

SVERKER 900

Application for testing Self-powered relays SEG (Woodward) WIP1 and WIC1

Self-Powered-Relay (SPR) takes its supply from the CT-s connected and also the energy for tripping the breaker. SPR either have special CT made for the relay or are made to be used directly with standard CT-s.

There are differences in how to set Sverker 900 when testing SPR that must be noticed.

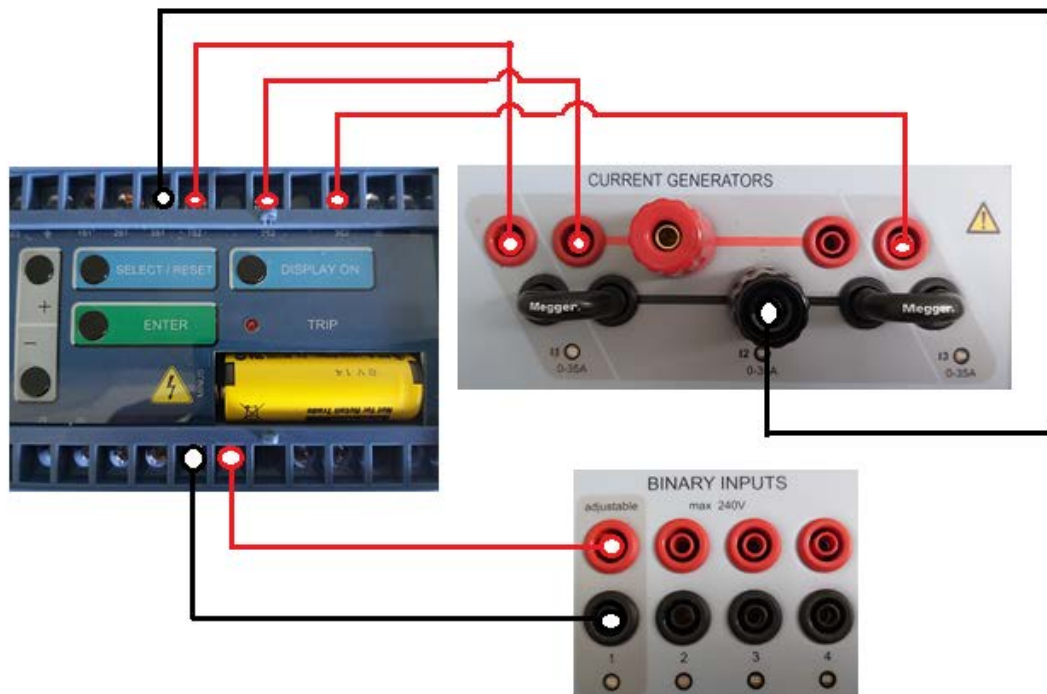
1. The level of pre fault current and time needed for pre fault.
2. The pickup level for trip signal if not dry contact is used.

Here secondary testing of SEG relay (formerly Woodward) WIP1 and WIC1 will be described.

Secondary testing of SEG (Woodward) WIP1

The WIP1 relay has a test mode choice where all the output relays are checked, can only be tested with battery applied and no current is flowing.

Test connection



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Control of test mode

The test is made in Sequence instrument, three steps are used to make the test.

STATE 1: Injection of 1A in L1, for 190ms.

STATE 2: No injection for 40ms.

STATE 3: Injection of 1A in L1, for 20s.

STATE 1

	1.00 A	0.0 °	50.000 Hz
U1	----	----	----
U2	----	----	----
U3	----	----	----

STATE 1(3)	
STATE ▶	BI NO TRIP ▣ 190 ms
TRIP ▣	BO END SEQ

STATE 2

	0.000 A	0.0 °	50.000 Hz
U1	----	----	----
U2	----	----	----
U3	----	----	----

STATE 2(3)	
STATE ▶	BI NO TRIP ▣ 40 ms
TRIP ▣	BO END SEQ

STATE 3

	1.00 A	0.0 °	50.000 Hz
U1	----	----	----
U2	----	----	----
U3	----	----	----

STATE 3(3)	
STATE ▶	BI NO TRIP ▣ 20000 ms
TRIP ▣	BO END SEQ

During the third step, the WIP-1 relay will start its own self-testing procedure. Several contacts will click if everything is all right, the test will end with “Press select button” and display will show “Test current Switch Off”

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Setting WIP1 into test mode

1. Press “Display On” press plus or minus until “Relay test” are selected.
2. Press “Select/Reset” now test mode is entered and password is required.
3. After password (default +++) has been entered display will show “Test current: Set to 1A.
4. Generate 1A with the current generators in parallel configuration.

