraint 1	VrestraintON	To disable the voltage restraint set VrestraintON = 0 in the ”Logic” tab page
	PHASE TOC1 BLOCK A, BLOCK B, BLOCK C	Phase Toc 1	Tripping direction	Set ”None” if the block signals are not controlled by the directional element
	PHASE IOCx FUNCTION	Phase Ioc x[A]	Out of Service	
	PHASE IOCx<A PICKUP	Phase Ioc x[A]	Current Setting	
	PHASE IOCx<A PICKUP DELAY	Phase Ioc x[A]	Time Dial	
	PHASE IOC<A RESET DELAY	Phase Ioc x[A]	Reset Delay	
	PHASE IOC<A BLOCK A, BLOCK B, BLOCK C	Phase Ioc x[A]	Tripping direction	Set ”None” if the block signals are not controlled by the directional element
	PHASE DIR 1 FUNCTION	DirPhase 1	Out of Service	
	PHASE DIR 1 ECA	DirPhase 1	Max Torque Angle	”Voltage Polarizing” tab page

Address	Relay Setting	Model block	Model setting	Note
	PHASE DIR 1 POLV1 THRESHOLD	DirPhase 1	Polarizing voltage	”Voltage Polarizing” tab page
	NEUTRAL TOC1 FUNCTION	Neutral Toc 1	Out of Service	
	NEUTRAL TOC1 PIKCUP	Neutral Toc 1	Current Setting	
	NEUTRAL TOC1 CURVE	Neutral Toc 1	Characteristic	
	NEUTRAL TOC1 TD MULTIPLIER	Neutral Toc 1	Time Dial	
	NEUTRAL TOC1 RESET	Neutral Toc 1	Reset Delay	
	NEUTRAL IOC x^A FUNCTION	Neutral Ioc x^A	Out of Service	
	NEUTRAL IOCx^A PICKUP	Neutral Ioc x^A	Current Setting	
	NEUTRAL IOCx^A PICKUP DELAY	Neutral Ioc x^A	Time Dial	
	NEUTRAL IOCx^A RESET DELAY	Neutral Ioc x^A	Reset Delay	
	NEUTRAL DIR OCx^A FUNCTION	DirNeutral x^A Fwd	Out of Service	
	NEUTRAL DIR OCx^A POS SEQ RESTRAINT	DirNeutral x^A K In	K	In the ”Logic” tab page
	NEUTRAL DIR OCx^A FWD ECA	DirNeutral x^A Fwd	Max. Torque Angle	In the ”Voltage polarizing” tab page
		DirNeutral x^A Rev		
	NEUTRAL DIR OCx^A FWD LIMIT ANGLE	DirNeutral x^A Fwd	Angle Operating Sector	
	NEUTRAL DIR OCx^A FWD PICKUP	DirNeutral x^A Fwd	Operating Current	In the ”Voltage polarizing” tab page
	NEG SEQ DIR OCx^A REV LIMIT ANGLE	DirNeutral x^A Rev	Angle Operating Sector	
	NEUTRAL DIR OCx^A REV PICKUP	DirNegSeq x^A Rev	Operating Current	
	GROUND TOC1 FUNCTION	Ground Toc 1	Out of Service	
	GROUND TOC1 PIKCUP	Ground Toc 1	Current Setting	
	GROUND TOC1 CURVE	Ground Toc 1	Characteristic	
	GROUND TOC1 TD MULTIPLIER	Ground Toc 1	Time Dial	
	GROUND TOC1 RESET	Ground Toc 1	Reset Delay	
	GROUND IOC1 FUNCTION	Ground Ioc1	Out of Service	
	GROUND IOC1 PICKUP	Ground Ioc1	Current Setting	
	GROUND IOC1 PICKUP DELAY	Ground Ioc1	Time Dial	
	GROUND IOC1 RESET DELAY	Ground Ioc1	Reset Delay	
	NEG SEQ DIR OCx^A FUNCTION	DirNegSeq Fwd x^A	Out of Service	
	NEG SEQ DIR OCx^A OFFSET	DirNegSeq x^A Offset	ZOFFSET	In the ”Logic” tab page
	NEG SEQ DIR OCx^A POS SEQ RESTRAINT	DirNegSeq x^A K I2	K	In the ”Logic” tab page
	NEG SEQ DIR OCx^A FWD ECA	DirNegSeq Fwd x^A	Max. Torque Angle	In the ”Voltage polarizing” tab page
		DirNegSeq Rev x^A		
	NEG SEQ DIR OCx^A FWD LIMIT ANGLE	DirNegSeq Fwd x^A	Angle Operating Sector	
	NEG SEQ DIR OCx^A FWD PICKUP	DirNegSeq Fwd x^A	Operating Current	In the ”Voltage polarizing” tab page
	NEG SEQ DIR OCx^A REV LIMIT ANGLE	DirNegSeq Rev x^A	Angle Operating Sector	

