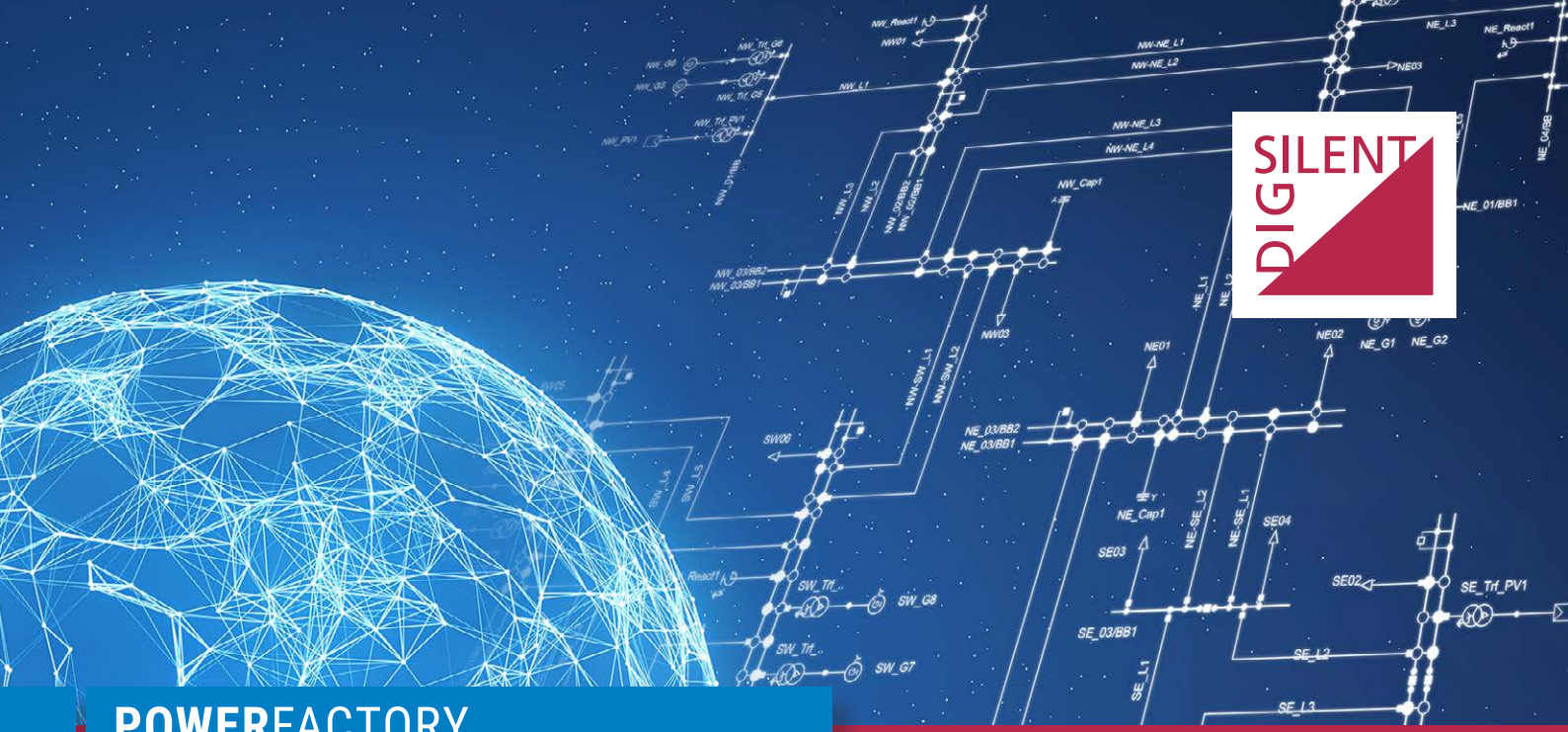

POWERFACTORY

PowerFactory 2021

Technical Reference

General Electric UR D60

PF2021

POWER SYSTEM SOLUTIONS

MADE IN GERMANY

Publisher:
DIgSILENT GmbH
Heinrich-Hertz-Straße 9
72810 Gomaringen / Germany
Tel.: +49 (0) 7072-9168-0
Fax: +49 (0) 7072-9168-88
info@digsilent.de

Please visit our homepage at:
https://www.digsilent.de

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Contents

1 Model information

Manufacturer General Electric

Model UR D60

Variants The General Electric UR D60 PowerFactory relay model can be used to simulate the firmware versions of the GE UR D60 relay up to revision 6.0.

2 General description

The General Electric UR D60 is a line distance protection relay with additional overcurrent and voltage protective elements.

The General Electric UR D60 PowerFactory relay model consists of a main relay model and the following sub relays:

- Phase Distance elements (F21)
- Ground Distance elements (F21)
- Overcurrent elements (F50 - F51 - F46)
- Voltage elements (F27 - F59)

The General Electric UR D60 PowerFactory relay model has been implemented trying to simulate the protective functions more commonly used.

