SIEMENS

ARABIA ELECTRIC LTD. Equipment

Distance Relay Type 7SA522

Installation, Testing and Commissioning Site Report

Site Test Report No.

:

Manufacturer	:	Rated Current	:
Type	:	Auxiliary Voltage	:
MLFB No.	:	CT Ratio	:
		PT Ratio	:

General Functions	Selected
Distance Protection	
Power Swing Detection	
Pilot Protection for Distance Protection	
SOTF	
Back Up O/C Protection	
Fault Locator	

Mechanical Check and Visual Inspection

Item	Description	Remarks
1	Check the name plate data according to the drawings and specifications	
2	Check for transportation damage and correct positioning	
3	Verify tightness of external wiring	

Electrical Checks

Item	Description	Remarks
1	All connections checked according to the wiring diagram	
2	Auxiliary power supply checked for rating and polarity	
3	CT shorting checked	
4	Indications checked	
5	Casing earthing checked	
6	Contact earthing checked	
7	Contact resistance of tripping and alarm checked	

Functional Test

1- Measurement:

Injected quantities

L1	L2	L3
57.73 V	57.73 V	57.73 V
1 A	1 A	1 A

Site Test Report No.
:

Measurement functions		0^0		45^o	
		primary	secondary	primary	secondary
Current 1L1					
Current 1L2					
Current 1L3					
3I0					
I1- positive					
I2- Negative					
Voltage UL1E					
Voltage UL2E					
Voltage UL3E					
Voltage UL12					
Voltage UL21					
Voltage UL31					
3U0					
U1- positive					
U2 – Negative					
Apparent power(S)					
Active power(P)					
Reactive power(Q)					
Frequency					
% values			0^o	45^o	
	Current 1L1				
	Current 1L2				
	Current 1L3				
	3I0				
	I1- positive				
	I2- Negative				
	Voltage UL1E				
	Voltage UL2E				
	Voltage UL3E				
	Voltage UL12				

	Voltage UL21			
	Voltage UL31			
	3U0			
	U1- positive			
	U2 – Negative			
	Apparent power(S)			
	Active power(P)			
	Reactive power(Q)			
	Frequency			
	Power factor			

Impedance secondary measurement

Injected impedance = 6 Ω

V.T ratio = 110 / 0.1 kv

C.T ratio = 1200 / 1

	Φ = 60°		Φ = 240°	
	calculated	measured	calculated	measured
RL_1				
XL_1				
RL_2				
XL_2				
RL_3				
XL_3				
RL_{12}				
XL_{12}				
RL_{23}				
XL_{23}				
RL_{31}				
XL_{31}				

Note : if injection of Z is from omicron distance but without RIO file of the relay setting you must adjust Zero sequence compensation factor = 0 in the relay setting for all zones and Zero sequence compensation factor = 0 in the tester setting that is from test object parameters then system settings.

2- Starting of Distance Protection test

Setting Value

- Phase Current threshold for distance measurement=0.1A
- 3Io threshold for neutral current pick up=0.1A
- 3Vo threshold for zero sequence voltage pick up= 5V

2.1-Earth fault detection

2.1.1- By zero sequence current $3I_0$ Thresholds add (1203)

Before test make sure that { fuse failure monitor add (2910) } and { voltage failure supervision add (2915) } are turned off.

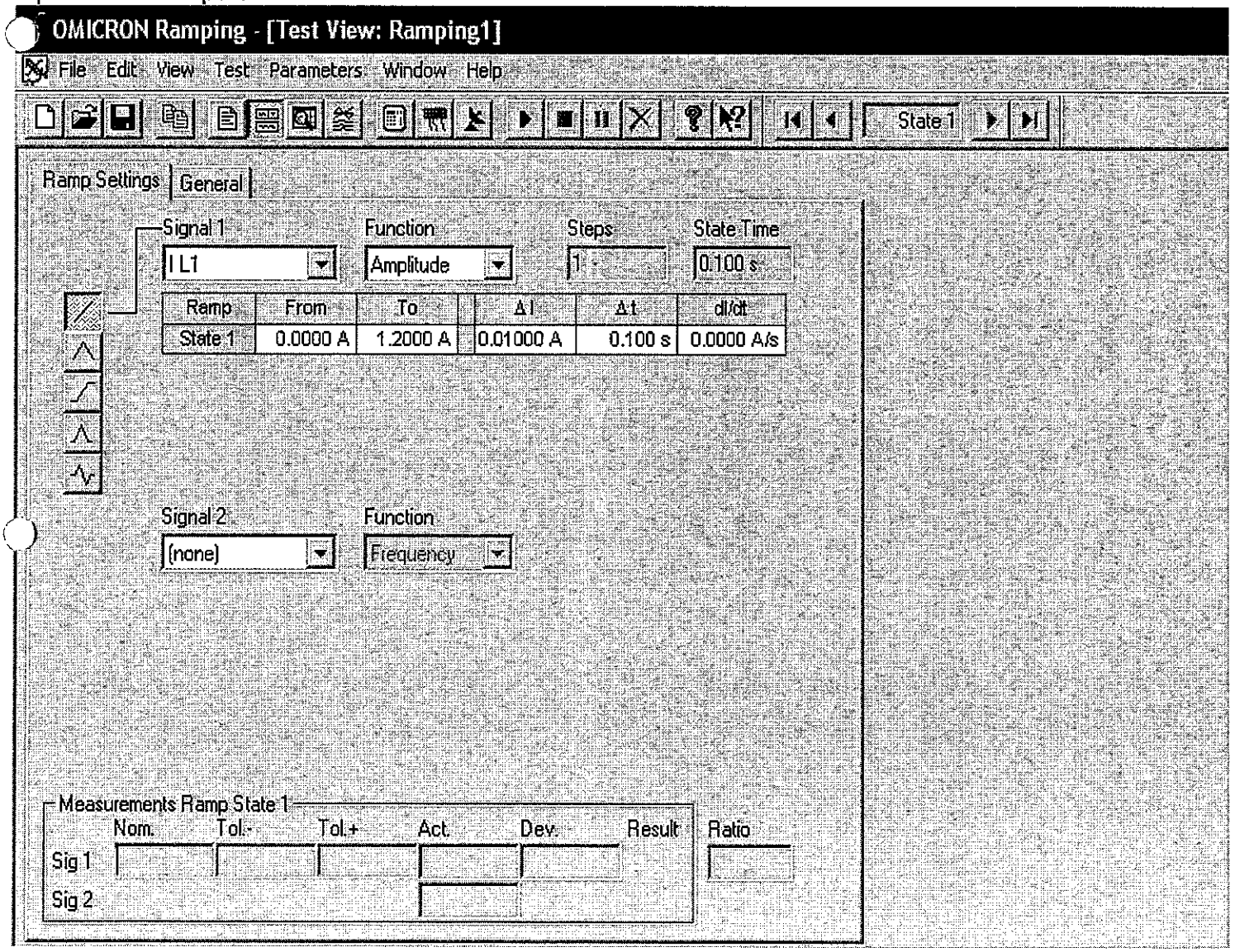
Also before testing raise the setting of 3I0 Threshold for neutral current pick up add (1203) more than phase current threshold for distance measuring add (1202).

Phase	Pick up		Drop Off	
	Calculated	Measured	Calculated	Measured
R-N				
S-N				
T-N				

Note the drop off current will be less than phase current threshold for distance measuring add (1202).

Pick up and drop off values can be done using Ramping from the Omicron test set
If the current setting = 1A and you want to get the pick up and drop off values you will simulate the following:
First choose the phase that will be tested from **signal 1** i.e. L1
The current will increased from 0 to 1.2A by the step **ΔI** within time **ΔT** till it reaches a value of pick up at this moment the binary output of the relay closes and activate the binary input of the tester to be (high 1) and the tester will save this current value. The current still increasing till it reaches 1.2A and after that it will decrease by step ΔI within time ΔT of state 2 till it reaches a

current value at which the relay drops off at this moment the binary output of the relay opens and the binary input of the tester will change its status so the tester save this current drop of value.
The current still decreasing till reaches 0 and the injection will stop.
For achieving that, follows the instructions as in the following figures.
After finishing click start to run the test
When the test is finished You can see the actual values of pickup and drop off from measurements Ramp state 1 and 2.
Make the test report **Long form** from **parameters** menu then **Report.**
Export report from **file** menu and choose **(rtf)** for saving it to be saved as word file.
Open the test report



OMICRON Ramping - [Detail View:Ramping1]

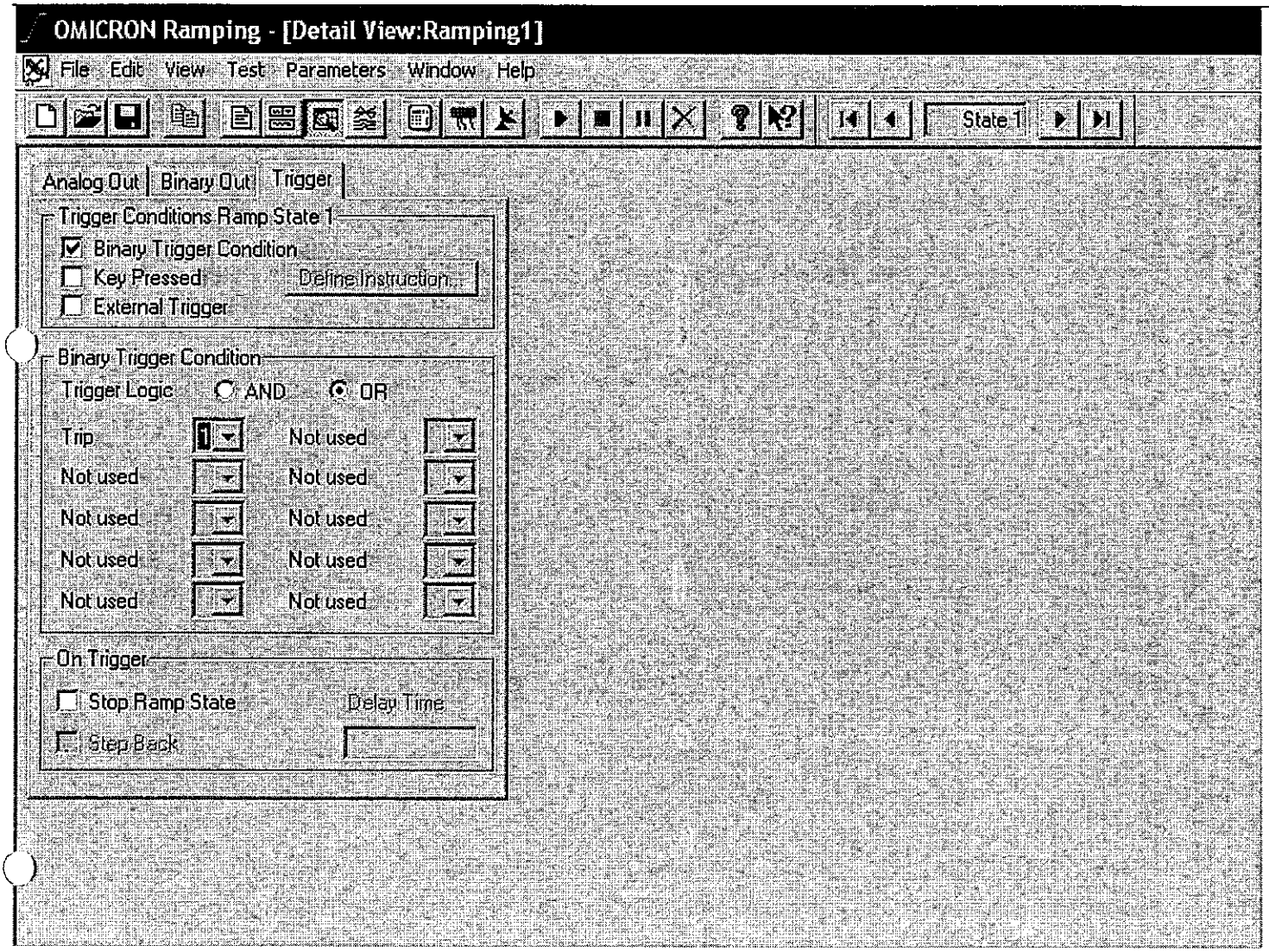
File Edit View Test Parameters Window Help

