Test Object - Device Settings

Substation/Bay:

Substation:		Substation address:	
Bay:		Bay address:	

Device:

Name/description:	Test Object	Manufacturer:	
Device type:		Device address:	
Serial/model number:			
Additional info 1:	Yazan Eissa		
Additional info 2:	lawal ibrahim okikiola		

Hardware Configuration

Test Equipment

Type	Serial Number
CMC156	NC693N

Hardware Check

Performed At	Result	Details
10.01.2025 09:27:08	Passed	

Advance Distance - SHOT:

Test Object - Device Settings

Substation/Bay:

Substation:		Substation address:	
Bay:		Bay address:	

Device:

Name/description:	Test Object	Manufacturer:	
Device type:		Device address:	
Serial/model number:			
Additional info 1:	Yazan Eissa		
Additional info 2:	lawal ibrahim okikiola		

Nominal Values:

f nom:	50,00 Hz	Number of phases:	3
V nom (secondary):	100,0 V	V primary:	110,0 kV
I nom (secondary):	1,000 A	I primary:	1,000 kA

Residual Voltage/Current Factors:

VLN / VN:	1,732	IN / I nom:	1,000
VN (secondary):	33,33 V	IN (secondary):	1,000 A
Residual Voltage	3 * V0	Residual Current	-3 * I0
Direction:		Direction:	

Limits:

V max:	200,0 V	I max:	50,00 A

Debounce/Deglitch Filters:

Debounce time:	3,000 ms	Deglitch time:	0,000 s

Overload Detection:

Suppression time: 50,00 ms

Other Device Properties:

Drop-out time: 20,00 ms

Test Object - Other RIO Functions

CB Configuration

Description	Name	Value
CB trip time	CB trip time	50,00 ms
CB close time	CB close time	100,00 ms
Times for 52a, 52b in percent of CB time	52a, 52b % of CB	20,00 %

Test Object - Distance Settings

System parameters:

Line length:	4,280 Ω	Line angle:	57,00 °
PT connection:	at line	CT starpoint:	Dir. line
Impedance correction 1A/I nom:	no		
Impedances in primary values:	no		

Tolerances:

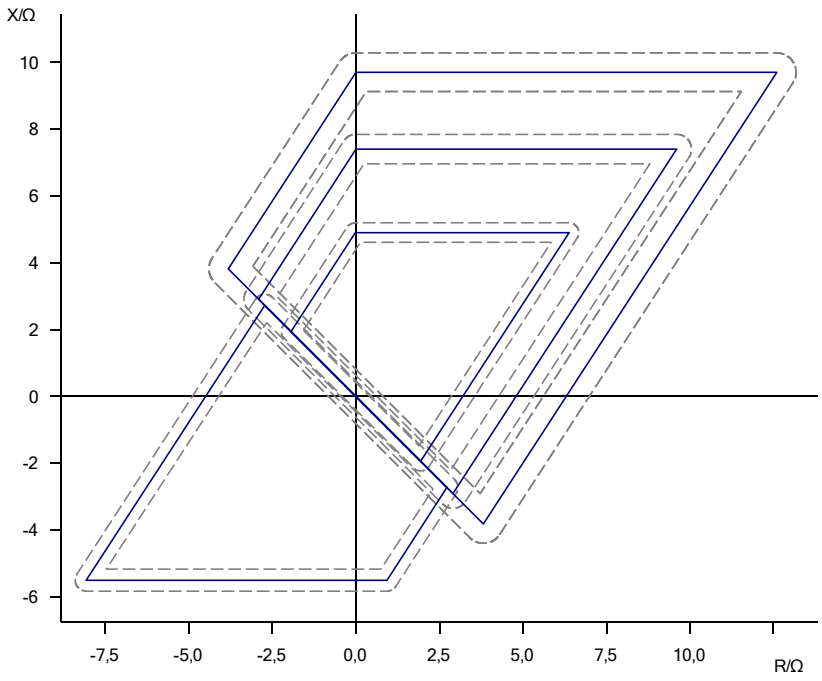
Tol. T rel.:	5,000 %		
Tol. T abs. +:	50,00 ms	Tol. T abs. -:	0,000 s
Tol. Z rel.:	5,000 %	Tol. Z abs.:	50,00 mΩ

Grounding factor:

kL mag.:	1,000000	kL angle:	0,000000°
Separate arc resistance:	no		

Zone Settings:

Label	Type	Fault loop	Trip time	Tol. T rel	Tol. T abs+	Tol. T abs-	Tol. Z rel.	Tol. Z abs
Z1 All	Tripping	All	0,000 s	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ
Z2 All	Tripping	All	300,0 ms	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ
Z3 All	Tripping	All	500,0 ms	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ
Z5 All	Tripping	All	1,500 s	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ
Z4 All	Tripping	All	500,0 ms	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ



Linked XRIO References

Reference Name	Unit	Value	XRIO Path
RIO.DEVICE.NOMINALVALUES.INOM	In	1,00 A	RIO/Device/Nominal Values/In
RIO.DEVICE.NOMINALVALUES.VNOM	V_nom	100,00 V	RIO/Device/Nominal Values/V nom

Comment

Test Module

Name:	OMICRON Advanced Distance	Version:	4.31
Test Start:	10-Jan-2025 10:00:37	Test End:	10-Jan-2025 10:02:16
User Name:		Manager:	
Company:			

Test Settings

Test model:

Test model:	Constant test current	ITest:	2,000 A
Allow reduction of ITest/VTest:	No	kS = kL:	No
ZS mag.:	0,000 Ω	ZS angle:	0,00 °
kS mag.:	1,000	kS angle:	0,00 °

Fault Inception:

Mode:	Random	Angle:	n/a
DC-offset:	No		

Times:

Prefault:	1,000 s	Max. fault:	6,000 s
Postfault:	500,0 ms	Time reference:	Fault inception

Other:

Extended zones:	Not active	Switch off at zero crossing:	Yes
Load current enabled:	No	Load current::	n/a

Search Settings:

Search res. rel.:	1,000 %	Search res. abs.:	50,00 mΩ
Ignore nominal characteristics:	No		
Search interval:	200,0 mΩ		

Binary Inputs:

Trigger Logic: OR

Name	Trigger State
trip	1
pick-up	X

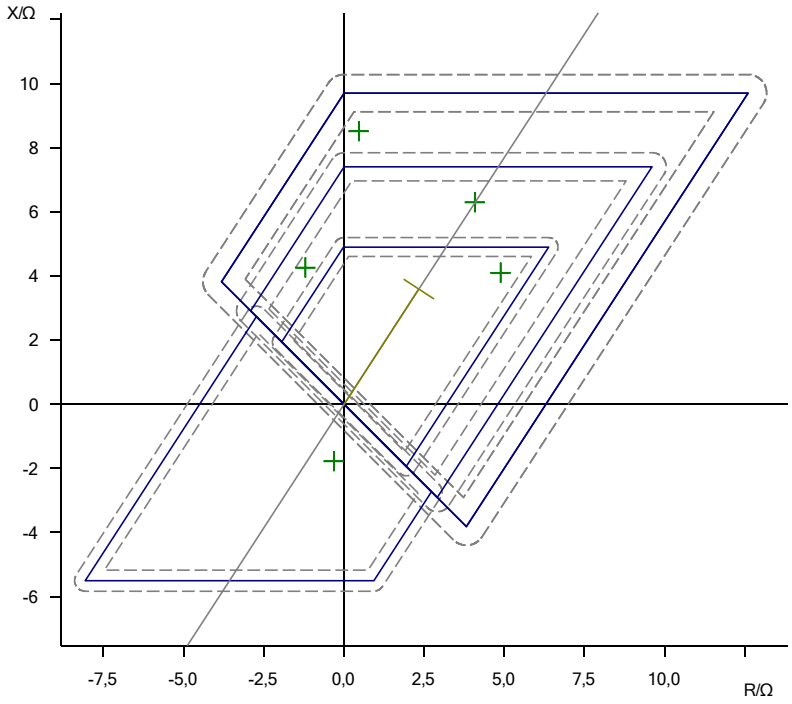
Binary Outputs:

Name	Fault inception Delay time	Slope	Trip Delay time	Slope

Test Results

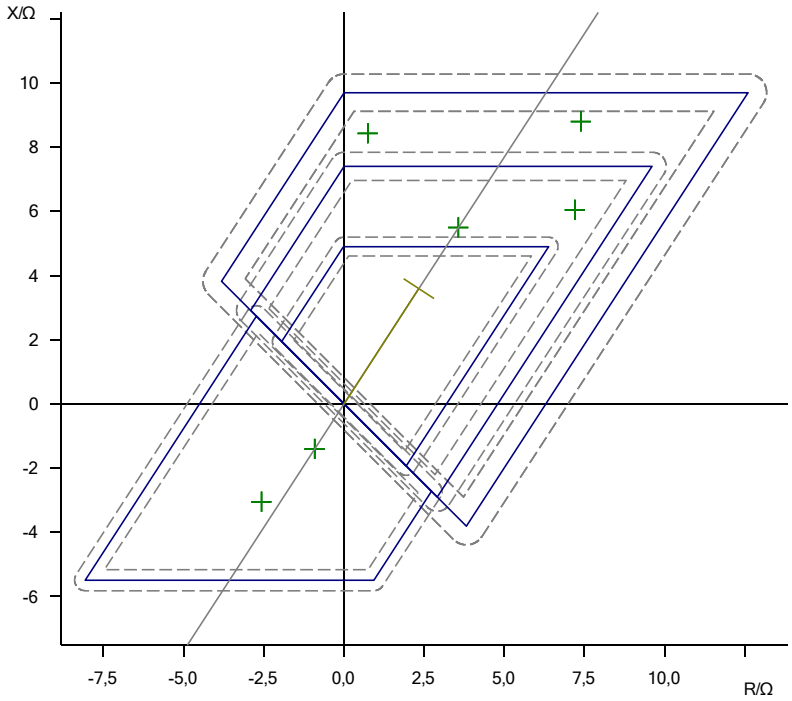
Shot Test: Fault Type L1-E

| Z |	Phi	%	% of	t nom	t act.	Dev.	ITest	Result
1,805 Ω	-100,00 °	n/a		500,0 ms	512,7 ms	2,54 %	2,000 A	Passed
6,369 Ω	40,00 °	n/a		0,000 s	21,70 ms	21,70 ms	2,000 A	Passed
8,519 Ω	86,90 °	n/a		500,0 ms	517,6 ms	3,52 %	2,000 A	Passed
4,426 Ω	105,85 °	n/a		300,0 ms	310,8 ms	3,6 %	2,000 A	Passed
7,500 Ω	57,00 °	n/a		300,0 ms	306,0 ms	2 %	2,000 A	Passed



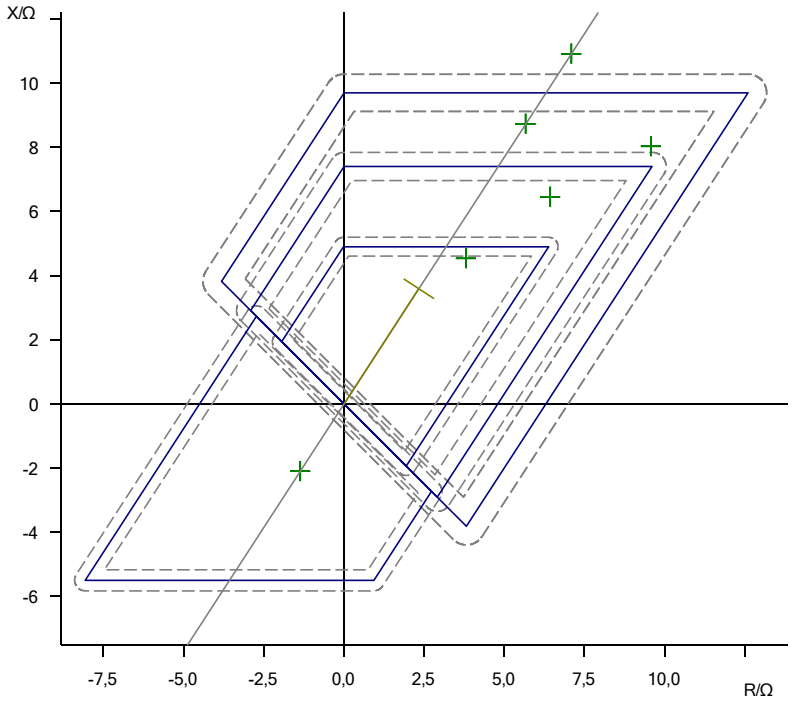
Shot Test: Fault Type L2-E

| Z |	Phi	%	% of	t nom	t act.	Dev.	ITest	Result
9,402 Ω	40,00 °	n/a		300,0 ms	305,8 ms	1,933 %	2,000 A	Passed
8,463 Ω	84,99 °	n/a		500,0 ms	507,8 ms	1,56 %	2,000 A	Passed
3,997 Ω	-130,00 °	n/a		500,0 ms	509,9 ms	1,98 %	2,000 A	Passed
11,49 Ω	50,00 °	n/a		500,0 ms	515,2 ms	3,04 %	2,000 A	Passed
6,549 Ω	57,00 °	n/a		300,0 ms	311,0 ms	3,667 %	2,000 A	Passed
1,679 Ω	-123,00 °	n/a		500,0 ms	503,8 ms	0,76 %	2,000 A	Passed



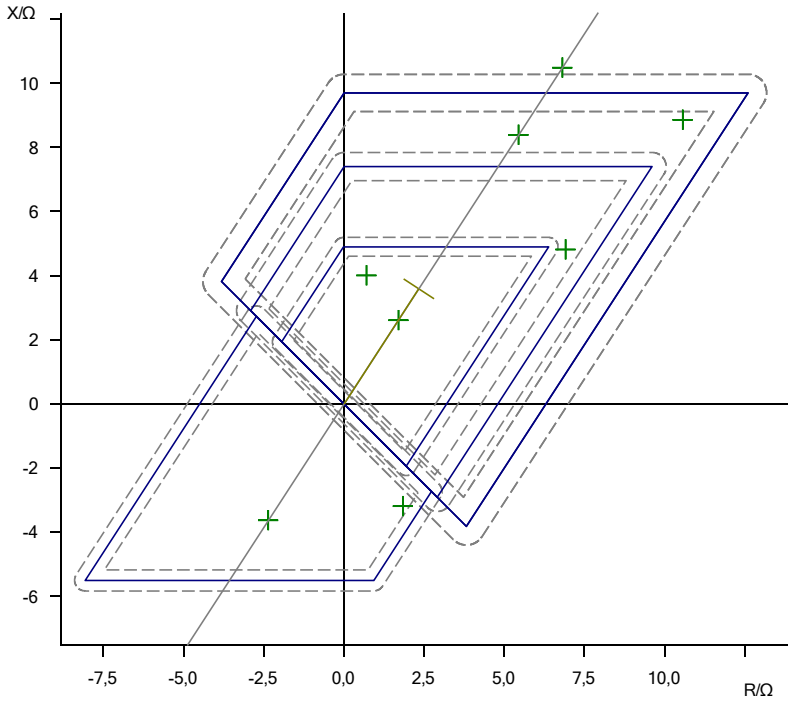
Shot Test: Fault Type L3-E

| Z |	Phi	%	% of	t nom	t act.	Dev.	ITest	Result
9,112 Ω	45,13 °	n/a		300,0 ms	309,9 ms	3,3 %	2,000 A	Passed
5,916 Ω	50,00 °	n/a		0,000 s	22,30 ms	22,30 ms	2,000 A	Passed
12,50 Ω	40,00 °	n/a		500,0 ms	516,0 ms	3,2 %	2,000 A	Passed
10,40 Ω	57,00 °	n/a		500,0 ms	512,3 ms	2,46 %	2,000 A	Passed
13,01 Ω	57,00 °	n/a		1,500 s	1,515 s	0,9667 %	2,000 A	Passed
2,500 Ω	-123,00 °	n/a		500,0 ms	506,3 ms	1,26 %	2,000 A	Passed



