Delta 4110/4310A

12kV Insulation Diagnostic System

Training Guide

Megger

Power on

Delta 4110/4310A Topics

- PowerDB Lite – New Test
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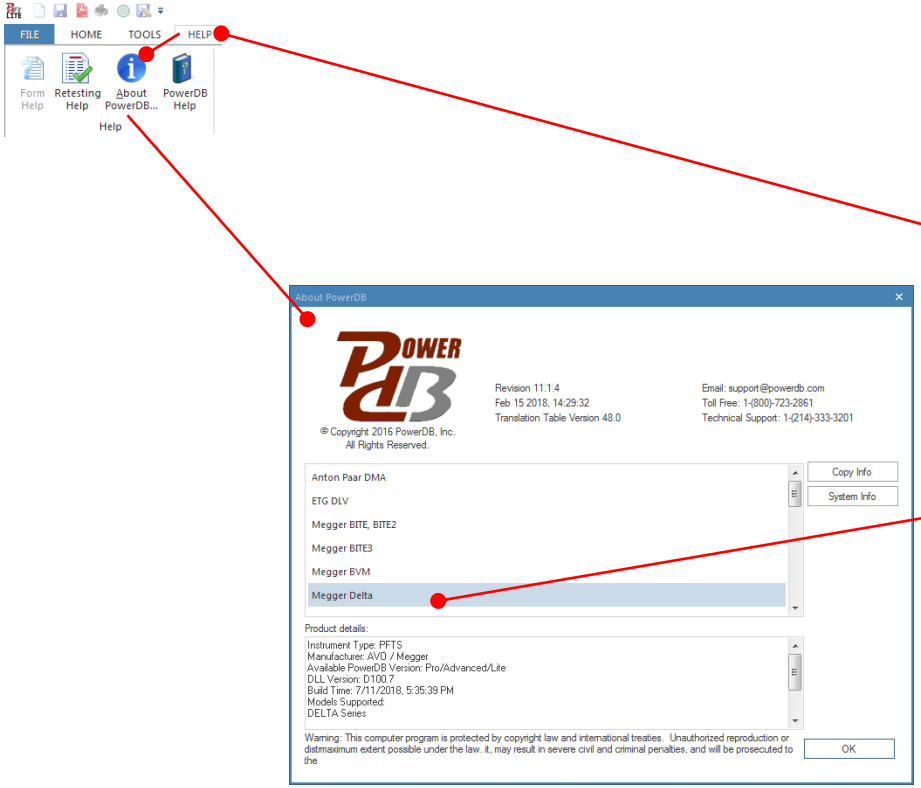
  - Selecting a form
  - Entering Nameplate
  - Saving
  - Testing
    - Test Type
    - Connection Diagram
    - Test Configuration
    - Running a Test
    - Viewing Results
  - Individual Temperature Correction (ITC)
  - Export to DTA5/6
- PowerDB Lite – Open Previous Test
  - Open (Continue) Test Result
  - New Test Result
  - Delete Test Result
- PowerDB Pro
  - Adding New Result
  - Trending
  - Import from DTA6
- Delta Manual Control
  - Object ID
  - Temperatures
  - Test Tag
  - Test Type
  - Interference Mode
  - Test Mode
  - Voltage/Frequency
  - Testing
    - Interlocks
    - Results
  - Settings
  - Graph
  - Results
  - Help
  - Status

Delta 4110/4310A – PowerDB Startup



- Check for PowerDB Updates

In PowerDB Lite, go to
Help
About PowerDB…
Select Megger Delta

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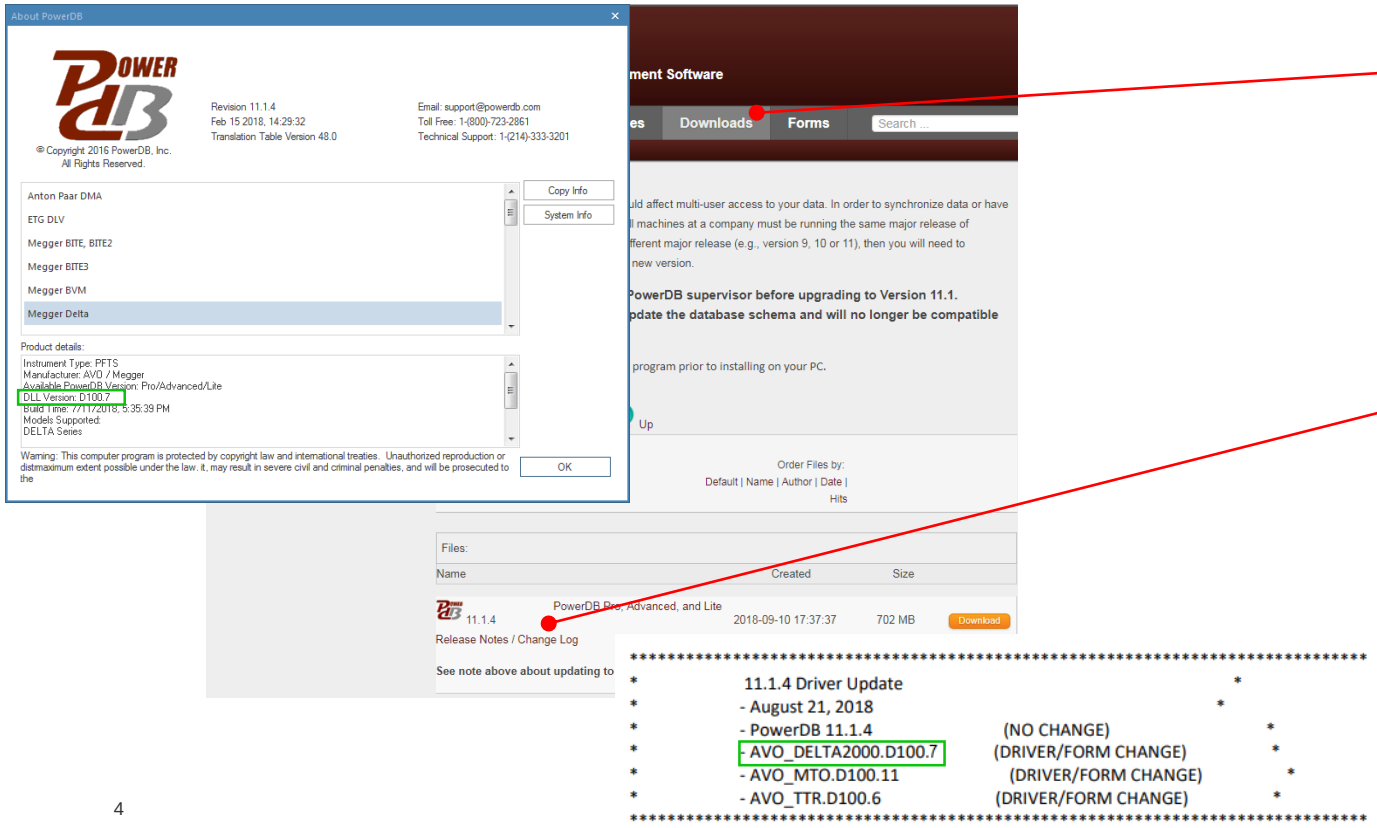
Delta 4110/4310A – PowerDB Startup



- Go to www.powerdb.com Downloads page
- Open change log and see if the Delta driver has been updated

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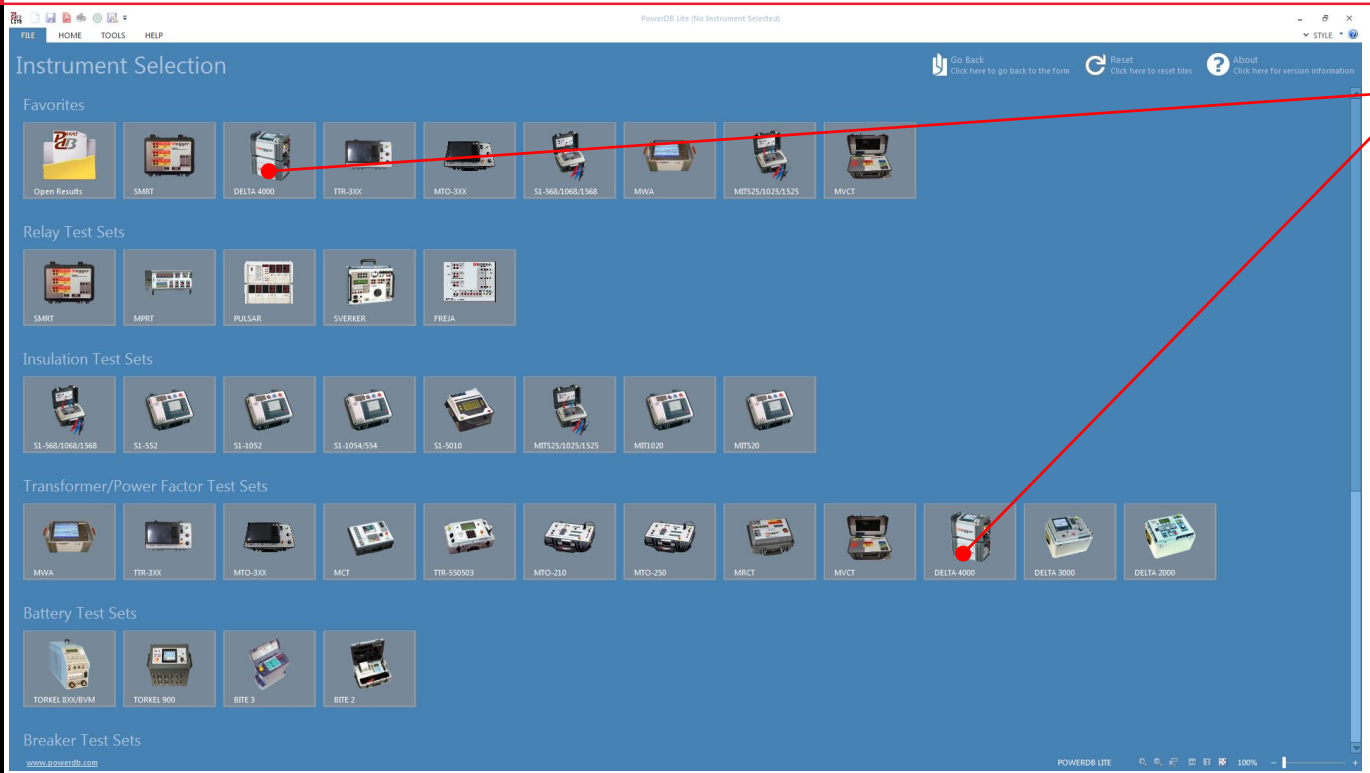
Delta 4110/4310A – PowerDB Startup



- Click on the DELTA 4000

DELTA 4000 will appear in your favorites after the first time you select it from Transformer/Power Factor Test Sets

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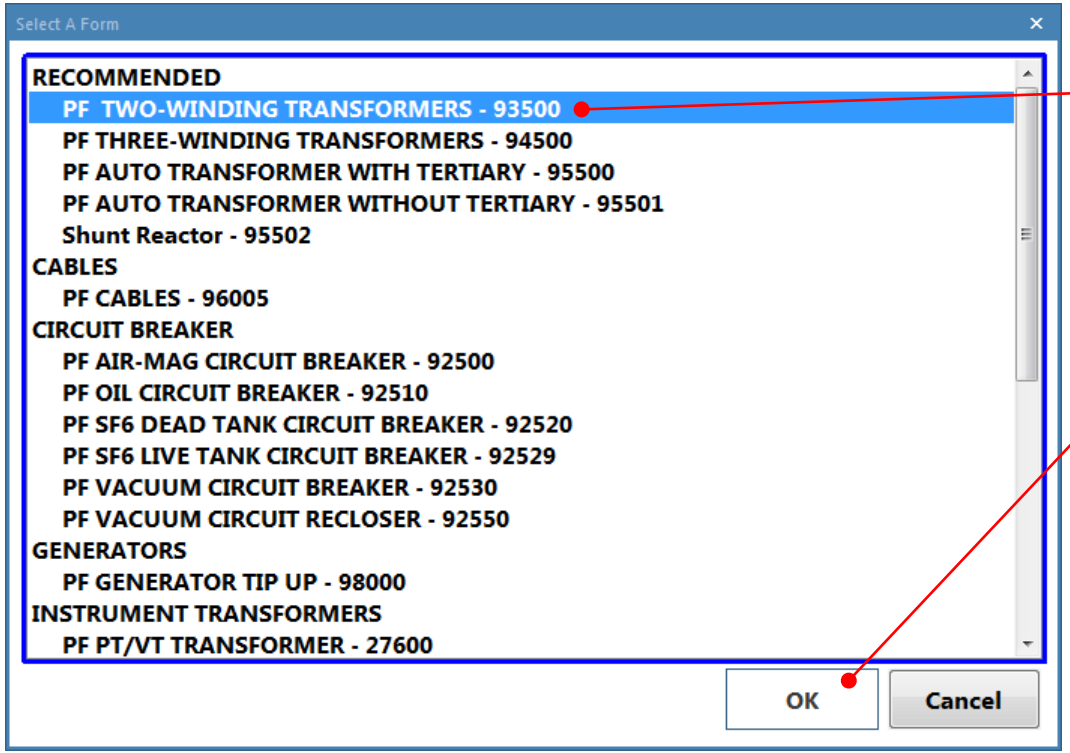
Delta 4110/4310A – Select Form



Select a form and click OK

Choose a form that is appropriate for the asset you are testing.

For the purpose of this training material, we will focus on Two-Winding Transformers

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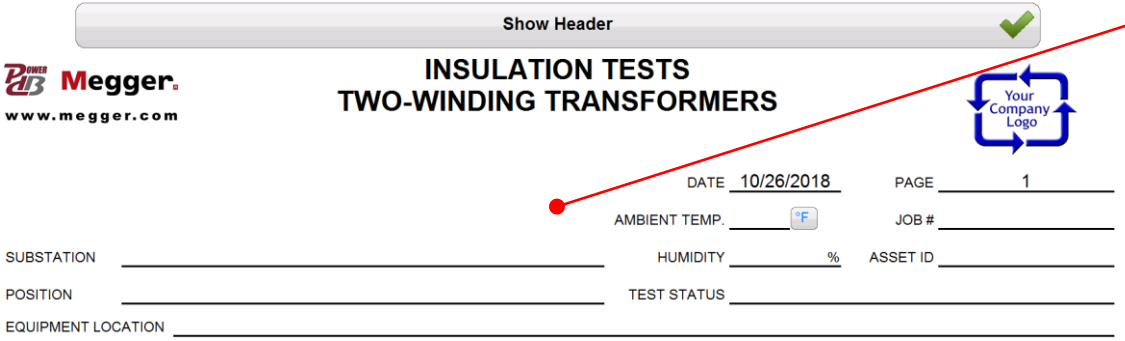
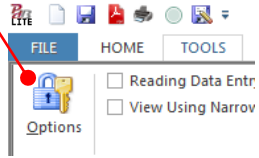
Delta 4110/4310A – Form Header



- Fill out Header information

Not required to run tests

Tools -> Options to set logos



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Delta 4110/4310A – Nameplate

NAMEPLATE DATA

MFR		CLASS		PHASES	
SER NO		COOLANT	OIL	REASON	
YEAR		TANK TYPE	SEALED	WEIGHT	lb
				WINDING MATERIAL	Cu
				OIL VOLUME	GAL
				OIL TEMP	°C
				IMPEDANCE	%
				WEATHER	
				BIL	kV

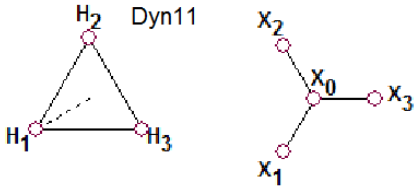

Diagram # 15 (ANSI)

	VOLTAGE (kV)		kVA	RATED I	# TAPS	NOMINAL	CHANGER	TAP SETTING
	L-L	L-G						
PRIMARY:					5	3	DETC	
SECOND:					1		OLTC	

COMMENTS:

- Fill out Nameplate

After saving, fields required for temperature correction will highlight red if unpopulated