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] [2].

3 Supported features

3.1 Measurement and acquisition

The voltage and the current are measured by three current transformers (”Ct”, ”Mutual Ct” and ”Neutral Ct” block) and one voltage transformer (”Vt” block).

Five measurement units (”Measurement”, ”Meas delta” , ”Measurement Seq”, ”Meas Neutral I”, and ”Meas Mutual” block) are fed by these CTs and the VT.

3.1.1 Available Units

- One three phase current transformer element (”Ct” block).
- One single phase current transformer measuring the ground current (”Neutral Ct” block).
- One single phase current transformer element measuring the ground current along an adjacent line (”Mutual Ct” block).
- One three phase voltage transformer element (”Vt” block).
- One three phase measurement element fed by the ’Ct” current transformer (”Measurement” block).
- One three phase measurement element calculating the phase-phase current and voltage values (”Meas delta” block).
- One three phase measurement element calculating the sequence values (”Measurement Seq” block).
- One single phase measurement element calculating the neutral current values (”Meas Neutral I” block).
- One single phase measurement element calculating the values of the neutral current along an adjacent line (”Meas Mutual” block).

3.1.2 Functionality

The input signals are sampled at 20 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 Phase Distance elements (F21) subrelay

This subrelay contains the distance protection elements which monitor the phase-phase loops.

3.2.1 Available Units

- Six under impedance quadrilateral elements (”Z1”, ”Z1E”, ”Z2”, ”Z3”, ”Z4”, ”Z5” block).
- Six mho elements (”Z1Mho”, ”Z1EMho”, ”Z2Mho”, ”Z3Mho”, ”Z4Mho”, ”Z5Mho” block).
- Six polarizing elements (”Polarizing 1”, ”Polarizing 1E”, ”Polarizing 2”, ”Polarizing 3”, ”Polarizing 4”, and ”Polarizing 5” block).
- Six directional element (”Dir-Z 1”, ”Dir-Z 1E”, ”Dir-Z 2”, ”Dir-Z 3”, ”Dir-Z 4”, and ”Dir-Z 5” block).
- Six timers (”ZT1m”, ”ZT1em”, ”ZT2m”, ”ZT3m”, ”ZT4m”, and ”ZT5m’ block).
- One reclosing block (”Reclosing” block).
- One load encroachment element (”Load Area” block).
- A minimum current supervision element (”Starting” block).

3.2.2 Functionality

The subrelay consists of six polygonal and six mho phase-phase loop distance elements.

Separate polarizing and directional elements can be set for each mho/polygonal element couple. The polarizing elements associated to the zone 1E element couple are configured to provide a 25 cycle voltage memory buffer which is activated when the voltage drops below 4%U_n.

A reclosing element can be configures to provide up to 4 breaker reclosing attempts when the fault has been cleared by the polygonal elements.

A load encroachment element is limiting the trip zone of both the polygonal and the mho elements.

An unique timer is connected to each mho/polygonal element couple.

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, the addresses are MODBUS MEMORY MAP addresses):

Address	Relay Setting	Model block	Model setting	Note
6700	Load Encroachment Function	Load Area	Out of Service (outserv)	
6703	Load Encroachment Reach	Load Area	R load (Ph-Ph) (Rloadphph)	
6704	Load Encroachment Angle	Load Area	PHI load Ph-Ph (philoadphph)	
7070	Phase Distance Zone x[1] Function	Zx[1]	Out of Service (outserv)	
7071	Phase Distance Zone x Current Supervision	Starting	Current I >>(Ip2)	
7072	Phase Distance Zone x[1] Reach	Zx[1]	Z Reach (Zmax)	

