Test Object - Device Settings

Substation/Bay:

Substation:
Bay:
Substation address:
Bay address:

Device:

Name/description: Test Object
Device type:
Serial/model number:
Additional info 1: Yazan Eissa
Additional info 2: Lawal Ibrahim Okikiola
Manufacturer:
Device address:

Hardware Configuration

Test Equipment

Type	Serial Number
CMC256plus	TF294W

Hardware Check

Performed At	Result	Details
10.01.2025 10:41:40	Passed	

Diff Configuration-prim:

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer
Vector Group: YY0

Winding/Leg Name:	Primary	Secondary
Voltage:	110,00 kV	110,00 kV
Power:	114,00 MVA	114,00 MVA
Starpoint Grounding:	No	No
Delta-connected CT:	No	No

CT:

Winding/Leg Name:	Primary	Secondary
CT Current Prim:	600,00 A	600,00 A
CT Current Sec:	1,00 A	1,00 A
CT Grounding:	tow. Prot. Obj.	tow. Prot. Obj.
Gnd CT Prim Current:	200,00 A	800,00 A
Gnd CT Sec Current:	1,00 A	1,00 A
Gnd CT Grounding:	n/a	n/a

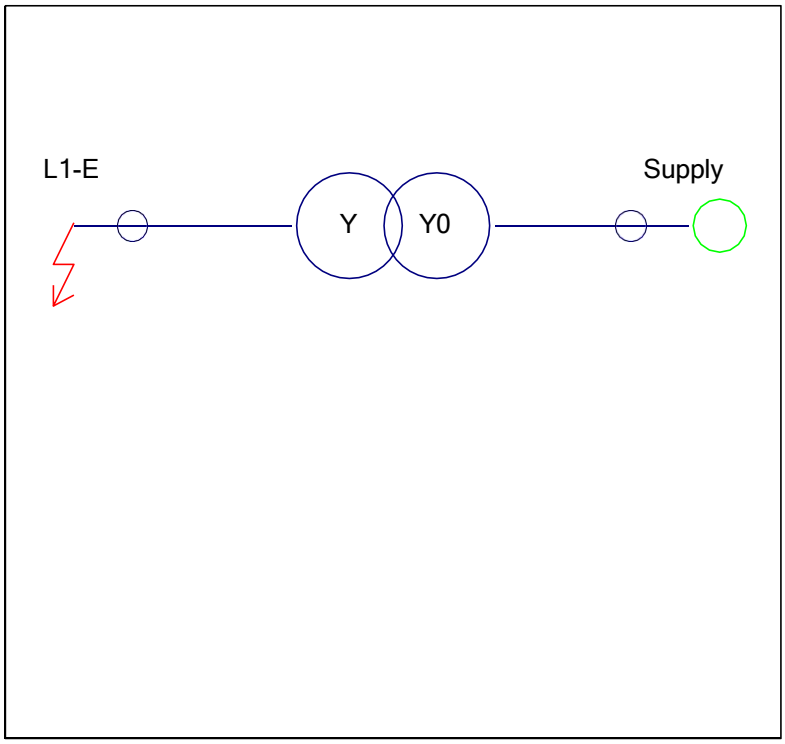
Protection device:

Reference Winding:	Primary
Ibias Calculation:	(|Ip| + |Is|) / K1 (K1 = 2,00)
Zero Seq. Elimination:	IL-I0
Reference Current:	PO nominal current
Ground CT Used:	No
Disable Comb. char.:	No

Idiff>:	0,50 In	tdiff>:	0,05 s
Idiff>>:	8,30 In	tdiff>>:	0,05 s
Itol rel:	2,00 %	ttol rel:	3,00 %
Itol abs:	0,05 In	ttol abs:	0,01 s

Graph:

Single Line View for Protected Object (YY0)



Test Module

Name:	OMICRON Diff Configuration	Version:	4.31
Test Start:	10-Jan-2025 11:44:58	Test End:	10-Jan-2025 11:45:47
User Name:		Manager:	
Company:			

Test Settings

Test time:	60 s	Apply Load Current:	No
Load Side:	n/a	Load Current:	0,00 In
Fault Side:	Primary	Supply Side:	Secondary
Vout enabled:	No	Vout winding:	Primary
Time-triggered:	No	Winding/leg output:	Primary

Binary Outputs

Test Results for Fault Type L1-E at Fault Location Primary

ITest = 1,00 In **State: Tested** **Result: Passed**

Phase	Primary	Secondary	Tertiary

Phase	Itest	Angle	Imeas	Angle	Itest	Angle	Imeas	Angle	Itest	Angle	Imeas	Angle
L1	1,00A	-180,0°	0,000A	0,000°	1,00A	0,0°	0,000A	0,000°	n/a	n/a	n/a	n/a
L2	0,50A	0,0°	0,000A	0,000°	0,50A	180,0°	0,000A	0,000°	n/a	n/a	n/a	n/a
L3	0,50A	0,0°	0,000A	0,000°	0,50A	180,0°	0,000A	0,000°	n/a	n/a	n/a	n/a
E	0,00A	0,0°	0,000A	0,000°	0,00A	0,0°	0,000A	0,000°	n/a	n/a	n/a	n/a

Phase	Imeas_diff	Imeas_bias
L1	0,000 In	0,000 In
L2	0,000 In	0,000 In
L3	0,000 In	0,000 In

Test State:

Test passed

1 out of 1 points tested.
1 points passed.
0 points failed.

Diff Configuration:

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer
Vector Group: YY0

Winding/Leg Name:	Primary	Secondary
Voltage:	110,00 kV	110,00 kV
Power:	114,00 MVA	114,00 MVA
Starpoint Grounding:	No	No
Delta-connected CT:	No	No

CT:

Winding/Leg Name:	Primary	Secondary
CT Current Prim:	600,00 A	600,00 A
CT Current Sec:	1,00 A	1,00 A
CT Grounding:	tow. Prot. Obj.	tow. Prot. Obj.
Gnd CT Prim Current:	200,00 A	800,00 A
Gnd CT Sec Current:	1,00 A	1,00 A
Gnd CT Grounding:	n/a	n/a

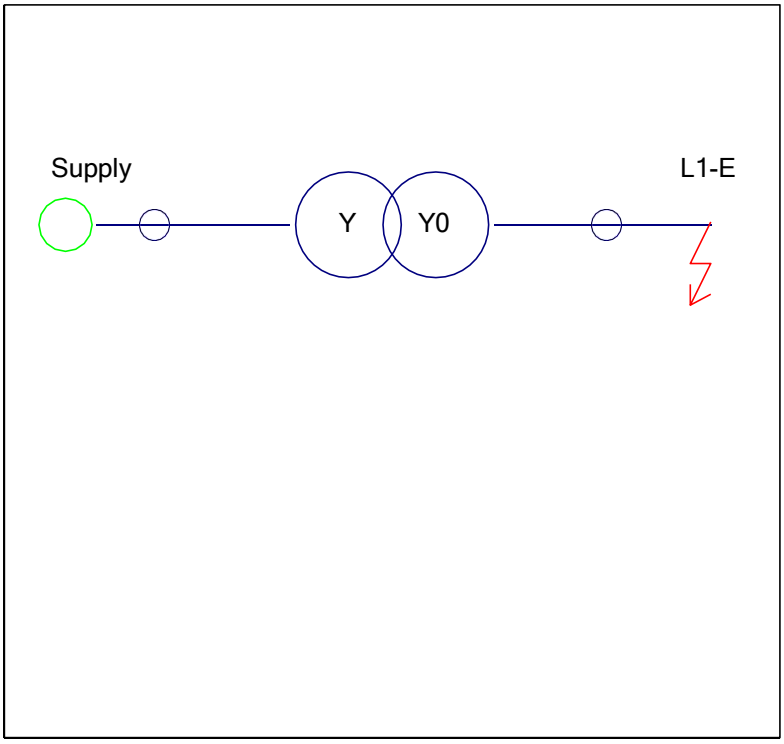
Protection device:

Reference Winding: Primary
Ibias Calculation: (|Ip| + |Is|) / K1 (K1 = 2,00)
Zero Seq. Elimination: IL-I0
Reference Current: PO nominal current
Ground CT Used: No
Disable Comb. char.: No

Idiff>:	0,50 In	tdiff>:	0,05 s
Idiff>>:	8,30 In	tdiff>>:	0,05 s
Itol rel:	2,00 %	ttol rel:	3,00 %
Itol abs:	0,05 In	ttol abs:	0,01 s

Graph:

Single Line View for Protected Object (YY0)



Test Module

Name:	OMICRON Diff Configuration	Version:	4.31
Test Start:	10-Jan-2025 11:26:08	Test End:	10-Jan-2025 11:26:13
User Name:		Manager:	
Company:			

Test Settings

Test time:	60 s	Apply Load Current:	No
Load Side:	n/a	Load Current:	0,00 In
Fault Side:	Secondary	Supply Side:	Primary
Vout enabled:	No	Vout winding:	Primary
Time-triggered:	No	Winding/leg output:	Primary

Binary Outputs

Test Results for Fault Type L1-E at Fault Location Secondary

ITest = 1,00 In **State: Tested** **Result: Passed**

Phase	Primary				Secondary				Tertiary			
	Itest	Angle	Imeas	Angle	Itest	Angle	Imeas	Angle	Itest	Angle	Imeas	Angle
L1	1,00A	0,0°	0,000A	0,000°	1,00A	-180,0°	0,000A	0,000°	n/a	n/a	n/a	n/a
L2	0,50A	180,0°	0,000A	0,000°	0,50A	0,0°	0,000A	0,000°	n/a	n/a	n/a	n/a
L3	0,50A	180,0°	0,000A	0,000°	0,50A	0,0°	0,000A	0,000°	n/a	n/a	n/a	n/a
E	0,00A	0,0°	0,000A	0,000°	0,00A	0,0°	0,000A	0,000°	n/a	n/a	n/a	n/a

Phase	Imeas_diff	Imeas_bias
L1	0,000 In	0,000 In
L2	0,000 In	0,000 In
L3	0,000 In	0,000 In

Test State:

Test passed

1 out of 1 points tested.
1 points passed.
0 points failed.

Diff Operating Characteristic - SHOT-line2line:

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer
Vector Group: YY0

Winding/Leg Name:	Primary	Secondary
Voltage:	110,00 kV	110,00 kV
Power:	114,00 MVA	114,00 MVA
Starpoint Grounding:	No	No
Delta-connected CT:	No	No

CT:

Winding/Leg Name:	Primary	Secondary
CT Current Prim:	600,00 A	600,00 A
CT Current Sec:	1,00 A	1,00 A
CT Grounding:	tow. Prot. Obj.	tow. Prot. Obj.
Gnd CT Prim Current:	200,00 A	800,00 A
Gnd CT Sec Current:	1,00 A	1,00 A
Gnd CT Grounding:	n/a	n/a

Protection device:

Reference Winding: Primary
Ibias Calculation: (|Ip| + |Is|) / K1 (K1 = 2,00)
Zero Seq. Elimination: IL-I0
Reference Current: PO nominal current
Ground CT Used: No
Disable Comb. char.: No

Idiff>:	0,50 In	tdiff>:	0,05 s
Idiff>>:	8,30 In	tdiff>>:	0,05 s
Itol rel:	2,00 %	ttol rel:	3,00 %
Itol abs:	0,05 In	ttol abs:	0,01 s

Test Module

Name:	OMICRON Diff Operating Characteristic	Version:	4.31
Test Start:	10-Jan-2025 11:02:34	Test End:	10-Jan-2025 11:02:56
User Name:		Manager:	
Company:			

Test Settings

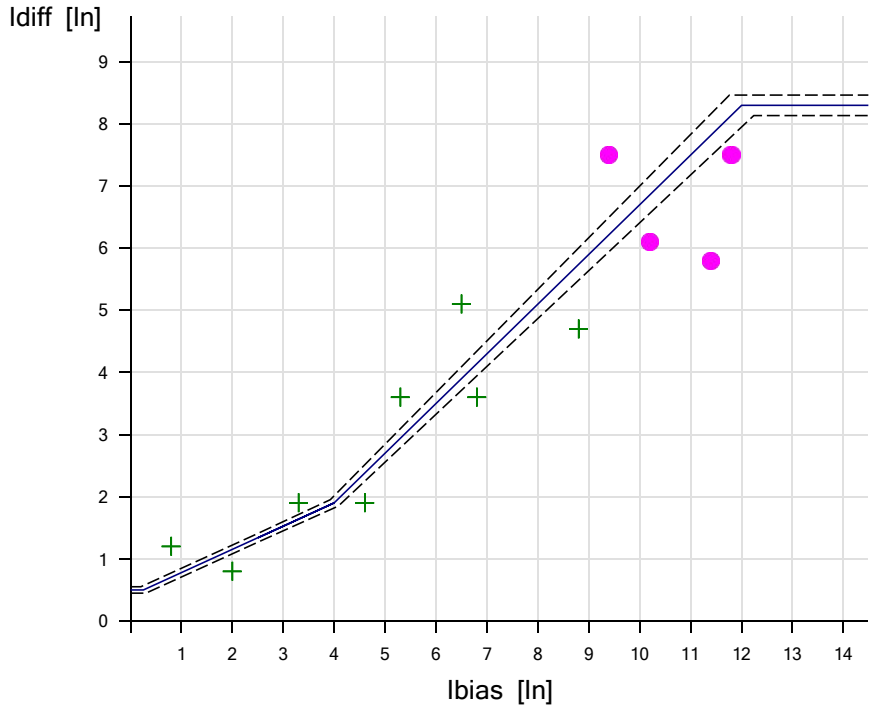
Testing:	Primary / Secondary		
Max. Test Time:	1,50 s	Delay Time:	0,25 s
Prefault:	No		
Prefault current:	0,00 In	Prefault time:	0,000 s
Vout enabled:	No	Vout winding:	Primary
Time-triggered:	No	Winding/leg output:	Primary

Binary Outputs

Test Results for Fault Type L2-L3 at Reference Side Primary

Idiff	Ibias	Nominal Trip Time	Actual Trip Time	State	Result
1,20 In	0,80 In	0,0500 s	0,0595 s	Tested	Passed
0,80 In	2,00 In	N/T	N/T	Tested	Passed
1,90 In	3,30 In	0,0500 s	0,0633 s	Tested	Passed
1,90 In	4,60 In	N/T	N/T	Tested	Passed
3,60 In	5,30 In	0,0500 s	0,0599 s	Tested	Passed
3,60 In	6,80 In	N/T	N/T	Tested	Passed
5,10 In	6,50 In	0,0500 s	0,0533 s	Tested	Passed
4,70 In	8,80 In	N/T	N/T	Tested	Passed
6,10 In	10,20 In	N/T	N/T	Out of range	n/a
5,80 In	11,40 In	N/T	N/T	Out of range	n/a
7,50 In	9,40 In	0,0500 s	N/T	Out of range	n/a
7,50 In	11,80 In	N/T	N/T	Out of range	n/a