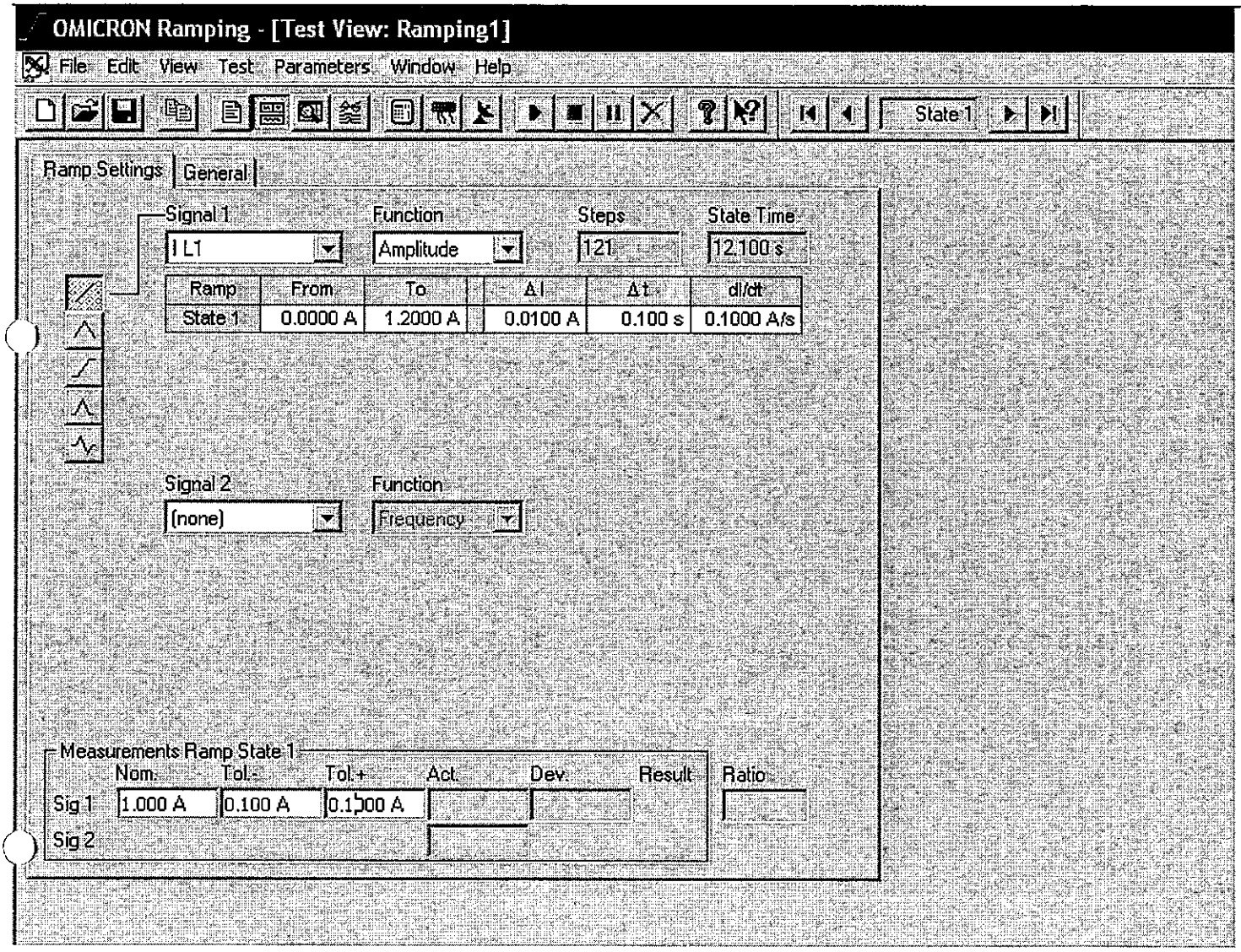
State 1

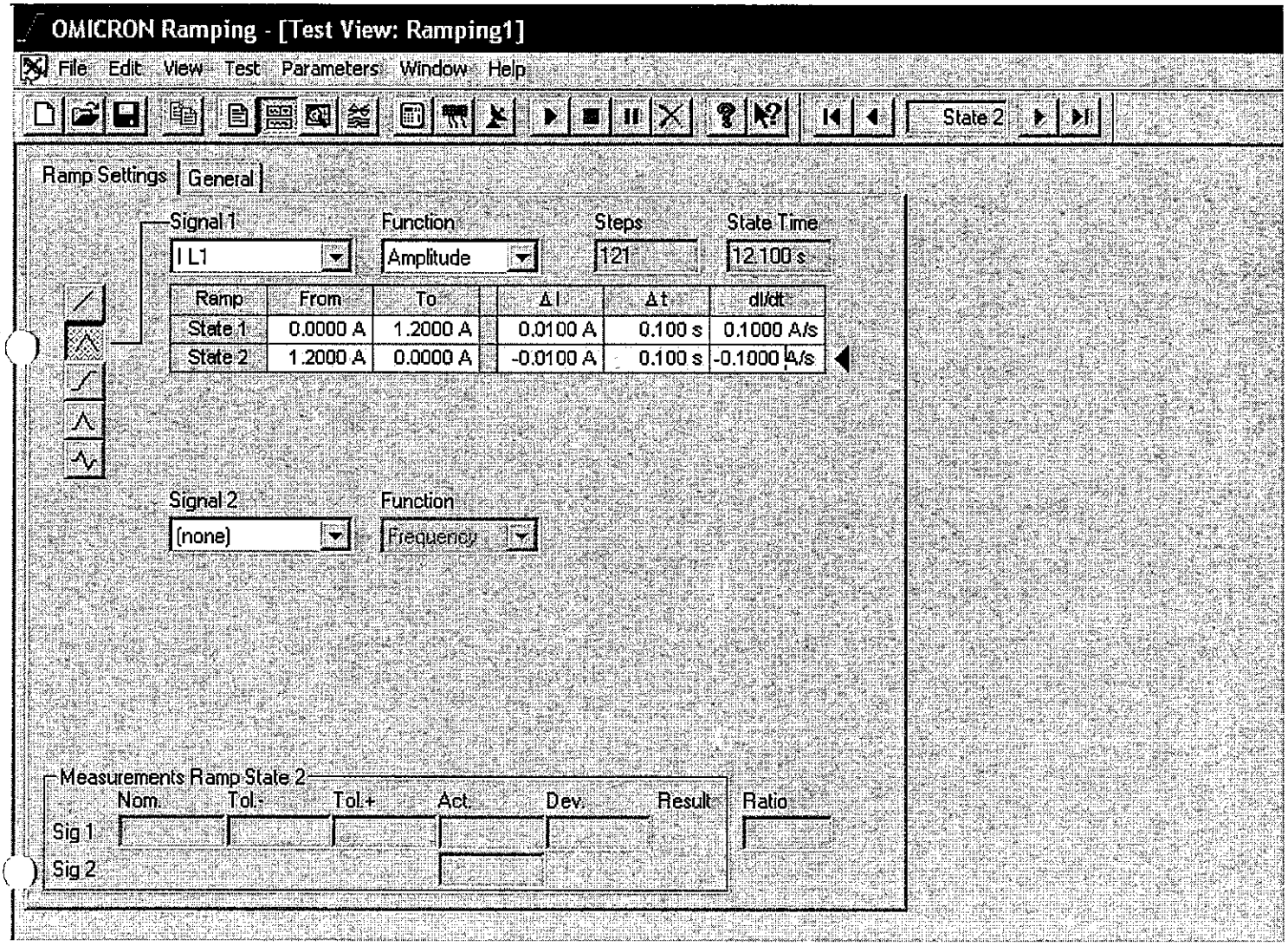
Analog Out | Binary Out | Trigger

	Ramp state 1		
V L1-E	0.000 V	0.00 °	60.000 Hz
V L2-E	0.000 V	-120.00 °	60.000 Hz
V L3-E	0.000 V	120.00 °	60.000 Hz
I L1	0.000 A	0.00 °	60.000 Hz
I L2	0.000 A	-120.00 °	60.000 Hz
I L3	0.000 A	120.00 °	60.000 Hz

☑ Force absolute phases


OMICRON Ramping - [Detail View:Ramping1]
File Edit View Test Parameters Window Help
State 1
Analog Out
Binary Out
Trigger
Trigger Conditions Ramp State 1
Binary Trigger Condition
Key Pressed
External Trigger
Define Instruction...
Binary Trigger Condition
Trigger Logic
AND
OR
Trip
Not used
On Trigger
Stop Ramp State
Delay Time
Step Back


OMICRON Ramping - [Test View: Ramping1]
File Edit View Test Parameters Window Help
State 1
Ramp Settings
General
Signal 1
I L1
Function
Amplitude
Steps
121
State Time
12.100 s
Ramp
From
To
ΔI
Δt
dI/dt
State 1
0.0000 A
1.2000 A
0.0100 A
0.100 s
0.1000 A/s
Signal 2
(none)
Function
Frequency
Measurements Ramp State 1
Nom.
Tol.-
Tol.+
Act.
Dev.
Result
Ratio
Sig 1
1.000 A
0.100 A
0.100 A
Sig 2


OMICRON Ramping - [Test View: Ramping1]
File Edit View Test Parameters Window Help
State 2
Ramp Settings
General
Signal 1
I L1
Function
Amplitude
Steps
121
State Time
12.100 s
Ramp | From | To | ΔI | Δt | dI/dt
State 1 | 0.0000 A | 1.2000 A | 0.0100 A | 0.100 s | 0.1000 A/s
State 2 | 1.2000 A | 0.0000 A | -0.0100 A | 0.100 s | -0.1000 A/s
Signal 2
(none)
Function
Frequency
Measurements Ramp State 2
Nom. Tol.- Tol.+ Act. Dev. Result
Ratio
Sig 1
Sig 2

OMICRON Ramping - [Detail View:Ramping1]

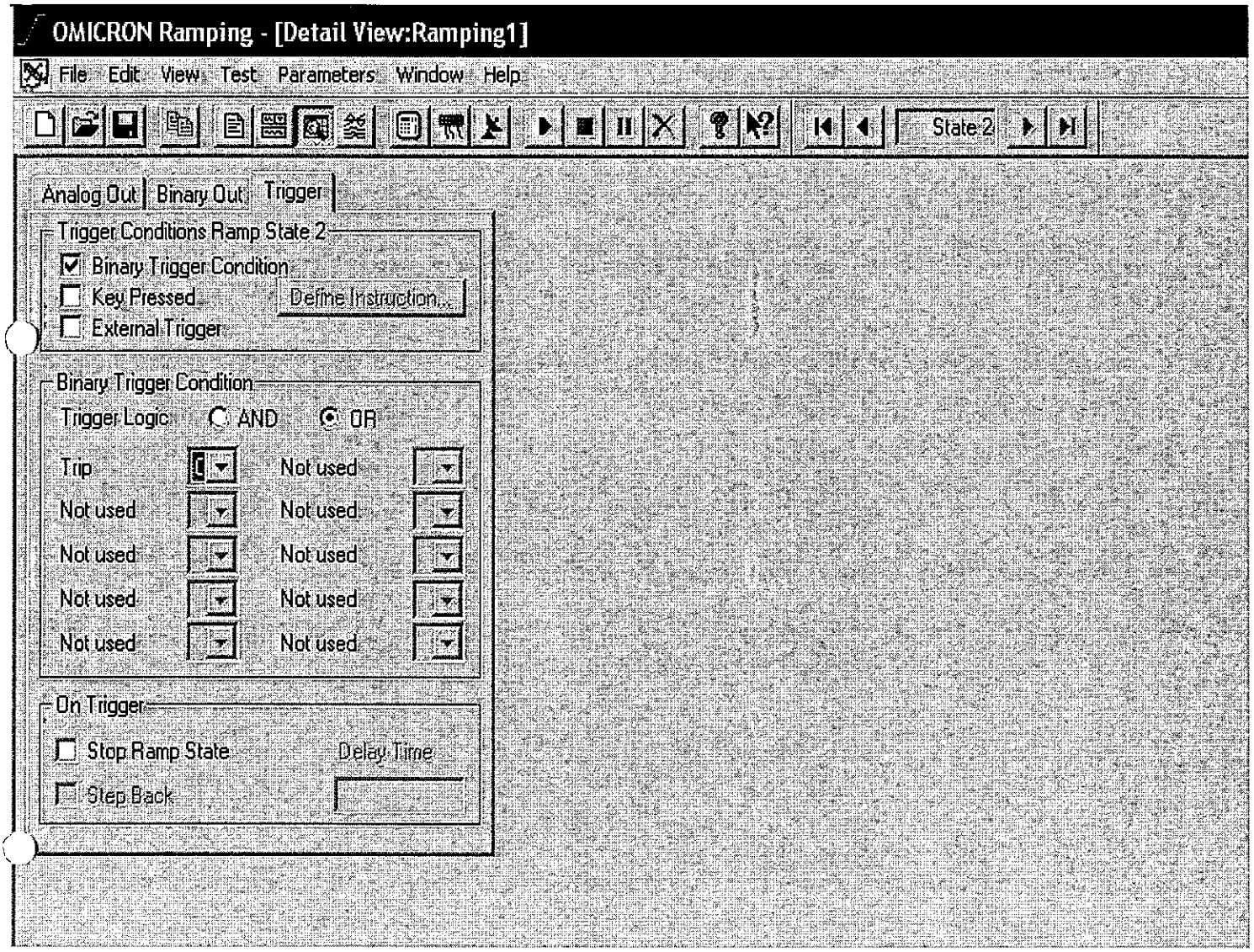
File Edit View Test Parameters Window Help

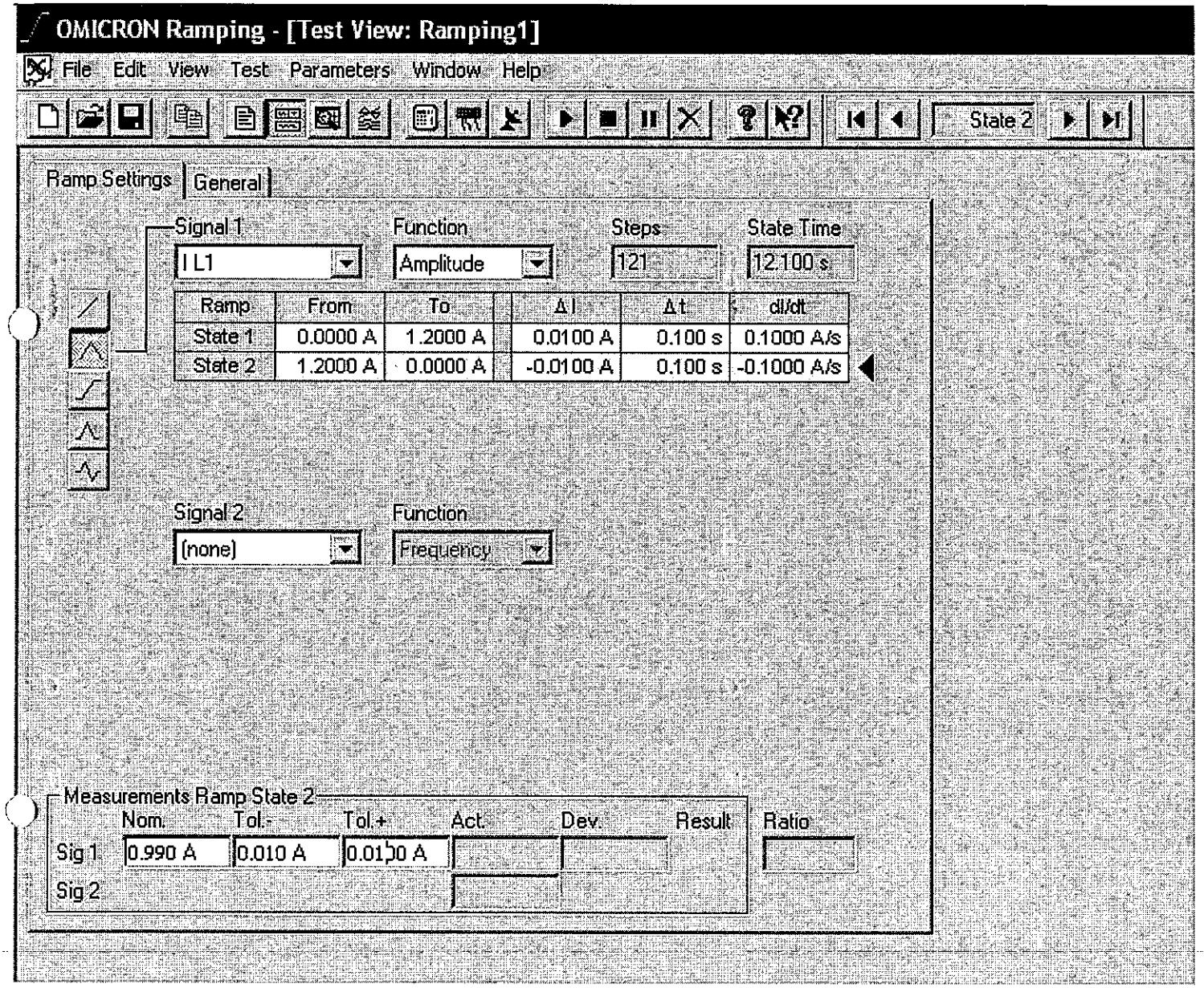
State 2

Analog Out | Binary Out | Trigger

	Ramp state 2		
V L1-E	0.000 V	0.00 °	60.000 Hz
V L2-E	0.000 V	-120.00 °	60.000 Hz
V L3-E	0.000 V	120.00 °	60.000 Hz
I L1	1.200 A	0.00 °	60.000 Hz
I L2	0.000 A	-120.00 °	60.000 Hz
I L3	0.000 A	120.00 °	60.000 Hz