The test current has to be generated before 30s have elapsed or the display goes back to standard mode “Protection Setting”. When 1A is generated the display shows “Relay Test is running”

Testing OC invers curve function with Pre Fault-Fault instrument in MTT mode.

(See Sverker 900 manual, for setting of Pf/f instrument BI and to make testing in MTT mode.)

All protection functions remain fully functional even if the battery is empty or not installed. Secondary testing is made as for a standard relay.

Example: WIP1 setting: $I_{>}=1,2A$ $k=0,1$ $I_{>=}=5A$ $t=100ms$

Keep connection as in “Control of test mode”, to set WIP1 follow below steps.

1. Press “Display On” then ones on plus, now you are in “Protection Setting”.
2. Press “Select/Reset” then plus or minus to change $I_{>}$ value press “Enter” until selected value comes up, if password is needed press “+++” then press “Enter” again.
3. When $I_{>}$ value is set press “Select/Reset” again to to set “Characteristic” repeate above to select. If password is still valid only press “Enter” until selected choise comes up.
4. Repeate point 2 and 3 above to change other parameters.

Setting of Sverker 900: Prefault=0,5A $t=1000ms$ First fault: 1,5A $t=5000ms$

Pre fault

I1	0.500 A	0.0 °	50.000 Hz
I2	0.500 A	240.0 °	50.000 Hz
I3	0.500 A	120.0 °	50.000 Hz
U1	-----	-----	-----
U2	-----	-----	-----
U3	-----	-----	-----

0 VDC BI

Prefault: 1000 ms

STOPPED

First Fault

I1	1.50 A	0.0 °	50.000 Hz
I2	0.000 A	240.0 °	50.000 Hz
I3	0.000 A	120.0 °	50.000 Hz
U1	-----	-----	-----
U2	-----	-----	-----
U3	-----	-----	-----

0 VDC BI

Max: 5000 ms Off Delay: 0 ms

STOPPED

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MTT in (armed) mode
To generate push black knob

Press on value for parameter
Turn the knob for next value.

Note: When one or two phase test is made the not used phase/phases has to be set to zero.

Test values presented in report program Sverker Viewer

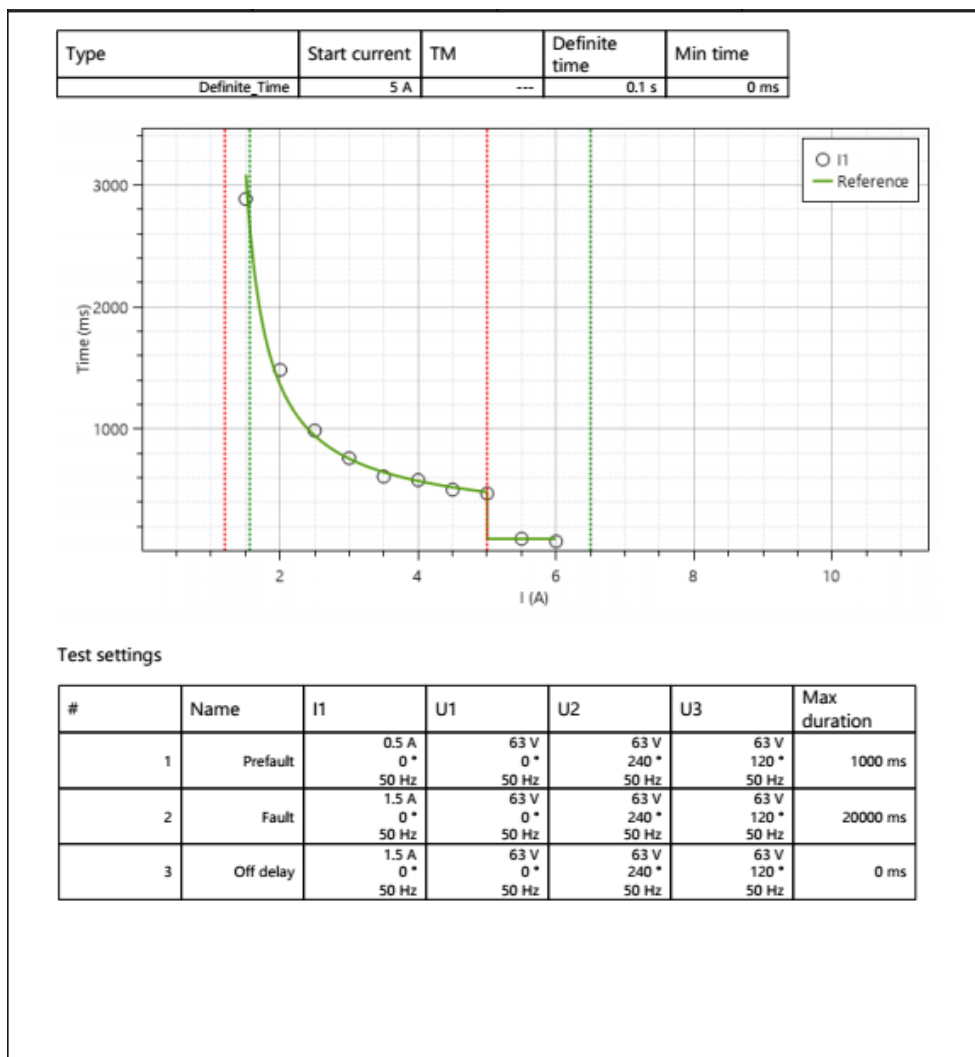
SVERKER Viewer		Megger Sweden AB	
Test equipment: Sverker 900		Test file created: 2020-09-04 05:14	
Station	Position	Type	Serial no.
Test room	Testrack	WIP1	