Operating Characteristic Diagram



Shot	1	2	3	4	5	6
Idiff: **Ibias:**	1,20 In 0,80 In	0,80 In 2,00 In	1,90 In 3,30 In	1,90 In 4,60 In	3,60 In 5,30 In	3,60 In 6,80 In
I Primary L1: **Phase Primary L1:**	0,000 A 0,000 °	0,000 A 0,000 °	0,000 A 0,000 °	0,000 A 0,000 °	0,000 A 0,000 °	0,000 A 0,000 °
I Primary L2: **Phase Primary L2:**	1,396 A -180,000 °	2,393 A -180,000 °	4,238 A -180,000 °	5,535 A -180,000 °	7,080 A -180,000 °	8,576 A -180,000 °
I Primary L3: **Phase Primary L3:**	1,396 A 0,000 °	2,393 A 0,000 °	4,238 A 0,000 °	5,535 A 0,000 °	7,080 A 0,000 °	8,576 A 0,000 °
I Secondary L1: **Phase Secondary L1:**	0,000 A 0,000 °	0,000 A 0,000 °	0,000 A 0,000 °	0,000 A 0,000 °	0,000 A 0,000 °	0,000 A 0,000 °
I Secondary L2: **Phase Secondary L2:**	0,199 A 0,000 °	1,596 A 0,000 °	2,344 A 0,000 °	3,640 A 0,000 °	3,490 A 0,000 °	4,986 A 0,000 °
I Secondary L3: **Phase Secondary L3:**	0,199 A 180,000 °	1,596 A 180,000 °	2,344 A 180,000 °	3,640 A 180,000 °	3,490 A 180,000 °	4,986 A 180,000 °
I Tertiary L1: **Phase Tertiary L1:**						

I Tertiary L2: **Phase Tertiary L2:** **I Tertiary L3:** **Phase Tertiary L3:**						
V L1: **Phase L1:** **V L2:** **Phase L2:** **V L3:** **Phase L3:**						
Shot	**7**	**8**	**9**	**10**	**11**	**12**
Idiff: **Ibias:**	5,10 In 6,50 In	4,70 In 8,80 In	6,10 In 10,20 In	5,80 In 11,40 In	7,50 In 9,40 In	7,50 In 11,80 In
I Primary L1: **Phase Primary L1:** **I Primary L2:** **Phase Primary L2:** **I Primary L3:** **Phase Primary L3:**	0,000 A 0,000 ° 9,025 A -180,000 ° 9,025 A 0,000 °	0,000 A 0,000 ° 11,119 A -180,000 ° 11,119 A 0,000 °	0,000 A 0,000 ° 13,213 A -180,000 ° 13,213 A 0,000 °	0,000 A 0,000 ° 14,261 A -180,000 ° 14,261 A 0,000 °	0,000 A 0,000 ° 13,114 A -180,000 ° 13,114 A 0,000 °	0,000 A 0,000 ° 15,507 A -180,000 ° 15,507 A 0,000 °
I Secondary L1: **Phase Secondary L1:** **I Secondary L2:** **Phase Secondary L2:** **I Secondary L3:** **Phase Secondary L3:**	0,000 A 0,000 ° 3,939 A 0,000 ° 3,939 A 180,000 °	0,000 A 0,000 ° 6,432 A 0,000 ° 6,432 A 180,000 °	0,000 A 0,000 ° 7,130 A 0,000 ° 7,130 A 180,000 °	0,000 A 0,000 ° 8,477 A 0,000 ° 8,477 A 180,000 °	0,000 A 0,000 ° 5,634 A 0,000 ° 5,634 A 180,000 °	0,000 A 0,000 ° 8,028 A 0,000 ° 8,028 A 180,000 °
I Tertiary L1: **Phase Tertiary L1:** **I Tertiary L2:** **Phase Tertiary L2:** **I Tertiary L3:** **Phase Tertiary L3:**						
V L1: **Phase L1:** **V L2:** **Phase L2:** **V L3:** **Phase L3:**						

Test State:

Test passed

12 out of 12 points tested.

12 points passed.

0 points failed.

Diff Operating Characteristics 3 phased:

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer

Vector Group: YY0

Winding/Leg Name:	Primary	Secondary
Voltage:	110,00 kV	110,00 kV
Power:	114,00 MVA	114,00 MVA
Starpoint Grounding:	No	No
Delta-connected CT:	No	No

CT:

Winding/Leg Name:	Primary	Secondary
CT Current Prim:	600,00 A	600,00 A
CT Current Sec:	1,00 A	1,00 A
CT Grounding:	tow. Prot. Obj.	tow. Prot. Obj.
Gnd CT Prim Current:	200,00 A	800,00 A
Gnd CT Sec Current:	1,00 A	1,00 A
Gnd CT Grounding:	n/a	n/a

Protection device:

Reference Winding:	Primary		
Ibias Calculation:	(|Ip| + |Is|) / K1 (K1 = 2,00)		
Zero Seq. Elimination:	IL-I0		
Reference Current:	PO nominal current		
Ground CT Used:	No		
Disable Comb. char.:	No		
Idiff>:	0,50 In	tdiff>:	0,05 s
Idiff>>:	8,30 In	tdiff>>:	0,05 s
Itol rel:	2,00 %	ttol rel:	3,00 %
Itol abs:	0,05 In	ttol abs:	0,01 s

Test Module

Name:	OMICRON Diff Operating Characteristic	Version:	4.31
Test Start:	10-Jan-2025 11:28:51	Test End:	10-Jan-2025 11:29:03
User Name:		Manager:	
Company:			

Test Settings

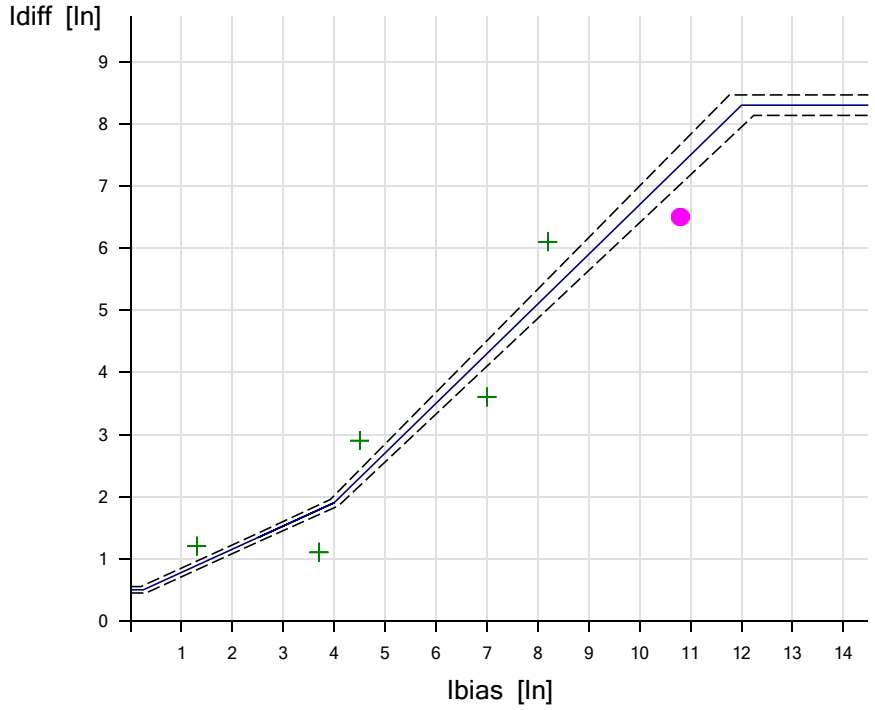
Testing:	Primary / Secondary		
Max. Test Time:	1,50 s	Delay Time:	0,25 s
Prefault:	No		
Prefault current:	0,00 In	Prefault time:	0,000 s
Vout enabled:	No	Vout winding:	Primary
Time-triggered:	No	Winding/leg output:	Primary