☐ Force absolute phases


OMICRON Ramping - [Detail View:Ramping1]
File Edit View Test Parameters Window Help
State 2
Analog Out
Binary Out
Trigger
Trigger Conditions Ramp State 2
Binary Trigger Condition
Key Pressed
Define Instruction...
External Trigger
Binary Trigger Condition
Trigger Logic
AND
OR
Trip
Not used
Not used
Not used
Not used
Not used
Not used
Not used
Not used
Not used
Not used
On Trigger
Stop Ramp State
Delay Time
Step Back


OMICRON Ramping - [Test View: Ramping1]
File Edit View Test Parameters Window Help
State 2
Ramp Settings
General
Signal 1
I L1
Function
Amplitude
Steps
121
State Time
12.100 s
Ramp | From | To | ΔI | Δt | dI/dt
State 1 | 0.0000 A | 1.2000 A | 0.0100 A | 0.100 s | 0.1000 A/s
State 2 | 1.2000 A | 0.0000 A | -0.0100 A | 0.100 s | -0.1000 A/s
Signal 2
(none)
Function
Frequency
Measurements Ramp State 2
Nom. Tol.- Tol.+ Act. Dev. Result Ratio
Sig 1 0.990 A 0.010 A 0.010 A
Sig 2

2.1.2- By zero sequence current $3I_0$ Thresholds and $3V_0$ Threshold add (1204)

Before test make sure that { fuse failure monitor add (2910) } and { voltage failure supervision add (2915) } are turned off.

Inject single phase current more than the setting of 3I0 Threshold for neutral current pick up add (1203) and single phase voltage less than $3U_o$ threshold zero sequence voltage pick up add (1204) then raise the voltage not gradually but shot till the relay picks up. Then decrease the voltage by shot not gradually till the relay drops off.

	Pick up	
3Vo	Calculated	Measured

2.2- Phase fault detection add (1202)

Phase	Pick up		Drop Off	
	Calculated	Measured	Calculated	Measured
R-S				
S-T				
T-R				

If you inject single phase current you you must raise the setting of { phase current threshold for distance measuring add (1202)} more than the setting of {3I0 Threshold for neutral current pick up add (1203)}

Note you can get the pickup and drop off values by RAMPING as in the case of zero sequence current threshold. But you must choose <u>signal 1</u> line to line i.e. (I L1 L2)

3- Zones reach & Time Testing

zone	time	setting	axis	Fault types							time
				R -N	Y-N	B-N	R-Y	Y-B	B-R	RYB	

Site Test Report No.

:

Z_1 forward	0	1	R									29.3
		2.5	X									
Z_{1B} forward	0.3	1.3	R									
		3.5	X									
Z_2 forward	0.5	2	R									
		5	X									
Z_3 reverse	1	3	R									
		6	X									
Z_4 forward	1.5	5	R									
		10	X									
Z_5 non directional	2.5	7	R									
		12	X									
		-7	R									
		-12	X									

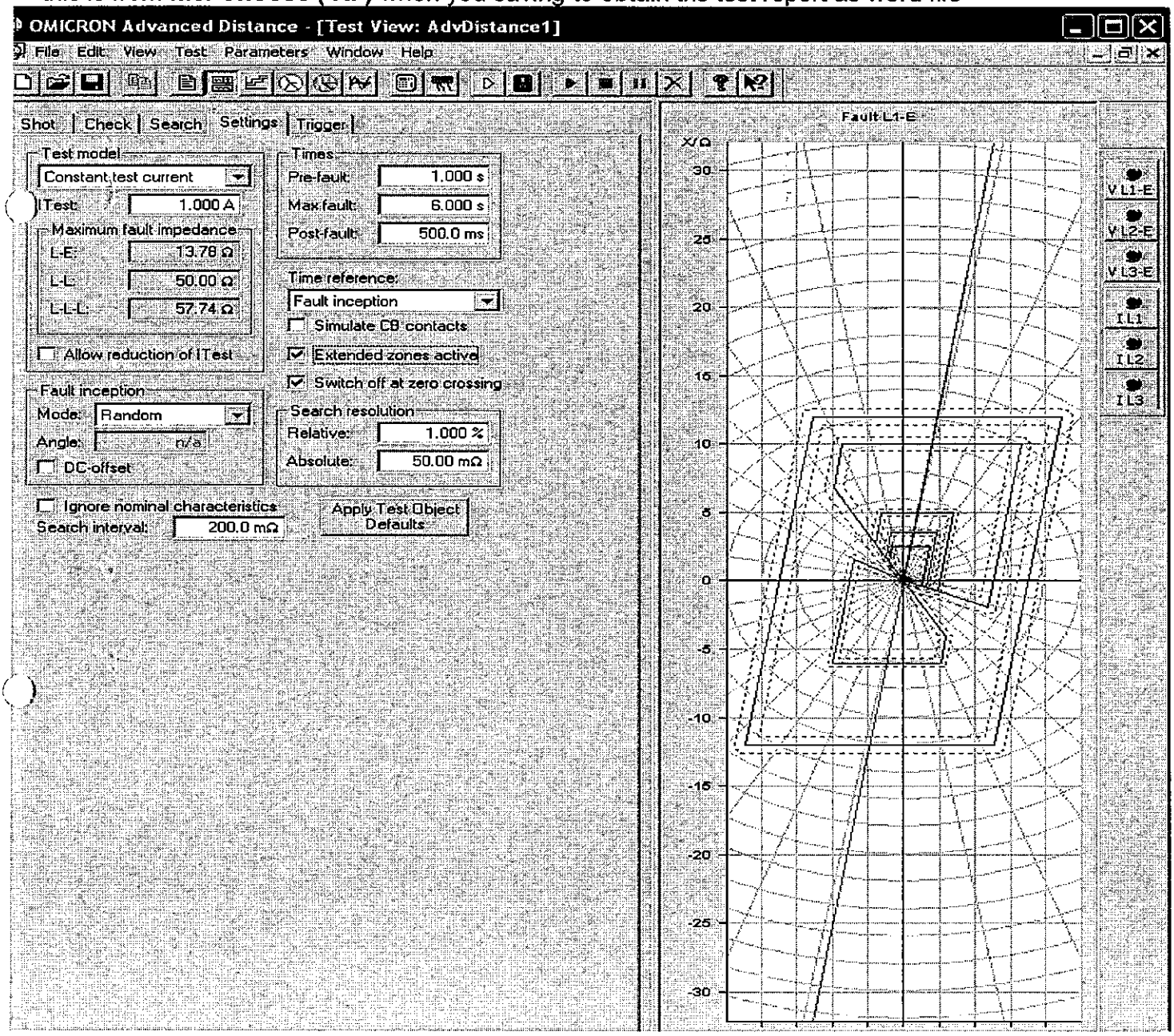
Note: you may find the trip time of relay around origin not accurate. if you face that you must raise the test current to 2 A that is the real simulation for these faults near V.T

You can check the reach and the times of the distance relay automatically by using the OMICRON tester by

1- Open distance then choose advanced distance
2- Open test object parameter
3- Import the RIO file of your relay setting
4- Now the zones characteristic will be shown
5- Open settings and adjust **(I test = 1A)** then click on **(extended zone active)** to activate Z_{1B}
6- Open **check** for testing zones time.
7- Adjust **(Z and Phi of the origin to 0)**
and **(Length** to value more than the max. reach of the outer zone i.e. 20 ohm)
and select **(all zones)** that is if you want to check all zone if not choose the required zone.
8- If you want to achieve the test at one angle only i.e. line angle 85°
adjust **(Angle = 85°)**
Then click **add to** and choose the fault type you want to do the test for or you may choose **ALL** to select all type faults. Then click **OK**
9- Open **Search** for testing zones reach.
10- Repeat steps 7 and 8
8- Click start button

9- The test is being begin and after it is finished open parameters then Report then select **Long form** to have all data in the test report.

10- Open the test report then export file to save it
this is from **file. Choose (rtf)** when you saving to obtain the test report as word file



Site Test Report No.