[1] x = 1,1E,2,3,4,5

Address	Relay Setting	Model block	Model setting	Note
7073	Phase Distance Zone x[1] Direction	Zx[1]	Tripping Direction (idir)	
7074	Phase Distance Zone x[1] Comparator Limit	Zx[1]	+X Angle (beta)	
7075	Phase Distance Zone x[1] Delay	ZTx[1]m	Time Setting (Tdelay)	
707A	Phase Distance Zone x[1] RCA	Zx[1]	Relay Angle (phi)	
707B	Phase Distance Zone x[1] DIR RCA	Dir-Z x[1]	Directional Angle, phi (phi)	phi = DIR RCA + DIR Comp Limit - 90°
707C	Phase Distance Zone x[1] DIR Comp Limit	Dir-Z x[1]	Directional Angle, alpha (alpha)	alpha = DIR Comp Limit - DIR RCA
707D	Phase Distance Zone x[1] Quad Right Blinder	Zx[1]	+R Resistance (Rmax)	
707E	Phase Distance Zone x[1] Quad Right Blinder RCA	Zx[1]	+R Angle (gamma)	
707F	Phase Distance Zone x[1] Quad Left Blinder	Zx[1]	-R Resistance (Rmin)	
7080	Phase Distance Zone x[1] Quad Left Blinder RCA	Zx[1]	-R Angle (gamma2)	
7084	Phase Distance Zone x[1] Rev Reach	Zx[1]	-Z Reach (Zmaxrev)	
7085	Phase Distance Zone x[1] Rev Reach RCA	Zx[1]	-Relay Angle (phi2)	
6890	Autoreclose Mode	Reclosing	Operation mode(operationmode)	in the ”Operation Mode” tab page
6891	Autoreclose Maximum Number of Shots	Reclosing	Operations to lockout (oplockout)	oplockout = Maximum Number of Shots + 1
689D	Autoreclose 3-Pole Dead Time 1	Reclosing	Reclosing interval 1 (recltime1)	
689E	Autoreclose 3-Pole Dead Time 2	Reclosing	Reclosing interval 2 (recltime2)	
68B1	Autoreclose 3-Pole Dead Time 3	Reclosing	Reclosing interval 3 (recltime3)	
68B2	Autoreclose 3-Pole Dead Time 4	Reclosing	Reclosing interval 4 (recltime4)	
68A2	Autoreclose Reset Time	Reclosing	Reset Time (resettime)	
6893	Autoreclose Close Time Breaker 1	Reclosing	Closing command duration (closingcomtime)	

3.3 Ground Distance elements (F21) subrelay

This subrelay contains the distance protection elements which monitor the phase-ground loops.

3.3.1 Available Units

- Six under impedance quadrilateral elements (”Z1G”, ”Z1EG”, ”Z2G”, ”Z3G”, ”Z4G”, ”Z5G” block).
- Six mho elements (”Z1GMho”, ”Z1EGMho”, ”Z2GMho”, ”Z3GMho”, ”Z4GMho”, ”Z5GMho” block).
- Six polarizing elements (”Polarizing 1”, ”Polarizing 1E”, ”Polarizing 2”, ”Polarizing 3”, ”Polarizing 4”, and ”Polarizing 5” block).
- Six directional element (”Dir-Z 1”, ”Dir-Z 1E”, ”Dir-Z 2”, ”Dir-Z 3”, ”Dir-Z 4”, and ”Dir-Z 5” block).
- Six timers (”ZT1m”, ”ZT1em”, ”ZT2m”, ”ZT3m”, ”ZT4m”, and ”ZT5m’ block).
- One reclosing block (”Reclosing” block).
- One load encroachment element (”Load Area” block).
- A minimum current supervision element (”Starting” block).

3.3.2 Functionality

The subrelay consists of six polygonal and six mho phase-ground loop distance elements.

Separate polarizing and directional elements can be set for each mho/polygonal element couple. The polarizing elements associated to the zone 1E element couple are configured to provide a 25 cycle voltage memory buffer which is activated when the voltage drops below 4%U_n.

A reclosing element can be configures to provide up to 4 breaker reclosing attempts when the fault has been cleared by the polygonal elements.

A load encroachment element is limiting the trip zone of both the polygonal and the mho elements.

An unique timer is connected to each mho/polygonal element couple.

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, the addresses are MODBUS MEMORY MAP addresses):

Address	Relay Setting	Model block	Model setting	Note
6700	Load Encroachment Function	Load Area	Out of Service (outserv)	
6703	Load Encroachment Reach	Load Area	R load (Ph-Ph) (Rloadphph)	
6704	Load Encroachment Angle	Load Area	PHI load Ph-Ph (philoadphph)	
7130	Ground Distance Zone x[2] Function	Zx[1]	Out of Service (outserv)	