Binary Outputs

Test Results for Fault Type L1-L2-L3 at Reference Side Primary

Idiff	Ibias	Nominal Trip Time	Actual Trip Time	State	Result
1,20 In	1,30 In	0,0500 s	0,0591 s	Tested	Passed
1,10 In	3,70 In	N/T	N/T	Tested	Passed
2,90 In	4,50 In	0,0500 s	0,0580 s	Tested	Passed
3,60 In	7,00 In	N/T	N/T	Tested	Passed
6,10 In	8,20 In	0,0500 s	0,0591 s	Tested	Passed
6,50 In	10,80 In	N/T	N/T	Out of range	n/a

Operating Characteristic Diagram



Shot	1	2	3	4	5	6
Idiff: **Ibias:**	1,20 In 1,30 In	1,10 In 3,70 In	2,90 In 4,50 In	3,60 In 7,00 In	6,10 In 8,20 In	6,50 In 10,80 In
I Primary L1: **Phase Primary L1:**	1,895 A -180,000 °	4,238 A -180,000 °	5,934 A -180,000 °	8,776 A -180,000 °	11,219 A -180,000 °	14,011 A -180,000 °
I Primary L2: **Phase Primary L2:**	1,895 A 60,000 °	4,238 A 60,000 °	5,934 A 60,000 °	8,776 A 60,000 °	11,219 A 60,000 °	14,011 A 60,000 °
I Primary L3: **Phase Primary L3:**	1,895 A -60,000 °	4,238 A -60,000 °	5,934 A -60,000 °	8,776 A -60,000 °	11,219 A -60,000 °	14,011 A -60,000 °
I Secondary L1: **Phase Secondary L1:**	0,698 A 0,000 °	3,141 A 0,000 °	3,042 A 0,000 °	5,186 A 0,000 °	5,136 A 0,000 °	7,529 A 0,000 °
I Secondary L2: **Phase Secondary L2:**	0,698 A -120,000 °	3,141 A -120,000 °	3,042 A -120,000 °	5,186 A -120,000 °	5,136 A -120,000 °	7,529 A -120,000 °
I Secondary L3: **Phase Secondary L3:**	0,698 A 120,000 °	3,141 A 120,000 °	3,042 A 120,000 °	5,186 A 120,000 °	5,136 A 120,000 °	7,529 A 120,000 °
I Tertiary L1: **Phase Tertiary L1:** **I Tertiary L2:** **Phase Tertiary L2:** **I Tertiary L3:** **Phase Tertiary L3:**						
V L1: **Phase L1:** **V L2:** **Phase L2:** **V L3:** **Phase L3:**						

Test State:

Test passed

6 out of 6 points tested.

6 points passed.

0 points failed.

iff Operating Characteristic - SHOT-line2earth:

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer
Vector Group: YY0

Winding/Leg Name:	Primary	Secondary
Voltage:	110,00 kV	110,00 kV
Power:	114,00 MVA	114,00 MVA
Starpoint Grounding:	No	No
Delta-connected CT:	No	No

CT:

Winding/Leg Name:	Primary	Secondary
CT Current Prim:	600,00 A	600,00 A
CT Current Sec:	1,00 A	1,00 A
CT Grounding:	tow. Prot. Obj.	tow. Prot. Obj.
Gnd CT Prim Current:	200,00 A	800,00 A
Gnd CT Sec Current:	1,00 A	1,00 A
Gnd CT Grounding:	n/a	n/a

Protection device:

Reference Winding: Primary
Ibias Calculation: (|Ip| + |Is|) / K1 (K1 = 2,00)
Zero Seq. Elimination: IL-I0
Reference Current: PO nominal current
Ground CT Used: No
Disable Comb. char.: No

Idiff>:	0,50 In	tdiff>:	0,05 s
Idiff>>:	8,30 In	tdiff>>:	0,05 s
Itol rel:	2,00 %	ttol rel:	3,00 %
Itol abs:	0,05 In	ttol abs:	0,01 s

Test Module

Name:	OMICRON Diff Operating Characteristic	Version:	4.31
Test Start:	10-Jan-2025 11:27:28	Test End:	10-Jan-2025 11:27:40
User Name:		Manager:	
Company:			

Test Settings

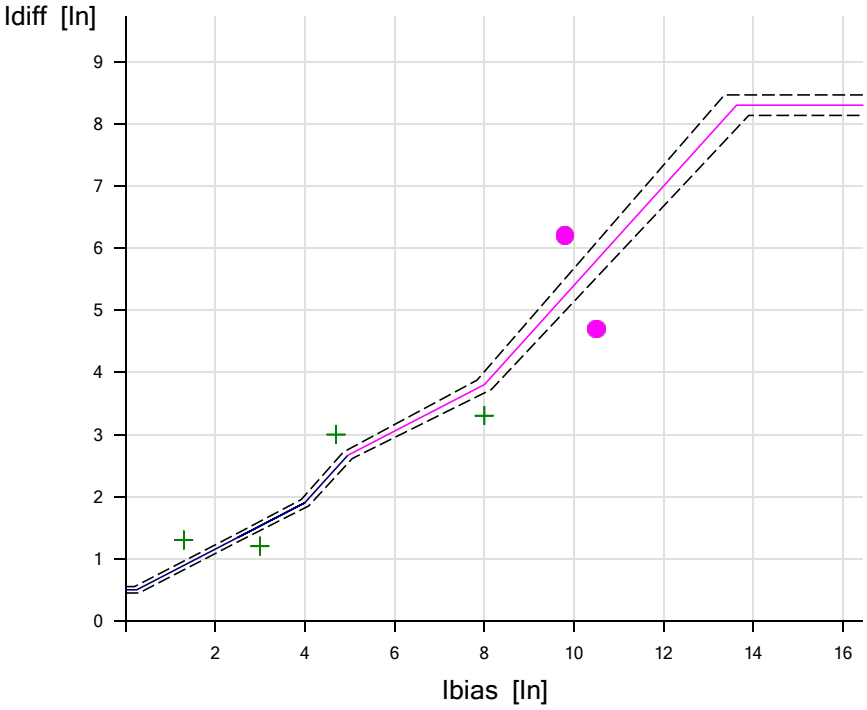
Testing:	Primary / Secondary		
Max. Test Time:	1,50 s	Delay Time:	0,25 s
Prefault:	No		
Prefault current:	0,00 In	Prefault time:	0,000 s
Vout enabled:	No	Vout winding:	Primary
Time-triggered:	No	Winding/leg output:	Primary