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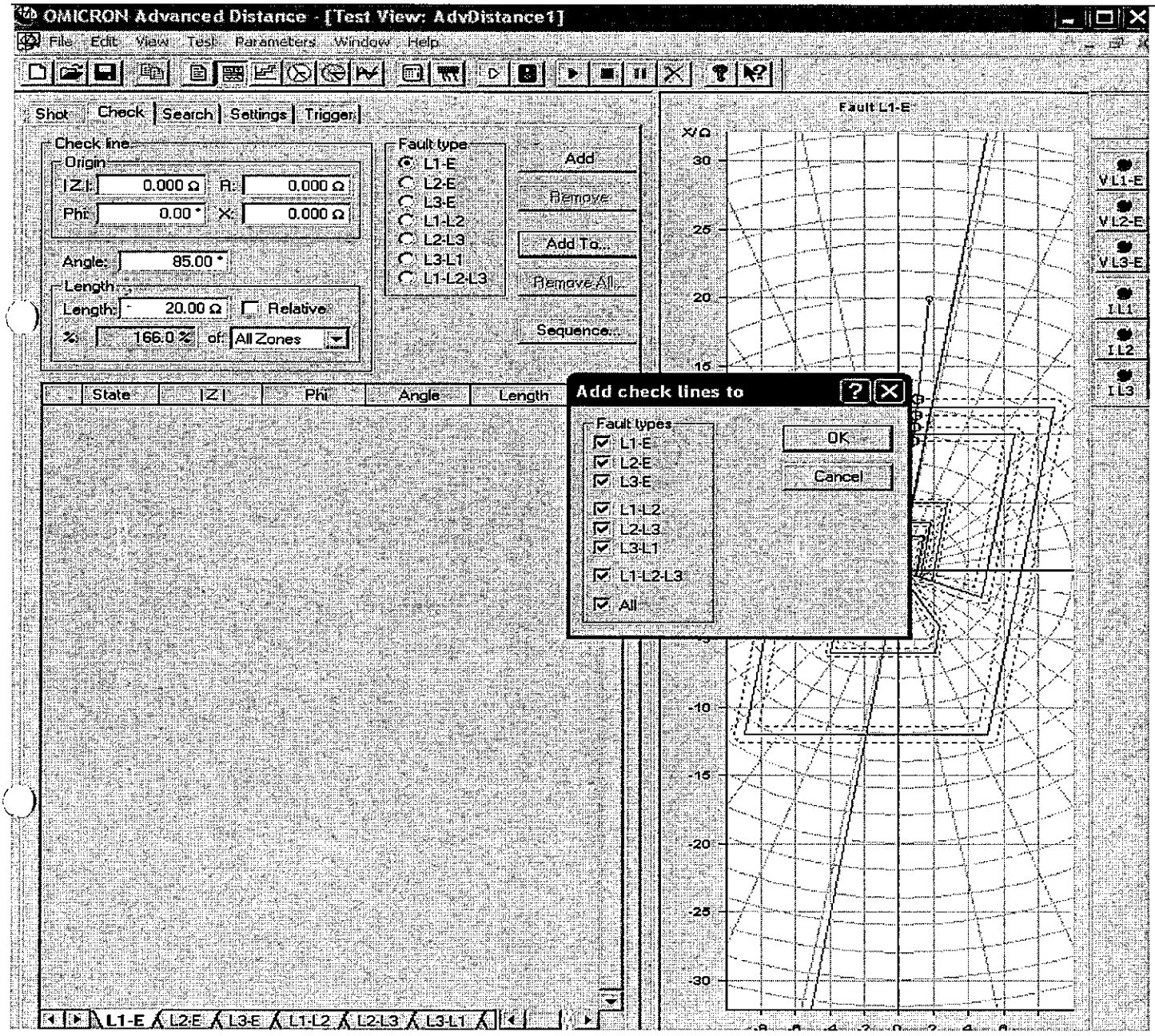
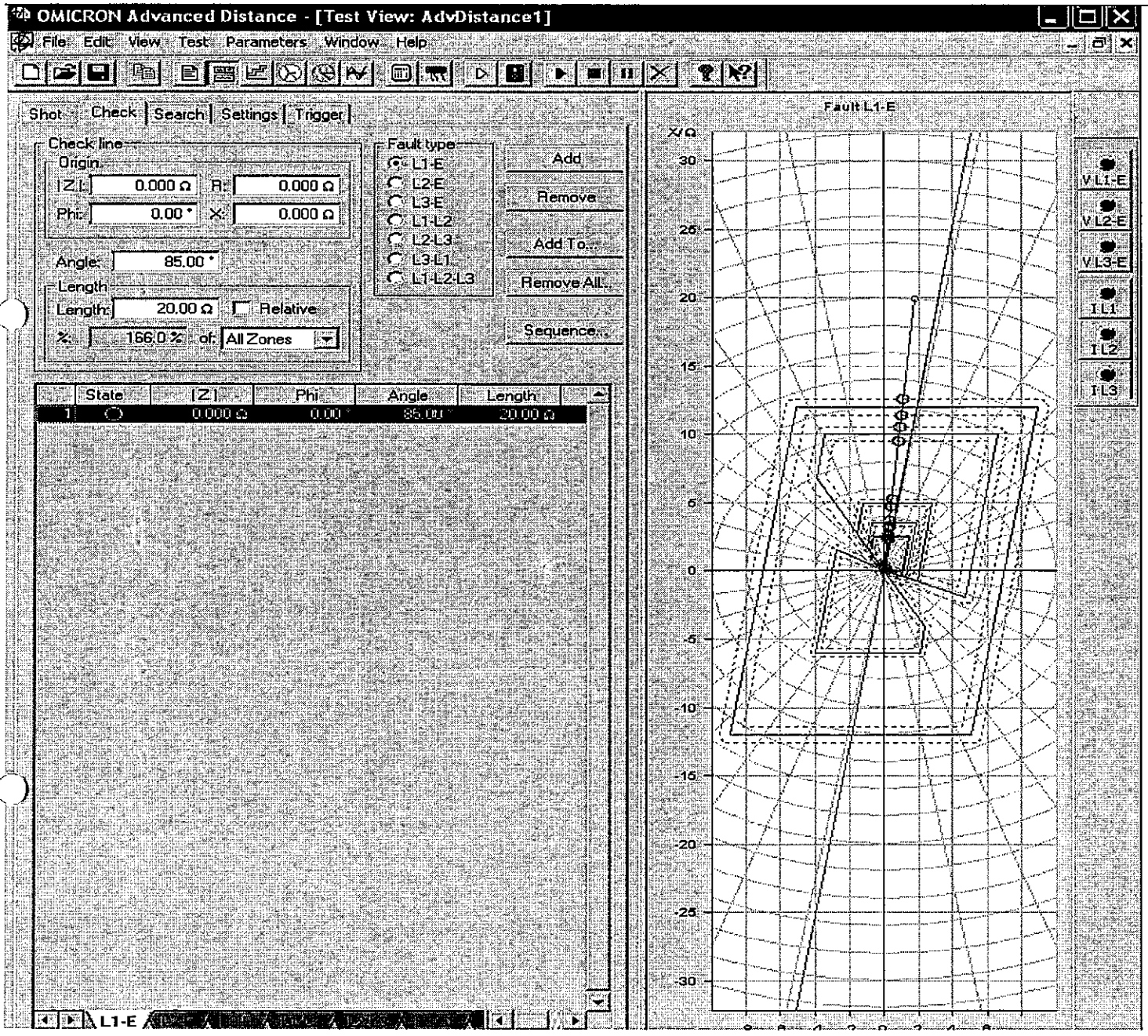
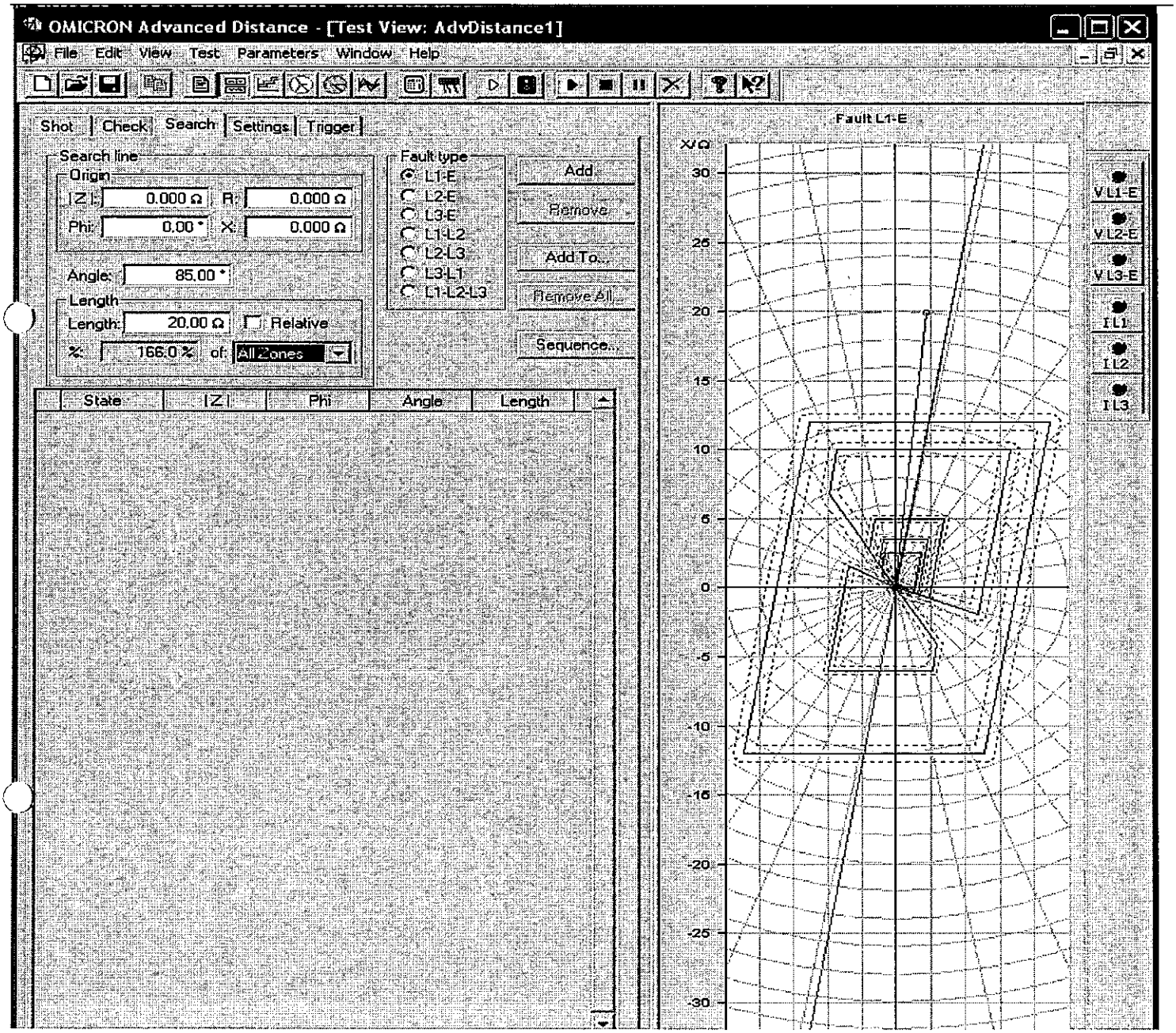
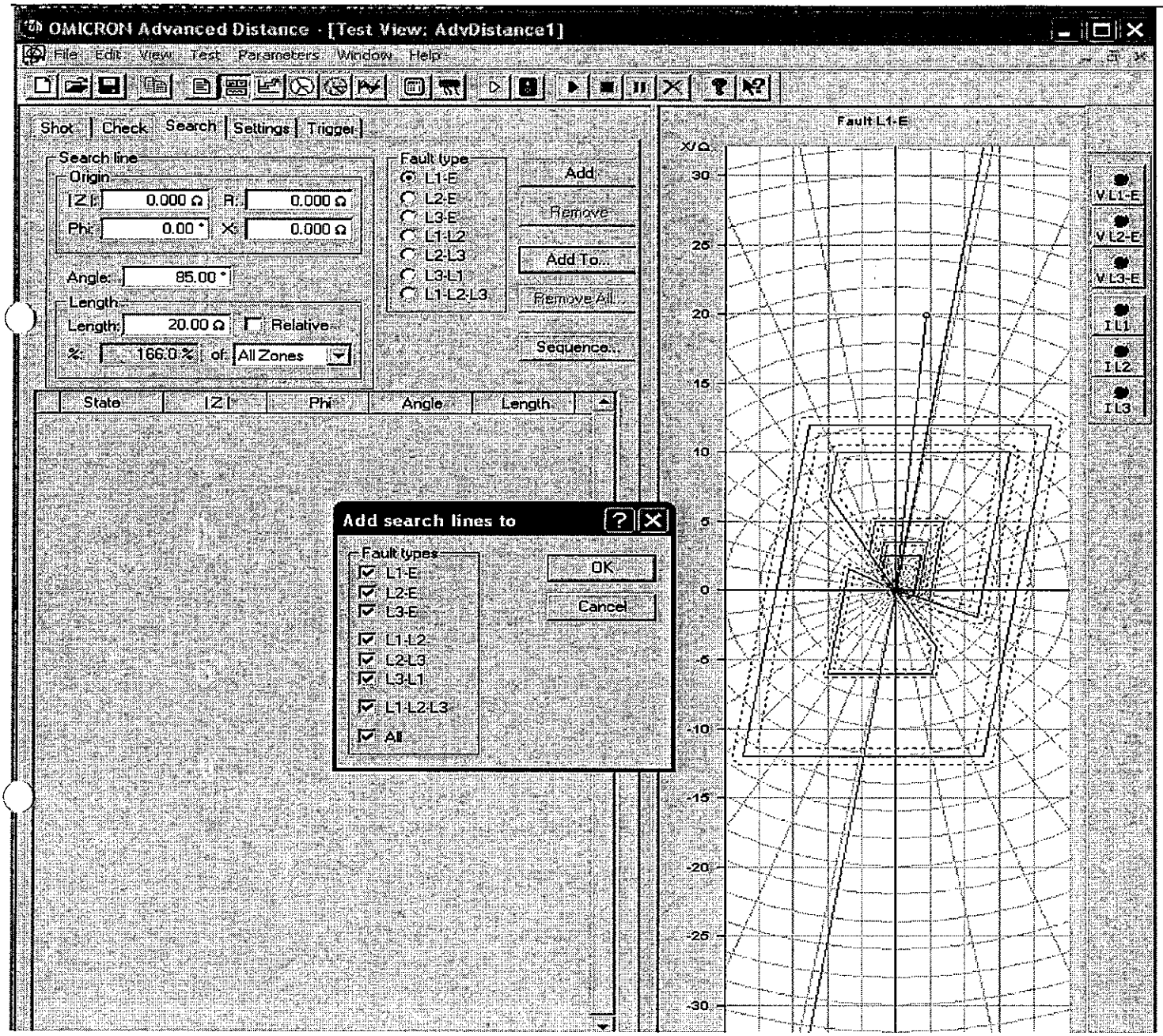
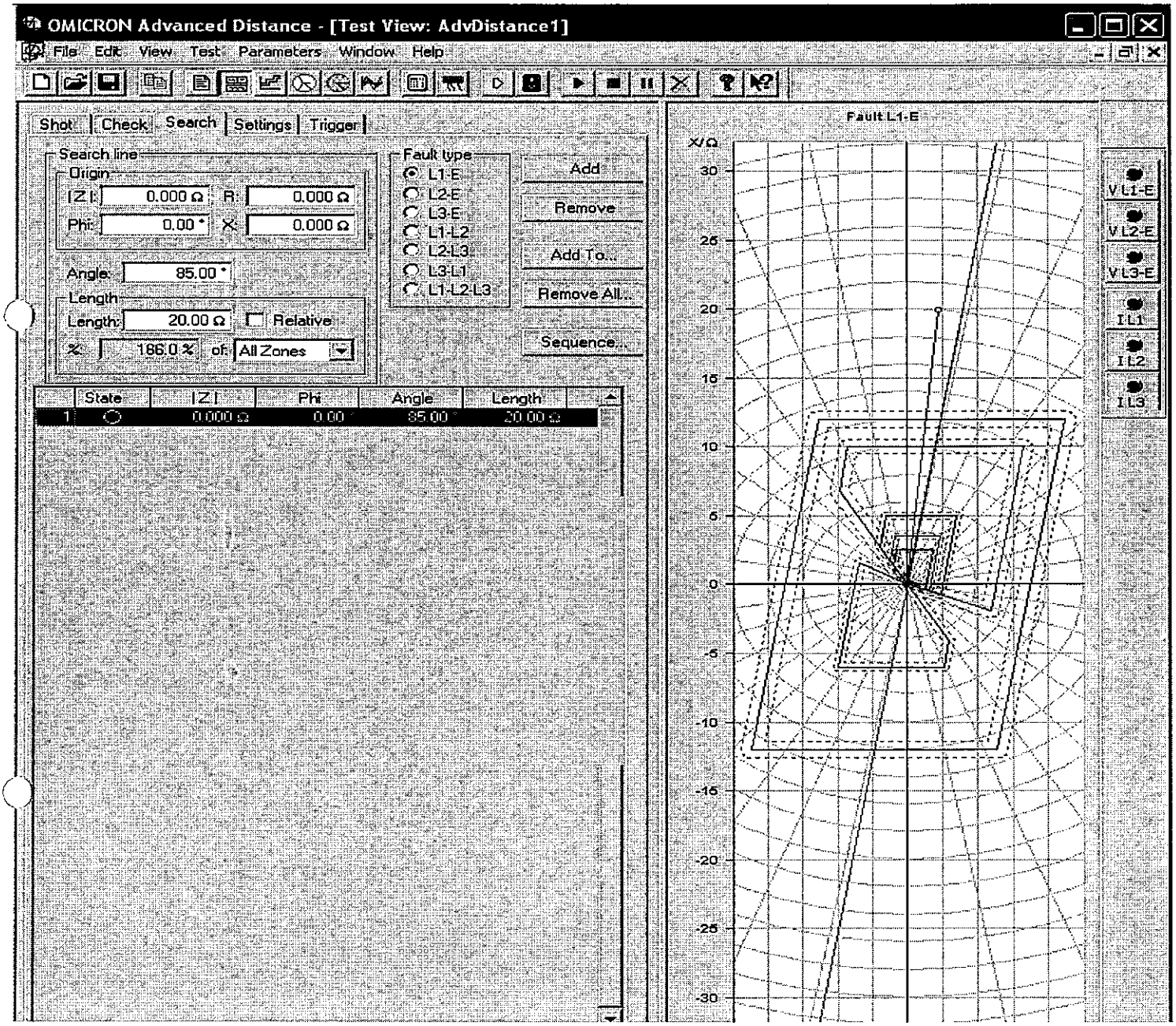



OMICRON Advanced Distance - [Test View: AdvDistance1]
File Edit View Test Parameters Window Help
Shot Check Search Settings Trigger
Check line
Origin
|Z|: 0.000 Ω R: 0.000 Ω
Phi: 0.00 ° X: 0.000 Ω
Angle: 85.00 °
Length
Length: 20.00 Ω Relative
%: 166.0 % of: All Zones
Fault type
L1-E
L2-E
L3-E
L1-L2
L2-L3
L3-L1
L1-L2-L3
Add
Remove
Add To...
Remove All
Sequence...
State |Z| Phi Angle Length
1 0.000 Ω 0.00 ° 85.00 ° 20.00 Ω
L1-E
Fault L1-E
X/Ω
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
V L1-E
V L2-E
V L3-E
I L1
I L2
I L3


OMICRON Advanced Distance - [Test View: AdvDistance1]
File Edit View Test Parameters Window Help
Shot Check Search Settings Trigger
Search line
Origin
|Z|: 0.000 Ω R: 0.000 Ω
Phi: 0.00 ° X: 0.000 Ω
Angle: 85.00 °
Length
Length: 20.00 Ω Relative
166.0 % of: All Zones
Fault type
L1-E
L2-E
L3-E
L1-L2
L2-L3
L3-L1
L1-L2-L3
Add
Remove
Add To...
Remove All
Sequence...
State |Z| Phi Angle Length
Fault L1-E
X/Ω
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
V L1-E
V L2-E
V L3-E
I L1
I L2
I L3