Address	Relay Setting	Model block	Model setting	Note
	NEG SEQ DIR OCx^A REV PICKUP	DirNegSeq Rev x^A	Operating Current	
	GENERATOR UNBAL FUNCTION	Gen Unbal STG1	Out of Service	
	GENERATOR UNBAL INOM	Gen Umbal Inom	GenUnbalInom	In the ”Logic” tab page
	GENERATOR UNBAL STG1 PICKUP	Gen Unbal STG1	Current Setting	
	GENERATOR UNBAL STG1 K VALUE	Gen Unbal STG1	Time Dial	
	GENERATOR UNBAL STG1 TMIN	Gen Unbal STG1	Min. Time	
	GENERATOR UNBAL STG1 TMAX	Gen Unbal STG1	Max. Time	
	GENERATOR UNBAL STG1 K RESET	Gen Unbal STG1	Reset Delay	
	GENERATOR UNBAL STG2 PICKUP	Gen Unbal STG2	Pickup Current	
	GENERATOR UNBAL STG2 DELAY	Gen Unbal STG2	Time Setting	
	THERMAL OVERLOAD PROTECTION BAS E CURRENT	Thermal protection x^A	Base Current	Base Curr In the ”Logic” tab page
	THERMAL OVERLOAD PROTECTION OVERLOAD FACTOR	Thermal protection x^A	Current Setting	
	THERMAL OVERLOAD PROTECTION TRIP TIME CONSTANT	Thermal protection x^A	Time Dial	
	THERMAL OVERLOAD PROTECTION RESET TIME CONSTANT	Thermal protection x^A	Reset Delay	

x^A = element number[1]

[1] x^A= 1,2

3.3 Voltage(F27-F59) subrelay

3.3.1 Available Units

- Three 3phase time inverse characteristic undervoltage elements (”Phase undervoltage 1”, ”Phase undervoltage 2” and ”Phase undervoltage 3”, ”Phase undervoltage 1 Mode”, ”Phase undervoltage 2 Mode”, ”Phase undervoltage 3 Mode”, ”Phase undervoltage 1 Minimum Voltage”, ”Phase undervoltage 2 Minimum Voltage” and ”Phase undervoltage 3 Minimum Voltage” block)
- One three phase time defined characteristic overvoltage element with delayed reset (”Phase overvoltage” and ”Phase overvoltage reset delay” block)
- Three zero sequence time inverse characteristic overvoltage elements with delayed reset(”Neutral overvoltage 1”, ”Neutral overvoltage 1 reset delay”, ”Neutral overvoltage 2”, Neutral overvoltage 2 reset delay”, ”Neutral overvoltage 3” and ”Neutral overvoltage 3 reset delay” block)
- Three negative sequence time defined characteristic overvoltage elements with delayed reset(”Negative Sequence overvoltage 1”, ”Negative Sequence overvoltage 1 reset delay”, ”Negative Sequence overvoltage 2”, ”Negative Sequence overvoltage 2 reset delay”, ”Negative Sequence overvoltage 3” and ”Negative Sequence overvoltage 3 reset delay” block)
- Two inverse characteristic overflux elements with delayed reset (”Volt/Hertz 1”, ”Volt/Hertz 1 T-Reset”, ”Volt/Hertz 2” and ”Volt/Hertz 2 T-Reset” block)
- One output block opening the associated breaker (”Output logic” block)