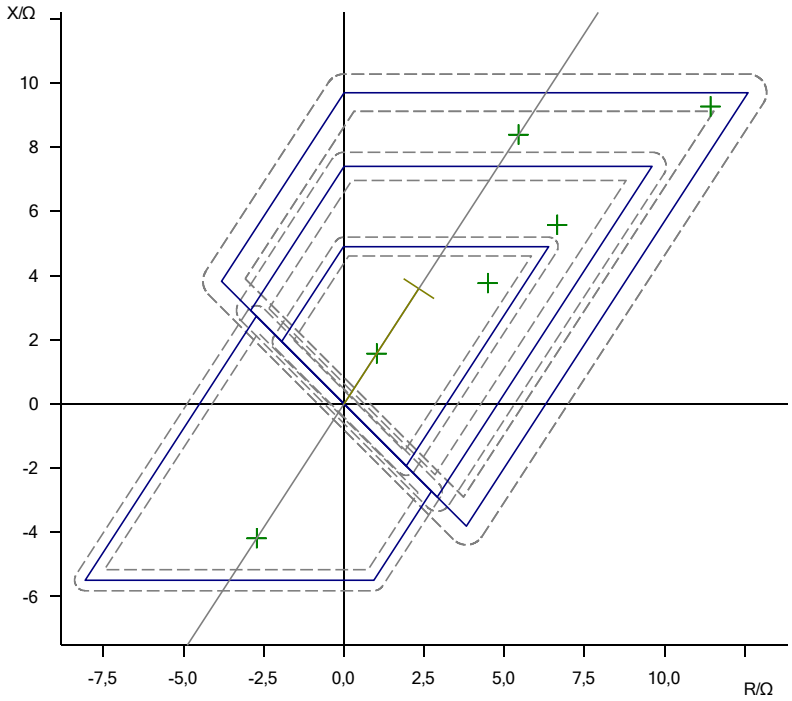
Shot Test: Fault Type L1-L2

| Z |	Phi	%	% of	t nom	t act.	Dev.	ITest	Result
4,066 Ω	80,00 °	n/a		0,000 s	21,40 ms	21,40 ms	2,000 A	Passed
8,420 Ω	34,87 °	n/a		300,0 ms	305,2 ms	1,733 %	2,000 A	Passed
13,79 Ω	40,00 °	n/a		500,0 ms	520,5 ms	4,1 %	2,000 A	Passed
3,676 Ω	-60,00 °	n/a		500,0 ms	508,4 ms	1,68 %	2,000 A	Passed
12,50 Ω	57,00 °	n/a		1,500 s	1,513 s	0,8867 %	2,000 A	Passed
10,00 Ω	57,00 °	n/a		500,0 ms	503,6 ms	0,72 %	2,000 A	Passed
3,118 Ω	57,00 °	n/a		0,000 s	19,70 ms	19,70 ms	2,000 A	Passed
4,330 Ω	-123,00 °	n/a		500,0 ms	502,4 ms	0,48 %	2,000 A	Passed



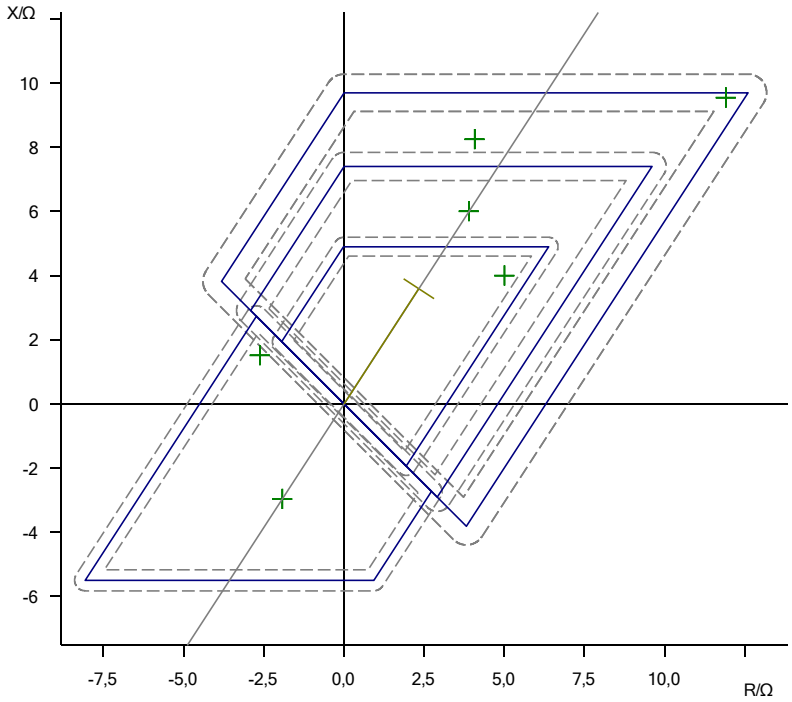
Shot Test: Fault Type L2-L3

| Z |	Phi	%	% of	t nom	t act.	Dev.	ITest	Result
5,853 Ω	40,00 °	n/a		0,000 s	20,20 ms	20,20 ms	2,000 A	Passed
8,681 Ω	40,00 °	n/a		300,0 ms	318,2 ms	6,067 %	2,000 A	Passed
14,72 Ω	39,02 °	n/a		500,0 ms	525,3 ms	5,06 %	2,000 A	Passed
10,00 Ω	57,00 °	n/a		500,0 ms	504,6 ms	0,92 %	2,000 A	Passed
5,000 Ω	-123,00 °	n/a		500,0 ms	504,6 ms	0,92 %	2,000 A	Passed
1,868 Ω	57,00 °	n/a		0,000 s	21,80 ms	21,80 ms	2,000 A	Passed



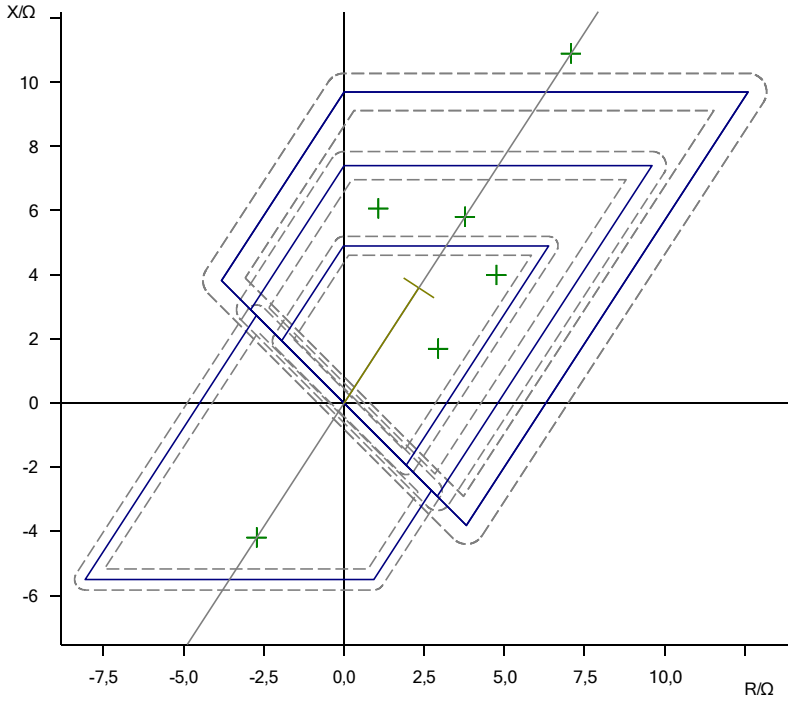
Shot Test: Fault Type L3-L1

| Z |	Phi	%	% of	t nom	t act.	Dev.	ITest	Result
6,403 Ω	38,66 °	n/a		0,000 s	21,70 ms	21,70 ms	2,000 A	Passed
9,205 Ω	63,72 °	n/a		500,0 ms	508,8 ms	1,76 %	2,000 A	Passed
15,27 Ω	38,69 °	n/a		500,0 ms	517,8 ms	3,56 %	2,000 A	Passed
3,024 Ω	150,00 °	n/a		500,0 ms	504,7 ms	0,94 %	2,000 A	Passed
7,158 Ω	57,00 °	n/a		300,0 ms	308,7 ms	2,9 %	2,000 A	Passed
3,537 Ω	-123,00 °	n/a		500,0 ms	511,7 ms	2,34 %	2,000 A	Passed



Shot Test: Fault Type L1-L2-L3

| Z |	Phi	%	% of	t nom	t act.	Dev.	ITest	Result
3,392 Ω	30,00 °	n/a		0,000 s	20,60 ms	20,60 ms	2,000 A	Passed
6,209 Ω	40,00 °	n/a		0,000 s	20,70 ms	20,70 ms	2,000 A	Passed
6,160 Ω	80,00 °	n/a		300,0 ms	311,5 ms	3,833 %	2,000 A	Passed
12,99 Ω	57,00 °	n/a		1,500 s	1,513 s	0,8467 %	2,000 A	Passed
6,926 Ω	57,00 °	n/a		300,0 ms	303,0 ms	1 %	2,000 A	Passed
5,000 Ω	-123,00 °	n/a		500,0 ms	510,4 ms	2,08 %	2,000 A	Passed



Shot Details:

Parameters:

Fault Type:	L1-E		
| Z |:	2,500 Ω	Phi:	-123,00 °
R:	-1,362 Ω	X:	-2,097 Ω
%:	n/a	% of:	
ITest:	2,000 A		

Results:

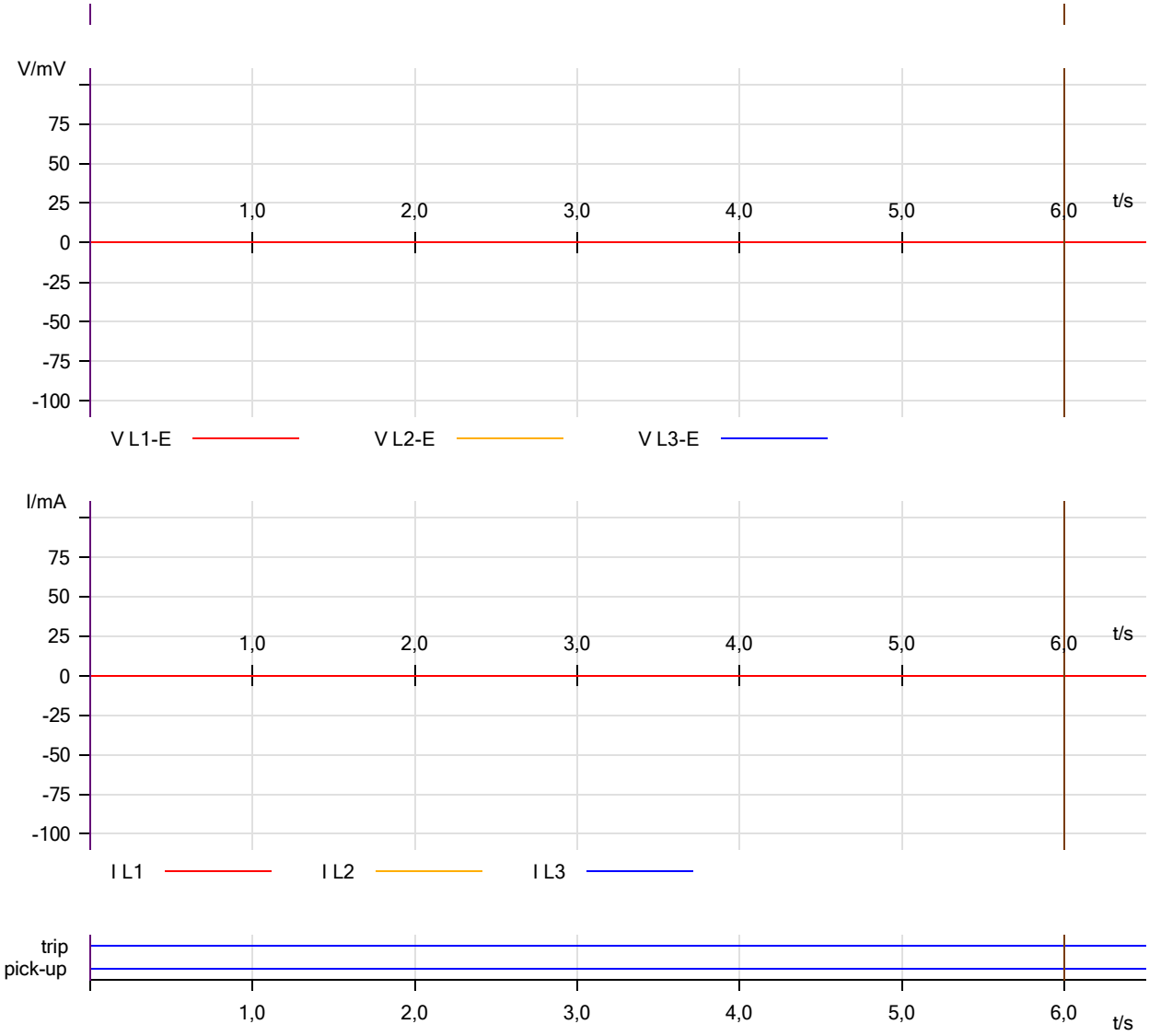
t act.:	n/a	Assessment:	Not tested
t nom:	500,0 ms	Dev.:	n/a
t min:	475,0 ms	t max:	550,0 ms

Fault Quantities (natural):

VL1:	10,00 V	0,00 °
VL2:	57,74 V	-120,00 °
VL3:	57,74 V	120,00 °
IL1:	2,000 A	123,00 °
IL2:	0,000 A	n/a
IL3:	0,000 A	n/a
VFault:	10,00 V	0,00 °
IFault:	2,000 A	123,00 °

Fault Quantities (symmetrical):

V0:	15,91 V	180,00 °
V1:	41,82 V	0,00 °
V2:	15,91 V	180,00 °
I0:	666,7 mA	123,00 °
I1:	666,7 mA	123,00 °
I2:	666,7 mA	123,00 °



Cursor Data

	Time	Signal	Value
Cursor 1	0,000 s	<none>	n/a
Cursor 2	6,000 s	<none>	n/a
C2 - C1	6,000 s		n/a

Test State:

Test passed

Advanced Distance-CHECK:

Test Object - Device Settings

Substation/Bay:

Substation:
Bay:

Substation address:
Bay address:

Device:

Name/description:	Test Object	Manufacturer:	
Device type:		Device address:	
Serial/model number:			
Additional info 1:	Yazan Eissa		
Additional info 2:	lawal ibrahim okikiola		

Nominal Values:

f nom:	50,00 Hz	Number of phases:	3
V nom (secondary):	100,0 V	V primary:	110,0 kV
I nom (secondary):	1,000 A	I primary:	1,000 kA

Residual Voltage/Current Factors:

VLN / VN:	1,732	IN / I nom:	1,000
VN (secondary):	33,33 V	IN (secondary):	1,000 A
Residual Voltage Direction:	3 * V0	Residual Current Direction:	-3 * I0

Limits:

V max:	200,0 V	I max:	50,00 A

Debounce/Deglitch Filters:

Debounce time:	3,000 ms	Deglitch time:	0,000 s

Overload Detection:

Suppression time:	50,00 ms

Other Device Properties:

Drop-out time:	20,00 ms

Test Object - Other RIO Functions

CB Configuration

Description	Name	Value
CB trip time	CB trip time	50,00 ms
CB close time	CB close time	100,00 ms
Times for 52a, 52b in percent of CB time	52a, 52b % of CB	20,00 %

Test Object - Distance Settings

System parameters:

Line length:	4,280 Ω	Line angle:	57,00 °
PT connection:	at line	CT starpoint:	Dir. line
Impedance correction 1A/I nom:	no		
Impedances in primary values:	no		

Tolerances:

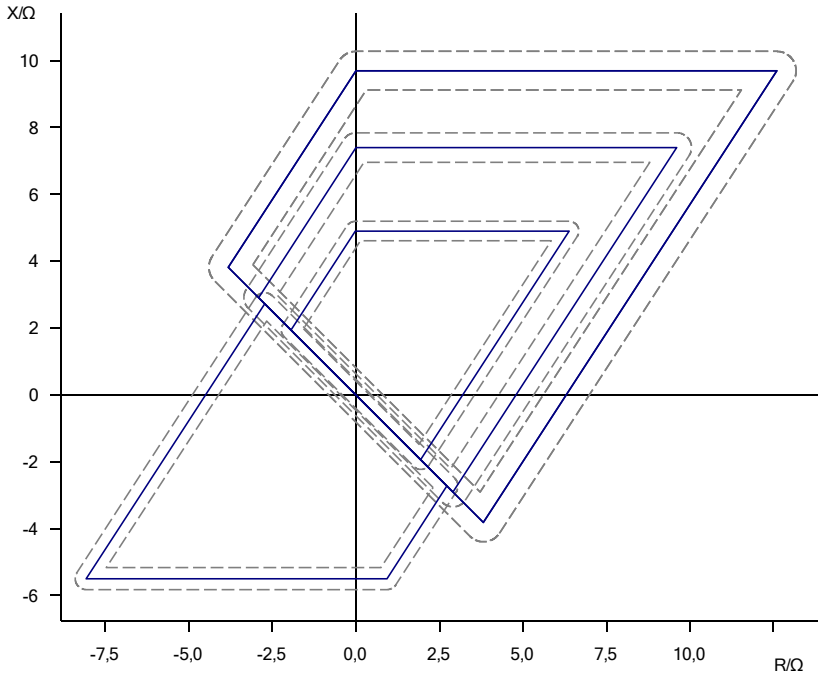
Tol. T rel.:	5,000 %		
Tol. T abs. +:	50,00 ms	Tol. T abs. -:	0,000 s
Tol. Z rel.:	5,000 %	Tol. Z abs.:	50,00 mΩ

Grounding factor:

kL mag.:	1,000000	kL angle:	0,000000°
Separate arc resistance:	no		

Zone Settings:

Label	Type	Fault loop	Trip time	Tol. T rel	Tol. T abs+	Tol. T abs-	Tol. Z rel.	Tol. Z abs
Z1 All	Tripping	All	0,000 s	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ
Z2 All	Tripping	All	300,0 ms	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ
Z3 All	Tripping	All	500,0 ms	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ
Z5 All	Tripping	All	1,500 s	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ
Z4 All	Tripping	All	500,0 ms	5,000 %	50,00 ms	0,000 s	5,000 %	50,00 mΩ



Linked XRIO References

Reference Name	Unit	Value	XRIO Path
RIO.DEVICE.NOMINALVALUES.INOM	In	1,00 A	RIO/Device/Nominal Values/In
RIO.DEVICE.NOMINALVALUES.VNOM	V_nom	100,00 V	RIO/Device/Nominal Values/V nom

Comment

Test Module

Name:	OMICRON Advanced Distance	Version:	4.31
Test Start:	10-Jan-2025 09:52:48	Test End:	10-Jan-2025 09:59:09
User Name:		Manager:	
Company:			