OMICRON Advanced Distance - [Test View: AdvDistance1]
File Edit View Test Parameters Window Help
Shot Check Search Settings Trigger
Search line
Origin
|Z|: 0.000 Ω R: 0.000 Ω
Phi: 0.00 ° X: 0.000 Ω
Angle: 85.00 °
Length
Length: 20.00 Ω Relative
%: 166.0 % of: All Zones
Fault type
L1-E
L2-E
L3-E
L1-L2
L2-L3
L3-L1
L1-L2-L3
Add
Remove
Add To...
Remove All
Sequence...
State |Z| Phi Angle Length
Add search lines to
Fault types
L1-E
L2-E
L3-E
L1-L2
L2-L3
L3-L1
L1-L2-L3
All
OK
Cancel
Fault L1-E
X/Ω
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
V L1-E
V L2-E
V L3-E
I L1
I L2
I L3



11- If you want to achieve the test within angle band

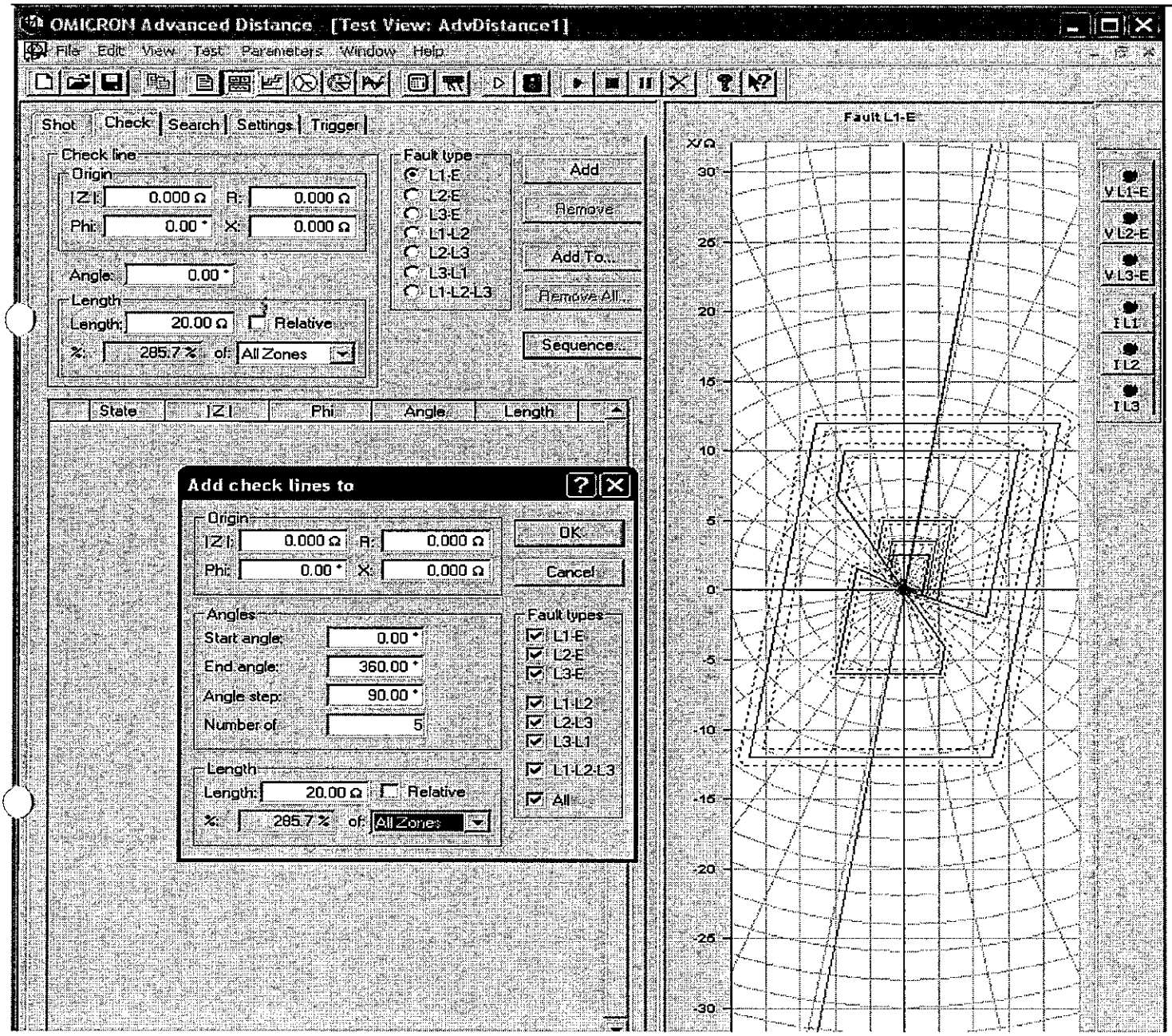
12- Open **check** for testing zones time.

13- Adjust **(Z and Phi of the origin to 0)** and adjust **(Angle = 0°)**
and **(Length** to value more than the max. reach of the outer zone i.e. 20 ohm)
and select **(all zones)** that is if you want to check all zone if not choose the required zone.
Or you may not to do that and begin with sequence

14- Then open **sequence**
Adjust **(Z and Phi of the origin to 0)**
Adjust **start angle to 0 and end angle to 360 and angle step to 90**
adjust **(Length** to value more than the max. reach of the outer zone i.e. 20 ohm)
and select **(all zones)** that is if you want to check all zone if not choose the required zone.
15- Click **OK**
16- Open **Search** for testing zones reach.
17- Repeat steps 13 to 15
18- Click start button
19 now the zones reach and time will be tested at the 0 , 90 , 180 , 270 angles.
That is because we put start angle 0 and end angle 360 and the angle step is 90.
You can choose the angle band you want to do the test within also by changing
Start angle and end angle and the angle step
20- After the test is finished open parameters then Report then select
Long form to have all data in the test report.
21- Open the test report then export file to save it
this is from **file. Choose (rtf)** when you saving to obtain the test report as word file

Site Test Report No.

:



Site Test Report No.

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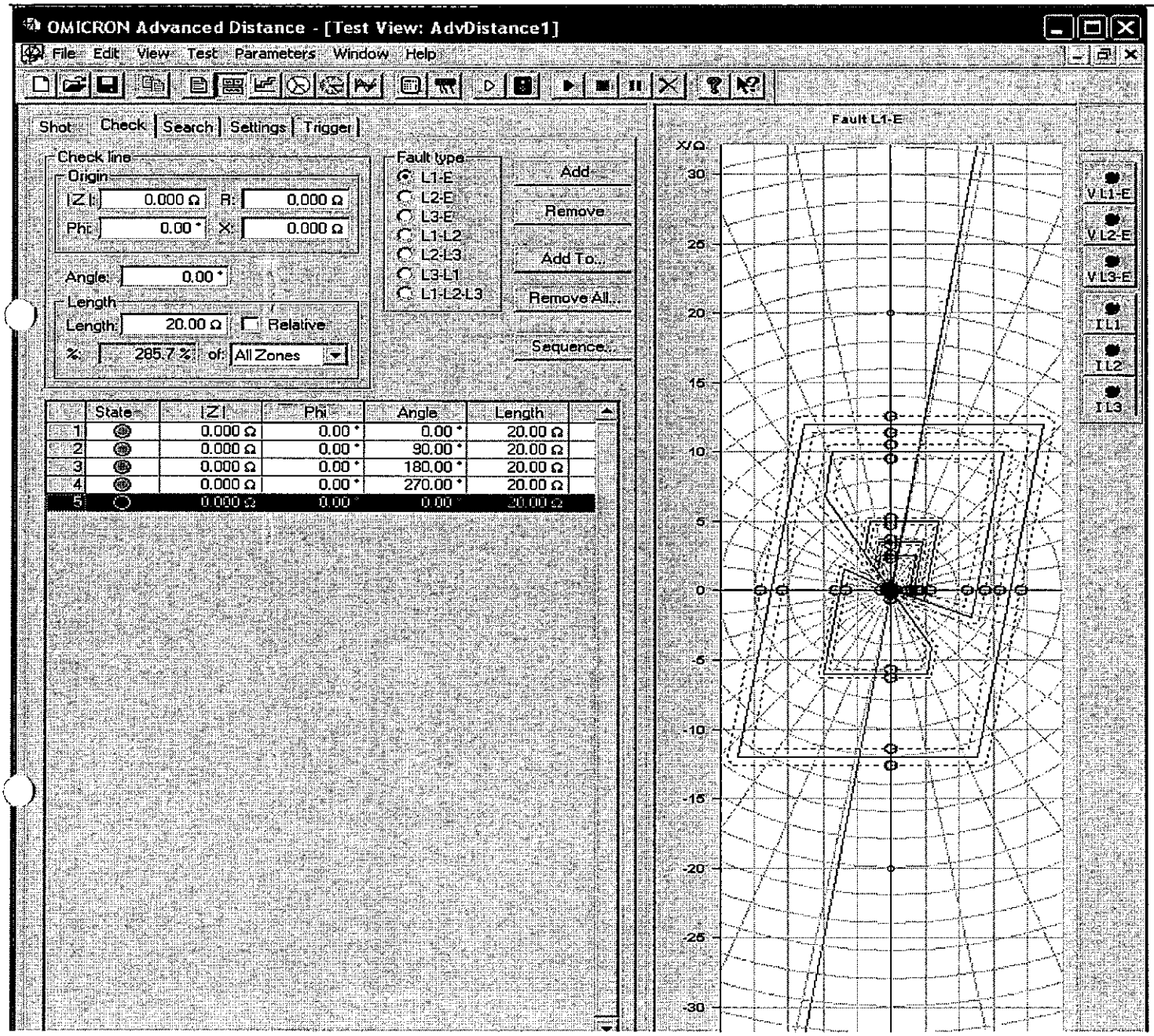
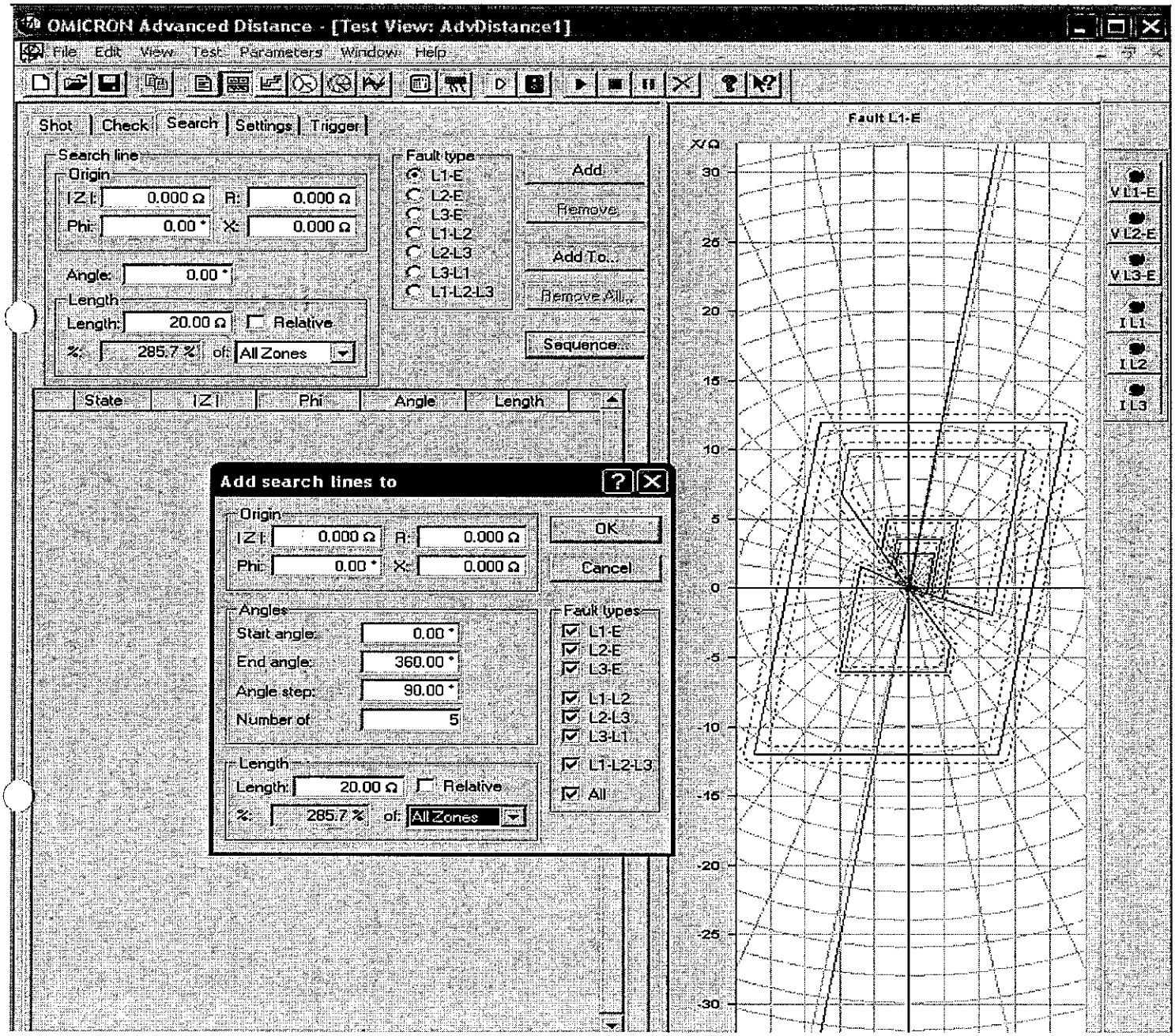
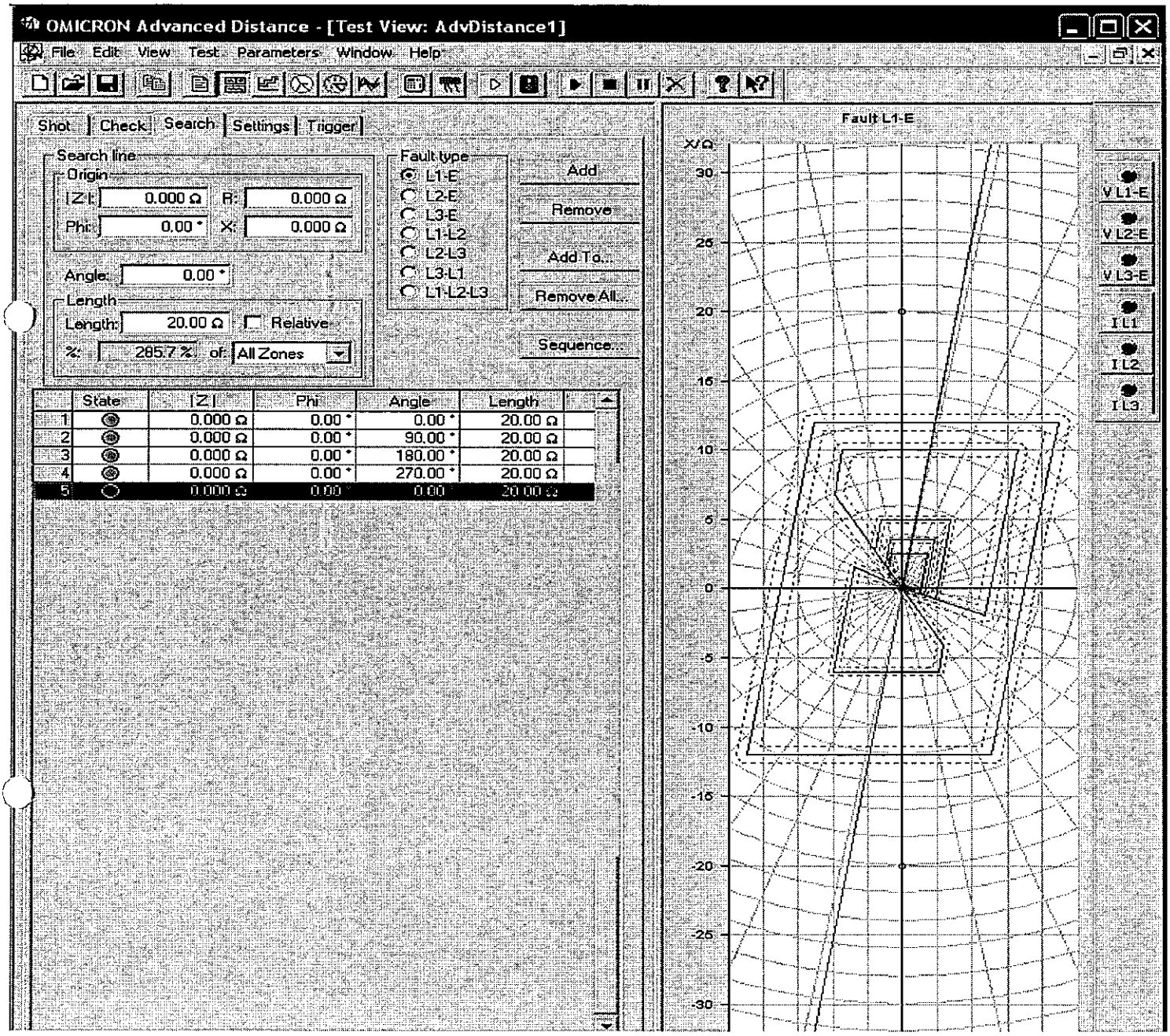