3.3.2 Functionality

All the over/undervoltage elements available in the relay except the auxiliary over/undervoltage elements have been implemented in the model. The phase undervoltage elements are supporting the following trip characteristics:

- Inverse
- Definite

The neutral overvoltage elements are supporting the following trip characteristics:

- Definite
- FlexCurve A
- FlexCurve B
- FlexCurve C

The overflux elements are supporting the following trip characteristics:

- Definite time
- Inverse curve A
- Inverse curve B

- Inverse curve C
- FlexCurve A
- FlexCurve B
- FlexCurve C
- FlexCurve D

Each undervoltage element can be set to use the phase-phase voltages or the phase-ground voltages; a minimum activation threshold is available as well.

Each overvoltage element can set with a user definable reset time.

3.3.3 Data input

The relationships between the relay settings and the model parameters can be found in the following table:

Address	Relay Setting	Model block	Model setting	Note
	PHASE UV1 FUNCTION	Phase undervoltage 1	Out of Service	
	PHASE UV1 MODE	Phase undervoltage 1 Mode	MODE	It must defined inside the ”Logic” tab page: write ”MODE=PHASEPHASE” to use the phase-phase voltage signals or ”MODE=PHASEGROUND” to use the phase-ground voltage signals
	PHASE UV1 PICKUP	Phase undervoltage 1	Input Setting	
	PHASE UV1 CURVE	Phase undervoltage 1	Characteristic	
	PHASE UV1 DELAY	Phase undervoltage 1	Time dial	
	PHASE UV1 MINIMUM VOLTAGE	Phase undervoltage 1 Minimum Voltage	Pickup Voltage	
	PHASE OV1 FUNCTION	Phase overvoltage	Out of Service	
	PHASE OV1 PICKUP	Phase overvoltage	Input Setting	
	PHASE OV1 PICKUP DELAY	Phase overvoltage	Time dial	
	PHASE OV1 RESET DELAY	Phase overvoltage reset delay	Time Setting	
	NEUTRAL OV1 FUNCTION	Neutral Overvoltage 1	Out of Service	
	NEUTRAL OV1 PICKUP	Neutral Overvoltage 1	Input Setting	
	NEUTRAL OV1 CURVE	Neutral Overvoltage 1	Characteristic	
	NEUTRAL OV1 PICKUP DELAY	Neutral Overvoltage 1	Time dial	
	NEUTRAL OV1 RESET DELAY	Neutral Overvoltage 1 reset delay	Time Setting	
	NEG SEQ OV1 FUNCTION	Negative Sequence Overvoltage 1	Out of Service	

Address	Relay Setting	Model block	Model setting	Note
	NEG SEQ OV1 PICKUP	Negative Sequence Overvoltage 1	Input Setting	
	NEG SEQ OV1 PICKUP DELAY	Negative Sequence Overvoltage 1	Time dial	
	NEG SEQ OV1 RESET DELAY	Negative Sequence Overvoltage 1 reset delay	Time Setting	
	VOLT/HZ 1 FUNCTION	Volt/Hertz 1	Out of Service	
	VOLT/HZ 1 PICKUP	Volt/Hertz 1	Input Setting	
	VOLT/HZ 1 CURVE	Volt/Hertz 1	Characteristic	
	VOLT/HZ 1 TD MULTIPLIER	Volt/Hertz 1	Time Dial	
	VOLT/HZ 1 T-RESET	Volt/Hertz 1 T-Reset	Time Setting	