Test Report				
All tests				
OC Invers				2020-09-04 05:15
I>= 1,2A k= 0,1 I>>= 5A t= 100ms				
Test result				
I1	Trip time	Bi	Event	Reference time
1.5 A 0° 50 Hz	2888 ms	1	Trig	3130 ms
2 A 0° 50 Hz	1486 ms	1	Trig	1363 ms
2.5 A 0° 50 Hz	988 ms	1	Trig	947 ms
3 A 0° 50 Hz	761 ms	1	Trig	757 ms
3.5 A 0° 50 Hz	610 ms	1	Trig	647 ms
4 A 0° 50 Hz	581 ms	1	Trig	574 ms
4.5 A 0° 50 Hz	503 ms	1	Trig	523 ms
5 A 0° 50 Hz	471 ms	1	Trig	100 ms
5.5 A 0° 50 Hz	100 ms	1	Trig	100 ms
6 A 0° 50 Hz	78 ms	1	Trig	100 ms
Reference				
Type	Start current	TM	Definite time	Min time
IEC_A_Inverse	1.2 A	0.1	---	0 ms

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Graf presented in report program Sverker Viewer



Secondary testing of SEG (Woodward) WIC1

WIC1 have special CT connected made for that relay, there are different standard CT types available for the WIC1. The setting for primary start value are set by the position off dipswitches 1-1 to 1-4 or by position of HEX switch 1

DIP 1-1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 1-2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 1-3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 1-4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 1	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
WIC1-W1	8	9	10	11	12	13	14	15	16	17	18	20	22	24	26	28
WIC1-W2	16	18	20	22	24	26	28	30	32	34	36	40	44	48	52	56
WIC1-W3	32	36	40	44	48	52	56	60	64	68	72	80	88	96	104	112
WIC1-W4	64	72	80	88	96	104	112	120	128	136	144	160	176	192	208	224
WIC1-W5	128	144	160	176	192	208	224	240	256	272	288	320	352	384	416	448
WIC1-W6	256	288	320	352	384	416	448	480	512	544	576	640	704	768	832	896

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The secondary set value is decided from the primary setting and has the same value for all standard CT-s. Setting for I> and I>> are then related to this value, see tables below.