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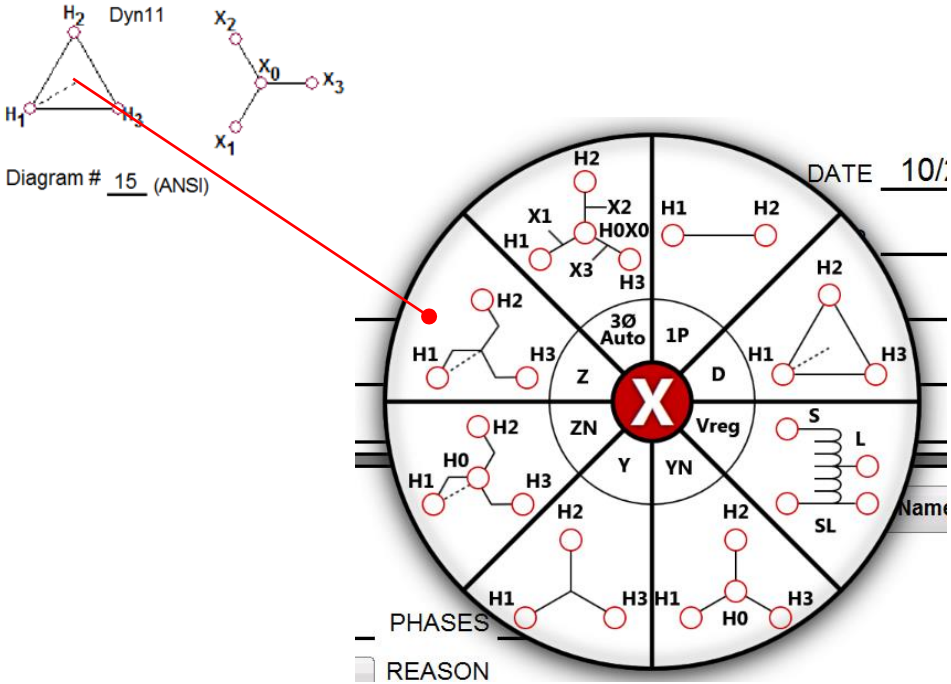
Delta 4110/4310A – Primary Vector



- Select Primary Vector

Match to nameplate

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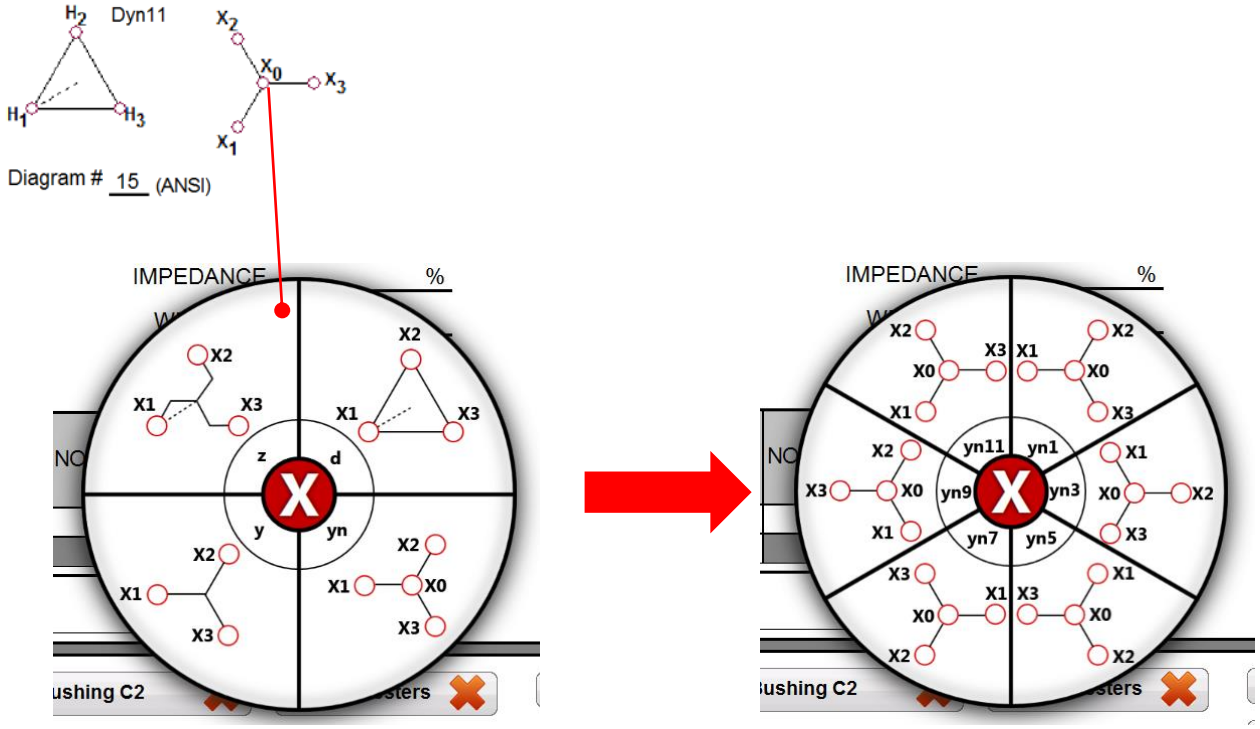
Delta 4110/4310A – Secondary Vector



- Select Secondary Vector

Select Secondary Vector Group, then Secondary Vector Phasing

Secondary Vector Groups and Phasing limited by Primary Vector selected

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Delta 4110/4310A – Bushing Nameplate

BUSHING NAMEPLATE						
Dsg	SERIAL NUM	MFR.	TYPE/CLASS	kV	AMPS	YEAR
H1						
H2						
H3						
N/A						
X1						
X2						
X3						
X0						

- Fill out Bushing Nameplate

Designations based on Vector

BUSHING NAMEPLATE						
Dsg	SERIAL NUM	MFR.	TYPE/CLASS	kV	AMPS	YEAR
H1		COB	L	5	5000	1999
H2		COB	L	5	5000	1999
H3		COB	L	5	5000	1999
N/A						
X1		BRUSH	ONA	7	2000	1929
X2		BRUSH	ONA	7	2000	1929
X3		BRUSH	ONA	7	2000	1929
X0		BRUSH	ONA	7	2000	1929

MFR, Type/Class, kV, AMPS, Year copies if unpopulated

H1 copies to H2/H3/H0
X1 copies to X2/X3/X0

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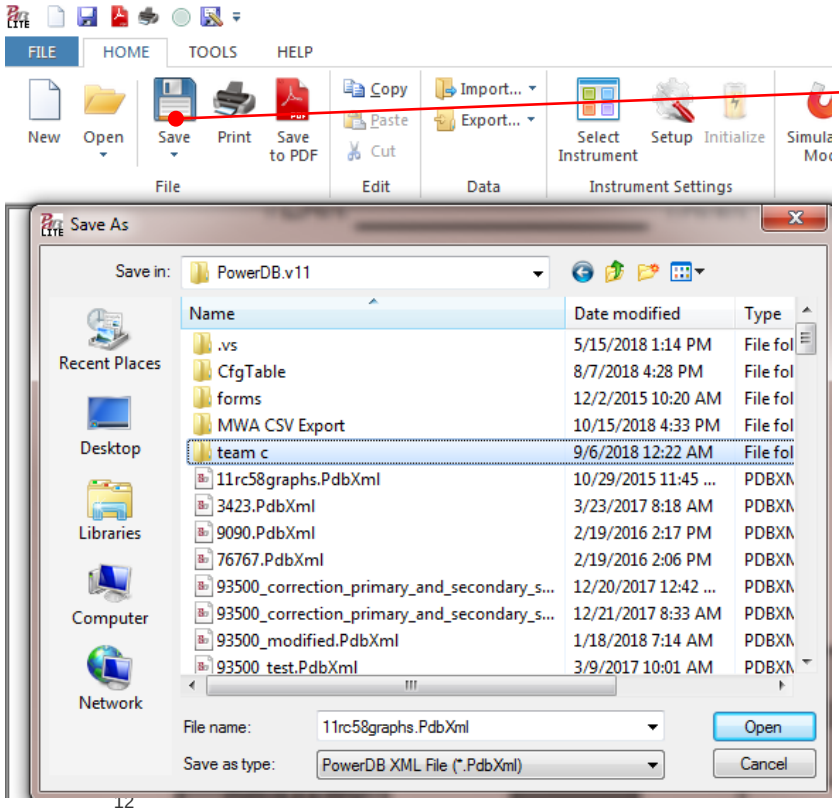
Delta 4110/4310A – Save Form



- Select Save in the ribbon bar

It is recommended to save before running tests.

If you do not save before running a test, PowerDB will ask you to save after every test completes until the result is saved.

PowerDB automatically saves after ever test if the form was previously saved

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Delta 4110/4310A – Test Sections

- Select which tests to display on the form

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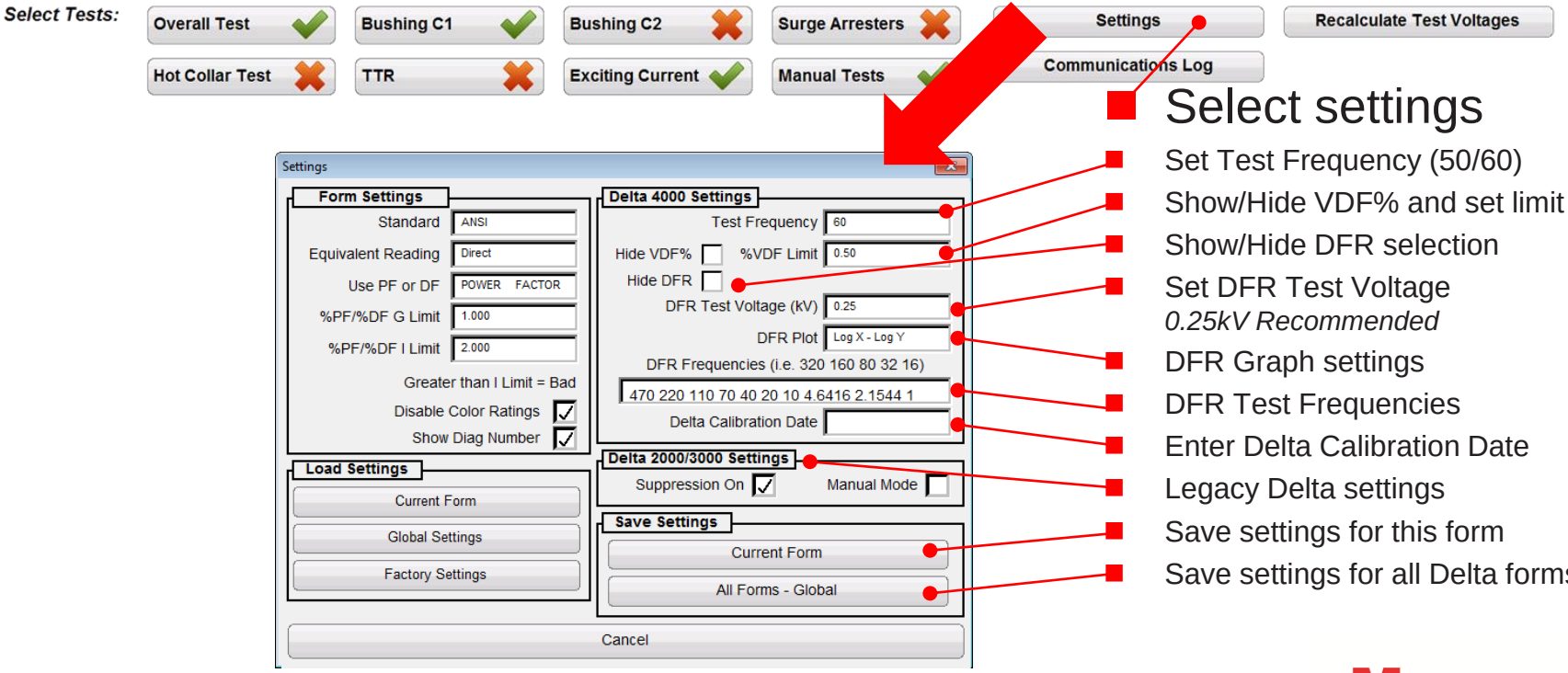
Delta 4110/4310A – Settings



Select settings

- Set Test Frequency (50/60)
- Show/Hide VDF% and set limit
- Show/Hide DFR selection
- Set DFR Test Voltage
  0.25kV Recommended
- DFR Graph settings
- DFR Test Frequencies
- Enter Delta Calibration Date
- Legacy Delta settings
- Save settings for this form
- Save settings for all Delta forms

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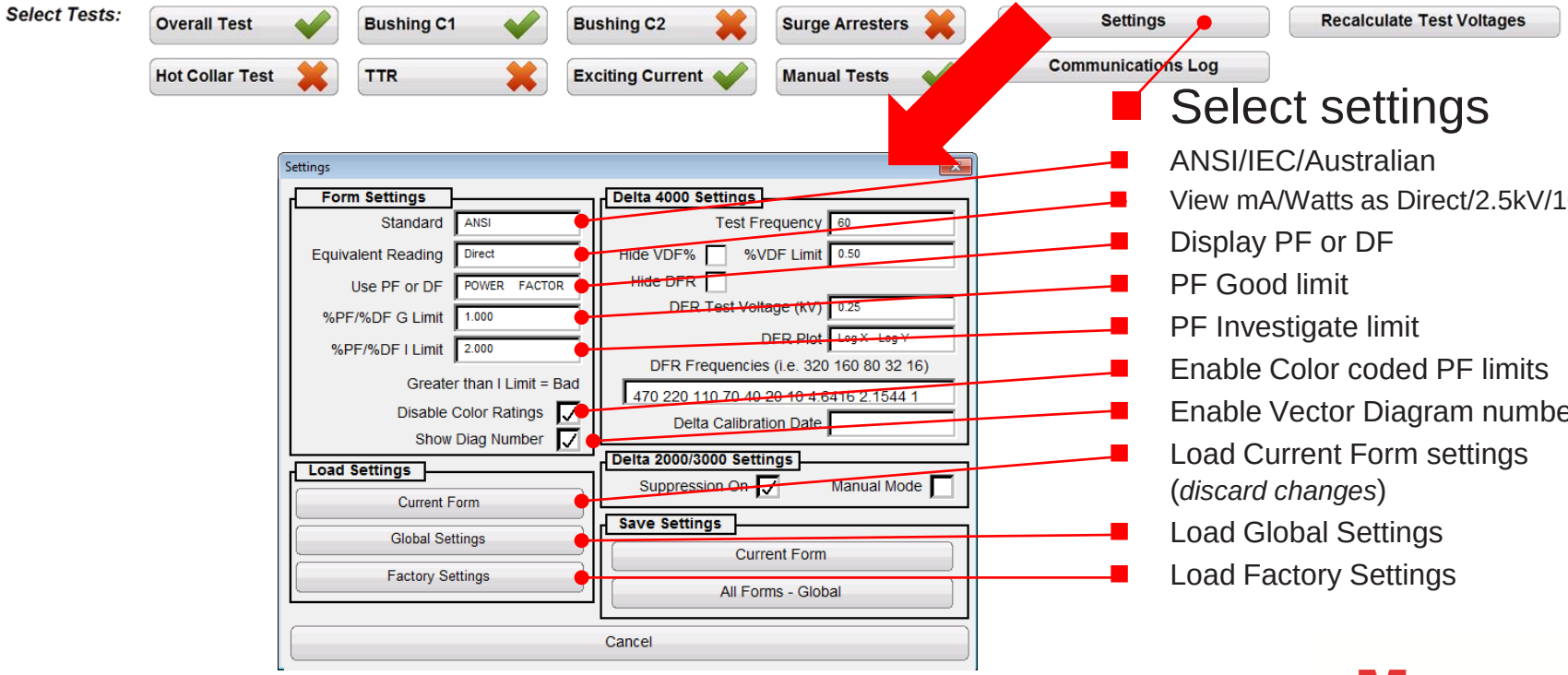
Delta 4110/4310A – Settings



Select settings

- ANSI/IEC/Australian
- View mA/Watts as Direct/2.5kV/10kV
- Display PF or DF
- PF Good limit
- PF Investigate limit
- Enable Color coded PF limits
- Enable Vector Diagram number
- Load Current Form settings (*discard changes*)
- Load Global Settings
- Load Factory Settings