3.4 Frequency(F81) subrelay

3.4.1 Available Units

- Six under frequency elements. Each element consists of the following blocks:
  - An under voltage limit block (”UnderFreq x MinVolt”)
  - An under current limit block (”UnderFreq x5 MinAmp”)
  - An under frequency block (”UnderFreq x5”)
  - A block implementing a delayed reset (”UnderFreq x5 reset delay”)
  - A calculation and a measurement block (”UFx5 Meas switch” and ”Meas Freq UFx5”)
- Four over frequency elements. Each element consists of the following blocks:
  - An over frequency block (”OverFreq x5”)
  - A block implementing a delayed reset (”OverFreq x5 reset delay”)
- Four Frequency rate of change elements. Each element consists of the following blocks:
  - An under voltage limit block (”Freq Rate x5 Ov Supv”)
  - An under current limit block (”Freq Rate x5 Oc Supv”)
  - A under frequency limit block (”Freq Rate x5 Min Frequency”)
  - A over frequency limit block (”Freq Rate x5 Max Frequency”)
  - A frequency rate of change element (”Freq Rate x5”)
  - A block implementing a delayed reset (”Freq Rate x5 reset delay”)
  - A logic block (”Freq Rate x5 Logic”)

3.4.2 Functionality

Under frequency elements The under frequency elements are using by default the voltage signals to measure the frequency. When the voltage is smaller than the voltage threshold inserted in the ”UnderFreq x5 MinVolt” block the current signals are used to measure the frequency. If also the current is smaller than the threshold inserted in the ”UnderFreq x5 MinAmp” block the element is blocked. Each element has a frequency threshold and a trip delay and can be set with a user configurable reset delay (”UnderFreq x5 reset delay” block).

Over frequency elements Each element has a frequency threshold and a trip delay and can be set with a user configurable reset delay (”OverFreq x5 reset delay” block).

Frequency rate of change elements The frequency rate of change elements are controlled by an under frequency threshold and an over frequency threshold, by a minimum voltage threshold and by a minimum current threshold. Each element has a frequency rate of change threshold and a trip delay and can be set with a user configurable reset delay (”Freq Rate x5 reset delay” block).

3.4.3 Data input

Under frequency elements The relationships between the relay settings and the model parameters can be found in the following table:

Address	Relay Setting	Model block	Model setting	Note
	UNDERFREQ 1 FUNCTION	UnderFreq 1	Out of Service	
	UNDERFREQ 1 MIN VOLT/AMP	UnderFreq 1 MinVolt	Pickup Voltage	The relay settings must be
		UnderFreq 1 MinAmp	Pickup Current	transferred in both model blocks
	UNDERFREQ 1 PICKUP	UnderFreq 1	Frequency	A value smaller than the system rated frequency must be set
	UNDERFREQ 1 DELAY	UnderFreq 1	Time Delay	
	UNDERFREQ 1 RESET DELAY	UnderFreq 1 reset delay	Time Setting	

No user input is required for the ”UnderFreq 1 Meas switch” and the ”Meas Freq UnderFreq 1” block.

Over frequency elements The relationships between the relay settings and the model parameters can be found in the following table:

Address	Relay Setting	Model block	Model setting	Note
	OVERFREQ 1 FUNCTION	OverFreq 1	Out of Service	
	OVERFREQ 1 PICKUP	OverFreq 1	Frequency	
	OVERFREQ 1 PICKUP DELAY	OverFreq 1	Time Delay	
	OVERFREQ 1 RESET DELAY	OverFreq 1 reset delay	Time Setting	

No user input is required for the ”Meas Freq OverFreq” block.

Frequency rate of change elements The relationships between the relay settings and the model parameters can be found in the following table:

Address	Relay Setting	Model block	Model setting	Note
	FREQ RATE 1 FUNCTION	Freq Rate 1	Out of Service	
	FREQ RATE 1 PICKUP	Freq Rate 1	Gradient df/dt	
	FREQ RATE 1 OV SUPV	Freq Rate 1	Ov Supv Pickup Voltage	
	FREQ RATE 1 OC SUPV	Freq Rate 1	Oc Supv Pickup Current	
	FREQ RATE 1 MIN FREQUENCY	Freq Rate 1	Min Frequency Frequency	
	FREQ RATE 1 MAX FREQUENCY	Freq Rate 1	Max Frequency Frequency	
	FREQ RATE 1 PICKUP DELAY	Freq Rate 1	Time Delay	
	FREQ RATE 1 RESET DELAY	Freq Rate 1	Time Setting	

No user input is required for the ”Meas Freq OverFreq” block.