Test Settings

Test model:

Test model:	Constant test current	ITest:	2,000 A
Allow reduction of ITest/VTest:	No	kS = kL:	No
ZS mag.:	0,000 Ω	ZS angle:	0,00 °
kS mag.:	1,000	kS angle:	0,00 °

Fault Inception:

Mode:	Random	Angle:	n/a
DC-offset:	No		

Times:

Prefault:	1,000 s	Max. fault:	6,000 s
Postfault:	500,0 ms	Time reference:	Fault inception

Other:

Extended zones:	Not active	Switch off at zero crossing:	Yes
Load current enabled:	No	Load current::	n/a

Search Settings:

Search res. rel.:	1,000 %	Search res. abs.:	50,00 mΩ
Ignore nominal characteristics:	No		
Search interval:	200,0 mΩ		

Binary Inputs:

Trigger Logic: OR

Name	Trigger State
trip	1
pick-up	X

Binary Outputs:

Name	Fault inception Delay time	Slope	Trip Delay time	Slope

Test Results

Check Test: Fault Type L1-E

| Z |:	0,000 Ω	Phi:	0,00 °	Angle:	0,00 °	Result:	Passed
Length:	10,11 Ω	%:	160,50 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
413,1 mΩ	0,00 °	0,000 s	23,10 ms	23,10 ms	2,000 A	Passed
2,852 Ω	0,00 °	0,000 s	21,80 ms	21,80 ms	2,000 A	Passed
3,548 Ω	0,00 °	300,0 ms	310,7 ms	3,567 %	2,000 A	Passed
4,274 Ω	0,00 °	300,0 ms	319,4 ms	6,467 %	2,000 A	Passed
5,326 Ω	0,00 °	500,0 ms	507,6 ms	1,52 %	2,000 A	Passed
5,611 Ω	0,00 °	500,0 ms	520,8 ms	4,16 %	2,000 A	Passed
6,990 Ω	0,00 °	1,500 s	1,515 s	1,027 %	2,000 A	Passed
6,990 Ω	0,00 °	1,500 s	1,509 s	0,5667 %	2,000 A	Passed

| Z |:	1,000 Ω	Phi:	0,00 °	Angle:	90,00 °	Result:	Passed
Length:	15,57 Ω	%:	160,50 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
4,715 Ω	77,76 °	0,000 s	25,40 ms	25,40 ms	2,000 A	Passed
5,288 Ω	79,10 °	300,0 ms	307,8 ms	2,6 %	2,000 A	Passed
7,030 Ω	81,82 °	300,0 ms	320,9 ms	6,967 %	2,000 A	Passed
7,905 Ω	82,73 °	500,0 ms	506,9 ms	1,38 %	2,000 A	Passed
9,176 Ω	83,74 °	500,0 ms	516,0 ms	3,2 %	2,000 A	Passed
10,33 Ω	84,44 °	1,500 s	1,517 s	1,12 %	2,000 A	Passed
10,33 Ω	84,44 °	1,500 s	1,516 s	1,073 %	2,000 A	Passed

| Z |:	1,000 Ω	Phi:	90,00 °	Angle:	0,00 °	Result:	Passed
Length:	11,15 Ω	%:	160,50 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
3,641 Ω	15,94 °	0,000 s	19,70 ms	19,70 ms	2,000 A	Passed
4,315 Ω	13,40 °	300,0 ms	316,7 ms	5,567 %	2,000 A	Passed
5,024 Ω	11,48 °	300,0 ms	315,4 ms	5,133 %	2,000 A	Passed
6,059 Ω	9,50 °	500,0 ms	515,2 ms	3,04 %	2,000 A	Passed
6,339 Ω	9,08 °	500,0 ms	511,8 ms	2,36 %	2,000 A	Passed
7,704 Ω	7,46 °	1,500 s	1,509 s	0,6 %	2,000 A	Passed
7,704 Ω	7,46 °	1,500 s	1,511 s	0,7 %	2,000 A	Passed

| Z |:	0,000 Ω	Phi:	0,00 °	Angle:	64,00 °	Result:	Passed

Length: 17,32 Ω %: 160,50 % % of: All zones

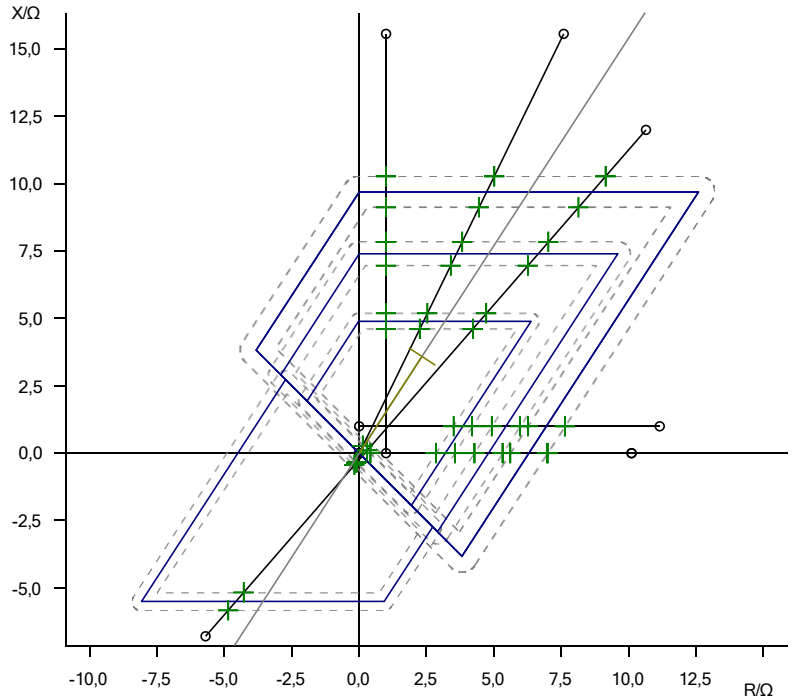
| Z |	Phi	t nom	t act.	Dev.	ITest	Result
309,0 mΩ	64,00 °	0,000 s	25,30 ms	25,30 ms	2,000 A	Passed
5,127 Ω	64,00 °	0,000 s	25,70 ms	25,70 ms	2,000 A	Passed
5,777 Ω	64,00 °	300,0 ms	313,5 ms	4,5 %	2,000 A	Passed
7,742 Ω	64,00 °	300,0 ms	319,1 ms	6,367 %	2,000 A	Passed
8,724 Ω	64,00 °	500,0 ms	508,2 ms	1,64 %	2,000 A	Passed
10,15 Ω	64,00 °	500,0 ms	516,9 ms	3,38 %	2,000 A	Passed
11,44 Ω	64,00 °	1,500 s	1,519 s	1,247 %	2,000 A	Passed
11,44 Ω	64,00 °	1,500 s	1,507 s	0,48 %	2,000 A	Passed

| Z |: 0,000 Ω Phi: 0,00 ° Angle: 0,00 ° Result: Passed
Length: 10,11 Ω %: 160,50 % % of: All zones

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
413,1 mΩ	0,00 °	0,000 s	22,70 ms	22,70 ms	2,000 A	Passed
2,852 Ω	0,00 °	0,000 s	21,40 ms	21,40 ms	2,000 A	Passed
3,548 Ω	0,00 °	300,0 ms	304,9 ms	1,633 %	2,000 A	Passed
4,274 Ω	0,00 °	300,0 ms	309,1 ms	3,033 %	2,000 A	Passed
5,326 Ω	0,00 °	500,0 ms	511,3 ms	2,26 %	2,000 A	Passed
5,611 Ω	0,00 °	500,0 ms	518,3 ms	3,66 %	2,000 A	Passed
6,990 Ω	0,00 °	1,500 s	1,517 s	1,153 %	2,000 A	Passed
6,990 Ω	0,00 °	1,500 s	1,506 s	0,3933 %	2,000 A	Passed

| Z |: 8,876 Ω Phi: -130,00 ° Angle: 48,99 ° Result: Passed
Length: 24,91 Ω %: 113,94 % % of: All zones