OMICRON Advanced Distance - [Test View: AdvDistance1]
File Edit View Test Parameters Window Help
Shot Check Search Settings Trigger
Search line
Origin
|Z|: 0.000 Ω R: 0.000 Ω
Phi: 0.00 ° X: 0.000 Ω
Angle: 0.00 °
Length
Length: 20.00 Ω Relative
%: 285.7 % of: All Zones
Fault type
L1-E
L2-E
L3-E
L1-L2
L2-L3
L3-L1
L1-L2-L3
Add
Remove
Add To...
Remove All...
Sequence...
State |Z| Phi Angle Length
Add search lines to
Origin
|Z|: 0.000 Ω R: 0.000 Ω
Phi: 0.00 ° X: 0.000 Ω
OK
Cancel
Angles
Start angle: 0.00 °
End angle: 360.00 °
Angle step: 90.00 °
Number of: 5
Length
Length: 20.00 Ω Relative
%: 285.7 % of: All Zones
Fault types
L1-E
L2-E
L3-E
L1-L2
L2-L3
L3-L1
L1-L2-L3
All
Fault L1-E
X/Ω
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
V L1-E
V L2-E
V L3-E
I L1
I L2
I L3

Site Test Report No.

:



4- Distance directionality check

note: If any zone is adjusted to nondirectional you must reverse it to be able to determine the undefined area. Also you must specify LEDs for distance pick up forward add (3719) and distance pick up reverse add (3720). Also you may specify binary outputs for them.
All of that can be done from the Masking from distance general.
Using RIO file you can do the test.

	Forward direction	Undefined area	Reverse direction	Undefined area
Earth fault	From 120 to -22	From 121 to 150	From 151 to -60	From -61 to -23
Phase ault	From to	From to	From to	From to

Also you can check that by quick CMC by injecting
U_1= 6 angle 0 I_1= 2A angle 19°
U_2= 57.73 angle -240 I_2= 0A
U_3= 57.73 angle 240 I_3= 0A
Note you must change setting of zero sequence compensation to zero, so the injected impedance will be U_1 / I_1
- When you start injection the relay will pick up in forward then increase the angle to be 20° also the relay will pick up in forward repeat that till the relay does not pick up, at this angle Φ_1 the undefined zone started record this angle. Go on in increasing the angle till the relay picks up in reverse direction, record this angle Φ_2

- Repeat the test but with angle(- 119°)
When you start injection the relay will pick up in forward then increase the angle to be - 120° also the relay will pick up in forward repeat that till the relay does not pick up, at this angle Φ_3 the undefined zone started record this angle. Go on in increasing the angle till the relay picks up in reverse direction, record this angle Φ_4 .

5- Distance Teleprotection scheme

5.1- Setting at POTT

Note: you have to specify a binary input for {Distance Tele. Carrier reception channel 1 add (4006)},LEDS for {Distance Tele. Carrier signal received add (4054)} and {Distance Tele. Carrier send signal add (4056)}

Injection status	Relay action should be	Relay actual action
Z_{1B} without C.R	Trip with Z_2 and C.S	
Z_{1B} with C.R	Trip with Z_{1B} and carrier send	
Z at Z_3 or Z_4 or Z_5	No carrier send	

5.2- Setting at PUTT

when you inject Z in Z_1 you will find that the relay trips with time T_1 and sends a carrier signal send . when you inject Z in Z_{1B} and there is a carrier receive you will find that the relay trips with time T_1 .

Injection status	Relay action should be	Relay actual action
Z in Z_1	Trip with time delayT_1 and carrier send	
Z_{1B} with C.R	Trip with time delayT_{1B}	
Z at Z_2 or Z_3 or Z_4 or Z_5	No carrier send	

5.3- Setting at Blocking

When you inject Z in reverse direction, you will find that the relay trip with its zone time and sends a carrier signal send to the remote end to block its Z_{1B} zone. when you inject Z in Z_{1B} and there is a carrier receive you will find that Z_{1B} is blocked and the relay trips with the nearest zone .

Injection status	Relay action should be	Relay actual action
Z in reverse	Trip with its time delay and carrier send	
Z_{1B} with C.R	Z_{1B} is blocked	

5.4- Setting at Unblocking

You must specify binary input for both { dis. Tele. Unblocking : unblock channel 1 add (4030)} And { dis. Tele. Unblocking : block channel 1 add (4031)}. When you inject Z in Z_{1B} , you will find that the relay behavior will be as in the table

Unblocking block BI	Unblocking unblock BI	Relay action	result
1	0	Relay blocks Z_{1B} and trips with the nearest zone	
0	1	Relay trips instantaneously with Z_{1B} and sends a carrier signal send to the remote end.	

6- Weak infeed with echo

6.1- Echo only

Status	Relay action should be	Relay action
C.B off & carrier receive	Echo signal send immediately	
C.B on & carrier receive	Echo signal send after time delay add (2502A)	

6.2- Echo and trip

Status	Relay action should be	Relay actual action
C.B off & carrier receive	Echo signal send immediately without local trip	
C.B on & carrier receive	Local trip and echo signal send after time delay add (2502A)	

6.3- weak infeed with echo and trip

Injection status	Relay action should be	Relay actual action
Weak infeed & C.B on & carrier receive	Send echo and local trip by weak infeed After time setting add (2502A)	

6.3.1 – under voltage pick up for local trip

if we apply one phase voltage less than setting 2505 and we apply the other two phases voltage by normal value and inject one phase current more than add.1130 and the other two phases by normal current value

All this with carrier receive then the relay will send an echo and weak in feed local trip after the time of add. 2502 but if the one phase voltage is more than the add. 2505 the relay will send echo only after time of add. 2502

	Measured
Setting add (2505A)	
Setting of open pole threshold add (1130A)	

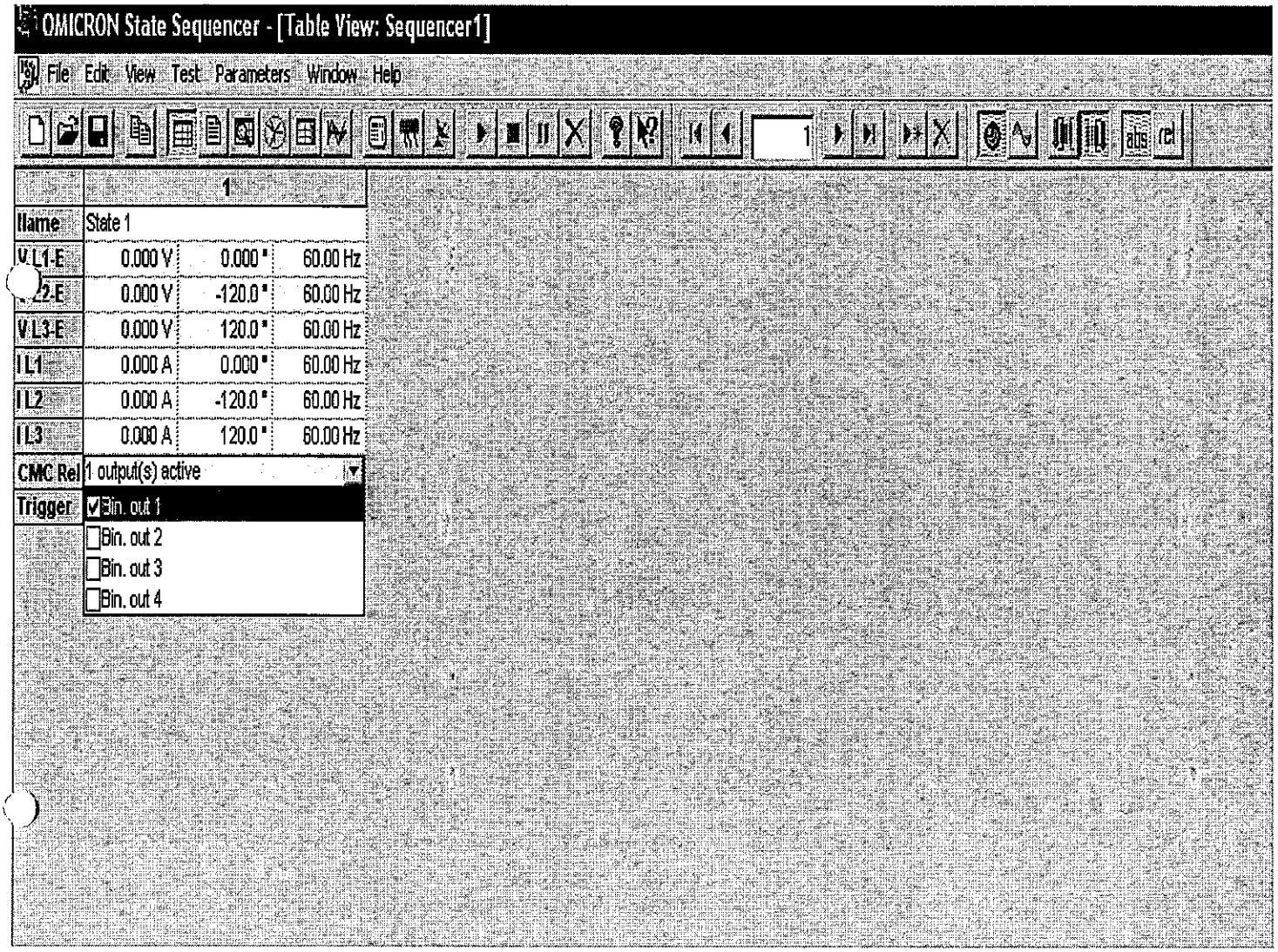
If the injected phase voltage of the faulted phase is more than the setting add (2505A) or the injected current of the faulted phase with relay starts echo signal only be sent without local trip.