Binary Outputs

Test Results for Fault Type L3-E at Reference Side Primary

Idiff	Ibias	Nominal Trip Time	Actual Trip Time	State	Result
1,30 In	1,30 In	0,0500 s	0,0613 s	Tested	Passed
1,20 In	3,00 In	N/T	N/T	Tested	Passed
3,00 In	4,70 In	0,0500 s	0,0614 s	Tested	Passed
3,30 In	8,00 In	N/T	N/T	Tested	Passed
6,20 In	9,80 In	0,0500 s	N/T	Out of range	n/a
4,70 In	10,50 In	N/T	N/T	Out of range	n/a

Operating Characteristic Diagram



Shot	1	2	3	4	5	6
Idiff: **Ibias:**	1,30 In 1,30 In	1,20 In 3,00 In	3,00 In 4,70 In	3,30 In 8,00 In	6,20 In 9,80 In	4,70 In 10,50 In
I Primary L1: **Phase Primary L1:** **I Primary L2:** **Phase Primary L2:** **I Primary L3:** **Phase Primary L3:**	0,972 A 0,000 ° 0,972 A 0,000 ° 1,945 A -180,000 °	1,795 A 0,000 ° 1,795 A 0,000 ° 3,590 A -180,000 °	3,091 A 0,000 ° 3,091 A 0,000 ° 6,183 A -180,000 °	4,812 A 0,000 ° 4,812 A 0,000 ° 9,623 A -180,000 °	6,432 A 0,000 ° 6,432 A 0,000 ° 12,864 A -180,000 °	6,407 A 0,000 ° 6,407 A 0,000 ° 12,815 A -180,000 °
I Secondary L1: **Phase Secondary L1:** **I Secondary L2:** **Phase Secondary L2:** **I Secondary L3:** **Phase Secondary L3:**	0,324 A 180,000 ° 0,324 A 180,000 ° 0,648 A 0,000 °	1,197 A 180,000 ° 1,197 A 180,000 ° 2,393 A 0,000 °	1,596 A 180,000 ° 1,596 A 180,000 ° 3,191 A 0,000 °	3,166 A 180,000 ° 3,166 A 180,000 ° 6,332 A 0,000 °	3,341 A 180,000 ° 3,341 A 180,000 ° 6,682 A 0,000 °	4,064 A 180,000 ° 4,064 A 180,000 ° 8,128 A 0,000 °
I Tertiary L1: **Phase Tertiary L1:** **I Tertiary L2:** **Phase Tertiary L2:** **I Tertiary L3:** **Phase Tertiary L3:**						
V L1: **Phase L1:** **V L2:** **Phase L2:** **V L3:** **Phase L3:**						

Test State:

Test passed

6 out of 6 points tested.

6 points passed.

0 points failed.

iff Operating Characteristic- SEARCH:

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer
Vector Group: YY0

Winding/Leg Name:	Primary	Secondary
Voltage:	110,00 kV	110,00 kV
Power:	114,00 MVA	114,00 MVA
Starpoint Grounding:	No	No
Delta-connected CT:	No	No

CT:

Winding/Leg Name:	Primary	Secondary
CT Current Prim:	600,00 A	600,00 A
CT Current Sec:	1,00 A	1,00 A
CT Grounding:	tow. Prot. Obj.	tow. Prot. Obj.
Gnd CT Prim Current:	200,00 A	800,00 A
Gnd CT Sec Current:	1,00 A	1,00 A
Gnd CT Grounding:	n/a	n/a

Protection device:

Reference Winding: Primary
Ibias Calculation: (|Ip| + |Is|) / K1 (K1 = 2,00)
Zero Seq. Elimination: IL-I0
Reference Current: PO nominal current
Ground CT Used: No
Disable Comb. char.: No

Idiff>:	0,50 In	tdiff>:	0,05 s
Idiff>>:	8,30 In	tdiff>>:	0,05 s
Itol rel:	2,00 %	ttol rel:	3,00 %
Itol abs:	0,05 In	ttol abs:	0,01 s

Test Module

Name:	OMICRON Diff Operating Characteristic	Version:	4.31
Test Start:	10-Jan-2025 11:07:50	Test End:	10-Jan-2025 11:09:14
User Name:		Manager:	
Company:			

Test Settings

General Settings:

Testing:	Primary / Secondary		
Max. Test Time:	1,50 s	Delay Time:	0,25 s
Prefault:	No		
Prefault current:	0,00 In	Prefault time:	0,000 s
Vout enabled:	No	Vout winding:	Primary
Time-triggered:	No	Winding/leg output:	Primary

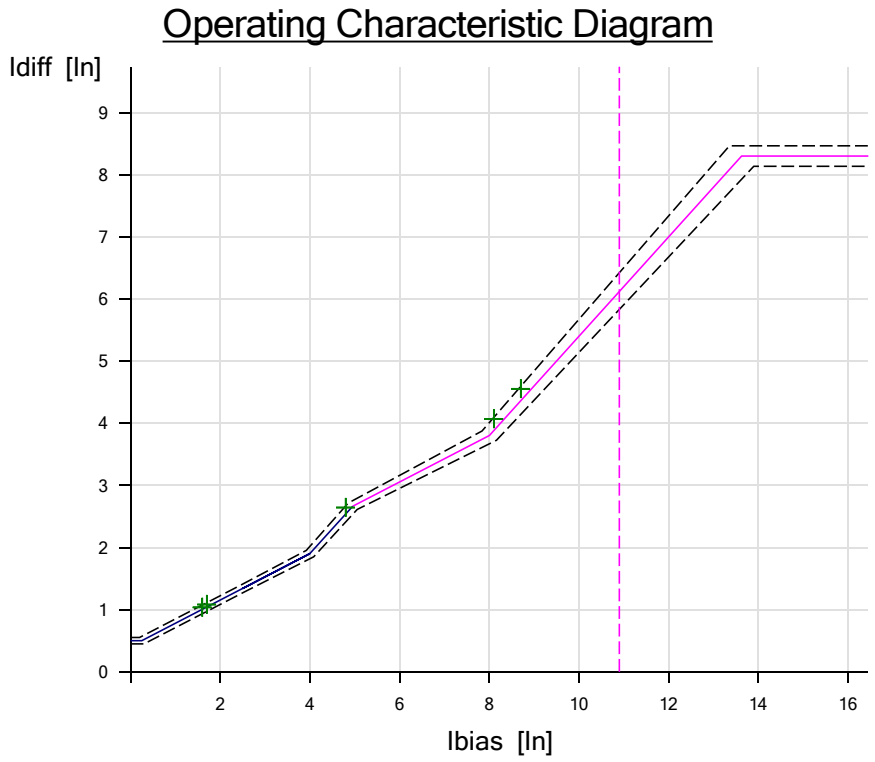
Search Test Settings:

Ignore Default Char.:	No		
Resolution Relative:	0,10 %	Resolution Absolute:	0,010 In

Binary Outputs

Test Results for Fault Location L2-E at Reference Side Primary

Ibias	Idiff Nominal	Idiff Actual	Dev (rel)	Dev (abs)	Check Test	State	Result
1,60 In	1,004 In	1,034 In	2,99 %	0,0300 In		Tested	Passed
1,70 In	1,041 In	1,080 In	3,71 %	0,0386 In		Tested	Passed
4,80 In	2,540 In	2,643 In	4,04 %	0,1027 In		Tested	Passed
8,10 In	3,880 In	4,069 In	4,88 %	0,1892 In		Tested	Passed
8,70 In	4,360 In	4,552 In	4,41 %	0,1922 In		Tested	Passed
10,90 In	6,120 In	n/a	n/a	n/a		Out of range	n/a



Test State:

Test passed

6 out of 6 points tested.