[2] x = 1,1E,2,3,4,5

Address	Relay Setting	Model block	Model setting	Note
7131	Ground Distance Zone x Current Supervision	Starting	Current I >>(Ip2)	
7132	Ground Distance Zone x[1] Reach	Zx[1]	Z Reach (Zmax)	
7133	Ground Distance Zone x[1] Direction	Zx[1]	Tripping Direction (idir)	
7134	Ground Distance Zone x[1] Comparator Limit	Zx[1]	+X Angle (beta)	
7135	Ground Distance Zone x[1] Delay	ZTx[1]m	Time Setting (Tdelay)	
713A	Ground Distance Zone x[1] Z0 Z1 Magnitude	Polarizing x[1]	k0 (k0)	
713B	Ground Distance Zone x[1] Z0 Z1 Angle	Polarizing x[1]	Angle (phik0)	
713C	Ground Distance Zone x[1] RCA	Zx[1]	Relay Angle (phi)	
713D	Ground Distance Zone x[1] DIR RCA	Dir-Z x[1]	Directional Angle, phi (phi)	phi = DIR RCA + DIR Comp Limit - 90°
713E	Ground Distance Zone x[1] DIR Comp Limit	Dir-Z x[1]	Directional Angle, alpha (alpha)	alpha = DIR Comp Limit - DIR RCA
713F	Ground Distance Zone x[1] Quad Right Blinder	Zx[1]	+R Resistance (Rmax)	
7140	Ground Distance Zone x[1] Quad Right Blinder RCA	Zx[1]	+R Angle (gamma)	
7141	Ground Distance Zone x[1] Quad Left Blinder	Zx[1]	-R Resistance (Rmin)	
7142	Ground Distance Zone x[1] Quad Left Blinder RCA	Zx[1]	-R Angle (gamma2)	
7143	Ground Distance Zone x[1] Z0M Z1 Magnitude	Polarizing x[1]	k0m (k0m)	
7144	Ground Distance Zone x[1] Z0M Z1 Angle	Polarizing x[1]	Angle (phik0m)	
7148	Ground Distance Zone x[1] Rev Reach	Zx[1]	-Z Reach (Zmaxrev)	
7149	Ground Distance Zone x[1] Rev Reach RCA	Zx[1]	-Relay Angle (phi2)	
6890	Autoreclose Mode	Reclosing	Operation mode(operationmode)	in the ”Operation Mode” tab page
6891	Autoreclose Maximum Number of Shots	Reclosing	Operations to lockout (oplockout)	oplockout = Maximum Number of Shots + 1
689D	Autoreclose 3-Pole Dead Time 1	Reclosing	Reclosing interval 1 (recltime1)	
689E	Autoreclose 3-Pole Dead Time 2	Reclosing	Reclosing interval 2 (recltime2)	
68B1	Autoreclose 3-Pole Dead Time 3	Reclosing	Reclosing interval 3 (recltime3)	
68B2	Autoreclose 3-Pole Dead Time 4	Reclosing	Reclosing interval 4 (recltime4)	
68A2	Autoreclose Reset Time	Reclosing	Reset Time (resettime)	
6893	Autoreclose Close Time Breaker 1	Reclosing	Closing command duration (closingcomtime)	

3.4 Overcurrent elements (F50 - F51 - F46) subrelay

3.4.1 Available Units

- Two 3 phase inverse time directional overcurrent elements (”Phase Toc 1” and ”Phase Toc 2” block).
- Two 3 phase definite time directional overcurrent elements (”Phase Ioc 1” and ”Phase Ioc 2” block).
- Two 3phase directional elements (”DirPhase 1” and ”DirPhase 2” block).
- Two neutral current inverse time directional overcurrent elements (”Neutral Toc 1” and ”Neutral Toc 2” block).
- Two neutral current definite time directional overcurrent elements (”Neutral Ioc 1” and ”Neutral Ioc 2” block).
- Two neutral current directional elements (”DirNeutral 1” and ”DirNeutral 2” block).
- Two ground current inverse time directional overcurrent elements (”Ground Toc 1” and ”Ground Toc 2” block).
- Two ground current definite time directional overcurrent elements (”Ground Ioc 1” and ”Ground Ioc 2” block).
- Two ground current directional elements (”DirGround 1” and ”DirGround 2” block).
- Two negative sequence current inverse time directional overcurrent elements (”Negative sequence Toc 1” and ”Negative sequence Toc 2” block).
- Two negative sequence current definite time directional overcurrent elements (”Negative sequence Ioc 1” and ”Negative sequence Ioc 2” block).
- Two negative sequence current directional elements (”DirNegSeq 1” and ”DirNegSeq 2” block).

3.4.2 Functionality

The model contains a reduced subset of the overcurrent protective elements available in the relay. Four set of overcurrent elements are available:

- Phase.
- Ground.
- Neutral current.
- Negative sequence current.

Each set consists of two inverse time characteristic overcurrent elements and two definite time overcurrent elements. Two directional elements are present in each set: the ”’Dir*xxxxx* 1” directional element can be used to control the ”*xxxxx* Toc 1” inverse time element and the ”*xxxxx* Ioc 1” definite time element, the ”’Dir*xxxxx* 2” directional element can be used to control the ”*xxxxx* Toc 2” inverse time element and the ”*xxxxx* Ioc 2” definite time element

The ground directional elements (”DirGround 1” and ”DirGround 2” block) simulate a simplified version of the *Wattmetric ground fault* feature. Please notice that the power threshold is equal to the product of the polarizing voltage threshold and of the operating current threshold.