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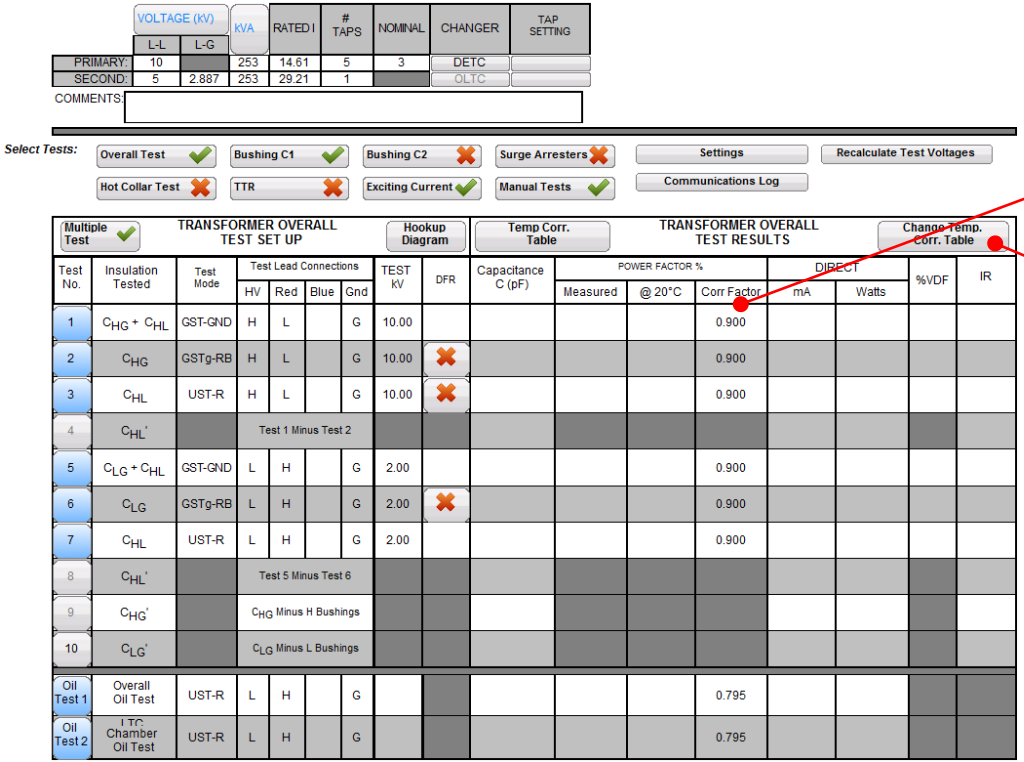
Delta 4110/4310A – Overall Test



	VOLTAGE (kV) L-L	VOLTAGE (kV) L-G	kVA	RATED I	# TAPS	NOMINAL	CHANGER	TAP SETTING
PRIMARY:	10		253	14.61	5	3	DETC	
SECOND:	5	2.887	253	29.21	1		OLTC	

COMMENTS:

Select Tests: Overall Test ✓ | Bushing C1 ✓ | Bushing C2 ✗ | Surge Arresters ✗ | Settings | Recalculate Test Voltages

Hot Collar Test ✗ | TTR ✗ | Exciting Current ✓ | Manual Tests ✓ | Communications Log

Multiple Test ✓ — TRANSFORMER OVERALL TEST SET UP — Hookup Diagram — Temp Corr. Table — TRANSFORMER OVERALL TEST RESULTS — Change Temp. Corr. Table

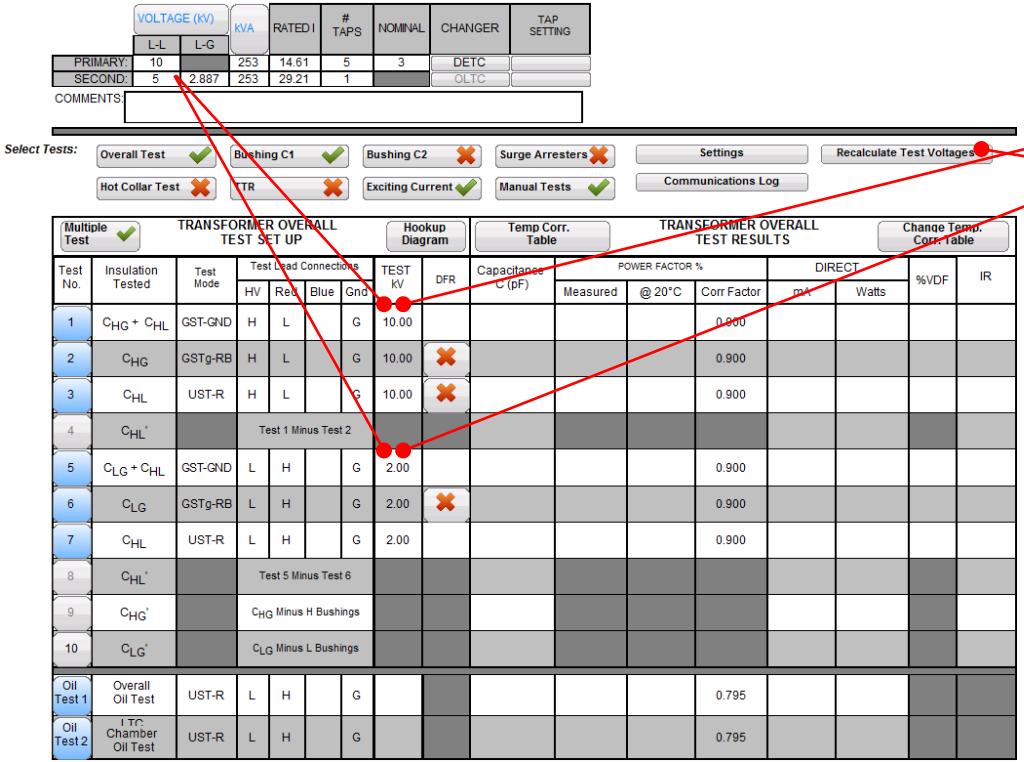
Test No.	Insulation Tested	Test Mode	Test Lead Connections HV	Red	Blue	Gnd	TEST kV	DFR	Capacitance C (pF)	POWER FACTOR % Measured	@ 20°C	Corr Factor	DIRECT mA	Watts	%VDF	IR
1	$C_{HG} + C_{HL}$	GST-GND	H	L		G	10.00					0.900				
2	C_{HG}	GSTg-RB	H	L		G	10.00	✗				0.900				
3	C_{HL}	UST-R	H	L		G	10.00	✗				0.900				
4	C_{HL}'		Test 1 Minus Test 2													
5	$C_{LG} + C_{HL}$	GST-GND	L	H		G	2.00					0.900				
6	C_{LG}	GSTg-RB	L	H		G	2.00	✗				0.900				
7	C_{HL}	UST-R	L	H		G	2.00					0.900				
8	C_{HL}'		Test 5 Minus Test 6													
9	C_{HG}'		C_{HG} Minus H Bushings													
10	C_{LG}'		C_{LG} Minus L Bushings													
Oil Test 1	Overall Oil Test	UST-R	L	H		G						0.795				
Oil Test 2	LTC Chamber Oil Test	UST-R	L	H		G						0.795				

- Corr Factor based on Transformer Year, Oil Temp, kV, kVA

Temperature Correction table can be changed, or manual correction factors can be entered with this button

Megger Power on

Delta 4110/4310A – Overall Test



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PRIMARY:	10		253	14.61	5	3	DETC	
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COMMENTS:

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1	$C_{HG} + C_{HL}$	GST-GND	H	L		G	10.00					0.900				
2	C_{HG}	GSTg-RB	H	L		G	10.00	✗				0.900				
3	C_{HL}	UST-R	H	L		G	10.00	✗				0.900				
4	C_{HL}'		Test 1 Minus Test 2													
5	$C_{LG} + C_{HL}$	GST-GND	L	H		G	2.00					0.900				
6	C_{LG}	GSTg-RB	L	H		G	2.00	✗				0.900				
7	C_{HL}	UST-R	L	H		G	2.00					0.900				
8	C_{HL}'		Test 5 Minus Test 6													
9	C_{HG}'		C_{HG} Minus H Bushings													
10	C_{LG}'		C_{LG} Minus L Bushings													
Oil Test 1	Overall Oil Test	UST-R	L	H		G						0.795				
Oil Test 2	LTC Chamber Oil Test	UST-R	L	H		G						0.795				

- Test kV based on nameplate

Use Recalculate Test Voltages if nameplate voltage entered was incorrect

Can be manually entered

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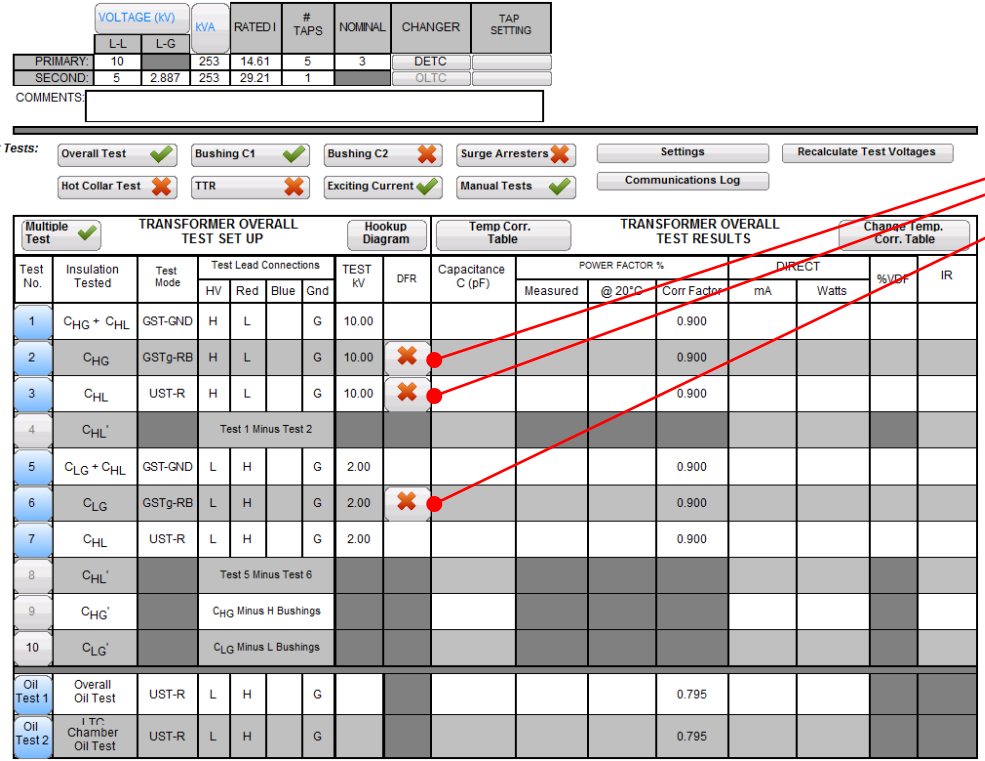
Delta 4110/4310A – Overall Test



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PRIMARY:	10		253	14.61	5	3	DETC	
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COMMENTS:

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1	$C_{HG} + C_{HL}$	GST-GND	H	L		G	10.00					0.900				
2	C_{HG}	GSTg-RB	H	L		G	10.00	✗				0.900				
3	C_{HL}	UST-R	H	L		G	10.00	✗				0.900				
4	C_{HL}'		Test 1 Minus Test 2													
5	$C_{LG} + C_{HL}$	GST-GND	L	H		G	2.00					0.900				
6	C_{LG}	GSTg-RB	L	H		G	2.00	✗				0.900				
7	C_{HL}	UST-R	L	H		G	2.00					0.900				
8	C_{HL}'		Test 5 Minus Test 6													
9	C_{HG}'		C_{HG} Minus H Bushings													
10	C_{LG}'		C_{LG} Minus L Bushings													
Oil Test 1	Overall Oil Test	UST-R	L	H		G						0.795				
Oil Test 2	LTC Chamber Oil Test	UST-R	L	H		G						0.795				

- Enable/Disable DFR Sweep

A single test will be run at the Test kV, followed by 250V DFR sweep (default setting)

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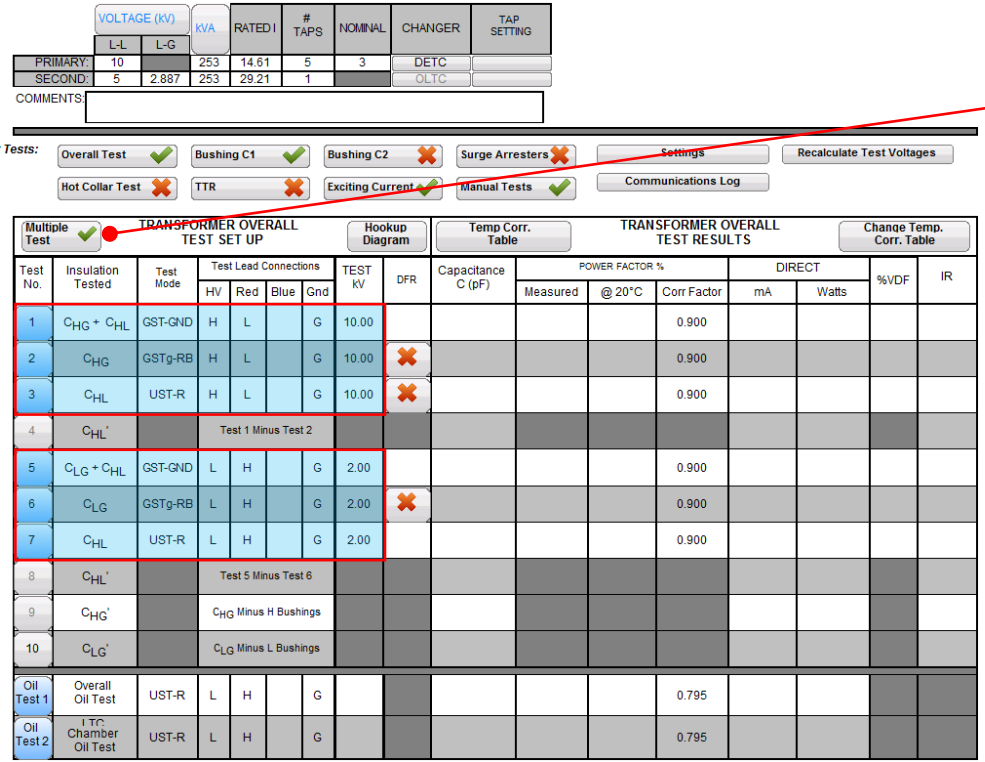
Delta 4110/4310A – Overall Test



	VOLTAGE (KV) L-L	VOLTAGE (KV) L-G	KVA	RATED I	# TAPS	NOMINAL	CHANGER	TAP SETTING
PRIMARY:	10		253	14.61	5	3	DETC	
SECOND:	5	2.887	253	29.21	1		OLTC	

COMMENTS:

Select Tests: Overall Test ✓ | Bushing C1 ✓ | Bushing C2 ✗ | Surge Arresters ✗ | Settings | Recalculate Test Voltages

Hot Collar Test ✗ | TTR ✗ | Exciting Current ✓ | Manual Tests ✓ | Communications Log

Multiple Test ✓ — TRANSFORMER OVERALL TEST SET UP | Hookup Diagram | Temp Corr. Table | TRANSFORMER OVERALL TEST RESULTS | Change Temp. Corr. Table

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1	$C_{HG} + C_{HL}$	GST-GND	H	L		G	10.00					0.900				
2	C_{HG}	GSTg-RB	H	L		G	10.00	✗				0.900				
3	C_{HL}	UST-R	H	L		G	10.00	✗				0.900				
4	C_{HL}'		Test 1 Minus Test 2													
5	$C_{LG} + C_{HL}$	GST-GND	L	H		G	2.00					0.900				
6	C_{LG}	GSTg-RB	L	H		G	2.00	✗				0.900				
7	C_{HL}	UST-R	L	H		G	2.00					0.900				
8	C_{HL}'		Test 5 Minus Test 6													
9	C_{HG}'		C_{HG} Minus H Bushings													
10	C_{LG}'		C_{LG} Minus L Bushings													
Oil Test 1	Overall Oil Test	UST-R	L	H		G						0.795				
Oil Test 2	LTC Chamber Oil Test	UST-R	L	H		G						0.795				