6 points passed.

0 points failed.

Diff Trip Time Characteristic:

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer

Vector Group: YY0

Winding/Leg Name:	Primary	Secondary
Voltage:	110,00 kV	110,00 kV
Power:	114,00 MVA	114,00 MVA
Starpoint Grounding:	No	No
Delta-connected CT:	No	No

CT:

Winding/Leg Name:	Primary	Secondary
CT Current Prim:	600,00 A	600,00 A
CT Current Sec:	1,00 A	1,00 A
CT Grounding:	tow. Prot. Obj.	tow. Prot. Obj.
Gnd CT Prim Current:	200,00 A	800,00 A
Gnd CT Sec Current:	1,00 A	1,00 A
Gnd CT Grounding:	n/a	n/a

Protection device:

Reference Winding:	Primary		
Ibias Calculation:	(|Ip| + |Is|) / K1 (K1 = 2,00)		
Zero Seq. Elimination:	IL-I0		
Reference Current:	PO nominal current		
Ground CT Used:	No		
Disable Comb. char.:	No		
Idiff>:	0,50 In	tdiff>:	0,05 s
Idiff>>:	8,30 In	tdiff>>:	0,05 s
Itol rel:	2,00 %	ttol rel:	3,00 %
Itol abs:	0,05 In	ttol abs:	0,01 s

Test Module

Name:	OMICRON Diff Trip Time Characteristic	Version:	4.31
Test Start:	10-Jan-2025 11:11:18	Test End:	10-Jan-2025 11:11:25
User Name:		Manager:	
Company:			

Test Settings

General Settings:

Testing:	Primary / Secondary		
Max. Test Time:	1,50 s	Delay Time:	0,25 s
Prefault:	No		
Prefault current:	0,00 In	Prefault time:	0,000 s
Vout enabled:	No	Vout winding:	Primary

Trip Time Test Settings:

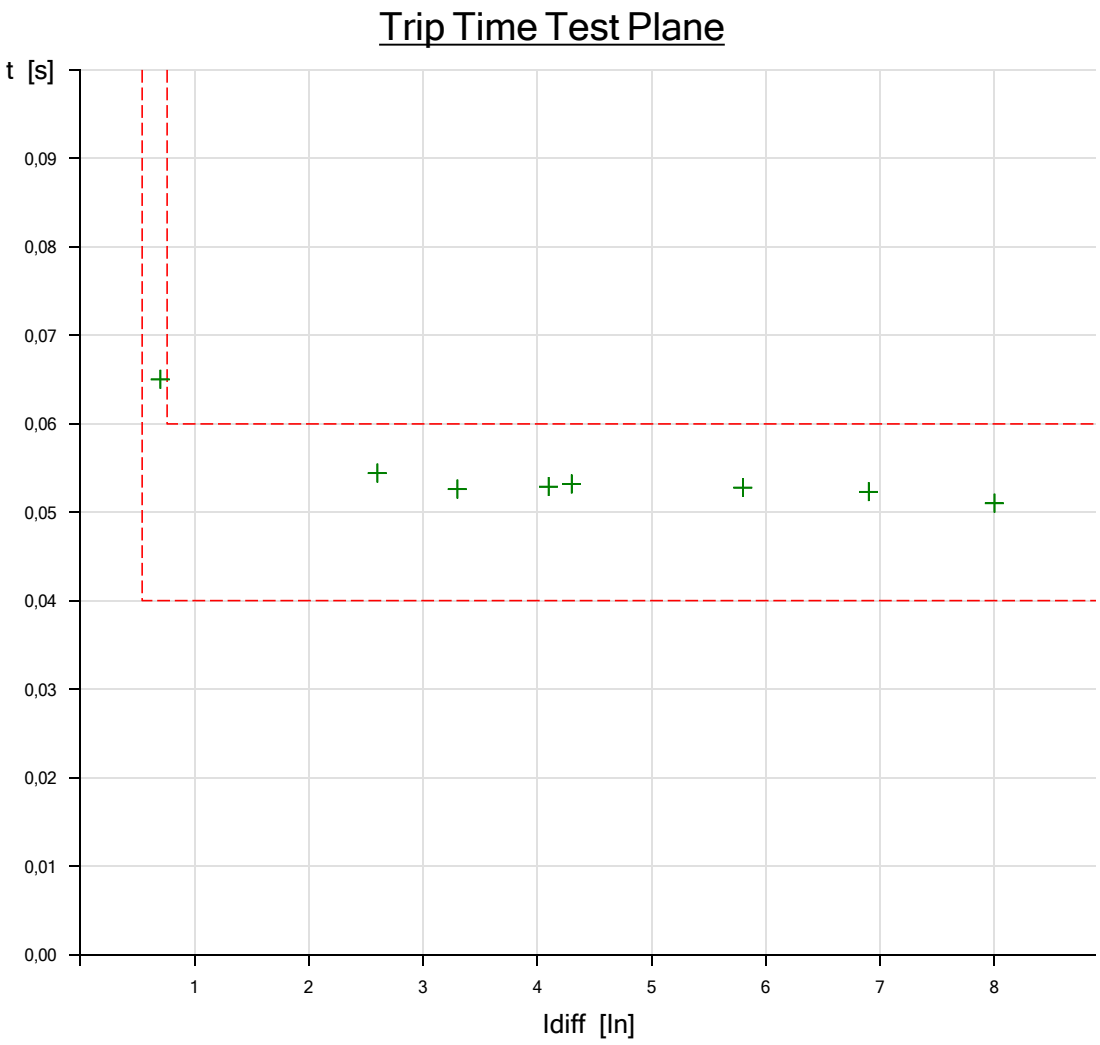
Slope of Test Line:	1,00		
I Factor Relative:	2,00 %	I Factor Absolute:	0,05 In
T Factor Relative:	3,00 %	T Factor Absolute:	0,01 s

The program uses the device tolerances!

Binary Outputs

Test Results for Fault Type L1-E at Reference Side Primary

Idiff	Ibias	Nominal Trip Time	Actual Trip Time	Dev (rel)	Dev (abs)	State	Result
2,60 In	2,60 In	0,0500 s	0,0544 s	8,80 %	0,0044 s	Tested	Passed
4,10 In	4,10 In	0,0500 s	0,0529 s	5,80 %	0,0029 s	Tested	Passed
5,80 In	5,80 In	0,0500 s	0,0528 s	5,60 %	0,0028 s	Tested	Passed
6,90 In	6,90 In	0,0500 s	0,0523 s	4,60 %	0,0023 s	Tested	Passed
8,00 In	8,00 In	0,0500 s	0,0510 s	2,00 %	0,0010 s	Tested	Passed
4,30 In	4,30 In	0,0500 s	0,0532 s	6,40 %	0,0032 s	Tested	Passed
3,30 In	3,30 In	0,0500 s	0,0526 s	5,20 %	0,0026 s	Tested	Passed
0,70 In	0,70 In	0,0500 s	0,0650 s	30,00 %	0,0150 s	Tested	Passed



State:

8 out of 8 points tested.
8 points passed.
0 points failed.