DIP 1-1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 1-2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 1-3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	ON	ON	ON	ON	ON
DIP 1-4	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	ON	ON
HEX switch I _s	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
WIC1-W1	8	9	10	11	12	13	14	15	16	17	18	20	22	24	26	28
Test current CD	0.32	0.36	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.80	0.88	0.96	1.04	1.12
WIC1-W2	16	18	20	22	24	26	28	30	32	34	36	40	44	48	52	56
Test current CD	0.32	0.36	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.80	0.88	0.96	1.04	1.12
WIC1-W3	32	36	40	44	48	52	56	60	64	68	72	80	88	96	104	112
Test current CD	0.32	0.36	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.80	0.88	0.96	1.04	1.12

Setting of definitive time or Characteristic curve

DIP 1-5	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 1-6	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 1-7	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 1-8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 2	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Characteristic	DEFT	N-INV	V-INV	E-INV	LI-INV	RI-INV	HV-Fuse	FR-Fuse	X	X	X	X	X	X	X	X

Secondary set value for I>

DIP 2-1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 2-2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 2-3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 2-4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 3	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
x Is	0.9	0.95	1	1.05	1.1	1.15	1.2	1.3	1.4	1.5	1.6	1.8	2	2.25	2.5	Exit

Setting of definitive time value or Characteristic curve value for “Factor a”

DIP 2-5	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 2-6	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 2-7	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON	ON	ON	ON
DIP 2-8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 4	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
time (s) *1	0.04	1	2	3	4	5	6	8	10	15	30	60	120	180	240	300
Time (s) *2	0.04	0.3	0.6	1	2	3	4	6	8	10	15	30	60	120	210	300
Factor “a”	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1	2	3	4	5	6	8	10

Secondary set value for I>> and time t>>

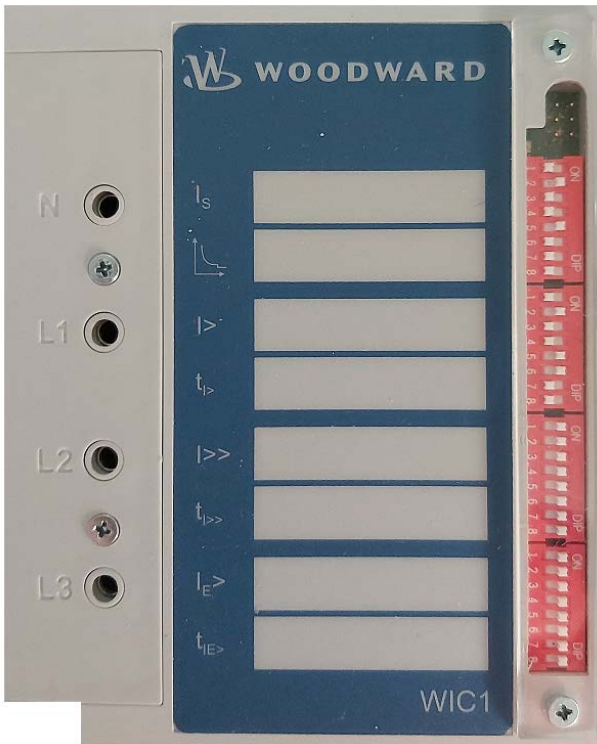
DIP 3-1	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 3-2	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 3-3	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 3-4	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 5	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
x Is	1	2	3	4	5	6	7	8	9	10	15	20	30	40	50	60

DIP 3-5	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
DIP 3-6	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 3-7	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON
DIP 3-8	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON
HEX 6	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
time (s)	0,04	0,07	0,1	0,15	0,2	0,25	0,3	0,4	0,5	0,6	0,8	1,0	1,5	2,0	3,0	4,0