- Enable/Disable Multiple Test

When multiple test is enabled, all high side tests or all low side tests will be run together

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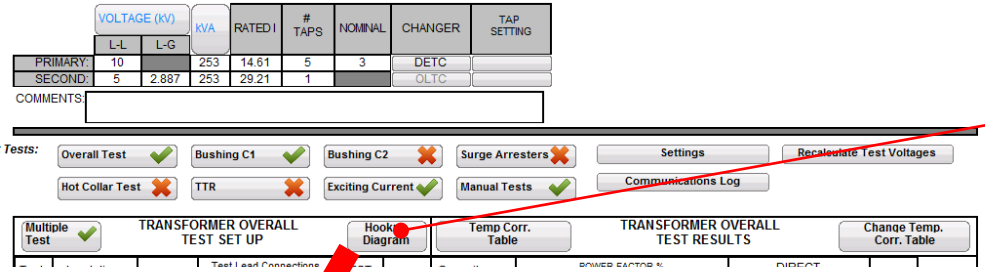
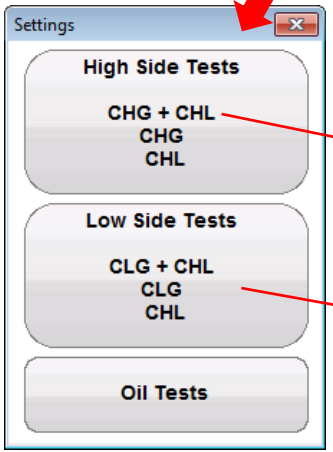
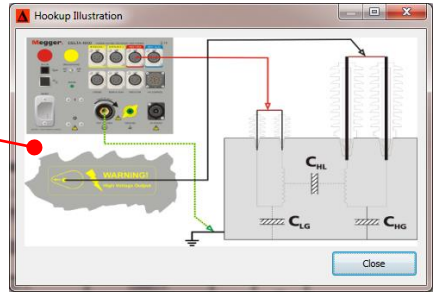
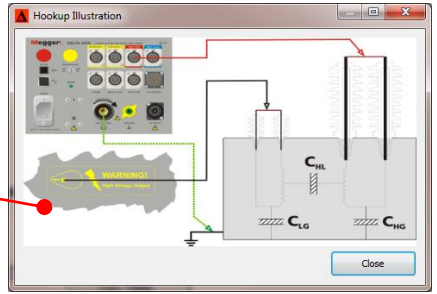
Delta 4110/4310A – Overall Test



- Review Hookup Diagrams







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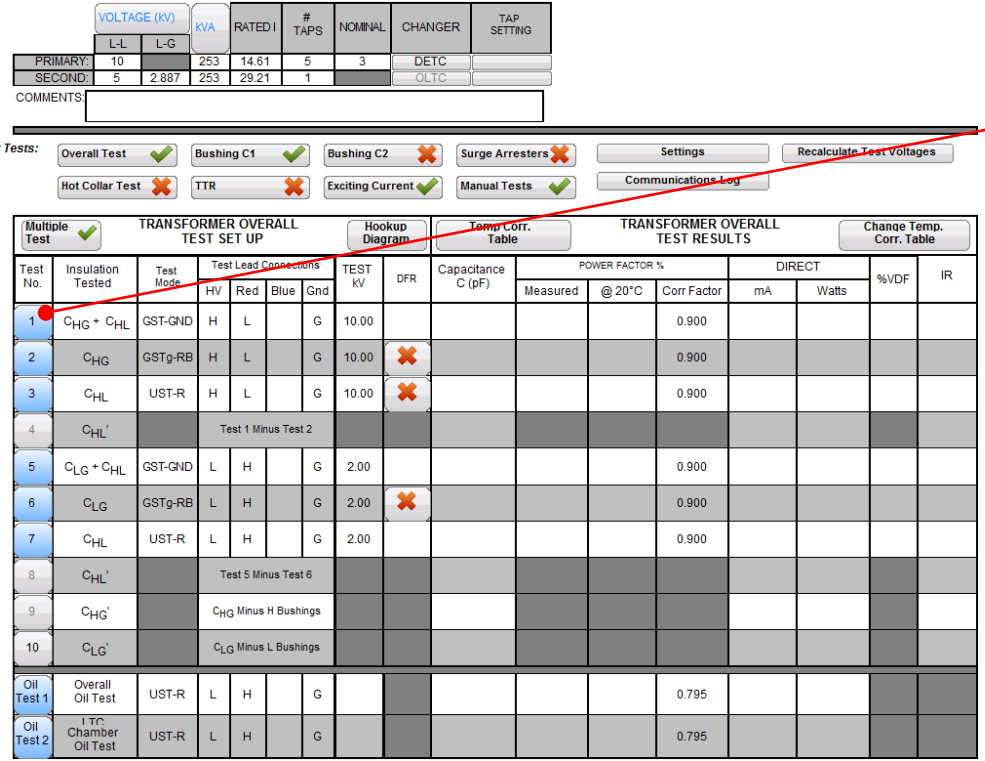
Delta 4110/4310A – Overall Test



	VOLTAGE (KV) L-L	VOLTAGE (KV) L-G	KVA	RATED I	# TAPS	NOMINAL	CHANGER	TAP SETTING
PRIMARY:	10		253	14.61	5	3	DETC	
SECOND:	5	2.887	253	29.21	1		OLTC	

COMMENTS:

Select Tests: Overall Test ✓ | Bushing C1 ✓ | Bushing C2 ✗ | Surge Arresters ✗ | Settings | Recalculate Test Voltages

Hot Collar Test ✗ | TTR ✗ | Exciting Current ✓ | Manual Tests ✓ | Communications Log

Multiple Test ✓ — TRANSFORMER OVERALL TEST SET UP — Hookup Diagram — Temp Corr. Table — TRANSFORMER OVERALL TEST RESULTS — Change Temp. Corr. Table

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1	C_{HG} + C_{HL}	GST-GND	H	L		G	10.00					0.900				
2	C_{HG}	GSTg-RB	H	L		G	10.00	✗				0.900				
3	C_{HL}	UST-R	H	L		G	10.00	✗				0.900				
4	C_{HL}'		Test 1 Minus Test 2													
5	C_{LG} + C_{HL}	GST-GND	L	H		G	2.00					0.900				
6	C_{LG}	GSTg-RB	L	H		G	2.00	✗				0.900				
7	C_{HL}	UST-R	L	H		G	2.00					0.900				
8	C_{HL}'		Test 5 Minus Test 6													
9	C_{HG}'		C_{HG} Minus H Bushings													
10	C_{LG}'		C_{LG} Minus L Bushings													
Oil Test 1	Overall Oil Test	UST-R	L	H		G						0.795				
Oil Test 2	LTC Chamber Oil Test	UST-R	L	H		G						0.795				

Run a test

Select any of the blue Test No. buttons to run a test

Turn on Delta 4110/4310A

Ensure the INT/EXT switch is set appropriately:

INT for control from 12" top

EXT for control from PC

If EXT, connect USB or Ethernet to PC

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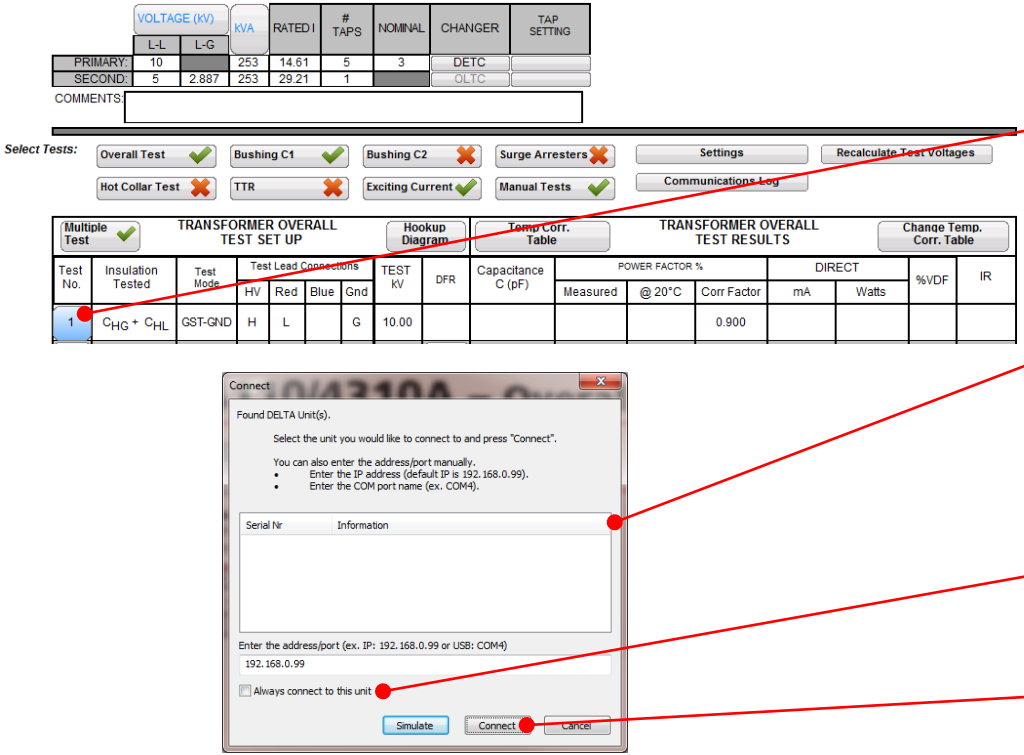
Delta 4110/4310A – Overall Test



- PC - Connect to the Delta

Serial Nr & information should automatically populate. If not, IP address listed can be used for Ethernet. For USB, consult Microsoft Device Manager for USB port

Select "Always connect to this unit" to skip connection step next time tests are run

Click Connect

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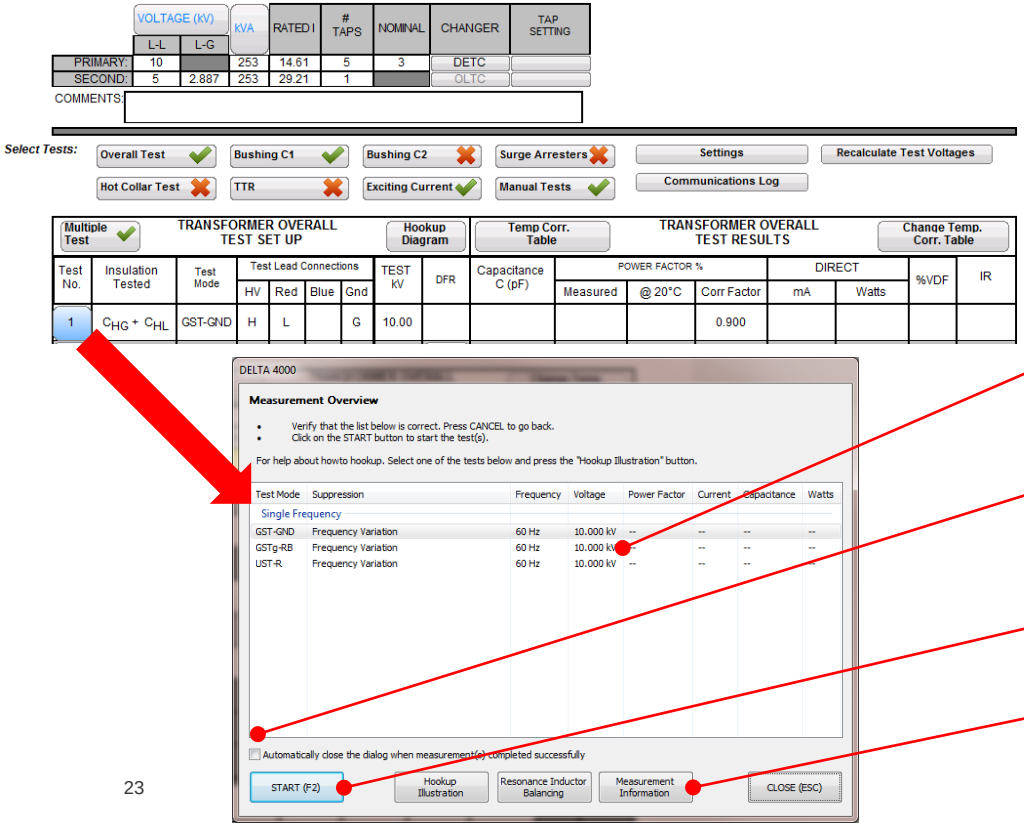
Delta 4110/4310A – Overall Test



- Measurement Screen

Verify Test Mode, Suppression, Frequency, and Voltage

Select Automatically close to immediately import results to PowerDB

Click Start to begin test

Measurement Information - view details during test

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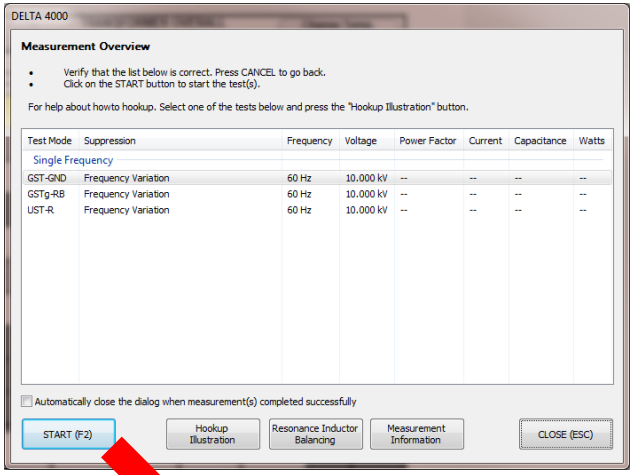
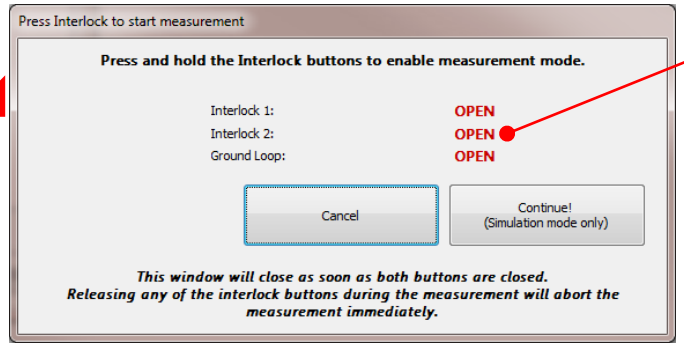
Power on

Delta 4110/4310A – Overall Test





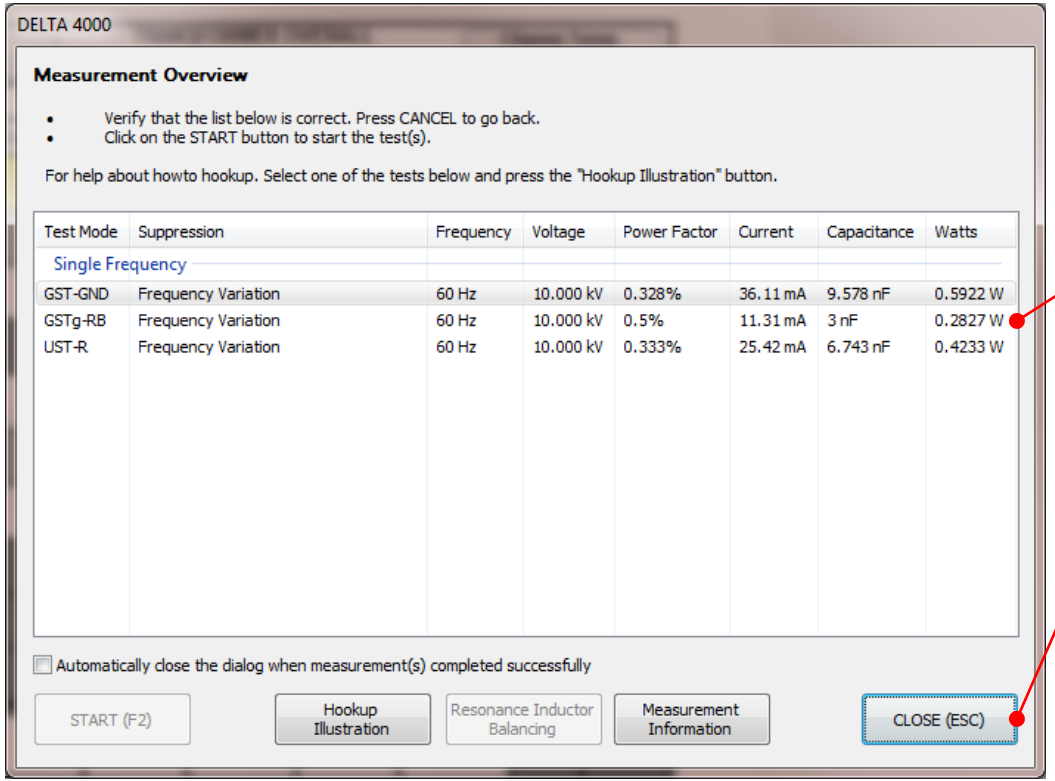
- Interlocks & Ground

Ground must be connected and Interlocks continuously engaged to begin and run test