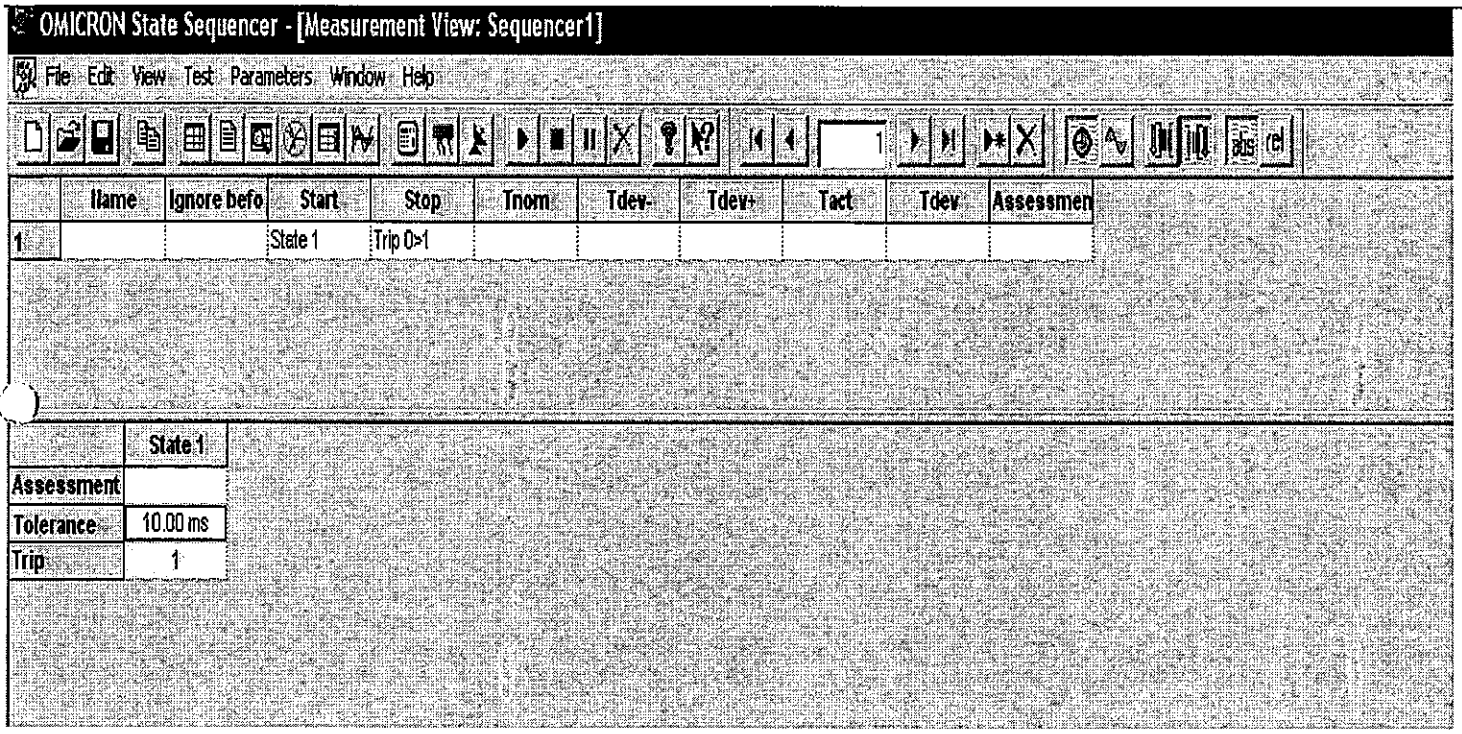
6.3.2- trip time delay for local trip

Be sure of specifying binary output of weak infeed trip command L123 add (4245)

Setting add (2502A)	Measured time (s)

You can measure the time as follow :
1- Active binary input for C.B closed
2- by using state sequencer by adjusting (the omicron tester) as shown
3- Use the binary output 1 as carrier receive
So when you start the tester the binary output 1 will close at the same time and the relay will have carrier receive so the relay will send echo and give local trip after the time delay and the tester will stop when the relay trips.


OMICRON State Sequencer - [Table View: Sequencer1]
File Edit View Test Parameters Window Help
1
Name State 1
V L1-E 0.000 V 0.000 ° 60.00 Hz
V L2-E 0.000 V -120.0 ° 60.00 Hz
V L3-E 0.000 V 120.0 ° 60.00 Hz
I L1 0.000 A 0.000 ° 60.00 Hz
I L2 0.000 A -120.0 ° 60.00 Hz
I L3 0.000 A 120.0 ° 60.00 Hz
CMC Rel 1 output(s) active
Trigger
Bin. out 1
Bin. out 2
Bin. out 3
Bin. out 4

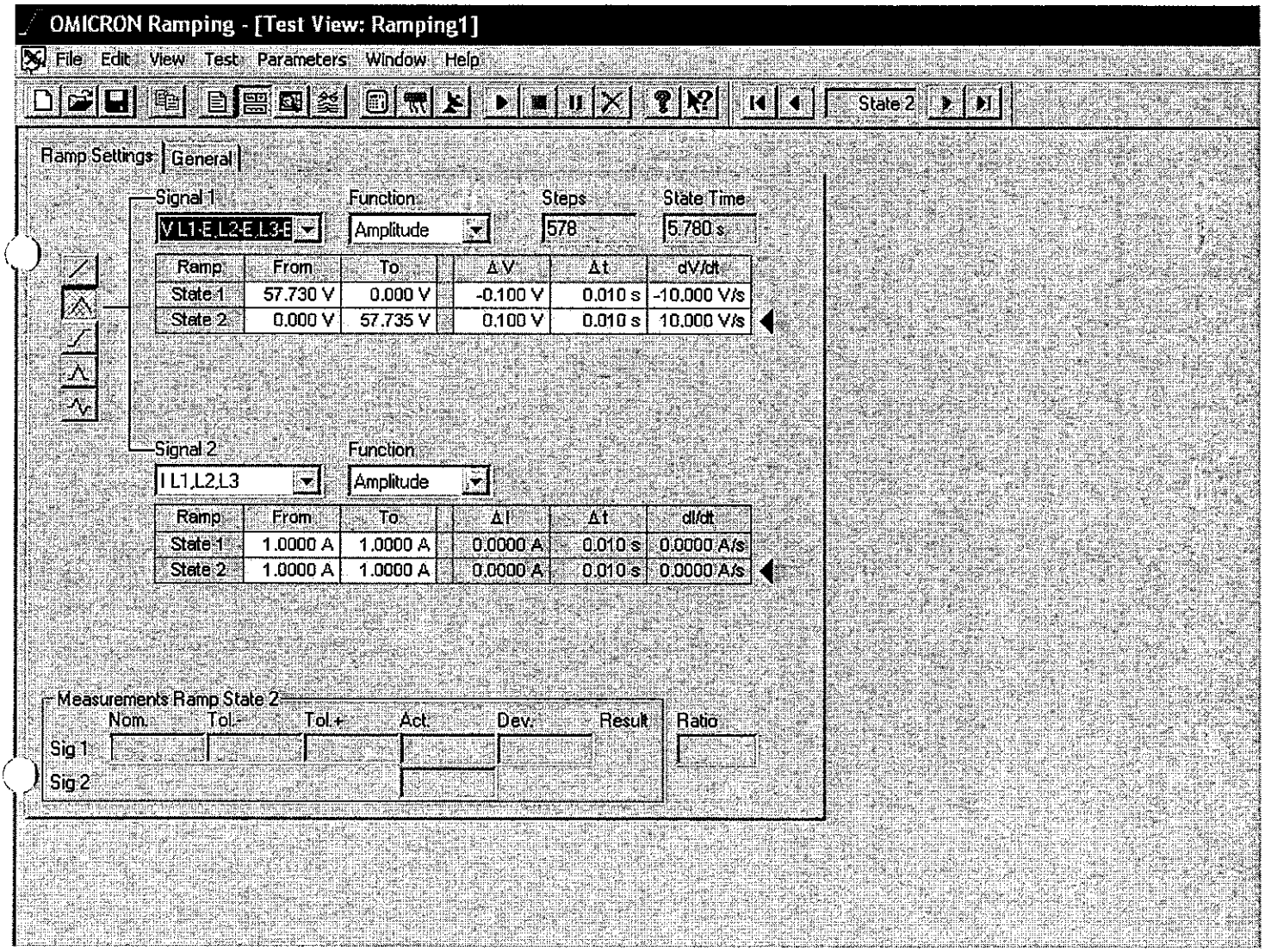


7- Power Swing

Raise the time setting of trip delay after power swing blocking add (2007) to more than the longest time of the distance zones

Power swing operating mode add (2002)	Relay action
All zones blocked	
Z_1 , Z_{1B} , Z_2 blocked	No trip with
	Trip with
Z_1 , Z_{1B} blocked	No trip with
	Trip with
Z_2 to Z_5 blocked	No trip with
	Trip with

There are two methods for verifying power swing
1- using Ramping
Open omicron program then choose Ramping
Adjust the state 1 and state 2 as in the picture.



- Specify led for {power swing detection add (4164)} that from masking then power swing.
- According to {Power swing operating mode add (2002)} = all zones blocked
- Start injection you will find that the Led will light that means power swing is detected and the all zones of distance are blocked
- To obtain the rate of impedance change at which the relay does not detect the power swing

increase the Δt little bit and start injection and repeat that till the relay does not recognize the power swing. You may change **ΔV.**

So dz / dt = ΔV / (I Δt)

For dz / dt > 6.5 the relay detect power swing
For dz / dt < 6.5 the relay doesn't detect power swing

That means, when the locus of the impedance stays and does not move for time in the zone, the relay recognize This case as a fault, but if locus of the impedance does not stay for time in the zone. And moves quickly to another locus the relay recognize This case as a power swing.

- To verify the other selections of {Power swing operating mode add (2002)} it will be difficult because you will find that the trip time will not be accurate that is because of the traveling of the impedance locus through zones till it reaches the appropriate zone for tripping.

Because of this reason we have to use state sequencer for verifying power swing detection And {Power swing operating mode add (2002)}.

2- Using state sequencer

At first you must put the zero sequence compensation factor in the relay = 0

By adjusting the first four states the relay will detect the power swing.
State 1 is adjusted so that the impedance is out of the the outer zone setting in R axis.
The next states are adjusted so that the impedance entered the zones and don't stay for more Time then the relay will detect power swing.
Also you can change the Duration of the impedance locus staying in the zone to obtain the rate of impedance change At Which the relay will not detect power swing.

Note: injected current = 1A

ΔV = 0.8 ohm

So dz / dt = ΔV / (I Δt)

For dz / dt > 6.5 the relay detect power swing
For dz / dt < 6.5 the relay doesn't detect power swing

- To verify the other selections of {Power swing operating mode add (2002)} it will be done by adding the fifth state but you must adjust its parameters so that the impedance equal value in the required zone. Also you must put the time of this state more than tha time of The required zone.

Site Test Report No.

:

OMICRON State Sequencer - [Table View: Eng.mohamed mogazy power swing 2]

File Edit View Test Parameters Window Help

	1			2			3			4			5		
Name	State 1			State 2			State 3			State 4			State 5		
V L1-E	8.000 V	0.000 °	60.00 Hz	7.200 V	0.000 °	60.00 Hz	6.400 V	0.000 °	60.00 Hz	5.600 V	0.000 °	60.00 Hz	1.243 V	0.000 °	60.00 Hz
V L2-E	8.000 V	-120.0 °	60.00 Hz	7.200 V	-120.0 °	60.00 Hz	6.400 V	-120.0 °	60.00 Hz	5.600 V	-120.0 °	60.00 Hz	1.243 V	-120.0 °	60.00 Hz
V L3-E	8.000 V	120.0 °	60.00 Hz	7.200 V	120.0 °	60.00 Hz	6.400 V	120.0 °	60.00 Hz	5.600 V	120.0 °	60.00 Hz	1.243 V	120.0 °	60.00 Hz
I L1	1.000 A	0.000 °	60.00 Hz	1.000 A	0.000 °	60.00 Hz	1.000 A	0.000 °	60.00 Hz	1.000 A	0.000 °	60.00 Hz	1.000 A	0.000 °	60.00 Hz
I L2	1.000 A	-120.0 °	60.00 Hz	1.000 A	-120.0 °	60.00 Hz	1.000 A	-120.0 °	60.00 Hz	1.000 A	-120.0 °	60.00 Hz	1.000 A	-120.0 °	60.00 Hz
I L3	1.000 A	120.0 °	60.00 Hz	1.000 A	120.0 °	60.00 Hz	1.000 A	120.0 °	60.00 Hz	1.000 A	120.0 °	60.00 Hz	1.000 A	120.0 °	60.00 Hz
CMC Rel	0 output(s) active			0 output(s) active			0 output(s) active			0 output(s) active			0 output(s) active		
Trigger	Time	1.000 s		Time	30.00 ms		Time	30.00 ms		Time	30.00 ms		Time	550.0 ms	

8- Back Up Over Current Protection: (Emergency)

Note: while testing any stage of over current you have to raise the setting of the other stages.

8.1- Inverse over current

8.1.1- For IEC curve add (2660) is normal curve

Setting: I_p > pick up add (2640) = A, T I_p time dial add(2641) = sec

Phase	Pick Up		Drop Off	
	Setting	Measured	Calculated	Measured
R-Y				
Y-B				
B-R				

Time

	R-Y	Y-B	B-R	Calculated time (sec)
Inj. Current = 2 I_p = 1A	1A	1A	1A	2.0 sec for T= 0.2
Measured time sec				
Inj. Current = 4 I_p = 2 A	2 A	2 A	2 A	0.5 sec for T= 0.1
Measured time sec				
Inj. Current = 6 I_p = 3 A	3 A	3 A	3 A	0.2 sec for T= 0.05
Measured time sec				

$T = 0.14T_P / \{(I/I_P)^{0.02} - 1\}$ (SEC), WHERE:

T : TRIP TIME
T_P : SETTING VALUE TIME MULTPLIER
I_P : SETTING VALUE CURRENT
I : FAULT CURRENT

Setting: $3I_0p$ pick up add (2650) = A, T3 I_0 p time dial add(2652) = sec

Phase	Pick Up		Drop Off	
	Setting	Measured	Calculated	Measured
R-N				
Y-N				
B-N				

Time

	R-Y	Y-B	B-R	Calculated time (sec)
Inj. Current = 2 I_p = 1A	1A	1A	1A	2.0 sec for T= 0.2
Measured time sec				
Inj. Current = 4 I_p = 2 A	2 A	2 A	2 A	0.5 sec for T= 0.1
Measured time sec				
Inj. Current = 6 I_p = 3 A	3 A	3 A	3 A	0.2 sec for T= 0.05
Measured time sec				

$T = 0.14T_P / \{(I/I_P)^{0.02} - 1\}$ (SEC), WHERE:
T : TRIP TIME
T_P : SETTING VALUE TIME MULTPLIER
I_P : SETTING VALUE CURRENT
I : FAULT CURRENT

8.1.2-For IEC curve add (2660) is very inverse curve

Setting: I_p > pick up add (2640) = A, T I_p time dial add(2641) = sec

Phase	Pick Up		Drop Off	
	Setting	Measured	Calculated	Measured
R-Y				
Y-B				
B-R				

Time

	R-Y	Y-B	B-R	Calculated time sec
Inj. Current = 2 I_p = 1A	1A	1A	1A	2.7 sec for T= 0.2
Measured time sec				
Inj. Current = 4 I_p = 2 A	2 A	2 A	2 A	0.43 sec for T= 0.1
Measured time sec				
Inj. Current = 6 I_p = 3 A	3 A	3 A	3 A	0.135 sec for T= 0.05
Measured time sec				

$T = 13.5\ T_P / \{(I/I_P) - 1\}$ (SEC), WHERE:
T : TRIP TIME
T_P : SETTING VALUE TIME MULTPLIER
I_P : SETTING VALUE CURRENT
I : FAULT CURRENT

Setting: $3I_0p$ pick up add (2650) = A, T3 I_0 p time dial add(2652) = sec

Phase	Pick Up		Drop Off	
	Setting	Measured	Calculated	Measured
R-N				
Y-N				
B-N				