3.5 Differential(F87) subrelay

3.5.1 Available Units

- One differential element (”Differential” block)
- Three current adapters for the differential element (”Winding 1 Adapter”, ”Winding 2 Adapter” and ”Winding 3 Adapter” block)
- Four restricted earth fault differential blocks (”REF1”, ”REF2”, ”REF3” and ”REF4” block)
- Four current adapters for the restricted earth fault differential element (”Winding Neutral 1 Adapter”, ”Winding Neutral 2 Adapter”, ”Winding Neutral 3 Adapter” and ”Winding Neutral 4 Adapter” block)
- Nine internal measurement element (”Diff RMS meas” block fro the differential element, ”REF1 RMS meas”, ”REF1 restr RMS meas”, ”REF2 RMS meas”, ”REF2 restr RMS meas”, ”REF3 RMS meas”, ”REF3 restr RMS meas”, ”REF4 RMS meas” and ”REF4 restr RMS meas” for the restricted earth fault differential elements)
- Four delayed reset elements for the restricted earth fault elements (”REF1 reset delay”, ”REF2 reset delay”, ”REF3 reset delay” and ”REF4 reset delay” block)
- Four logic block which allow inserting the restricted earth fault slope value (”REF1 restrain slope”, ”REF2 restrain slope”, ”REF3 restrain slope” and ”REF4 restrain slope” block)
- Some additional calculation blocks used by the restricted earth fault elements (”REF1calc”, ”REF2calc”, ”REF3calc”, ”REF4calc” block calculating the restricted earth fault differential current and I1 component of the restrain current; ”REF1 RestrainCalc”, ”REF2 RestrainCalc”, ”REF3 RestrainCalc” and ”REF4 RestrainCalc” block calculating the restrain current)

3.5.2 Functionality

3 Phase differential The 3 phase differential feature is implemented by the ”Differential” block; the block supports up to three 3phase current inputs, two current biased restraint slopes. Before being processed by the differential element the currents are recalculated, taking care of the different CT ratios, by the current adapters. The internal measurement element is calculating the RMS value of the differential current vectors returned by the differential element. The 3p phase differential element is fed by the ”Ct”, ”Remote Ct1” and ”Remote Ct2” current transformer.

Restricted earth fault differential Four restricted earth fault elements are available. The restraint logic supported by the model is affected by the following simplifications: ” The multiplier of the negative sequence component of the restraining signal (IR2) is always 3. (in the relay is 1 the first two cycles following complete de-energization) ” The post filtering isn’t present so no decaying memory is available for the restraining signal All other restraining current selection logics are fully supported. The restricted earth fault elements are connected in the following way:

The restricted earth fault elements are connected in the following way:

The relationships between the relay settings and the model parameters can be found in the following table:

Element	3 Phase current measurement CT	Neutral measurement CT
REF1	Ct	Neutral Ct1
REF2	Remote Ct1	Neutral Ct1
REF3	Ct	Neutral Ct2
REF4	Remote Ct1	Neutral Ct2

Such connection should reproduce the more common protection schemes. Other schemes can be simulated modifying the connection scheme.