***OPEN** will change to **CLOSED** after ground and interlocks engaged*

Megger
Power on

Delta 4110/4310A – Overall Test



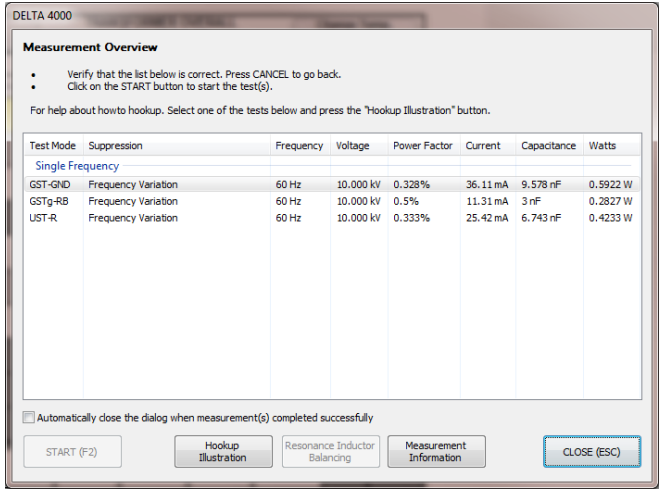
- Measurement Complete

Review measurement information

Click Close to return to PowerDB form

Megger
Power on

Delta 4110/4310A – Overall Test



Multiple Test ✔ | TRANSFORMER OVERALL TEST SET UP | Hookup Diagram | Temp Corr. Table | TRANSFORMER OVERALL TEST RESULTS | Change Temp. Corr. Table

Test No.	Insulation Tested	Test Mode	Test Lead Connections				TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
			HV	Red	Blue	Gnd				Measured	@ 20°C	Corr Factor	mA	Watts		
1	$C_{HG} + C_{HL}$	GST-GND	H	L		G	10.00		9,578.00	0.33	0.30	0.900	36.1084	0.5922	1.00	G
2	C_{HG}	GSTg-RB	H	L		G	10.00	✖	3,000.00	0.50	0.45	0.900	11.3099	0.2827	1.00	G
3	C_{HL}	UST-R	H	L		G	10.00	✖	6,743.00	0.33	0.30	0.900	25.4207	0.4233	1.00	G

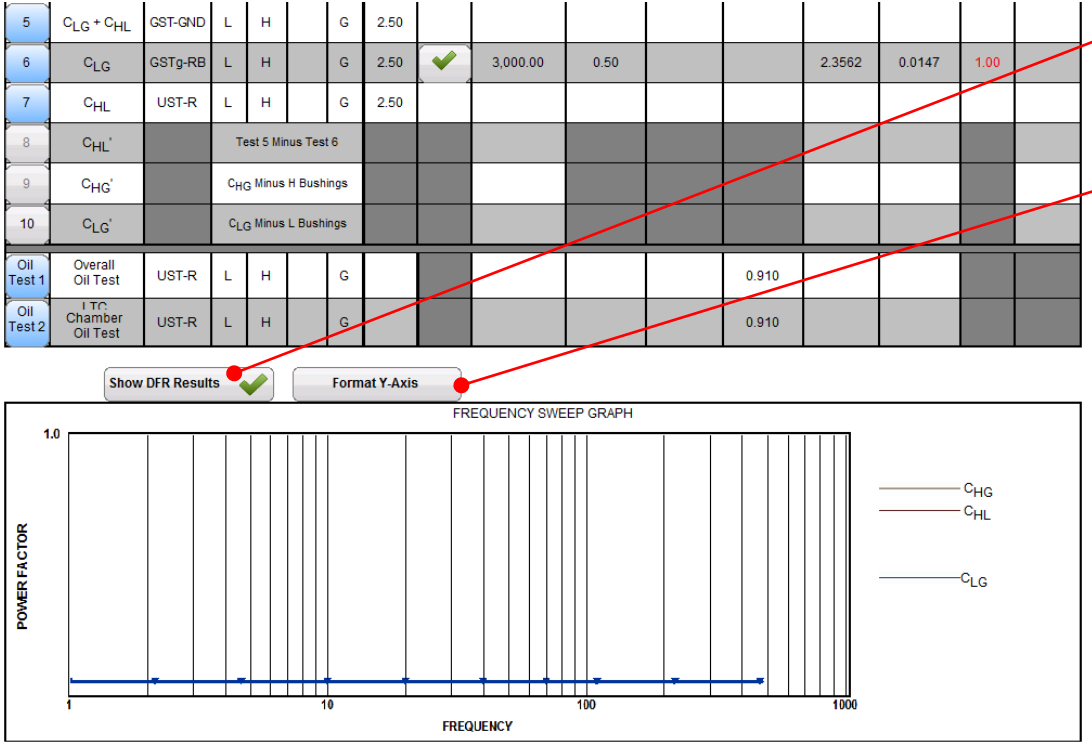
- Data Imports into PowerDB

Review measurement information

IR based on settings

Megger
Power on

Delta 4110/4310A – Overall Test

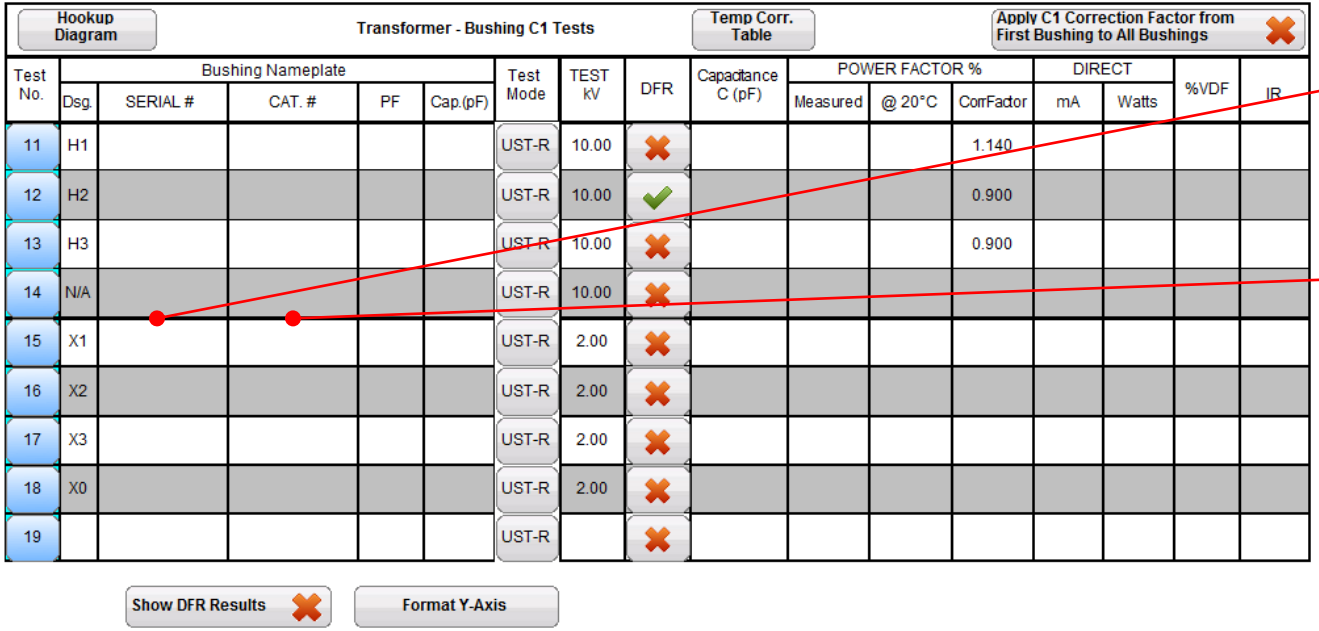


- Show/Hide DFR Graph

Format Y-Axis to see more/less of the graph

Megger
Power on

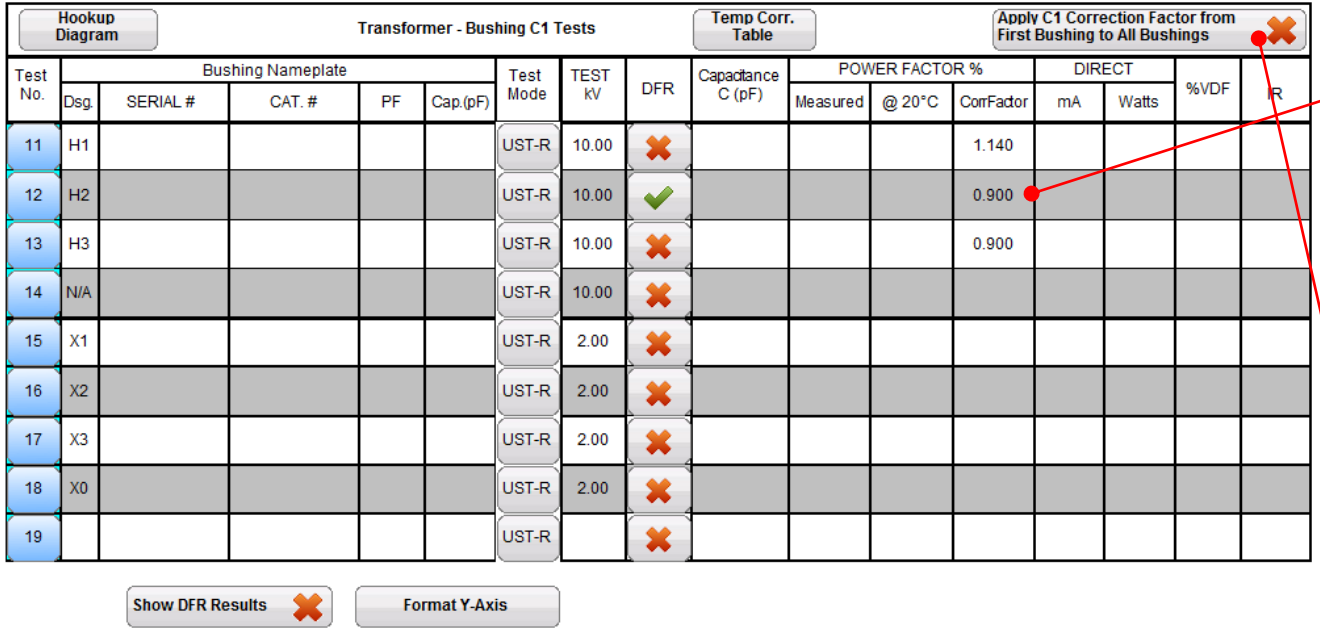
Delta 4110/4310A – Bushing C1 Test



- Serial # based on Bushing Nameplate
- Cat # can be entered here

Megger
Power on

Delta 4110/4310A – Bushing C1 Test



Hookup Diagram | Transformer - Bushing C1 Tests | Temp Corr. Table | Apply C1 Correction Factor from First Bushing to All Bushings

Test No.	Bushing Nameplate					Test Mode	TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)					Measured	@ 20°C	CorrFactor	mA	Watts		
11	H1					UST-R	10.00	✗				1.140				
12	H2					UST-R	10.00	✓				0.900				
13	H3					UST-R	10.00	✗				0.900				
14	N/A					UST-R	10.00	✗								
15	X1					UST-R	2.00	✗								
16	X2					UST-R	2.00	✗								
17	X3					UST-R	2.00	✗								
18	X0					UST-R	2.00	✗								
19						UST-R		✗								

Show DFR Results ✗ | Format Y-Axis

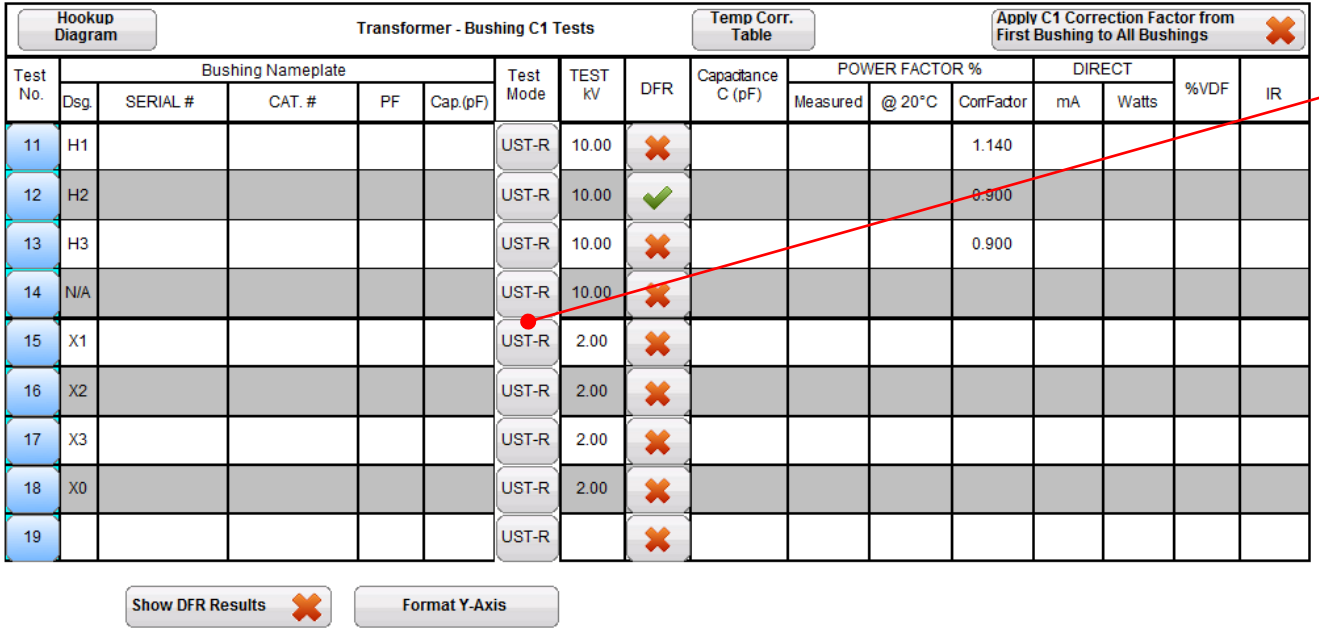
- Corr. Factor based on Ambient Temp, Oil Temp, Type/Class of bushing