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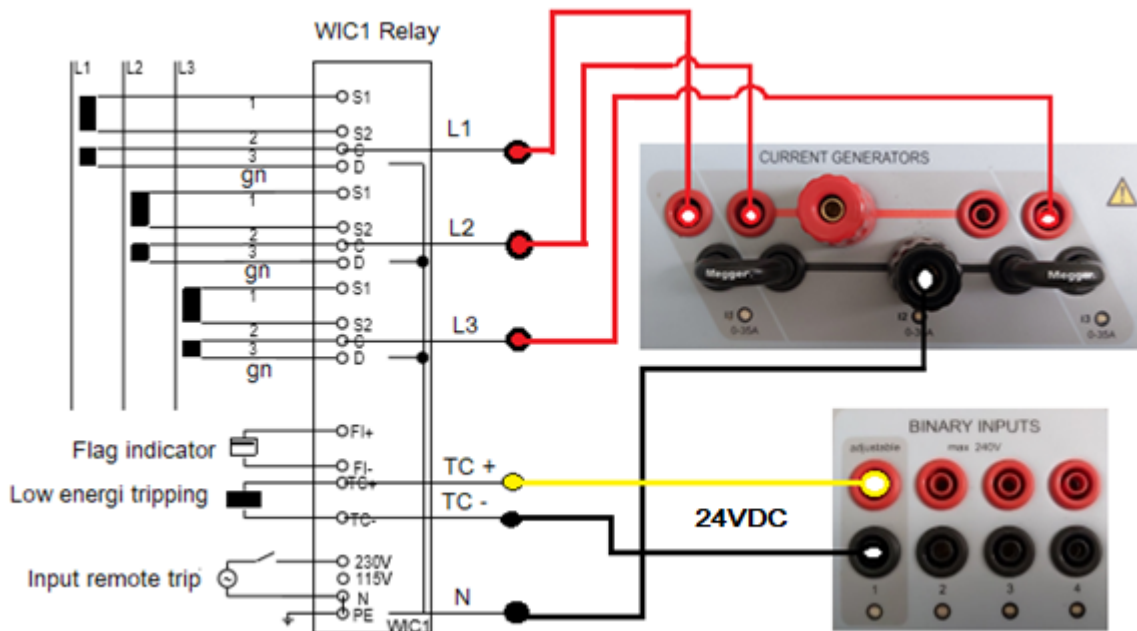
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WIC1 input for secondary injection and DIP switches for setting.



Connection for “Flag indicator”, “Low energy trip”, “Input remote trip” and “CT-s” are made under the cover.

The CT-s has a test winding inside and when the secondary test method is used, the test current is injected through the CD test winding, see drawing below.



SVERKER 900**Application for testing Self-powered relays SEG (Woodward) WIP1 and WIC1****Secondary test values**

Example: With DIP 1-1 to 1-4 set to "OFF" secondary start value I_s will be 0,32A for any standard CT used. The relation between current generated into test winding connection CD and the current that are simulated from primary side off CT are described in table below.

Example: For WIC1-W2 the corresponding primary current for 0,32A secondary will be 0,32Ax50A. This means that the current going back to S1-S2 should be the same as for primary injection with 16A.

CT Type	Induced Current	Primary Current	Transformation Ratio
WIC1-WE1	1A	25A	25:1
WIC1-W1	1A	25A	25:1
WIC1-WE2	1A	50A	50:1
WIC1-W2	1A	50A	50:1
WIC1-W3	1A	100A	100:1
WIC1-W4	1A	200A	200:1
WIC1-W5	1A	400A	400:1
WIC1-W6	1A	800A	800:1

Testing OC invers curve function with PreFault-Fault instrument in MTT mode.

(See Sverker 900 manual, for setting of Pf/f instrument BI and to make testing in MTT mode.)

Prefault is needed to energize the relay before trip. Without prefault the relay will show a slightly longer trip time

In this example the relay WIC1-W2 is used, see DIP switch position marked above for Protection setting: $I_{>=} I_s \times 1,4 = 0,45A$ $a = 0,2$ (NI curve) $I_{>>} = I_s \times 8 = 2,56A$ $t = 200ms$

Testing is made as for WIP1 but with below setting.

Setting of Sverker 900: Prefault= 0,25A $t = 5s$ First fault= 0,6A

BI1 set to 10VDC and debounce 30ms.

(BI1-s voltage level has to be set above 5V or the relay will trip instantaneously)

The relay is tested with points taken from trip by one phase fault at the time and with the other two phases set to zero.

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Points taken for one phase fault