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
7,589 Ω	-129,83 °	1,500 s	1,518 s	1,207 %	2,000 A	Passed
6,720 Ω	-129,68 °	500,0 ms	517,5 ms	3,5 %	2,000 A	Passed
479,4 mΩ	-111,97 °	500,0 ms	509,7 ms	1,94 %	2,000 A	Passed
373,9 mΩ	-106,28 °	500,0 ms	506,3 ms	1,26 %	2,000 A	Passed
341,7 mΩ	-103,76 °	500,0 ms	515,9 ms	3,18 %	2,000 A	Passed
322,4 mΩ	19,97 °	0,000 s	20,00 ms	20,00 ms	2,000 A	Passed
6,244 Ω	47,55 °	0,000 s	32,00 ms	32,00 ms	2,000 A	Passed
7,018 Ω	47,71 °	300,0 ms	312,9 ms	4,3 %	2,000 A	Passed
9,359 Ω	48,03 °	300,0 ms	320,7 ms	6,9 %	2,000 A	Passed
10,53 Ω	48,14 °	500,0 ms	509,6 ms	1,92 %	2,000 A	Passed
12,23 Ω	48,26 °	500,0 ms	513,6 ms	2,72 %	2,000 A	Passed
13,76 Ω	48,34 °	1,500 s	1,514 s	0,9 %	2,000 A	Passed
13,76 Ω	48,34 °	1,500 s	1,516 s	1,047 %	2,000 A	Passed



Check Test: Fault Type L2-L3

| Z |:	11,66 Ω	Phi:	75,23 °	Angle:	-80,14 °	Result:	Passed
Length:	17,25 Ω	%:	131,32 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
10,75 Ω	72,98 °	1,500 s	1,507 s	0,4667 %	2,000 A	Passed
10,75 Ω	72,98 °	1,500 s	1,504 s	0,2667 %	2,000 A	Passed
9,717 Ω	69,85 °	500,0 ms	517,7 ms	3,54 %	2,000 A	Passed
8,616 Ω	65,52 °	500,0 ms	504,1 ms	0,82 %	2,000 A	Passed
7,892 Ω	61,85 °	300,0 ms	315,3 ms	5,1 %	2,000 A	Passed
6,573 Ω	52,18 °	300,0 ms	306,7 ms	2,233 %	2,000 A	Passed
6,189 Ω	48,12 °	0,000 s	24,30 ms	24,30 ms	2,000 A	Passed
5,156 Ω	29,36 °	0,000 s	20,90 ms	20,90 ms	2,000 A	Passed
4,936 Ω	19,92 °	300,0 ms	308,0 ms	2,667 %	2,000 A	Passed
4,860 Ω	9,47 °	300,0 ms	315,1 ms	5,033 %	2,000 A	Passed
5,038 Ω	-5,45 °	500,0 ms	512,6 ms	2,52 %	2,000 A	Passed
5,142 Ω	-9,22 °	500,0 ms	510,6 ms	2,12 %	2,000 A	Passed
5,920 Ω	-24,97 °	1,500 s	1,500 s	0,0267 %	2,000 A	Passed
5,920 Ω	-24,97 °	1,500 s	1,510 s	0,6467 %	2,000 A	Passed

| Z |:	10,84 Ω	Phi:	81,52 °	Angle:	253,29 °	Result:	Passed
Length:	18,54 Ω	%:	109,45 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
10,38 Ω	81,89 °	1,500 s	1,517 s	1,1 %	2,000 A	Passed
10,38 Ω	81,89 °	1,500 s	1,512 s	0,82 %	2,000 A	Passed
9,190 Ω	83,01 °	500,0 ms	521,1 ms	4,22 %	2,000 A	Passed
7,875 Ω	84,65 °	500,0 ms	518,6 ms	3,72 %	2,000 A	Passed
6,975 Ω	86,14 °	300,0 ms	318,6 ms	6,2 %	2,000 A	Passed
5,189 Ω	90,69 °	300,0 ms	311,0 ms	3,667 %	2,000 A	Passed
3,571 Ω	99,04 °	0,000 s	22,00 ms	22,00 ms	2,000 A	Passed
1,942 Ω	126,35 °	0,000 s	39,30 ms	39,30 ms	2,000 A	Passed
1,631 Ω	145,32 °	500,0 ms	506,9 ms	1,38 %	2,000 A	Passed
1,619 Ω	146,68 °	500,0 ms	510,4 ms	2,08 %	2,000 A	Passed
1,587 Ω	151,14 °	500,0 ms	511,2 ms	2,24 %	2,000 A	Passed
6,068 Ω	-121,53 °	500,0 ms	501,8 ms	0,36 %	2,000 A	Passed
6,732 Ω	-120,04 °	1,500 s	1,512 s	0,8 %	2,000 A	Passed

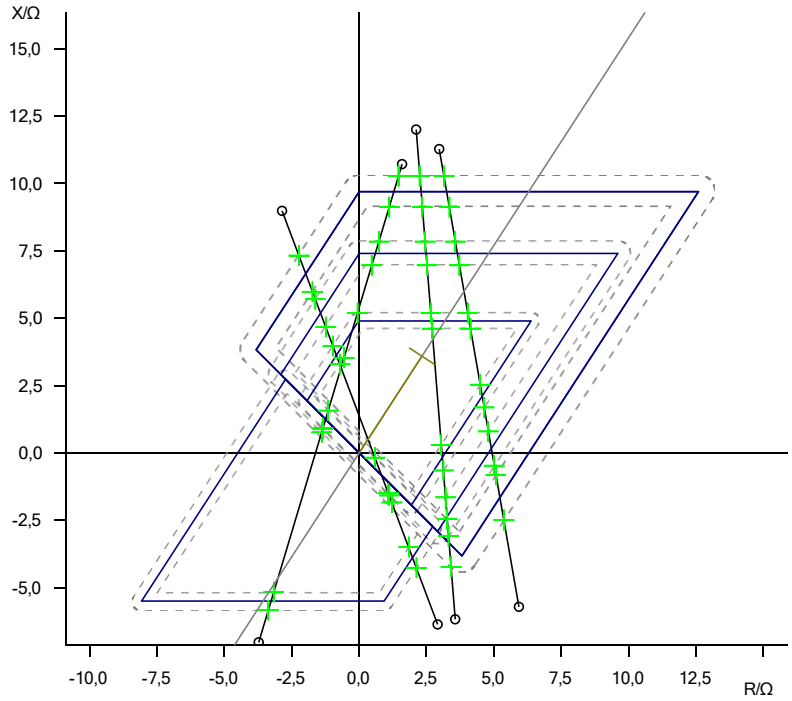
| Z |:	9,420 Ω	Phi:	107,67 °	Angle:	-69,37 °	Result:	Passed
Length:	16,39 Ω	%:	119,33 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
7,654 Ω	106,98 °	1,500 s	1,500 s	0,0267 %	2,000 A	Passed
7,654 Ω	106,98 °	1,500 s	1,510 s	0,6867 %	2,000 A	Passed
6,222 Ω	106,14 °	500,0 ms	513,5 ms	2,7 %	2,000 A	Passed
5,926 Ω	105,91 °	500,0 ms	516,6 ms	3,32 %	2,000 A	Passed
4,835 Ω	104,85 °	300,0 ms	301,9 ms	0,6333 %	2,000 A	Passed
4,084 Ω	103,78 °	300,0 ms	306,0 ms	2 %	2,000 A	Passed
3,365 Ω	102,30 °	0,000 s	21,50 ms	21,50 ms	2,000 A	Passed
610,9 mΩ	-16,43 °	0,000 s	21,90 ms	21,90 ms	2,000 A	Passed
1,850 Ω	-54,09 °	500,0 ms	507,7 ms	1,54 %	2,000 A	Passed
1,933 Ω	-54,76 °	500,0 ms	508,3 ms	1,66 %	2,000 A	Passed
2,200 Ω	-56,57 °	500,0 ms	503,9 ms	0,78 %	2,000 A	Passed
3,951 Ω	-62,28 °	500,0 ms	507,0 ms	1,4 %	2,000 A	Passed
4,760 Ω	-63,49 °	1,500 s	1,503 s	0,2133 %	2,000 A	Passed

| Z |:	12,18 Ω	Phi:	80,00 °	Angle:	-85,44 °	Result:	Passed
Length:	18,23 Ω	%:	118,49 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
10,52 Ω	77,64 °	1,500 s	1,509 s	0,5867 %	2,000 A	Passed
10,52 Ω	77,64 °	1,500 s	1,504 s	0,2467 %	2,000 A	Passed
9,418 Ω	75,58 °	500,0 ms	514,2 ms	2,84 %	2,000 A	Passed
8,214 Ω	72,67 °	500,0 ms	514,8 ms	2,96 %	2,000 A	Passed
7,400 Ω	70,11 °	300,0 ms	318,6 ms	6,2 %	2,000 A	Passed
5,833 Ω	62,89 °	300,0 ms	312,2 ms	4,067 %	2,000 A	Passed
5,343 Ω	59,59 °	0,000 s	21,90 ms	21,90 ms	2,000 A	Passed
3,063 Ω	5,67 °	0,000 s	19,80 ms	19,80 ms	2,000 A	Passed
3,192 Ω	-11,80 °	300,0 ms	310,0 ms	3,333 %	2,000 A	Passed
3,603 Ω	-27,22 °	300,0 ms	313,4 ms	4,467 %	2,000 A	Passed