Manual temp correction can be entered in the first row

Correction factor for first bushing can be copied to all bushings

Megger
Power on

Delta 4110/4310A – Bushing C1 Test

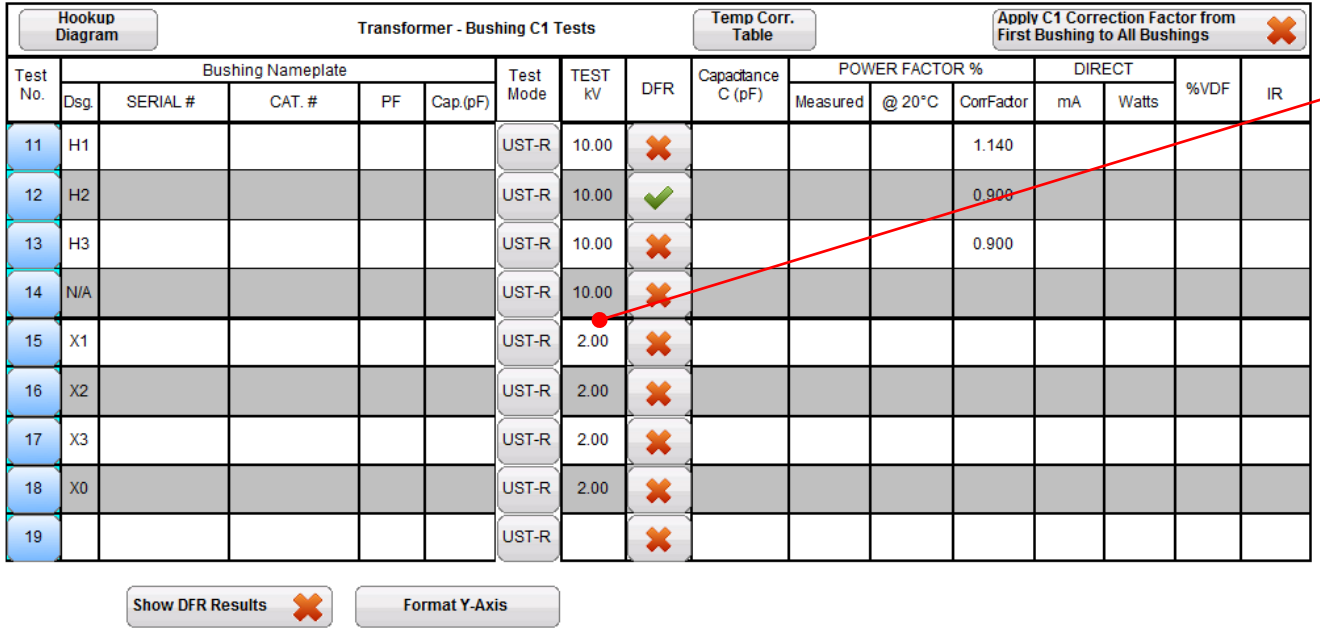


- Select Test Mode

UST-R
UST-B

Megger
Power on

Delta 4110/4310A – Bushing C1 Test



Hookup Diagram | Transformer - Bushing C1 Tests | Temp Corr. Table | Apply C1 Correction Factor from First Bushing to All Bushings

Test No.	Bushing Nameplate					Test Mode	TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)					Measured	@ 20°C	CorrFactor	mA	Watts		
11	H1					UST-R	10.00					1.140				
12	H2					UST-R	10.00					0.900				
13	H3					UST-R	10.00					0.900				
14	N/A					UST-R	10.00									
15	X1					UST-R	2.00									
16	X2					UST-R	2.00									
17	X3					UST-R	2.00									
18	X0					UST-R	2.00									
19						UST-R										

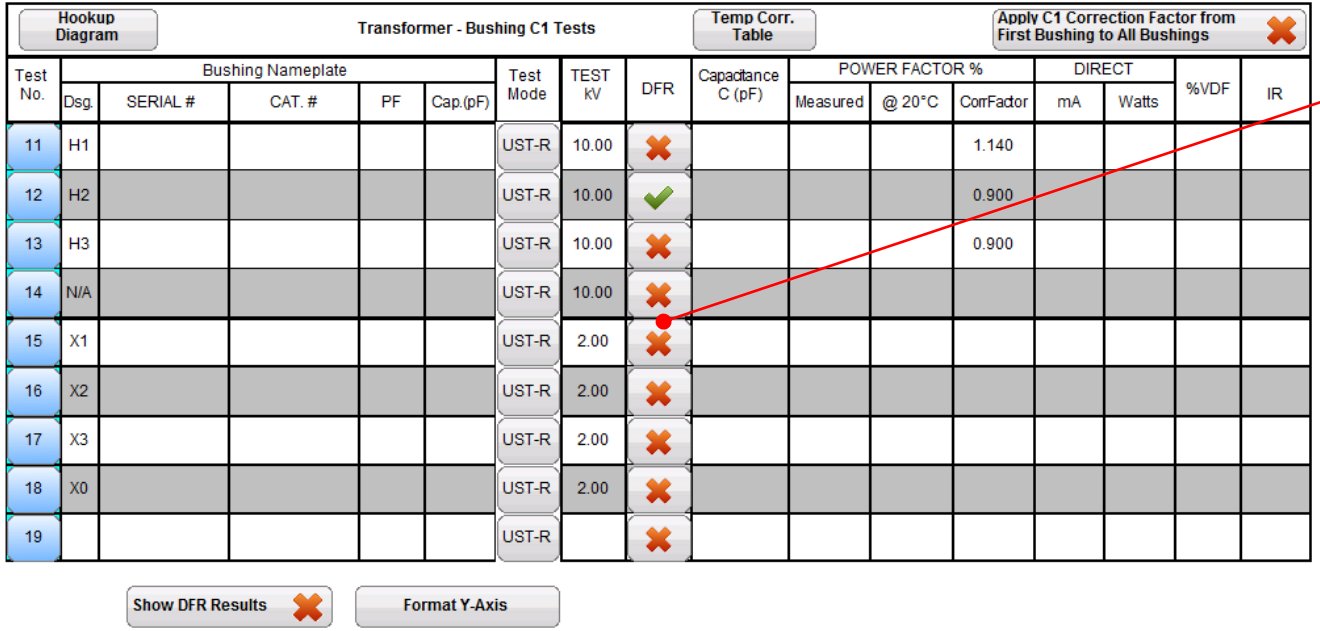
Show DFR Results | Format Y-Axis

- Test kV based on Nameplate

Can be manually entered

Megger
Power on

Delta 4110/4310A – Bushing C1 Test



- Enable/Disable DFR Sweep

A single test will be run at the Test kV, followed by 250V DFR sweep (default setting)

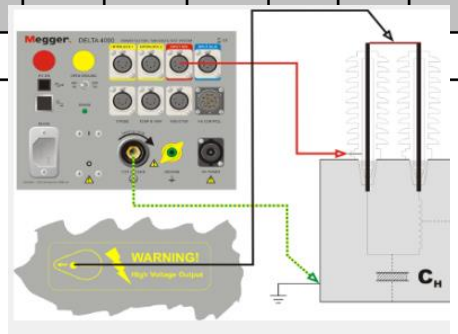
Megger
Power on

Delta 4110/4310A – Bushing C1 Test

Hookup Diagram | Transformer - Bushing C1 Tests | Temp Corr. Table | Apply C1 Correction Factor from First Bushing to All Bushings

Test No.	Bushing Nameplate					Test Mode	TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)					Measured	@ 20°C	CorrFactor	mA	Watts		
11	H1					UST-R	10.00	✗				1.140				
12	H2					UST-R	10.00	✓				0.900				
13	H3					UST-R	10.00	✗				0.900				
14	N/A					UST-R	10.00	✗								
15	X1					UST-R	2.00	✗								
16	X2					UST-R	2.00	✗								
17	X3					UST-R	2.00	✗								
18	X0					UST-R	2.00	✗								
19						UST-R										

Show DFR Results | Format Y-Axis



- Review Hookup Diagrams

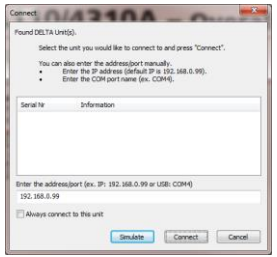
Megger
Power on

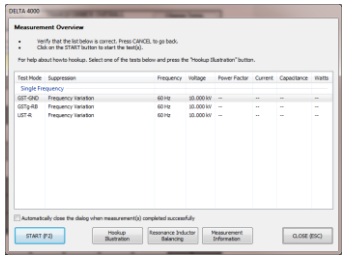
Delta 4110/4310A – Bushing C1 Test

Hookup Diagram | Transformer - Bushing C1 Tests | Temp Corr. Table | Apply C1 Correction Factor from First Bushing to All Bushings

Test No.	Bushing Nameplate					Test Mode	TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)					Measured	@ 20°C	CorrFactor	mA	Watts		
11	H1					UST-R	10.00	✗				1.140				
12	H2					UST-R	10.00	✓				0.900				
13	H3					UST-R	10.00	✗				0.900				
14	N/A					UST-R	10.00	✗								
15	X1					UST-R	2.00	✗								
16	X2					UST-R	2.00	✗								
17	X3					UST-R	2.00	✗								
18	X0					UST-R	2.00	✗								
19						UST-R		✗								

Show DFR Results ✗ | Format Y-Axis





- Run a test

Connection and Measurement Screen same as Overall Test

Show DFR results same as Overall Test

Review measurement information

Megger
Power on

Delta 4110/4310A – Bushing C2 Test

Transformer - Bushing C2 Tests

Test No.	Bushing Nameplate					Test Mode	TEST kV	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)				Measured	@ 20°C	CorrFactor	mA	Watts		
20	H1					GSTg-RB	0.50				1.140				
21	H2					GSTg-RB	0.50				0.900				
22	H3					GSTg-RB	0.50				0.900				
23	N/A					GSTg-RB	0.50								
24	X1					GSTg-RB	0.50								
25	X2					GSTg-RB	0.50								
26	X3					GSTg-RB	0.50								
27	X0					GSTg-RB	0.50								

- Serial # based on Bushing Nameplate
- Cat # based on C1 test

Megger
Power on

Delta 4110/4310A – Bushing C2 Test

Transformer - Bushing C2 Tests

Test No.	Bushing Nameplate					Test Mode	TEST kV	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)				Measured	@ 20°C	CorrFactor	mA	Watts		
20	H1					GSTg-RB	0.50				1.140				
21	H2					GSTg-RB	0.50				0.900				
22	H3					GSTg-RB	0.50				0.900				
23	N/A					GSTg-RB	0.50								
24	X1					GSTg-RB	0.50								
25	X2					GSTg-RB	0.50								
26	X3					GSTg-RB	0.50								
27	X0					GSTg-RB	0.50								

- Corr. Factor based on Ambient Temp, Oil Temp, Type/Class of bushing

Manual temp correction can be entered in the first row

Megger
Power on

Delta 4110/4310A – Bushing C2 Test

Transformer - Bushing C2 Tests

Test No.	Bushing Nameplate					Test Mode	TEST kV	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)				Measured	@ 20°C	CorrFactor	mA	Watts		
20	H1					GSTg-RB	0.50				1.140				
21	H2					GSTg-RB	0.50				0.900				
22	H3					GSTg-RB	0.50				0.900				
23	N/A					GSTg-RB	0.50								
24	X1					GSTg-RB	0.50								
25	X2					GSTg-RB	0.50								
26	X3					GSTg-RB	0.50								
27	X0					GSTg-RB	0.50								

- Select Test Mode

UST-R
UST-B
UST-RB
GST-GND
GSTg-R
GSTg-B
GSTg-RB

Megger
Power on

Delta 4110/4310A – Bushing C2 Test

Transformer - Bushing C2 Tests

Test No.	Bushing Nameplate					Test Mode	TEST kV	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)				Measured	@ 20°C	CorrFactor	mA	Watts		
20	H1					GSTg-RB	0.50				1.140				
21	H2					GSTg-RB	0.50				0.900				
22	H3					GSTg-RB	0.50				0.900				
23	N/A					GSTg-RB	0.50								
24	X1					GSTg-RB	0.50								
25	X2					GSTg-RB	0.50								
26	X3					GSTg-RB	0.50								
27	X0					GSTg-RB	0.50								

- Test kV based on Nameplate

Can be manually entered

Megger
Power on

Delta 4110/4310A – Bushing C2 Test

Transformer - Bushing C2 Tests

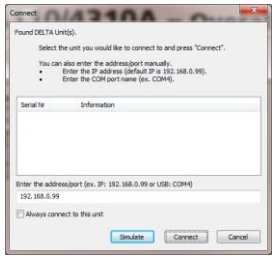
Test No.	Bushing Nameplate					Test Mode	TEST kV	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)				Measured	@ 20°C	CorrFactor	mA	Watts		
20	H1					GSTg-RB	0.50				1.140				
21	H2					GSTg-RB	0.50				0.900				
22	H3					GSTg-RB	0.50				0.900				
23	N/A					GSTg-RB	0.50								
24	X1					GSTg-RB	0.50								
25	X2					GSTg-RB	0.50								
26	X3					GSTg-RB	0.50								
27	X0					GSTg-RB	0.50								

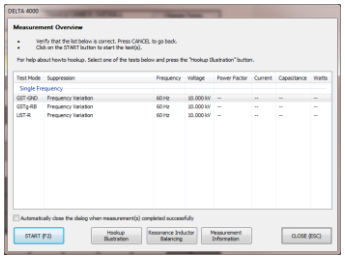
- Run a test

Connection and Measurement Screen same as Overall Test

Show DFR results same as Overall Test

Review measurement information





Megger
Power on

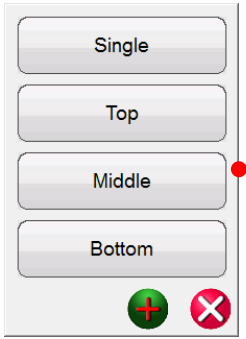
Delta 4110/4310A – Surge Arrester Test

Hookup Diagram

Transformer - Surge Arresters Tests

Number of Tests: 8

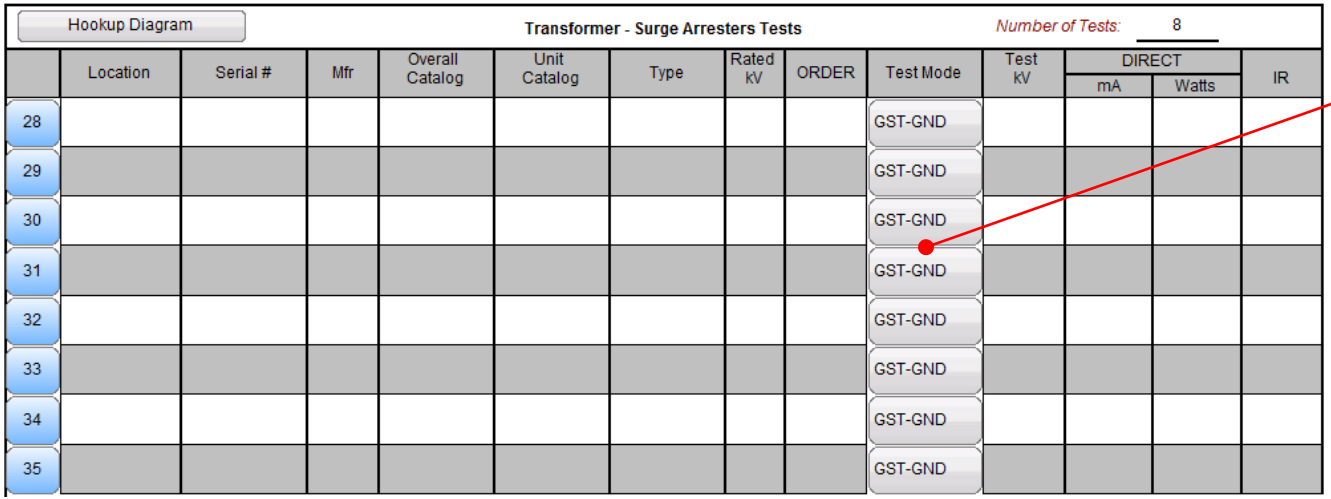
	Location	Serial #	Mfr	Overall Catalog	Unit Catalog	Type	Rated kV	ORDER	Test Mode	Test kV	DIRECT		IR
											mA	Watts	
28									GST-GND				
29									GST-GND				
30									GST-GND				
31									GST-GND				
32									GST-GND				
33									GST-GND				
34									GST-GND				
35									GST-GND				



- Select Number of Tests
- Enter:
  - Location
  - SN
  - MFR
  - Overall Catalog
  - Unit Catalog
  - Type
  - Rated kV
  - Order

Megger
Power on

Delta 4110/4310A – Surge Arrester Test



Hookup Diagram

Transformer - Surge Arresters Tests

Number of Tests: 8

	Location	Serial #	Mfr	Overall Catalog	Unit Catalog	Type	Rated kV	ORDER	Test Mode	Test kV	DIRECT		IR
											mA	Watts	
28									GST-GND				
29									GST-GND				
30									GST-GND				
31									GST-GND				
32									GST-GND				
33									GST-GND				
34									GST-GND				
35									GST-GND				