Time

	R-Y	Y-B	B-R	Calculated time sec
Inj. Current = 2 I_p = 1A	1A	1A	1A	2.7 sec for T= 0.2
Measured time sec				
Inj. Current = 4 I_p = 2 A	2 A	2 A	2 A	0.43 sec for T= 0.1
Measured time sec				
Inj. Current = 6 I_p = 3 A	3 A	3 A	3 A	0.135 sec for T= 0.05
Measured time sec				

$T = 13.5\ T_P / \{(I/I_P) - 1\}$ (SEC), WHERE:
T : TRIP TIME
T_P : SETTING VALUE TIME MULTPLIER
I_P : SETTING VALUE CURRENT
I : FAULT CURRENT

8.1.3- For IEC curve add (2660) is extremely curve

Setting: I_p > pick up add (2640) = A, T I_p time dial add(2641) = sec

Phase	Pick Up		Drop Off	
	Setting	Measured	Calculated	Measured
R-Y				
Y-B				
B-R				

Time

	R-Y	Y-B	B-R	Calculated time sec

Inj. Current = 2 I_p = 1A	1A	1A	1A	5.3 sec for T= 0.2
Measured time sec				
Inj. Current = 4 I_p = 2 A	2 A	2 A	2 A	0.53 sec for T= 0.1
Measured time sec				
Inj. Current = 6 I_p = 3 A	3 A	3 A	3 A	0.114 sec for T= 0.05
Measured time sec				

$T = 80\ T_P / \{(I/I_P)^2 - 1\}$ (SEC), WHERE:
T : TRIP TIME
T_P : SETTING VALUE TIME MULTPLIER
I_P : SETTING VALUE CURRENT
I : FAULT CURRENT

Setting: $3I_0$p pick up add (2650) = A, T3 I_0 p time dial add(2652) = sec

Phase	Pick Up		Drop Off	
	Setting	Measured	Calculated	Measured
R-N				
Y-N				
B-N				

Time

	R-Y	Y-B	B-R	Calculated time sec
Inj. Current = 2 I_p = 1A	1A	1A	1A	5.3 sec for T= 0.2
Measured time sec				
Inj. Current = 4 I_p = 2 A	2 A	2 A	2 A	0.53 sec for T= 0.1
Measured time sec				
Inj. Current = 6 I_p = 3 A	3 A	3 A	3 A	0.114 sec for T= 0.05
Measured time sec				

$T = 80\ T_P / \{(I/I_P)^2 - 1\}$ (SEC), WHERE:
T : TRIP TIME
T_P : SETTING VALUE TIME MULTPLIER
I_P : SETTING VALUE CURRENT
I : FAULT CURRENT

8.1.4- For IEC curve add (2660) is long inverse

Setting: I_p > pick up add (2640) = A, T I_p time dial add(2641) = sec

Phase	Pick Up		Drop Off	
	Setting	Measured	Calculated	Measured
R-Y				
Y-B				
B-R				

Time

	R-Y	Y-B	B-R	Calculated time sec
Inj. Current = 2 I_p = 1A	1A	1A	1A	24sec for T= 0.2
Measured time sec				
Inj. Current = 4 I_p = 2 A	2 A	2 A	2 A	4 sec for T= 0.1
Measured time sec				
Inj. Current = 6 I_p = 3 A	3 A	3 A	3 A	1.2 sec for T= 0.05
Measured time sec				

$T = 120T_P / \{(I/I_P) - 1\}$ (SEC), WHERE:
T : TRIP TIME
T_P : SETTING VALUE TIME MULTPLIER
I_P : SETTING VALUE CURRENT
I : FAULT CURRENT

Setting: $3I_0p$ pick up add (2650) = A, T3 I_0 p time dial add(2652) = sec

Phase	Pick Up		Drop Off	
	Setting	Measured	Calculated	Measured
R-N				
Y-N				
B-N				

Time

	R-Y	Y-B	B-R	Calculated time sec

Inj. Current = 2 I_p = 1A	1A	1A	1A	24sec for T= 0.2
Measured time sec				
Inj. Current = 4 I_p = 2 A	2 A	2 A	2 A	4 sec for T= 0.1
Measured time sec				
Inj. Current = 6 I_p = 3 A	3 A	3 A	3 A	1.2 sec for T= 0.05
Measured time sec				

$T = 120T_P / \{(I/I_P) - 1\}$ (SEC), WHERE:
T : TRIP TIME
T_P : SETTING VALUE TIME MULTPLIER
I_P : SETTING VALUE CURRENT
I : FAULT CURRENT

8.2- low set stage I >

Setting: I_{ph} > pick up add (2620) = A, T I_{ph} > time delay add(2621) = sec

Phase	I_{ph} > Pick Up		Drop Off		Operating Time (s) for A	
	Setting	Measured	Calculated	Measured	Setting	Measured
R-Y						
Y-B						
B-R						

Setting : $3I_0$ > pick up add (2622) = A, T $3I_0$ > time delay add(2623) = sec

Phase	$3I_0$ > Pick Up		Drop Off		Operating Time (s) for A	
	Setting	Measured	Calculated	Measured	Setting	Measured
R-N						
Y-N						
B-N						

8.3- high set stage I >>

Setting: I_{ph} >> pick up add (2610) = A, T I_{ph} >> time delay add(2611) = sec

Phase	I_{ph} >> Pick Up		Drop Off		Operating Time (s) for 2xIset	
	Setting	Measured	Calculated	Measured	Setting	Measured
R-Y						

Y-B						
B-R						

Setting : $3I_0$ >> pick up add (2612) = A, T $3I_0$ >> time delay add(2613) = sec

Phase	$3I_0$ >>				Operating Time (s) for A	
	Pick Up		Drop Off			
	Setting	Measured	Calculated	Measured	Setting	Measured
R-N						
Y-N						
B-N						

2.4- I- STUB

Note: you must specify a binary input active low for { Enable I- STUB bus function add (7131)} and binary output and led for { O/C I- STUB TRIP add (7235)}.

Setting: I_{ph} > STUB pick up add (2630) = A, T I_{ph} time delay add (2631) = sec

Phase	I_{ph} > STUB				Operating Time (s) for A	
	Pick Up		Drop Off			
	Setting	Measured	Calculated	Measured	Setting	Measured
R-Y						
Y-B						
B-R						

Setting : $3I_0$ > STUB pick up add (2632) = A, T $3I_0$ STUB time delay add(2633) = sec

Phase	$3I_0$ > STUB				Operating Time (s) for A	
	Pick Up		Drop Off			
	Setting	Measured	Calculated	Measured	Setting	Measured
R-N						
Y-N						
B-N						

9- Switch On to Fault

For C.B closure recognition add (1134) by binary input manual close only
Raise setting of seal in time after manual closure add (1150A) to 30 sec
Activate the binary inputs of C.B off and manual close

9.1- SOTF associated with distance protection
Disable the back up over current protection add (2601)
Disable the instantaneous high speed SOTF O/C add (2404)
According to the specified zone that with instantaneous trip after SOTF is active add (1232)
For with zone Z_{1B}
Inject Z in this zone twice one with the activation of the binary inputs of C.B off and manual close and the other without them

	Applied fault in zone	measured time (s)
with the activation of the binary inputs of C.B off and manual close	Z_{1B}	
without the activation of the binary inputs of C.B off and manual close	Z_{1B}	
with the activation of the binary inputs of C.B off and manual close	Z_2	
	Z_3	
	Z_4	
	Z_5	

Note : 1- According to the {recognition of the line closure with add (1134)}, if it is selected to current or voltage or manual close Binary input, For checking SOTF function you must activate binary input of C.B off and no need to that of manual close.
2- According to the {recognition of the line closure with add (1134)}, if it is selected to current flow or manual close Binary input you can check SOTF function without binary input of manual close but binary input of C.B off must be exist.

9.2- SOTF associated with back up over current
Disable the distance protection add (1201)
Disable the instantaneous high speed SOTF O/C add (2404)
Inject current more than the setting {Iph >> pick up add (2610)} twice one with the activation of the binary inputs of C.B off and manual close and the other without them. Repeat that with {Iph > pick up add (2620)} and {Iph > pick up add (2640)}

address		Setting (A)	Pick up current (A)	Injected current (A)	measured time (s)
Iph >> pickup add (2610)	with the activation of the binary inputs of C.B off and manual close				
	without the activation of the binary inputs of C.B off and manual close				

Iph > pick up add (2620)	with the activation of the binary inputs of C.B off and manual close				
	without the activation of the binary inputs of C.B off and manual close				
Ip > pick up add (2640)	with the activation of the binary inputs of C.B off and manual close				
	without the activation of the binary inputs of C.B off and manual close				

Note : when you test any one of current stages you should raise the pick up setting of the others stages

Note : 1- According to the {recognition of the line closure with add (1134)}, if it is selected to current or voltage or manual close Binary input, For checking SOTF function you must activate binary input of C.B off and no need to that of manual close.
2- According to the {recognition of the line closure with add (1134)}, if it is selected to current flow or manual close Binary input you can check SOTF function without binary input of manual close but binary input of C.B off must be exist.

9.3- Instantaneous high speed SOTF O/C

Disable the distance protection add (1201)
Disable back up over current protection add (2601)
Inject current more than the setting{ Iph >>> pick up add (2404)} twice one with the activation of the binary inputs of C.B off and manual close and the other without them

Note: Instantaneous high speed SOTF O/C has a private trip SOTF- O/C trip command L123 add (4295) so you must specify binary output and a LED for it. This can be done from the Masking from SOTF over current. Also you can specify binary output for SOTF- O/C picked up add (4281) that is for determining pick up value but it is not important because the operation of SOTF is instantaneous.

	Setting (A)	Pick up current (A)	Injected current (A)	measured time (s)
with the activation of the binary inputs of C.B off and manual close				
without the activation of the binary inputs of C.B off and manual close				

Note : 1- According to the {recognition of the line closure with add (1134)}, if it is selected to current or voltage or manual close Binary input, For checking SOTF function you must activate binary input of C.B off and no need to that of manual close.
2- According to the {recognition of the line closure with add (1134)}, if it is selected to current flow or manual close Binary input you can check SOTF function without binary input of manual close but binary input of C.B off must be exist.

10- Fuse failure monitoring

For voltage fail supervision add (2915) is with current supervision

Note: before starting the test you must specify Leds to failure voltage absent add (168) And V.T fuse failure alarm instantaneous add (170) and V.T fuse failure alarm> 10sec add (169) and distance is blocked add (3652) also you may specify a binary output for V.T fuse failure alarm> 10sec add (169) and distance is blocked add (3652) to be able measuring the time, all of that can be done from the Masking in distance general and measurement supervision.

10.1- For balanced load

If the current is balanced in the 3 – phase and its amplitude is more than the setting {maximum current threshold I< add (2912A)} and the voltage difference in between any two phases is more than the setting {minimum voltage threshold U> add (2911A)}, the fuse failure monitor FFM will appear instantaneously with distance blocking.

10.1.1- Fuse failure measurement add (2911A)

Injected current in 3- phase = 0.2 A

minimum voltage threshold U> add (2911A) setting	Pick up voltage (V)			FFM and distance block appear inst.
	R	S	T	
30 V		57.73	57.73	
	57.73		57.73	
	57.73	57.73		

10.1.2- FFM maximum current threshold I< add (2912A)

Difference voltage is more than 30v

Maximum current threshold I< add (2912A) setting	Pick up current (A)			FFM and distance block appear inst.
	R	S	T	

0.1 A				

10.1.3- For current less than the setting of Maximum current threshold I< add (2912A) and Difference voltage is more than 30v, FFM will appear after 10 sec with distance blocking. ☐

10.2- For unbalanced load

10.2.1- If the current is unbalanced in the 3 – phase and the amplitude of the zero sequence current is more than the setting {maximum current threshold I< add (2912A)} and the voltage difference in between any two phases is more than the setting {minimum voltage threshold U> add (2911A)}, the fuse failure monitor FFM and distance blocking will not appear. ☐

10.2.2- If the current is unbalanced in the 3 – phase and the amplitude of the zero sequence current is less than the setting {maximum current threshold I< add (2912A)} and the voltage difference in between any two phases is more than the setting {minimum voltage threshold U> add (2911A)}, the fuse failure monitor FFM and distance blocking will appear after 10 sec. ☐

You can verify 10.2.1 and 10.2.2 by injecting single phase current.

10.3- maximum voltage threshold U< (3 phase) add (2913A)

1-You can check that with applying the normal voltage 3 – phase and 3- phase current above the setting of {open pole threshold add (1130A) } and the voltage is reduced in the 3- phase to less than the setting { maximum voltage threshold U< (3 phase) add (2913A)} **a voltage absent** will appear after a time delay setting {delay voltage failure supervision add (2916A)}. ☐

Injected current = 0.2 A

Maximum voltage threshold U< add (2913A) setting	Pick up voltage (V)			FFM and distance block appear inst.
	R	S	T	
5 V				

2-You can check that with applying the normal voltage 3 – phase and 3- phase current **less** than the setting of {phase setting threshold for distance measurement add (1202) } and the voltage is reduced in the 3- phase to **equal** the value of the setting { maximum voltage threshold U< (3 phase) add (2913A)} **a FFM** will appear instantaneously . ☐

3- As in 2 but the current is **more** than the setting of {phase setting threshold for distance measurement add (1202) } **a voltage absent** will appear instantaneously.

11- Fault locator
Line length = 6 Km **Z = 0.1526 Ω / km** **Φ = 81°**

	R-N	Y-N	B-N	R-Y	Y-B	B-R
Injected impedance						
Relay reading (Km)						

The injected impedance with angle = 81°

12- Memory test

12.1 Memory time measurement test

Sequence-1						Sequence-2						Sequence-3					
Time =2sec						Time was changed						Time =0.5sec					
Va	Vb	Vc	Ia	Ib	Ic	Va	Vb	Vc	Ia	Ib	Ic	Va	Vb	Vc	Ia	Ib	Ic
57.73	57.73	57.73	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	1	1	1
180	60	300	0	-120	12 0	---	----	--	--	--	---	---	---	---	0	-120	120

Memory time measurement =

12.2 Memory voltage measurement test

Sequence-1						Sequence-2						Sequence-3					
Voltage for this fault was changed						Time =1sec						Time =0.5sec					
Va	Vb	Vc	Ia	Ib	Ic	Va	Vb	Vc	Ia	Ib	Ic	Va	Vb	Vc	Ia	Ib	Ic
57.73	57.73	57.73	0.2	0.2	0.2	0	0	0	0	0	0	0	0	0	1	1	1
180	60	300	0	-120	12 0	---	----	--	--	--	---	---	---	---	0	-120	120

Memory voltage measurement =