General Assessment: Test passed

Diff Harmonic Restraint - SHOT:

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer
Vector Group: YY0

Winding/Leg Name:	Primary	Secondary
Voltage:	110,00 kV	110,00 kV
Power:	114,00 MVA	114,00 MVA
Starpoint Grounding:	No	No
Delta-connected CT:	No	No

CT:

Winding/Leg Name:	Primary	Secondary
CT Current Prim:	600,00 A	600,00 A
CT Current Sec:	1,00 A	1,00 A
CT Grounding:	tow. Prot. Obj.	tow. Prot. Obj.
Gnd CT Prim Current:	200,00 A	800,00 A
Gnd CT Sec Current:	1,00 A	1,00 A
Gnd CT Grounding:	n/a	n/a

Protection device:

Reference Winding:	Primary		
Ibias Calculation:	(|Ip| + |Is|) / K1 (K1 = 2,00)		
Zero Seq. Elimination:	IL-I0		
Reference Current:	PO nominal current		
Ground CT Used:	No		
Disable Comb. char.:	No		
Idiff>:	0,50 In	tdiff>:	0,05 s
Idiff>>:	8,30 In	tdiff>>:	0,05 s
Itol rel:	2,00 %	ttol rel:	3,00 %
Itol abs:	0,05 In	ttol abs:	0,01 s

Harmonic Settings:

HR tol abs: 1,00 % HR tol rel: 3,00 %

Harmonic Order	Start point		End point	
	Ixf/Idiff	Idiff/In	Ixf/Idiff	Idiff/In
2	20,00 %	0,50	20,00 %	8,30

Test Module

Name:	OMICRON Diff Harmonic Restraint	Version:	4.31
Test Start:	10-Jan-2025 11:11:37	Test End:	10-Jan-2025 11:12:03
User Name:		Manager:	
Company:			

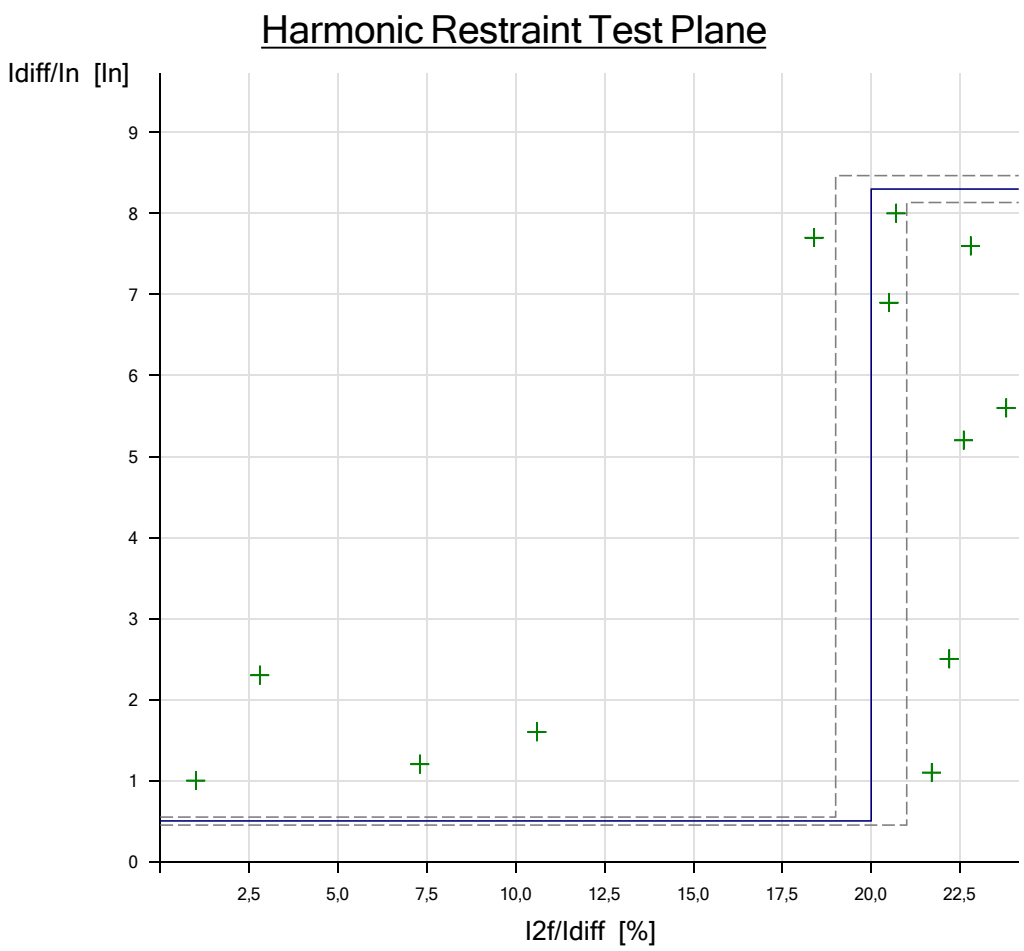
Test Settings

Testing:	Primary	Tested Harmonic:	2
Max. Test Time:	1,50 s	Delay Time:	0,25 s
Active Postfault:	No	Postfault Time:	0,04 s
Vout enabled:	No	Vout winding:	Primary

Binary Outputs

Test Results for Testphase L1-L2-L3 at Reference Side Primary for 2. Harmonic

Idiff	Ixf/Idiff	Angle (Ixf,Idiff)	Trip	State	Result
1,20 I/In	7,30 %	-120,0 °	Yes	Tested	Passed
1,10 I/In	21,70 %	-120,0 °	No	Tested	Passed
1,60 I/In	10,60 %	-120,0 °	Yes	Tested	Passed
5,20 I/In	22,60 %	-120,0 °	No	Tested	Passed
1,00 I/In	1,00 %	-120,0 °	Yes	Tested	Passed
2,50 I/In	22,20 %	-120,0 °	No	Tested	Passed
2,30 I/In	2,80 %	-120,0 °	Yes	Tested	Passed
6,90 I/In	20,50 %	-120,0 °	No	Tested	Passed
7,60 I/In	22,80 %	-120,0 °	No	Tested	Passed
8,00 I/In	20,70 %	-120,0 °	Yes	Tested	Passed
7,70 I/In	18,40 %	-120,0 °	Yes	Tested	Passed
5,60 I/In	23,80 %	-120,0 °	No	Tested	Passed



State:

12 out of 12 points tested.
12 points passed.
0 points failed.