- Select Test Mode

UST-R
UST-B
UST-RB
GST-GND
GSTg-R
GSTg-B
GSTg-RB

Megger
Power on

Delta 4110/4310A – Surge Arrester Test

Hookup Diagram

Transformer - Surge Arresters Tests

Number of Tests: 8

	Location	Serial #	Mfr	Overall Catalog	Unit Catalog	Type	Rated kV	ORDER	Test Mode	Test kV	DIRECT		IR
											mA	Watts	
28									GST-GND				
29									GST-GND				
30									GST-GND				
31									GST-GND				
32									GST-GND				
33									GST-GND				
34									GST-GND				
35									GST-GND				

Enter Test kV

Megger
Power on

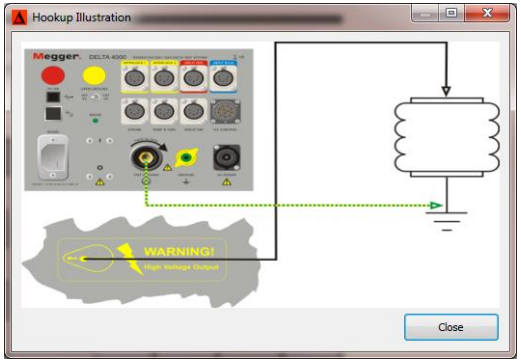
Delta 4110/4310A – Surge Arrester Test

Hookup Diagram

Transformer - Surge Arresters Tests

Number of Tests: 8

	Location	Serial #	Mfr	Overall Catalog	Unit Catalog	Type	Rated kV	ORDER	Test Mode	Test kV	DIRECT		IR
											mA	Watts	
28									GST-GND				
29									GST-GND				
30									GST-GND				
31									GST-GND				
32									GST-GND				
33									GST-GND				
34									GST-GND				
35									GST-GND				



- Review Hookup Diagrams

Megger
Power on

Delta 4110/4310A – Surge Arrester Test

Hookup Diagram

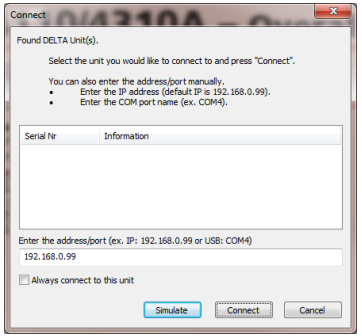
Transformer - Surge Arresters Tests *Number of Tests:* 8

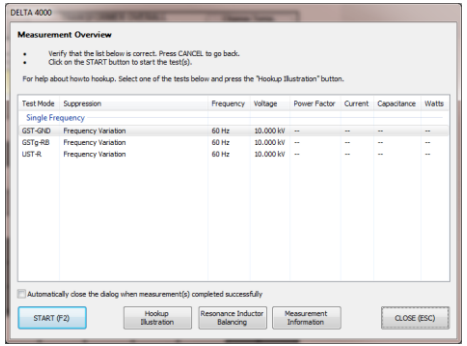
	Location	Serial #	Mfr	Overall Catalog	Unit Catalog	Type	Rated kV	ORDER	Test Mode	Test kV	DIRECT mA	DIRECT Watts	IR
28									GST-GND				
29									GST-GND				
30									GST-GND				
31									GST-GND				
32									GST-GND				
33									GST-GND				
34									GST-GND				
35									GST-GND				

- Run a test

Connection and Measurement Screen same as Overall Test

Review measurement information





Megger
Power on

Delta 4110/4310A – Hot Collar Test

Bushing Hot Collar Tests

Test No.	Dsg	Serial #	Skirt #	Test Mode	Test kV	DIRECT		
						mA	Watts	IR
36	H1			GST-GND	10.00			
37	H2			GST-GND	10.00			
38	H3			GST-GND	10.00			
39	N/A			GST-GND	10.00			
40	X1			GST-GND	2.00			
41	X2			GST-GND	2.00			
42	X3			GST-GND	2.00			
43	X0			GST-GND	2.00			
44				GST-GND				
45				GST-GND				

- Designation based on Bushing Nameplate
- Enter:
  Serial #
  Skirt #

Megger
Power on

Delta 4110/4310A – Hot Collar Test

Bushing Hot Collar Tests

Test No.	Dsg	Serial #	Skirt #	Test Mode	Test kV	DIRECT		IR
						mA	Watts	
36	H1			GST-GND	10.00			
37	H2			GST-GND	10.00			
38	H3			GST-GND	10.00			
39	N/A			GST-GND	10.00			
40	X1			GST-GND	2.00			
41	X2			GST-GND	2.00			
42	X3			GST-GND	2.00			
43	X0			GST-GND	2.00			
44				GST-GND				
45				GST-GND				

- Select Test Mode

UST-R
UST-B
UST-RB
GST-GND
GSTg-R
GSTg-B
GSTg-RB

Megger
Power on

Delta 4110/4310A – Hot Collar Test

Bushing Hot Collar Tests

Test No.	Dsg	Serial #	Skirt #	Test Mode	Test kV	DIRECT		IR
						mA	Watts	
36	H1			GST-GND	10.00			
37	H2			GST-GND	10.00			
38	H3			GST-GND	10.00			
39	N/A			GST-GND	10.00			
40	X1			GST-GND	2.00			
41	X2			GST-GND	2.00			
42	X3			GST-GND	2.00			
43	X0			GST-GND	2.00			
44				GST-GND				
45				GST-GND				

- Test kV based on Nameplate

Can be manually entered

Megger
Power on

Delta 4110/4310A – Hot Collar Test

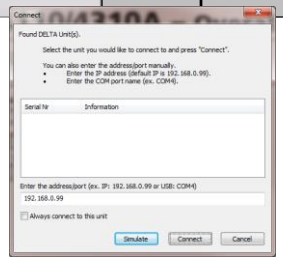
Bushing Hot Collar Tests

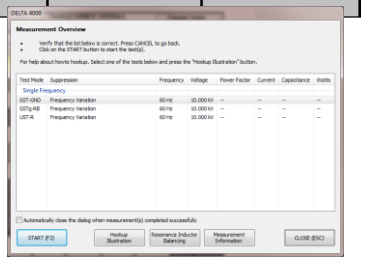
Test No.	Dsg	Serial #	Skirt #	Test Mode	Test kV	DIRECT		IR
						mA	Watts	
36	H1			GST-GND	10.00			
37	H2			GST-GND	10.00			
38	H3			GST-GND	10.00			
39	N/A			GST-GND	10.00			
40	X1			GST-GND	2.00			
41	X2			GST-GND	2.00			
42	X3			GST-GND	2.00			
43	X0			GST-GND	2.00			
44				GST-GND				
45				GST-GND				

- Run a test

Connection and Measurement Screen same as Overall Test

Review measurement information





Megger
Power on

Delta 4110/4310A – Exciting Current Test

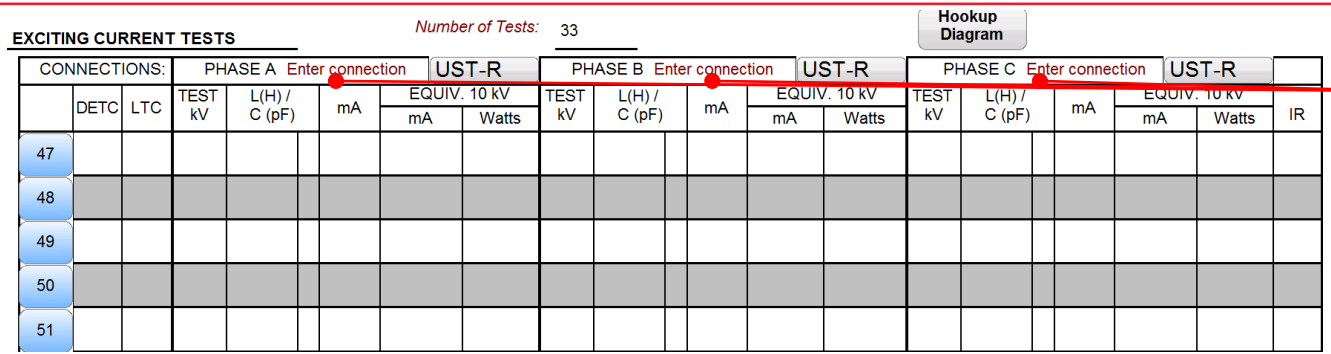
EXCITING CURRENT TESTS *Number of Tests:* 33 **Hookup Diagram**

CONNECTIONS:			PHASE A Enter connection			UST-R		PHASE B Enter connection			UST-R		PHASE C Enter connection			UST-R		
	DETC	LTC	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	IR
47																		
48																		
49																		
50																		
51																		

- Enter tap information

Megger Power on

Delta 4110/4310A – Exciting Current Test



EXCITING CURRENT TESTS

Number of Tests: 33

Hookup Diagram

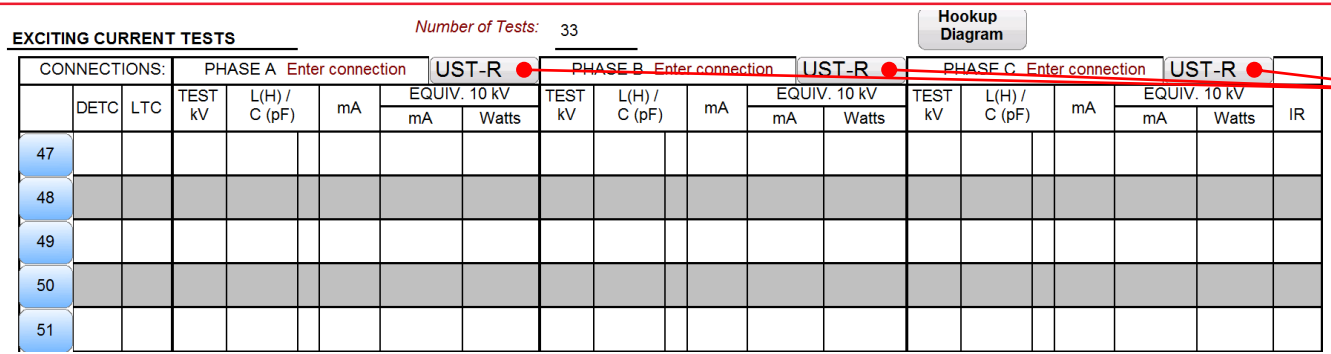
CONNECTIONS:			PHASE A Enter connection		UST-R			PHASE B Enter connection		UST-R			PHASE C Enter connection		UST-R			
	DETC	LTC	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	IR
47																		
48																		
49																		
50																		
51																		

- Enter Phase Connections

H1-H3, H2-H1, H3-H1, etc

Megger
Power on

Delta 4110/4310A – Exciting Current Test

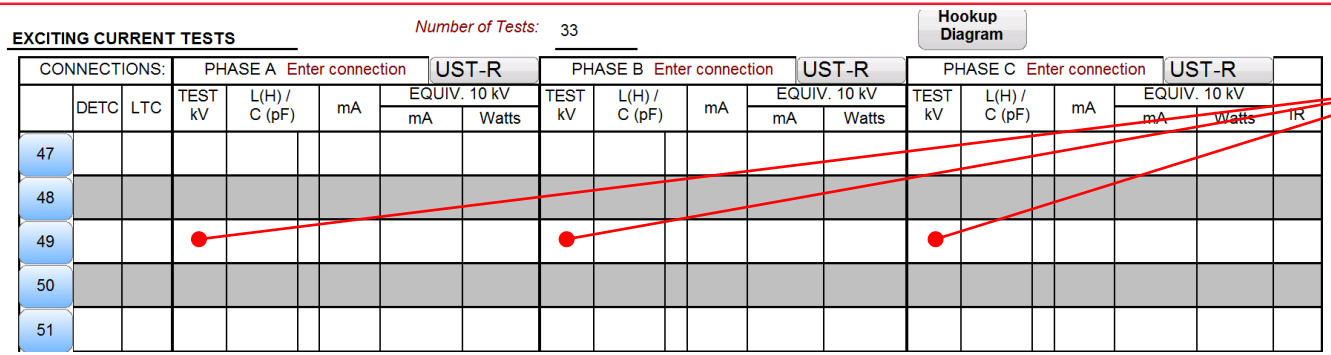


Select Test Mode

Each phase can use a different test mode

Megger
Power on

Delta 4110/4310A – Exciting Current Test



Test kV based on Nameplate

Can be manually entered

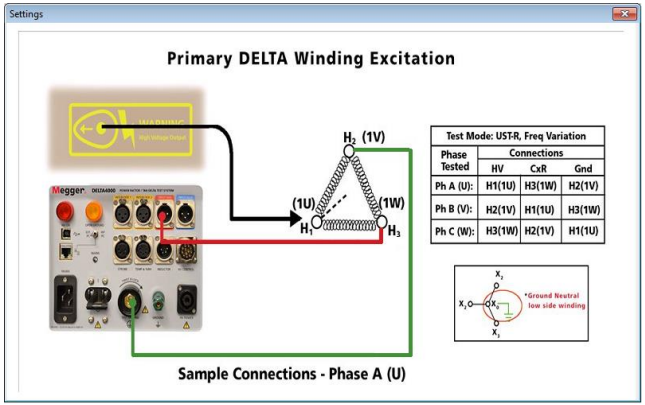
Megger
Power on

Delta 4110/4310A – Exciting Current Test

EXCITING CURRENT TESTS *Number of Tests:* 33

Hookup Diagram

CONNECTIONS:			PHASE A Enter connection		UST-R			PHASE B Enter connection		UST-R			PHASE C Enter connection		UST-R			
	DETC	LTC	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	IR
47																		
48																		
49																		
50																		
51																		



- Review Hookup Diagrams

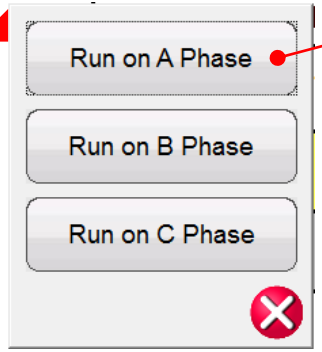
Diagram will change if Y selected for Primary

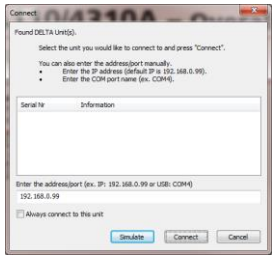
Megger Power on

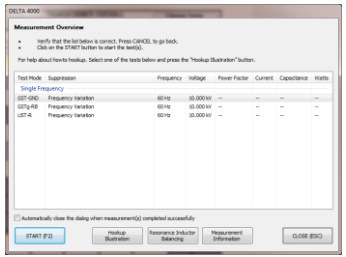
Delta 4110/4310A – Exciting Current Test

EXCITING CURRENT TESTS *Number of Tests:* 33 **Hookup Diagram**

CONNECTIONS:			PHASE A Enter connection		UST-R			PHASE B Enter connection		UST-R			PHASE C Enter connection		UST-R			
	DETC	LTC	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	TEST kV	L(H) / C (pF)	mA	EQUIV. 10 kV mA	EQUIV. 10 kV Watts	IR
47																		
48																		
49																		
50																		
51																		