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 curve”

3.4.3 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
5900	Phase Time Overcurrent 1 Function	Phase Toc 1	Out of Service (outserv)	
5903	Phase Time Overcurrent 1 Pickup	Phase Toc 1	Current Setting (ipset)	
5904	Phase Time Overcurrent 1 Curve	Phase Toc 1	Characteristic (pcharac)	
5905	Phase Time Overcurrent 1 Multiplier	Phase Toc 1	Time Dial (tpset)	
5908	Phase TOC 1 Block For Each Phase (3 items)	Phase Toc 1	Characteristic (pcharac)	Set ”None” if the block signals are not controlled by the directional element
5910	Phase Time Overcurrent 2 Function	Phase Toc 2	Out of Service (outserv)	
5913	Phase Time Overcurrent 2 Pickup	Phase Toc 2	Current Setting (ipset)	
5914	Phase Time Overcurrent 2 Curve	Phase Toc 2	Characteristic (pcharac)	
5915	Phase Time Overcurrent 2 Multiplier	Phase Toc 2	Time Dial (tpset)	
5918	Phase TOC 2 Block For Each Phase (3 items)	Phase Toc 2	Characteristic (pcharac)	Set ”None” if the block signals are not controlled by the directional element
5A00	Phase Instantaneous Overcurrent 1 Function	Phase Ioc 1	Out of Service (outserv)	
5A02	Phase Instantaneous Overcurrent 1 Pickup	Phase Ioc 1	Pickup Current (Ipset)	
5A03	Phase Instantaneous Overcurrent 1 Delay	Phase Ioc 1	Time Setting (Tset)	

Address	Relay Setting	Model block	Model setting	Note
5A10	Phase Instantaneous Overcurrent 2 Function	Phase Ioc 2	Out of Service (outserv)	
5A12	Phase Instantaneous Overcurrent 2 Pickup	Phase Ioc 2	Pickup Current (Ipset)	
5A13	Phase Instantaneous Overcurrent 2 Delay	Phase Ioc 2	Time Setting (Tset)	
5B00	Neutral Time Overcurrent 1 Function	Neutral Toc 1	Out of Service (outserv)	
5B03	Neutral Time Overcurrent 1 Pickup	Neutral Toc 1	Current Setting (ipset)	
5B04	Neutral Time Overcurrent 1 Curve	Neutral Toc 1	Characteristic (pcharac)	
5B05	Neutral Time Overcurrent 1 Multiplier	Neutral Toc 1	Time Dial (tpset)	
5B07	Neutral TOC 1 Block	Neutral Toc 1	Characteristic (pcharac)	Set ”None” if the block signals are not controlled by the directional element
5B10	Neutral Time Overcurrent 2 Function	Neutral Toc 2	Out of Service (outserv)	
5B13	Neutral Time Overcurrent 2 Pickup	Neutral Toc 2	Current Setting (ipset)	
5B14	Neutral Time Overcurrent 2 Curve	Neutral Toc 2	Characteristic (pcharac)	
5B15	Neutral Time Overcurrent 2 Multiplier	Neutral Toc 2	Time Dial (tpset)	
5B17	Neutral TOC 2 Block	Neutral Toc 2	Characteristic (pcharac)	Set ”None” if the block signals are not controlled by the directional element
5C00	Neutral Instantaneous Overcurrent 1 Function	Neutral Ioc 1	Out of Service (outserv)	
5C02	Neutral Instantaneous Overcurrent 1 Pickup	Neutral Ioc 1	Pickup Current (Ipset)	
5C03	Neutral Instantaneous Overcurrent 1 Delay	Neutral Ioc 1	Time Setting (Tset)	
5C10	Neutral Instantaneous Overcurrent 2 Function	Neutral Ioc 2	Out of Service (outserv)	
5C12	Neutral Instantaneous Overcurrent 2 Pickup	Neutral Ioc 2	Pickup Current (Ipset)	
5C13	Neutral Instantaneous Overcurrent 2 Delay	Neutral Ioc 2	Time Setting (Tset)	
5D00	Ground Time Overcurrent 1 Function	Ground Toc 1	Out of Service (outserv)	
5D03	Ground Time Overcurrent 1 Pickup	Ground Toc 1	Current Setting (ipset)	
5D04	Ground Time Overcurrent 1 Curve	Ground Toc 1	Characteristic (pcharac)	
5D05	Ground Time Overcurrent 1 Multiplier	Ground Toc 1	Time Dial (tpset)	
5D07	Ground TOC 1 Block	Ground Toc 1	Characteristic (pcharac)	Set ”None” if the block signals are not controlled by the directional element
5D10	Ground Time Overcurrent 2 Function	Ground Toc 2	Out of Service (outserv)	
5D13	Ground Time Overcurrent 2 Pickup	Ground Toc 2	Current Setting (ipset)	
5D14	Ground Time Overcurrent 2 Curve	Ground Toc 2	Characteristic (pcharac)	
5D15	Ground Time Overcurrent 2 Multiplier	Ground Toc 2	Time Dial (tpset)	
5D17	Ground TOC 2 Block	Ground Toc 2	Characteristic (pcharac)	Set ”None” if the block signals are not controlled by the directional element