4,084 Ω	-36,86 °	500,0 ms	504,1 ms	0,82 %	2,000 A	Passed
4,535 Ω	-42,96 °	500,0 ms	517,2 ms	3,44 %	2,000 A	Passed
5,431 Ω	-51,11 °	1,500 s	1,514 s	0,9467 %	2,000 A	Passed
5,431 Ω	-51,11 °	1,500 s	1,509 s	0,58 %	2,000 A	Passed



Check Test: Fault Type L1-L2-L3

| Z |:	15,00 Ω	Phi:	51,52 °	Angle:	249,51 °	Result:	Passed
Length:	19,53 Ω	%:	119,21 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
13,52 Ω	49,47 °	1,500 s	1,511 s	0,76 %	2,000 A	Passed
13,52 Ω	49,47 °	1,500 s	1,506 s	0,4133 %	2,000 A	Passed
12,37 Ω	47,51 °	500,0 ms	512,3 ms	2,46 %	2,000 A	Passed
11,11 Ω	44,87 °	500,0 ms	515,8 ms	3,16 %	2,000 A	Passed
10,27 Ω	42,68 °	300,0 ms	312,0 ms	4 %	2,000 A	Passed
6,347 Ω	22,62 °	300,0 ms	306,7 ms	2,233 %	2,000 A	Passed
4,642 Ω	-17,22 °	500,0 ms	511,4 ms	2,28 %	2,000 A	Passed
4,709 Ω	-30,72 °	500,0 ms	507,5 ms	1,5 %	2,000 A	Passed
5,388 Ω	-51,16 °	1,500 s	1,513 s	0,8533 %	2,000 A	Passed
5,388 Ω	-51,16 °	1,500 s	1,500 s	0,02 %	2,000 A	Passed

| Z |:	12,50 Ω	Phi:	66,61 °	Angle:	253,07 °	Result:	Passed
Length:	19,32 Ω	%:	108,92 %	% of:	All zones		

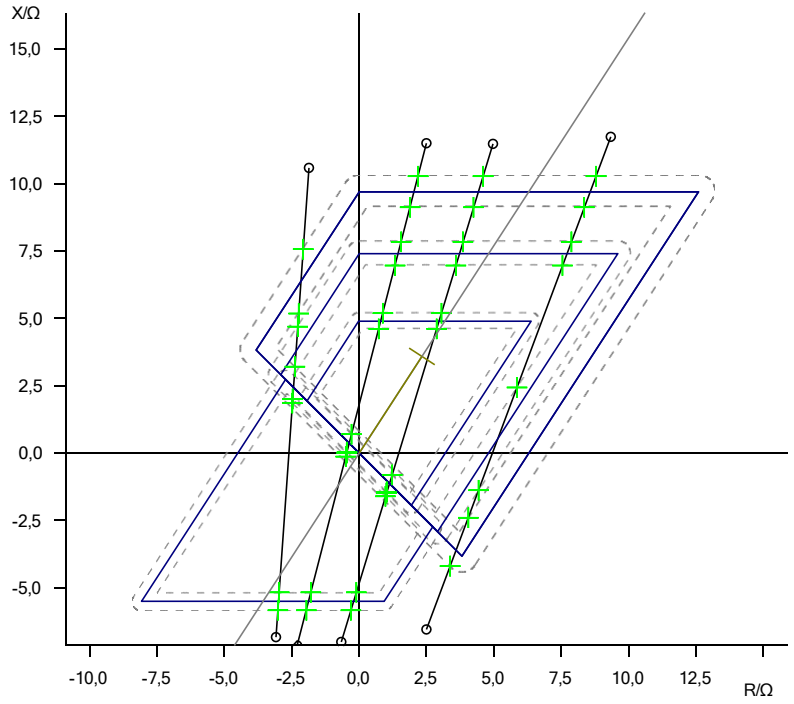
| Z |	Phi	t nom	t act.	Dev.	ITest	Result
11,26 Ω	65,90 °	1,500 s	1,506 s	0,3733 %	2,000 A	Passed
11,26 Ω	65,90 °	1,500 s	1,507 s	0,4867 %	2,000 A	Passed
10,06 Ω	65,04 °	500,0 ms	514,7 ms	2,94 %	2,000 A	Passed
8,738 Ω	63,81 °	500,0 ms	517,2 ms	3,44 %	2,000 A	Passed
7,829 Ω	62,73 °	300,0 ms	318,9 ms	6,3 %	2,000 A	Passed
6,021 Ω	59,57 °	300,0 ms	305,9 ms	1,967 %	2,000 A	Passed
5,429 Ω	58,07 °	0,000 s	22,30 ms	22,30 ms	2,000 A	Passed
1,466 Ω	-33,50 °	0,000 s	37,70 ms	37,70 ms	2,000 A	Passed
1,772 Ω	-54,49 °	500,0 ms	513,7 ms	2,74 %	2,000 A	Passed
1,797 Ω	-55,51 °	500,0 ms	509,4 ms	1,88 %	2,000 A	Passed
1,880 Ω	-58,57 °	500,0 ms	511,2 ms	2,24 %	2,000 A	Passed
5,173 Ω	-91,18 °	500,0 ms	506,9 ms	1,38 %	2,000 A	Passed
5,836 Ω	-93,01 °	1,500 s	1,513 s	0,8733 %	2,000 A	Passed

| Z |:	11,77 Ω	Phi:	77,74 °	Angle:	255,56 °	Result:	Passed
Length:	19,25 Ω	%:	109,64 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
10,51 Ω	78,00 °	1,500 s	1,502 s	0,12 %	2,000 A	Passed
10,51 Ω	78,00 °	1,500 s	1,511 s	0,7133 %	2,000 A	Passed
9,315 Ω	78,31 °	500,0 ms	514,7 ms	2,94 %	2,000 A	Passed
7,994 Ω	78,77 °	500,0 ms	507,1 ms	1,42 %	2,000 A	Passed
7,085 Ω	79,18 °	300,0 ms	318,5 ms	6,167 %	2,000 A	Passed
5,265 Ω	80,43 °	300,0 ms	304,4 ms	1,467 %	2,000 A	Passed
4,665 Ω	81,06 °	0,000 s	22,70 ms	22,70 ms	2,000 A	Passed
751,0 mΩ	112,11 °	0,000 s	20,40 ms	20,40 ms	2,000 A	Passed
453,6 mΩ	175,10 °	500,0 ms	517,2 ms	3,44 %	2,000 A	Passed
462,3 mΩ	-179,82 °	500,0 ms	510,6 ms	2,12 %	2,000 A	Passed
511,6 mΩ	-165,41 °	500,0 ms	518,1 ms	3,62 %	2,000 A	Passed
5,474 Ω	-109,13 °	500,0 ms	505,8 ms	1,16 %	2,000 A	Passed
6,150 Ω	-108,61 °	1,500 s	1,515 s	1 %	2,000 A	Passed

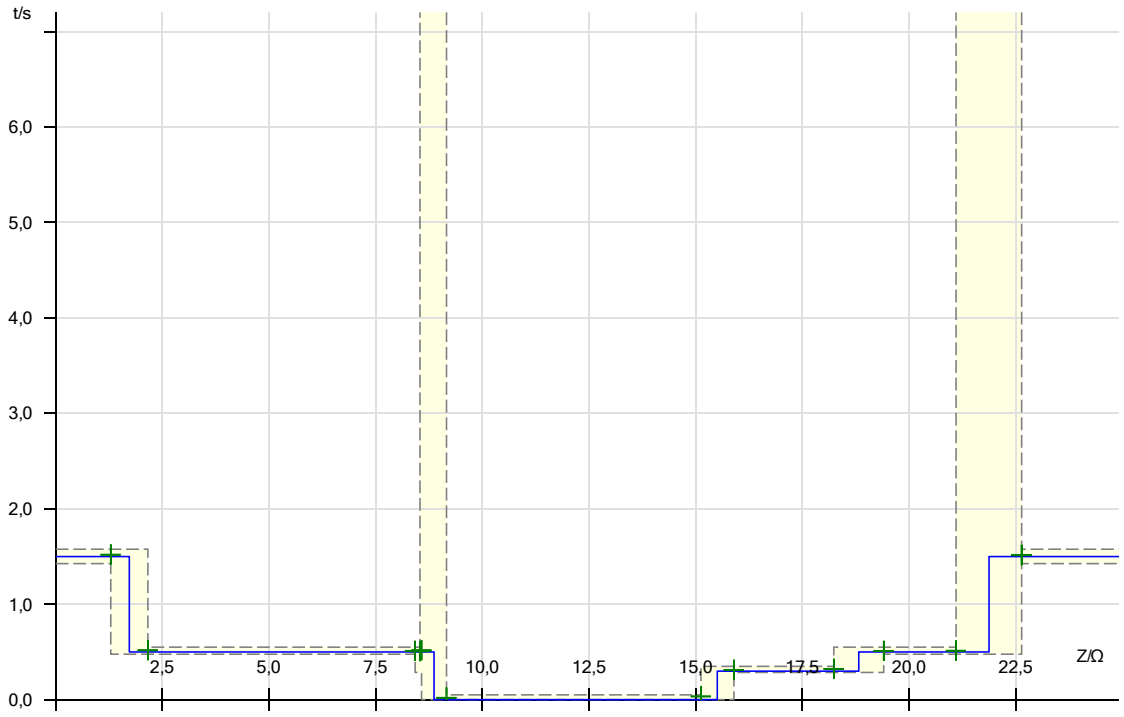
| Z |:	10,74 Ω	Phi:	100,00 °	Angle:	265,98 °	Result:	Passed
Length:	17,46 Ω	%:	108,30 %	% of:	All zones		