3.5.3 Data input

Please note that the nominal current values MUST be entered in all the measurement unit (”Diff RMS meas” block fro the differential element, ”REF1 RMS meas”, ”REF1 restr RMS meas”, ”REF2 RMS meas”, ”REF2 restr RMS meas”, ”REF3 RMS meas”, ”REF3 restr RMS meas”, ”REF4 RMS meas” and ”REF4 restr RMS meas” for the restricted earth fault differential elements)

The relationships between the 3phase differential settings and the model parameters can be found in the following table:

Address	Relay Setting	Model block	Model setting	Note
	Stator Diff Pickup	Differential	Differential Current Base Threshold	
	Stator Diff CT Line End Source	Winding 1 Adapter	Current transformer ratio	In both blocks please don’t set the ”Nominal Terminal Phase-Phase voltage” value. Set inside ”Winding 1 Adapter” the ”Current transformer ratio” value equal to the local CT ratio (i.e. for a 2500/5 CT set ”500”, for a 400/1 CT set ”400”). Set inside ”Winding 2 Adapter”the ”Current transformer ratio” value equal to the first remote CT ratio. The ”Current transformer connection” must be left equal to ”none”.
		Winding 2 Adapter		
	Stator Diff Neutral End Source	Winding 3 Adapter	Current transformer ratio	As above. Set the ”Current transformer ratio” value equal to the 2nd remote CT ratio.
	Stator Diff Slope 1	Differential	Restraint percentage 1	
	Stator Diff Slope 2	Differential	Restraint percentage 2	
	Stator Diff Break 2	Differential	Restraint 2nd slope	

The relationships between the Restricted earth fault differential settings and the model parameters can be found in the following table (listed settings are for the first restricted earth fault element, other element settings have the same relationship):

Address	Relay Setting	Model block	Model setting	Note
	Restd Grnd FT1 pickup	REF1	Pickup Current	
		Winding Neutral 1 Adapter	Current transformer ratio	The ”Current transformer ratio” value must be equal to the neutral CT ratio (i.e. for a 1000/5 CT set ”200”, for a 100/1 CT set ”100”). Don’t set the ”Nominal Terminal Phase-Phase voltage” value.
	Restd Grnd FT1 slope	REF1 restrain slope	Slope	The value must be entered in the ”Logic” tab page. Default string = ”Slope = 80”
	Restd Grnd FT1 Pickup Delay	REF1	Time Setting	

Address	Relay Setting	Model block	Model setting	Note
	Restd Grnd FT1 Reset Delay	REF1 reset delay	Time Setting	

3.6 Loss of excitation(F40) subrelay

3.6.1 Available Units

- Three under impedance quadrilateral elements (”Inner zone polygonal”, ”Middle zone polygonal” and ”Outer zone polygonal” block).
- Three mho elements (”Inner zone mho”, ”Middle zone mho” and ”Outer zone mho” block).
- Three out of step detection and power swing elements (”Out Of Step Middle-Inner”, ”Out Of Step Outer-Middle” and ”Out Of Step Outer-Inner” block)
- An out of step trip additional delay element (”OS Time Delay” block)
- A minimum current supervision element (”I supervision” block)

3.6.2 Functionality

The subrelay implements both the two steps and the three steps operation modes for the power swing blocking feature and the out of step trip. Please disable the ”Middle zone polygonal”, ”Middle zone mho”, ”Out Of Step Middle-Inner” and the ”Out Of Step Outer-Middle” block to activate the two steps operation mode. Please disable the ”Out Of Step Outer-Inner” block to activate the three steps operation mode. Both the mho operating characteristics and the quadrilateral characteristics are supported. Please use the quadrilateral characteristics also to simulate the blinder which can be used with the mho; in that case set to a very large value the ”+X” reach of the quadrilateral elements and ”+R Reach” and the ”-R Reach” equal to the blinder intersections with the R axis.

3.6.3 Data input

The relationships between the relay settings and the model parameters can be found in the following table:

Address	Relay Setting	Model block	Model setting	Note
	Power Swing	I supervision	Pickup current	
	Power Swing Fwd Reach	Inner zone mho	Replica Impedance	
		Middle zone mho	Replica Impedance	
		Outer zone mho	+X Reach	
		Inner zone polygonal	+X Reach	
	Power Swing Quad Fwd Reach Mid	Middle zone polygonal	+X Reach	
	Power Swing Quad Fwd Reach Out	Outer zone polygonal	+X Reach	
	Power Swing Fwd RCA	Inner zone mho	Relay Angle	
		Middle zone mho	Relay Angle	
		Outer zone mho	Relay Angle	
		Inner zone polygonal	Relay Angle	