Address	Relay Setting	Model block	Model setting	Note
5E00	Ground Instantaneous Overcurrent 1 Function	Ground Ioc 1	Out of Service (outserv)	
5E02	Ground Instantaneous Overcurrent 1 Pickup	Ground Ioc 1	Pickup Current (Ipset)	
5E03	Ground Instantaneous Overcurrent 1 Delay	Ground Ioc 1	Time Setting (Tset)	
5E10	Ground Instantaneous Overcurrent 2 Function	Ground Ioc 2	Out of Service (outserv)	
5E12	Ground Instantaneous Overcurrent 2 Pickup	Ground Ioc 2	Pickup Current (Ipset)	
5E13	Ground Instantaneous Overcurrent 2 Delay	Ground Ioc 2	Time Setting (Tset)	
6300	Negative Sequence Time Overcurrent 1 Function	Negative Sequence Toc 1	Out of Service (outserv)	
6302	Negative Sequence Time Overcurrent 1 Pickup	Negative Sequence Toc 1	Current Setting (ipset)	
6303	Negative Sequence Time Overcurrent 1 Curve	Negative Sequence Toc 1	Characteristic (pcharac)	
6304	Negative Sequence Time Overcurrent 1 Multiplier	Negative Sequence Toc 1	Time Dial (tpset)	
6306	Negative Sequence TOC 1 Block	Negative Sequence Toc 1	Characteristic (pcharac)	Set ”None” if the block signals are not controlled by the directional element
6310	Negative Sequence Time Overcurrent 2 Function	Negative Sequence Toc 2	Out of Service (outserv)	
6312	Negative Sequence Time Overcurrent 2 Pickup	Negative Sequence Toc 2	Current Setting (ipset)	
6313	Negative Sequence Time Overcurrent 2 Curve	Negative Sequence Toc 2	Characteristic (pcharac)	
6314	Negative Sequence Time Overcurrent 2 Multiplier	Negative Sequence Toc 2	Time Dial (tpset)	
6316	Negative Sequence TOC 2 Block	Negative Sequence Toc 2	Characteristic (pcharac)	Set ”None” if the block signals are not controlled by the directional element
6400	Negative Sequence Instantaneous Overcurrent 1 Function	Negative Sequence Ioc 1	Out of Service (outserv)	
6402	Negative Sequence Instantaneous Overcurrent 1 Pickup	Negative Sequence Ioc 1	Pickup Current (Ipset)	
6403	Negative Sequence Instantaneous Overcurrent 1 Delay	Negative Sequence Ioc 1	Time Setting (Tset)	
6410	Negative Sequence Instantaneous Overcurrent 2 Function	Negative Sequence Ioc 2	Out of Service (outserv)	
6412	Negative Sequence Instantaneous Overcurrent 2 Pickup	Negative Sequence Ioc 2	Pickup Current (Ipset)	
6413	Negative Sequence Instantaneous Overcurrent 2 Delay	Negative Sequence Ioc 2	Time Setting (Tset)	
7260	Phase Directional Overcurrent 1 Function	DirPhase 1	Out of Service (outserv)	
7263	Phase Directional Overcurrent 1 ECA	DirPhase 1	Max. Torque Angle (mtau)	in the ”Voltage Polarizing” tab page
7264	Phase Directional Overcurrent 1 Pol V Threshold	DirPhase 1	Polarizing Voltage (upolu)	in the ”Voltage Polarizing” tab page
7270	Phase Directional Overcurrent 2 Function	DirPhase 2	Out of Service (outserv)	
7273	Phase Directional Overcurrent 2 ECA	DirPhase 2	Max. Torque Angle (mtau)	in the ”Voltage Polarizing” tab page
7274	Phase Directional Overcurrent 2 Pol V Threshold	DirPhase 2	Polarizing Voltage (upolu)	in the ”Voltage Polarizing” tab page
7280	Neutral Directional Overcurrent 1 Function	DirNeutral 1	Out of Service (outserv)	