| Z |	Phi	t nom	t act.	Dev.	ITest	Result
7,844 Ω	105,36 °	1,500 s	1,505 s	0,32 %	2,000 A	Passed
7,844 Ω	105,36 °	1,500 s	1,501 s	0,0933 %	2,000 A	Passed
5,648 Ω	113,42 °	500,0 ms	505,8 ms	1,16 %	2,000 A	Passed
5,216 Ω	115,92 °	500,0 ms	507,8 ms	1,56 %	2,000 A	Passed
3,992 Ω	126,67 °	300,0 ms	316,3 ms	5,433 %	2,000 A	Passed
3,180 Ω	140,92 °	500,0 ms	509,6 ms	1,92 %	2,000 A	Passed
3,096 Ω	143,19 °	500,0 ms	508,1 ms	1,62 %	2,000 A	Passed
5,966 Ω	-119,89 °	500,0 ms	505,5 ms	1,1 %	2,000 A	Passed
6,563 Ω	-117,38 °	1,500 s	1,518 s	1,22 %	2,000 A	Passed



Check Test: Fault Type L1-E

| Z |:	8,876 Ω	Phi:	-130,00 °	Angle:	48,99 °	Result:	Passed
Length:	24,91 Ω	%:	113,94 %	% of:	All zones		



Shot Details:

Parameters:

Fault Type:	L1-E		
| Z |:	6,563 Ω	Phi:	-117,38 °
R:	-3,019 Ω	X:	-5,828 Ω
%:	n/a	% of:	
ITest:	2,000 A		

Results:

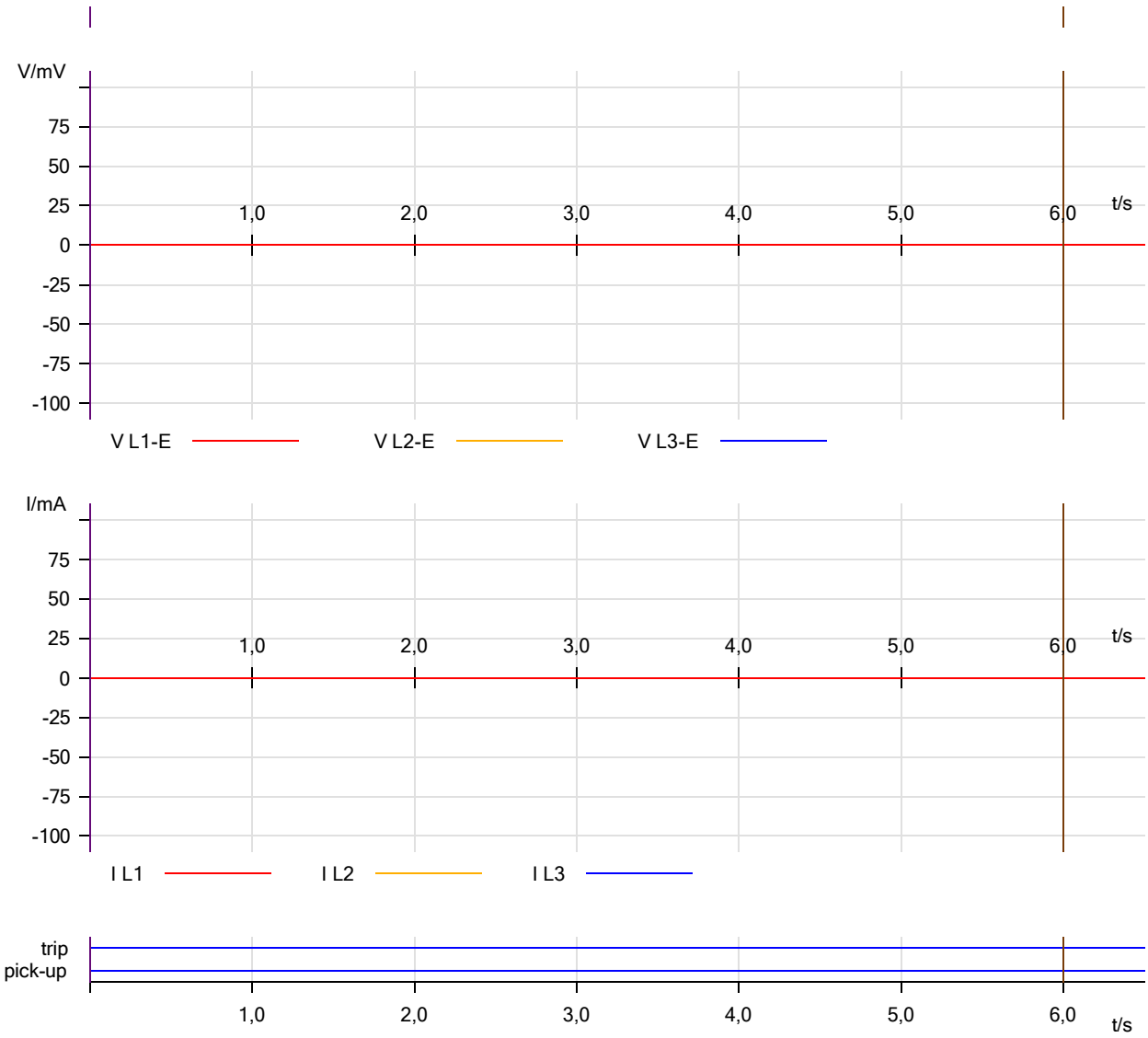
t act.:	n/a	Assessment:	Not tested
t nom:	1,500 s	Dev.:	n/a
t min:	1,425 s	t max:	1,575 s

Fault Quantities (natural):

VL1:	26,25 V	0,00 °
VL2:	57,74 V	-120,00 °
VL3:	57,74 V	120,00 °
IL1:	2,000 A	117,38 °
IL2:	0,000 A	n/a
IL3:	0,000 A	n/a
VFault:	26,25 V	0,00 °
IFault:	2,000 A	117,38 °

Fault Quantities (symmetrical):

V0:	10,49 V	180,00 °
V1:	47,24 V	0,00 °
V2:	10,49 V	180,00 °
I0:	666,7 mA	117,38 °
I1:	666,7 mA	117,38 °
I2:	666,7 mA	117,38 °



Cursor Data

	Time	Signal	Value
Cursor 1	0,000 s	<none>	n/a
Cursor 2	6,000 s	<none>	n/a
C2 - C1	6,000 s		n/a

Test State:
Test passed

Some comments on the lab

1. Test Setup and Configuration

- Nominal Values: The configuration matches a typical three-phase system with a nominal voltage of 110 kV and nominal current of 1,000 A, ensuring the settings are well-suited for high-voltage transmission line protection
-
- Zone Settings: The defined zones (Z1-Z5) provide a comprehensive reach for detecting faults at varying distances, with trip times optimized for quick clearance near the source and appropriate delays for downstream zones.

2. Performance Observations

- Fault Detection:

  - The system effectively identified and isolated faults across various fault types, including single-phase (L1-E, L2-E, L3-E), phase-to-phase (L1-L2, L2-L3, L3-L1), and three-phase (L1-L2-L3) faults.
  - All test results were within the configured tolerances for impedance and timing, indicating precise operation of the distance protection relay.

- Trip Timing:

  - The trip times closely adhered to nominal values, with deviations mostly within 5%, which is an excellent indicator of the relay's consistency and reliability.
  - Prefault and postfault conditions were handled appropriately, showing clear differentiation between normal and fault conditions.

3. Zone Impedance Characteristics

- The relay successfully discriminated faults within defined impedance zones, ensuring selective protection.
- The impedance plane plots demonstrate accurate coverage of the protected line sections, with no overreach or underreach observed.

4. Harmonics and Noise Handling

- Minimal deviation in trip characteristics suggests effective filtering of harmonics and transient noise, preventing false tripping during non-fault conditions.

5. Critical Scenarios

- Fault scenarios with varying fault inception angles, fault resistances, and complex impedance paths were correctly identified and cleared, reflecting the relay's robustness.
- Randomized fault initiation confirmed the relay's reliability under dynamically varying conditions.