General Assessment: Test passed

Diff Harmonic Restraint - SEARCH:

Test Object - Differential Parameters

Protected Object:

Protected Object: Transformer
Vector Group: YY0

Winding/Leg Name:	Primary	Secondary
Voltage:	110,00 kV	110,00 kV
Power:	114,00 MVA	114,00 MVA
Starpoint Grounding:	No	No
Delta-connected CT:	No	No

CT:

Winding/Leg Name:	Primary	Secondary
CT Current Prim:	600,00 A	600,00 A
CT Current Sec:	1,00 A	1,00 A
CT Grounding:	tow. Prot. Obj.	tow. Prot. Obj.
Gnd CT Prim Current:	200,00 A	800,00 A
Gnd CT Sec Current:	1,00 A	1,00 A
Gnd CT Grounding:	n/a	n/a

Protection device:

Reference Winding:	Primary		
Ibias Calculation:	(|Ip| + |Is|) / K1 (K1 = 2,00)		
Zero Seq. Elimination:	IL-I0		
Reference Current:	PO nominal current		
Ground CT Used:	No		
Disable Comb. char.:	No		
Idiff>:	0,50 In	tdiff>:	0,05 s
Idiff>>:	8,30 In	tdiff>>:	0,05 s
Itol rel:	2,00 %	ttol rel:	3,00 %
Itol abs:	0,05 In	ttol abs:	0,01 s

Harmonic Settings:

HR tol abs: 1,00 % HR tol rel: 3,00 %

Harmonic Order	Start point		End point	
	Ixf/Idiff	Idiff/In	Ixf/Idiff	Idiff/In
2	20,00 %	0,50	20,00 %	8,30

Test Module

Name:	OMICRON Diff Harmonic Restraint	Version:	4.31
Test Start:	10-Jan-2025 10:58:54	Test End:	10-Jan-2025 11:02:20
User Name:		Manager:	
Company:			

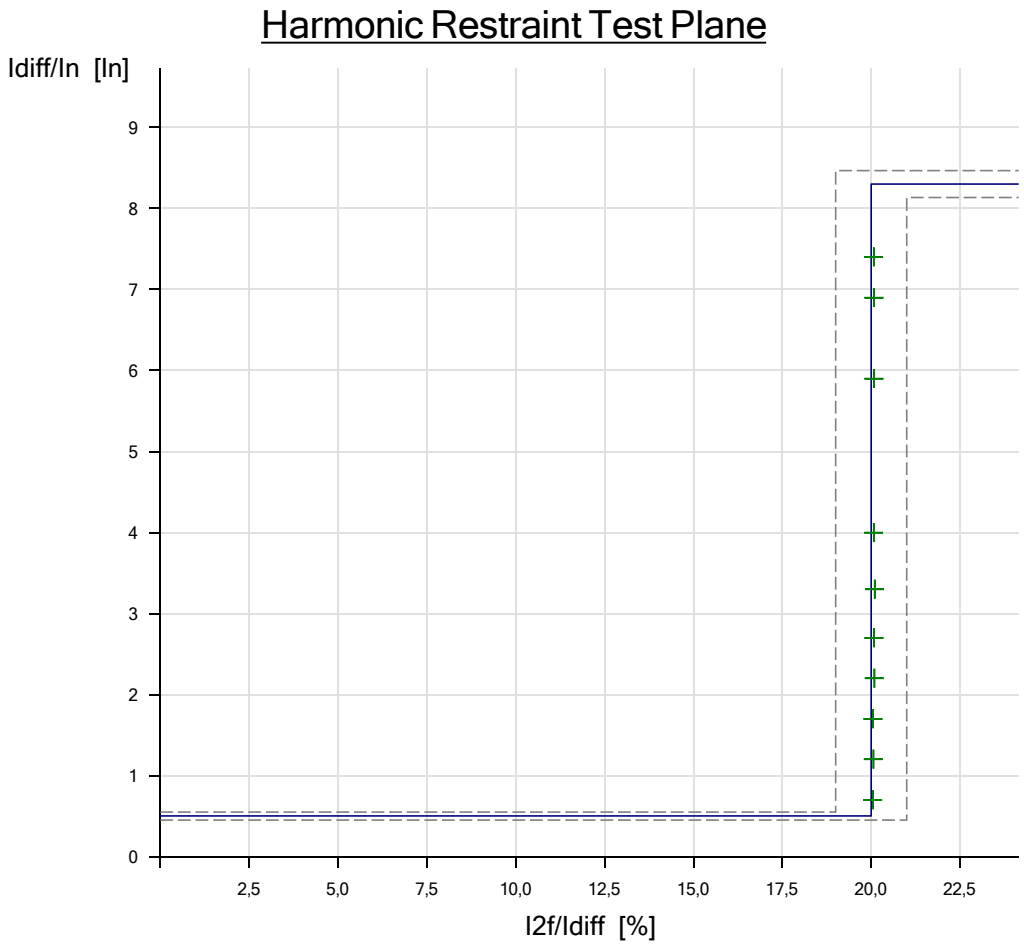
Test Settings

Testing:	Primary	Tested Harmonic:	2
Max. Test Time:	1,50 s	Delay Time:	0,25 s
Postfault active:	No	Postfault Time:	0,04 s
Ignore Default Char.:	No	Search resolution:	0,010
Vout enabled:	No	Vout winding:	Primary

Binary Outputs

Test Results for Testphase L1-E at Reference Side Primary for 2. Harmonic

Idiff	Ixf/Idiff Nominal	Ixf/Idiff Actual	Angle (Ixf,Idiff)	Dev (rel)	Dev.(abs)	Check Test	State	Result
0,70 I/In	20,000 %	20,04 %	-120,0 °	0,21 %	0,0429		Tested	Passed
1,20 I/In	20,000 %	20,07 %	-120,0 °	0,33 %	0,0663		Tested	Passed
1,70 I/In	20,000 %	20,05 %	-120,0 °	0,25 %	0,0507		Tested	Passed
2,20 I/In	20,000 %	20,09 %	-120,0 °	0,45 %	0,0898		Tested	Passed
7,40 I/In	20,000 %	20,07 %	-120,0 °	0,37 %	0,0741		Tested	Passed
6,90 I/In	20,000 %	20,08 %	-120,0 °	0,41 %	0,0819		Tested	Passed
5,90 I/In	20,000 %	20,08 %	-120,0 °	0,41 %	0,0819		Tested	Passed
2,70 I/In	20,000 %	20,08 %	-120,0 °	0,41 %	0,0819		Tested	Passed
3,30 I/In	20,000 %	20,10 %	-120,0 °	0,49 %	0,0976		Tested	Passed
4,00 I/In	20,000 %	20,07 %	-120,0 °	0,37 %	0,0741		Tested	Passed



State:

10 out of 10 points tested.
10 points passed.
0 points failed.

General Assessment: Test passed

Some comments on the lab

- **Test Accuracy and Consistency**:
  - The results demonstrate consistent performance of the protection system across multiple test scenarios. For instance, the trip times remained within the specified tolerance range, reflecting the reliability of the differential protection settings.

· **Operating Characteristic**:

- · The operating characteristic curves for Idiff and Ibias align well with the expected thresholds. The clear distinction between the tripping and non-tripping regions confirms the accuracy of the protection logic and its ability to avoid maloperation under normal conditions.

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Harmonic Restraint Validation:

- The harmonic restraint function has successfully mitigated potential misoperations due to transformer inrush currents, as shown by the harmonic restraint results. This confirms robust protection against transient conditions like energization.

· **Fault Sensitivity**:

- Sensitivity to faults is demonstrated by the system's response at low Idiff values. This sensitivity ensures prompt isolation of faults while maintaining stability for through-load and external fault scenarios.

· **Tested Scenarios**:

- Tests for line-to-line, line-to-earth, and three-phase faults indicate comprehensive coverage of possible fault conditions, affirming the system's adaptability to diverse fault scenarios.

· **Test Pass Rate**:

- A 100% pass rate across all test points underscores the precision of the current transformers (CTs), the protection settings, and the implementation of the protection algorithm.