Address	Relay Setting	Model block	Model setting	Note
7283	Neutral Directional Overcurrent 1 ECA	DirNeutral 1	Max. Torque Angle (mtau)	in the ”Voltage Polarizing” tab page
7284	Neutral Directional Overcurrent 1 Forward Limit Angle	DirNeutral 1	Angle Operating Sector(phisec)	
7285	Neutral Directional Overcurrent 1 Forward Pickup	DirNeutral 1	Operating Current (curopu)	in the ”Voltage Polarizing” tab page
7290	Neutral Directional Overcurrent 2 Function	DirNeutral 2	Out of Service (outserv)	
7293	Neutral Directional Overcurrent 2 ECA	DirNeutral 2	Max. Torque Angle (mtau)	in the ”Voltage Polarizing” tab page
7294	Neutral Directional Overcurrent 2 Forward Limit Angle	DirNeutral 2	Angle Operating Sector(phisec)	
7295	Neutral Directional Overcurrent 2 Forward Pickup	DirNeutral 2	Operating Current (curopu)	in the ”Voltage Polarizing” tab page
72A0	Negative Sequence Directional Overcurrent 1 Function	DirNegSeq 1	Out of Service (outserv)	
72A3	Neutral Directional Overcurrent 1 ECA	DirNegSeq 1	Max. Torque Angle (mtau)	in the ”Voltage Polarizing” tab page
72A4	Negative Sequence Directional Overcurrent 1 Forward Limit Angle	DirNegSeq 1	Angle Operating Sector(phisec)	
72A5	Negative Sequence Directional Overcurrent 1 Forward Pickup	DirNegSeq 1	Operating Current (curopu)	in the ”Voltage Polarizing” tab page
72B0	Negative Sequence Directional Overcurrent 2 Function	DirNegSeq 2	Out of Service (outserv)	
72B3	Negative Sequence Directional Overcurrent 2 ECA	DirNegSeq 2	Max. Torque Angle (mtau)	in the ”Voltage Polarizing” tab page
72B4	Negative Sequence Directional Overcurrent 2 Forward Limit Angle	DirNegSeq 2	Angle Operating Sector(phisec)	
72B5	Negative Sequence Directional Overcurrent 2 Forward Pickup	DirNegSeq 2	Operating Current (curopu)	in the ”Voltage Polarizing” tab page
B300	Wattmetric ground fault 1 function	DirGround 1	Out of Service (outserv)	
B303	Wattmetric ground fault 1 overvoltage pickup	DirGround 1	Polarizing Voltage (upolu)	in the ”Voltage Polarizing” tab page
B305	Wattmetric ground fault 1 overcurrent pickup	DirGround 1	Operating Current (curopu)	in the ”Voltage Polarizing” tab page
B308	Wattmetric ground fault 1 ECA	DirGround 1	Max. Torque Angle (mtau)	in the ”Voltage Polarizing” tab page
6061	Wattmetric ground fault 2 function	DirGround 2	Out of Service (outserv)	
6064	Wattmetric ground fault 2 overvoltage pickup	DirGround 2	Polarizing Voltage (upolu)	in the ”Voltage Polarizing” tab page
6066	Wattmetric ground fault 2 overcurrent pickup	DirGround 2	Operating Current (curopu)	in the ”Voltage Polarizing” tab page
6069	Wattmetric ground fault 2 ECA	DirGround 2	Max. Torque Angle (mtau)	in the ”Voltage Polarizing” tab page

3.5 Voltage elements (F27 - F59) subrelay

3.5.1 Available Units

- Two 3 phase definite time undervoltage elements (”Phase undervoltage 1”, and ”Phase undervoltage 2” block).
- One three phase definite time overvoltage element (”Phase overvoltage” block).
- Three zero sequence definite time overvoltage elements (”Neutral overvoltage 1”, ”Neutral overvoltage 2”, and ”Neutral overvoltage 3” block).
- One negative sequence definite time overvoltage element (”Negative sequence Overvoltage” block).

3.5.2 Functionality

All the over/undervoltage elements available in the relay except the auxiliary over/undervoltage elements have been implemented in the model. They are modeled with a simplified layout and only a definite trip characteristic is present.

3.5.3 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
7000	Phase Undervoltage 1 Function	Phase undervoltage 1	Out of Service (outserv)	
7002	Phase Undervoltage 1 Pickup	Phase undervoltage 1	Pickup Voltage (Uset)	
7004	Phase Undervoltage 1 Delay	Phase undervoltage 1	Time Delay (Tdel)	
7013	Phase Undervoltage 2 Function	Phase undervoltage 2	Out of Service (outserv)	
7015	Phase Undervoltage 2 Pickup	Phase undervoltage 2	Pickup Voltage (Uset)	
7017	Phase Undervoltage 2 Delay	Phase undervoltage 2	Time Delay (Tdel)	
7040	Phase Overvoltage 1 Function	Phase overvoltage	Out of Service (outserv)	
7042	Phase Overvoltage 1 Pickup	Phase overvoltage	Pickup Voltage (Uset)	
7043	Phase Overvoltage 1 Delay	Phase overvoltage	Time Delay (Tdel)	
64A0	Negative Sequence Overvoltage Function	Negative sequence Overvoltage	Out of Service (outserv)	
64A2	Negative Sequence Overvoltage Pickup	Negative sequence Overvoltage	Pickup Voltage (Uset)	
64A3	Negative Sequence Overvoltage Delay	Negative sequence Overvoltage	Time Delay (Tdel)	
7F00	Neutral Overvoltage 1 Function	Neutral Overvoltage 1	Out of Service (outserv)	
7F02	Neutral Overvoltage 1 Pickup	Neutral Overvoltage 1	Pickup Voltage (Uset)	
7F03	Neutral Overvoltage 1 Pickup Delay	Neutral Overvoltage 1	Time Delay (Tdel)	
7F10	Neutral Overvoltage 2 Function	Neutral Overvoltage 2	Out of Service (outserv)	
7F12	Neutral Overvoltage 2 Pickup	Neutral Overvoltage 2	Pickup Voltage (Uset)	
7F13	Neutral Overvoltage 2 Pickup Delay	Neutral Overvoltage 2	Time Delay (Tdel)	
7F20	Neutral Overvoltage 3 Function	Neutral Overvoltage 3	Out of Service (outserv)	
7F22	Neutral Overvoltage 3 Pickup	Neutral Overvoltage 3	Pickup Voltage (Uset)	
7F23	Neutral Overvoltage 3 Pickup Delay	Neutral Overvoltage 3	Time Delay (Tdel)	