Address	Relay Setting	Model block	Model setting	Note
		Middle zone polygonal	Relay Angle	
		Outer zone polygonal	Relay Angle	
	Power Swing Rev Reach	Inner zone mho	Offset Impedance	Insert a negative value in the mho blocks
		Middle zone mho	Offset Impedance	Insert a negative value in the mho blocks
		Outer zone mho	Offset Impedance	Insert a negative value in the mho blocks
		Inner zone polygonal	Offset Impedance	
	Power Swing Rev Reach Mid	Middle zone polygonal	-X Reach	
	Power Swing Rev Reach Out	Outer zone polygonal	-X Reach	
	Power Swing Rev RCA	Inner zone mho	Offset Angle	
		Middle zone mho	Offset Angle	
		Outer zone mho	Offset Angle	
	Power Swing Outer Limit Angle	Outer zone mho	Character.Angle	
	Power Swing Middle Limit Angle	Middle zone mho	Character.Angle	
	Power Swing Inner Limit Angle	Inner zone mho	Character.Angle	
	Power Swing Outer RGT Blinder	Outer zone polygonal	+R Resistance	
	Power Swing Middle RGT Blinder	Middle zone polygonal	+R Resistance	
	Power Swing Inner RGT Blinder	Inner zone polygonal	+R Resistance	
	Power Swing Outer LFT Blinder	Outer zone polygonal	-R Resistance	
	Power Swing Middle LFT Blinder	Middle zone polygonal	-R Resistance	
	Power Swing Inner LFT Blinder	Inner zone polygonal	-R Resistance	
	Power swing Pickpup Delay 1	Out Of Step Outer-Middle	tP1	”Timers” tab page, set ”Out Of Step Outer-Inner” for the 2 steps operation mode
		Out Of Step Outer-Inner		
	Power swing Reset Delay 1	Out Of Step Outer-Middle	tH	”Timers” tab page, set ”Out Of Step Outer-Inner” for the 2 steps operation mode
		Out Of Step Outer-Inner		
	Power swing Pickpup Delay 2	Out Of Step Middle-Inner	tP1	”Timers” tab page, used only for the 3 steps operation mode
	Power swing Pickpup Delay 3	Power Swing Pickup Delay 3	Time setting	
	Power swing Pickpup Delay 4	Power Swing Pickup Delay 4	tP1	”Timers” tab page

3.7 Output logic

3.7.1 Available Units

The output logic is implemented by the ”Output Logic” block located in each subrelay and by the ”Output Logic” block located in the main relay.

3.7.2 Functionality

The ”Output Logic” block located in the main relay is operating the breaker. Please disable the ”Output Logic” block in the main relay to disable the relay model ability to open the power circuit. The signal operating the breaker is ”yout”. Height additional output signals (”H1” . . . . ”H8”) freely configurable are available.

3.7.3 Data input

The configuration of the ”H1”. . . ”H8” output signals can be done in the ”Logic” tab page of the ”Output Logic” block.

4 Features not supported

4.1 Overcurrent(F50-F51-F46) subrelay

The following features are not supported:

- Breaker failure
- Trip bus

4.2 Voltage(F27-F59) subrelay

The following features are not supported:

- Third harmonic neutral undervoltage
- Auxiliary overvoltage
- Syncrocheck

4.3 Frequency(F81) subrelay

The following features are not supported:

- Turbine frequency out of band accumulated operating time

4.4 Differential(F87) subrelay

The following features are not supported:

- None

4.5 Loss of excitation(F40) subrelay

The following features are not supported:

- None

5 References

[1] GE Multilin, 215 Anderson Avenue, Markham - Ontario Canada L6E 1B3. *G30 Generator Protection System UR Series Instruction Manual G30 Revision: 5.9x Manual P/N: 1601-0166-W1 (GEK-113380)*, 2011.