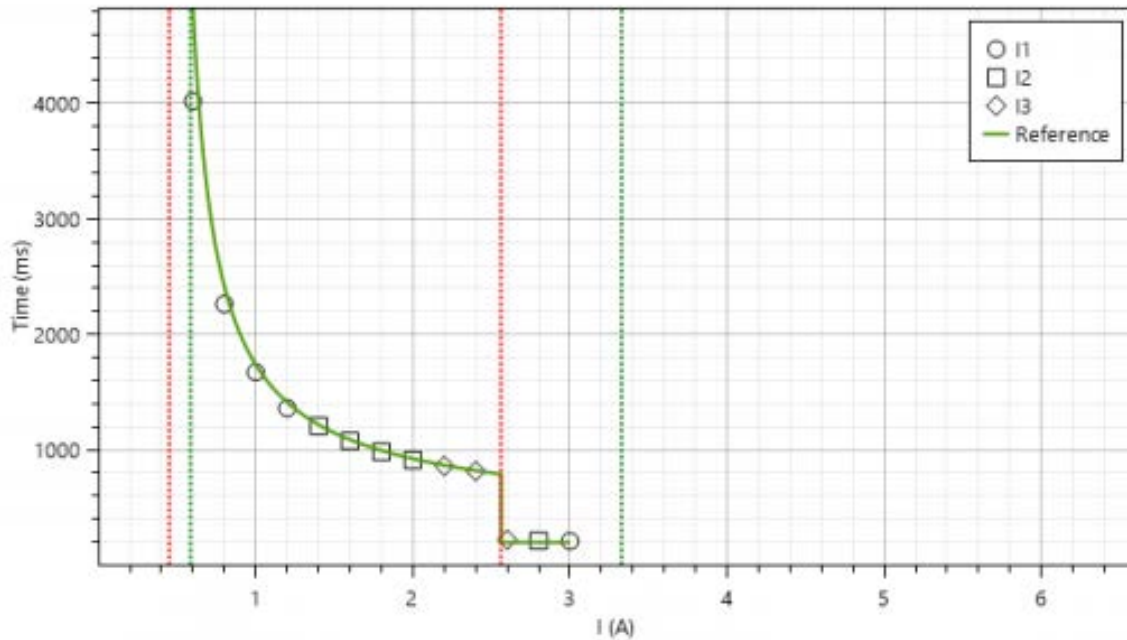
SVERKER Viewer			Megger Sweden AB			
Test equipment: Sverker 900			Test file created: 2020-09-23 16:08			
O/C normal inverse						
O/C normal inverse			2020-10-08 16:37			
Enfas test I>=0,45 a=0,2 I>>=2,56 t=200ms						
Test result						
I1	I2	I3	Trip time	BI	Event	Reference time
0.6 A 0 * 50 Hz	0 A 240 * 50 Hz	0 A 120 * 50 Hz	4022 ms		1 Trig	4852 ms
0.8 A 0 * 50 Hz	0 A 240 * 50 Hz	0 A 120 * 50 Hz	2265 ms		1 Trig	2419 ms
1 A 0 * 50 Hz	0 A 240 * 50 Hz	0 A 120 * 50 Hz	1674 ms		1 Trig	1739 ms
1.2 A 0 * 50 Hz	0 A 240 * 50 Hz	0 A 120 * 50 Hz	1362 ms		1 Trig	1413 ms
0 A 0 * 50 Hz	1.4 A 240 * 50 Hz	0 A 120 * 50 Hz	1209 ms		1 Trig	1220 ms
0 A 0 * 50 Hz	1.6 A 240 * 50 Hz	0 A 120 * 50 Hz	1077 ms		1 Trig	1090 ms
0 A 0 * 50 Hz	1.8 A 240 * 50 Hz	0 A 120 * 50 Hz	984 ms		1 Trig	996 ms
0 A 0 * 50 Hz	2 A 240 * 50 Hz	0 A 120 * 50 Hz	912 ms		1 Trig	925 ms
0 A 0 * 50 Hz	0 A 240 * 50 Hz	2.2 A 120 * 50 Hz	862 ms		1 Trig	868 ms
0 A 0 * 50 Hz	0 A 240 * 50 Hz	2.4 A 120 * 50 Hz	817 ms		1 Trig	822 ms
0 A 0 * 50 Hz	0 A 240 * 50 Hz	2.6 A 120 * 50 Hz	222 ms		1 Trig	200 ms
0 A 0 * 50 Hz	2.8 A 240 * 50 Hz	0 A 120 * 50 Hz	213 ms		1 Trig	200 ms
3 A 0 * 50 Hz	0 A 240 * 50 Hz	0 A 120 * 50 Hz	210 ms		1 Trig	200 ms
Reference						

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Graphical presentation

Type	Start current	TM	Definite time	Min time
IEC A Inverse	0.45 A	0.2	---	0 ms
Definite Time	2.56 A	---	0.2 s	0 ms



For a deeper reading please consider the Megger Technical Guide on the same subject: "Testing self-powered relays with SVERKER 900" that can be found here:

https://www.researchgate.net/publication/344340419_Testing_self-powered_relays_with_SVERKER_900_-_V01

Or under Megger address:

<https://megger.com/relay-and-substation-test-system-sverker900#technical>