3.6 Output logic

3.6.1 Available Units

The output logic is implemented by the ”Output Logic Distance” and by the ”OutputLogic OverCurrr and Voltage” block which are located in the main relay.

3.6.2 Functionality

Each *Output Logic* block located in the main relay can operate the power breaker. Please disable both the ”Output Logic Distance” block and the ”OutputLogic OverCurrr and Voltage ”block to disable the relay model ability to open the power circuit.

The ”Output Logic Distance” block can trigger a 3 phase trip or a single phase trip for phase ground faults or a two phase trip for phase-phase faults. The output signals are *yout* (3 phase trip), *yout_A* (phase A trip), *yout_B* (phase B trip), *yout_C* (phase C trip).

The ”OutputLogic OverCurrr and Voltage” block can trigger only 3 phase trip commands and the signal operating the breaker is *OUT1*.

3.6.3 Data input

The ”Output Logic Distance” block can be configured to trigger a 3 phase trip selecting the *yout* trip signal in the ”Tripping signals” (sTripsig) combo box in the ”Basic Data” tab page and setting the *single_pole_trip* and the *two_poles_trip* variable equal to ”NOTRIP” in the ”Logic” tab page.

The single phase trip can be enabled setting the *single_pole_trip* variable equal to ”TRIP” and the *two_poles_trip* variable equal to ”NOTRIP” in the ”Logic” tab page.

The two phase trip can be enabled setting the *single_pole_trip* variable equal to ”NOTRIP” and the *two_poles_trip* variable equal to ”TRIP” in the ”Logic” tab page.

4 Features not supported

4.1 Phase Distance elements (F21) subrelay

The following features are not supported:

- Separated starting current values for each distance zone element.
- Pilot accelerated trips (DUTT, POTT, PUTT etc.).
- Power swing detect.
- Polarizing ”Self polarizing feature” (”FORCE SELF POLAR” parameter).
- Negative sequence current as operating current in the polarizing block.
- Load encroachment minimum voltage threshold, trip time delay , and reset time delay.

4.2 Ground Distance elements (F21) subrelay

The following features are not supported:

- Separated starting current values for each distance zone element.
- Pilot accelerated trips (DUTT, POTT, PUTT etc.).
- Power swing detect.
- Polarizing ”Self polarizing feature” (”FORCE SELF POLAR” parameter).
- Negative sequence current as operating current in the polarizing block.
- Load encroachment minimum voltage threshold, trip time delay , and reset time delay.

4.3 Overcurrent elements (F50 - F51 - F46) subrelay

The following features are not supported:

- Thermal overload protection.
- Line pickup.
- Sensitive directional power.
- Wattmetric zero seq directional: curve and curve time delay.
- Voltage restrain.
- Reset curves.
- Neutral directional element positive sequence restraint.
- FlexLogic and Flex recloser curves.

4.4 Voltage elements (F27 - F59) subrelay

The following features are not supported:

- Inverse time trip characteristics.
- User configurable reset delay.
- Auxiliary overvoltage.
- Auxiliary undervoltage.

4.5 Generic features

The following features are not supported:

- Breaker Failure.
- Frequency elements.

5 References

[1] GE Multilin, 215 Anderson Avenue, Markham - Ontario Canada L6E 1B3. *D60 Line Distance Relay Instruction Manual D60 Revision: 3.3x Manual P/N: 1601-0089-E2 (GEK-106408A)*, 2003.

[2] GE Multilin, 215 Anderson Avenue, Markham - Ontario Canada L6E 1B3. *D60 Line Distance Relay Instruction Manual D60 Revision: 6.0x Manual P/N: 1601-0089-X2 (GEK-113617)*, 2012.