- Run a test

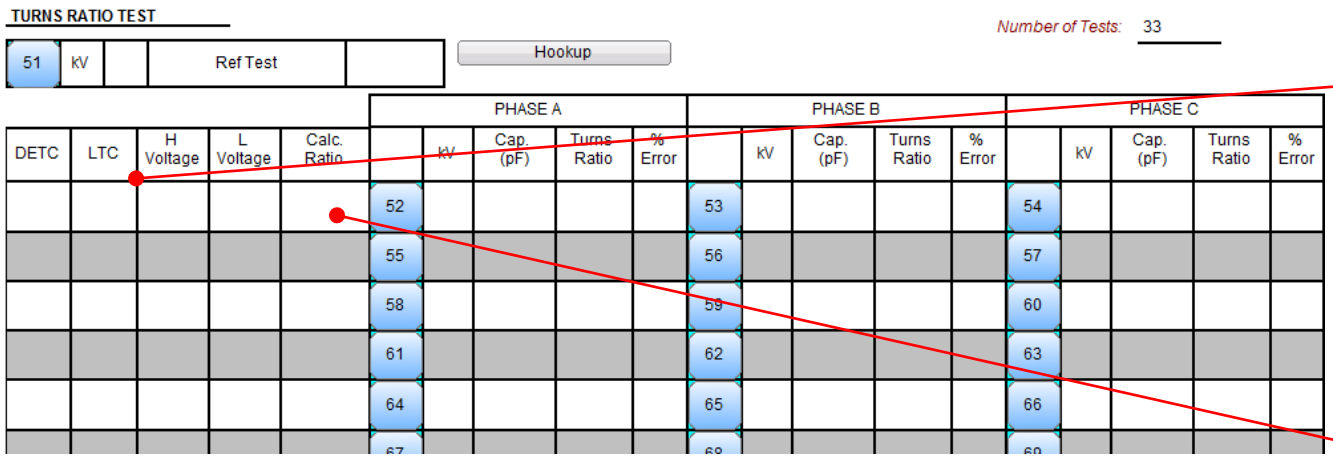
Each phase chosen separately

Connection and Measurement Screen same as Overall Test

Review measurement information

Megger Power on

Delta 4110/4310A – TTR Test



- Enter Tap Information

DETC Tap Label
LTC Tap Label
H Voltage
L Voltage

H Voltage & L Voltage required to calculate ratio

Megger
Power on

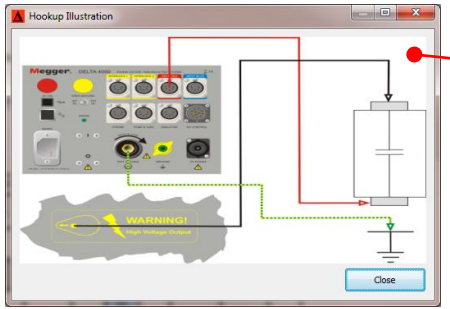
Delta 4110/4310A – TTR Test

TURNS RATIO TEST

Number of Tests: 33

51	kV		Ref Test		Hookup

					PHASE A					PHASE B					PHASE C				
DETC	LTC	H Voltage	L Voltage	Calc. Ratio		kV	Cap. (pF)	T… R…	% Error		kV	Cap. (pF)	Turns Ratio	% Error		kV	Cap. (pF)	Turns Ratio	% Error
					52					53					54				
					55					56					57				
					58					59					60				
					61					62					63				
					64					65					66				
					67					68					69				

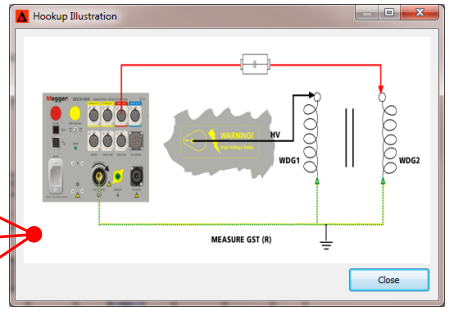


REF [TTR] CAP

Phase A

Phase B

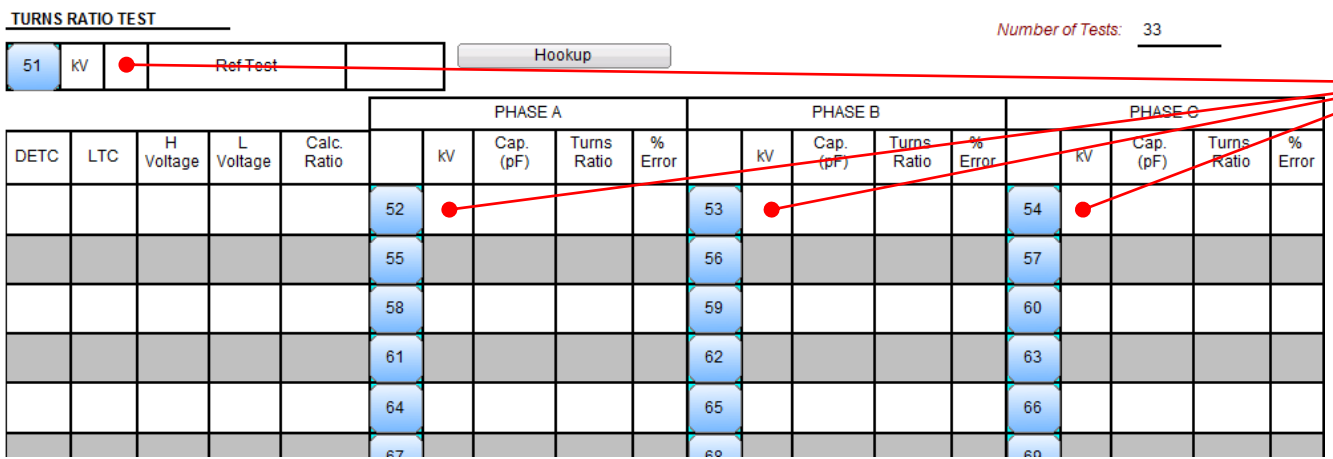
Phase C



- Review Hookup Diagrams

Megger
Power on

Delta 4110/4310A – TTR Test



Enter Test kV

Reference Capacitor
Phase A
Phase B
Phase C

Megger
Power on

Delta 4110/4310A – TTR Test

TURNS RATIO TEST

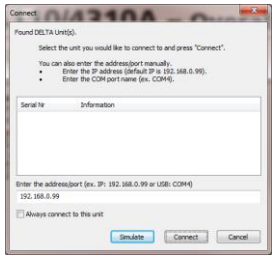
Number of Tests: 33

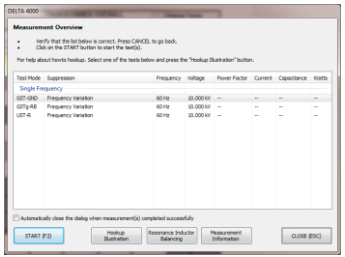
51	kV		Ref Test		Hookup

					PHASE A					PHASE B					PHASE C				
DETC	LTC	H Voltage	L Voltage	Calc. Ratio		kV	Cap. (pF)	Turns Ratio	% Error		kV	Cap. (pF)	Turns Ratio	% Error		kV	Cap. (pF)	Turns Ratio	% Error
					52					53					54				
					55					56					57				
					58					59					60				
					61					62					63				
					64					65					66				
					67					68					69				

- Run test on Reference Capacitor

Connection and Measurement Screen same as Overall Test





Megger
Power on

Delta 4110/4310A – TTR Test

TURNS RATIO TEST

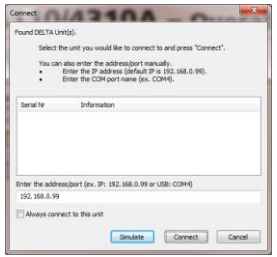
Number of Tests: 33

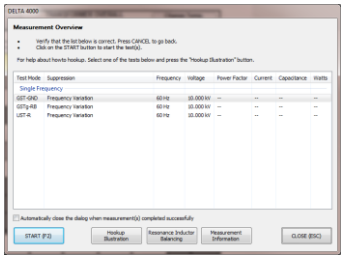
51	kV		Ref Test		Hookup

					PHASE A					PHASE B					PHASE C				
DETC	LTC	H Voltage	L Voltage	Calc. Ratio		kV	Cap. (pF)	Turns Ratio	% Error		kV	Cap. (pF)	Turns Ratio	% Error		kV	Cap. (pF)	Turns Ratio	% Error
					52					53					54				
					55					56					57				
					58					59					60				
					61					62					63				
					64					65					66				
					67					68					69				

- Run test on Tap + Phase

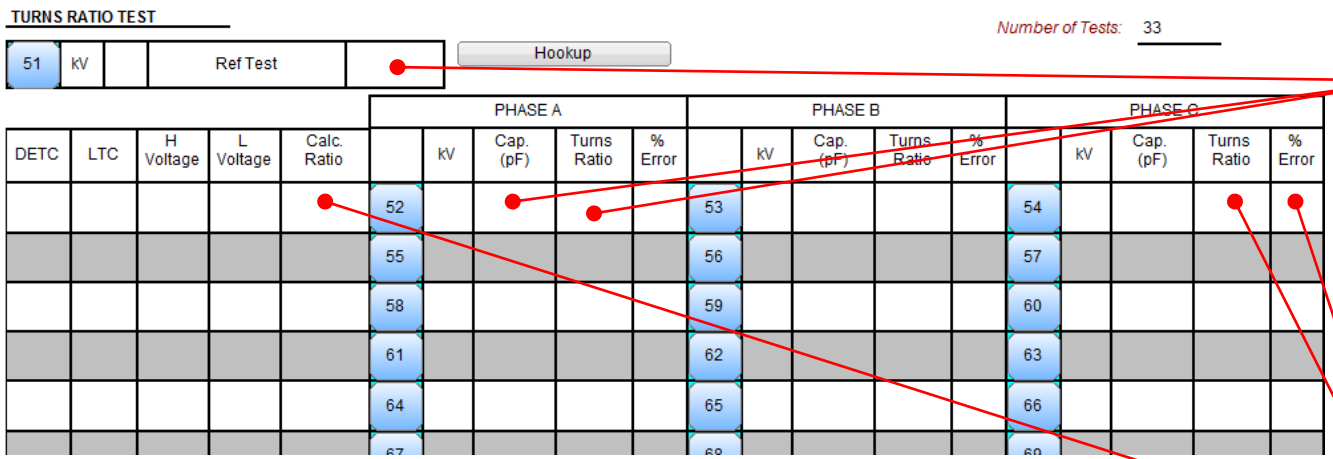
Connection and Measurement Screen same as Overall Test





Megger
Power on

Delta 4110/4310A – TTR Test

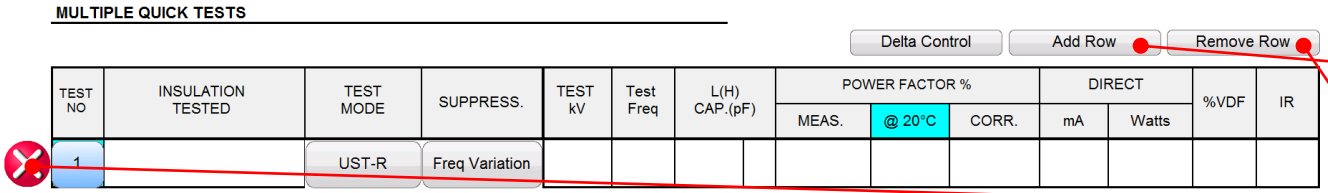


Turns Ratio based on Reference Capacitor capacitance and Phase capacitance

% Error based on Calc Ratio and Turns Ratio

Megger
Power on

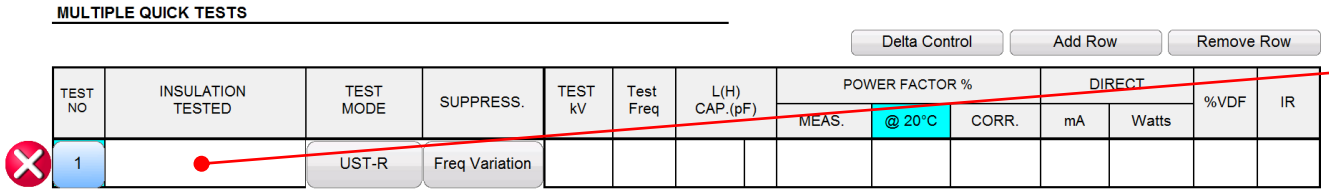
Delta 4110/4310A – Manual Test



- Add rows from the test table
- Remove rows from the test table

Megger
Power on

Delta 4110/4310A – Manual Test



Enter Insulation information

Megger
Power on

Delta 4110/4310A – Manual Test

MULTIPLE QUICK TESTS

Delta Control | Add Row | Remove Row

TEST NO	INSULATION TESTED	TEST MODE	SUPPRESS.	TEST kV	Test Freq	L(H) CAP.(pF)		POWER FACTOR %			DIRECT		%VDF	IR
								MEAS.	@ 20°C	CORR.	mA	Watts		
1		UST-R	Freq Variation											

Select Test Mode

Megger
Power on

Delta 4110/4310A – Manual Test

MULTIPLE QUICK TESTS

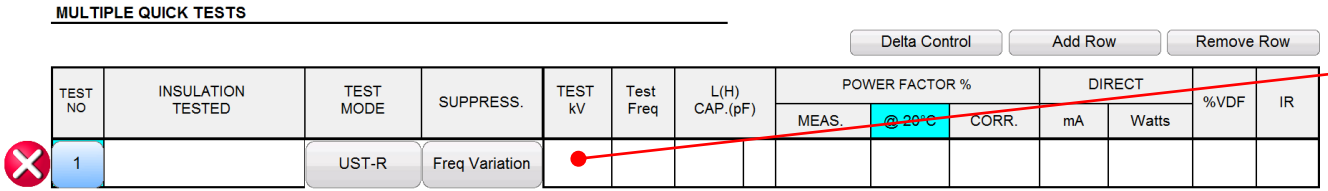
Delta Control | Add Row | Remove Row

TEST NO	INSULATION TESTED	TEST MODE	SUPPRESS.	TEST kV	Test Freq	L(H) CAP.(pF)		POWER FACTOR %			DIRECT		%VDF	IR
								MEAS.	@ 20°C	CORR.	mA	Watts		
1		UST-R	Freq Variation											

Select suppression mode

Megger
Power on

Delta 4110/4310A – Manual Test

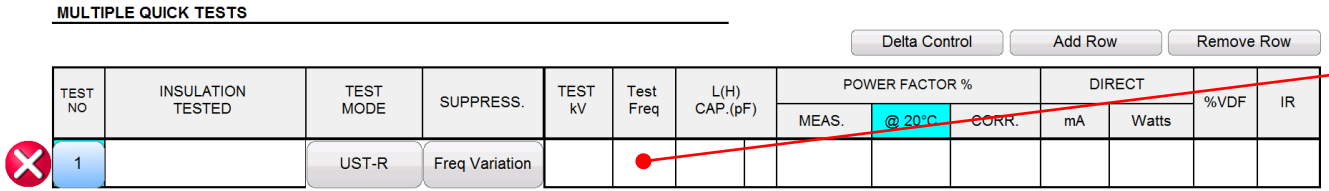


Enter Test kV

A single test will be run at the Test kV, followed by 250V DFR sweep (default setting)

Megger
Power on

Delta 4110/4310A – Manual Test

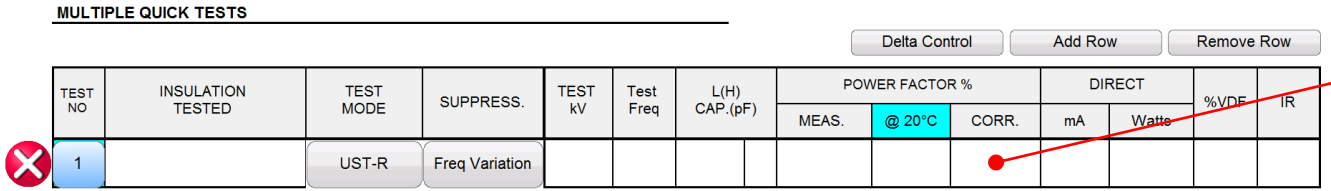


Enter Test Frequency

Settings will be used if no frequency entered

Megger
Power on

Delta 4110/4310A – Manual Test



Enter Correction Factor

Megger
Power on

Delta 4110/4310A – Manual Test

MULTIPLE QUICK TESTS

Delta Control | Add Row | Remove Row

TEST NO	INSULATION TESTED	TEST MODE	SUPPRESS.	TEST kV	Test Freq	L(H) CAP.(pF)		POWER FACTOR %			DIRECT		%VDF	IR
								MEAS.	@ 20°C	CORR.	mA	Watts		
1		UST-R	Freq Variation											

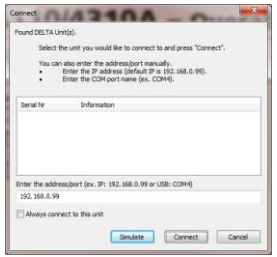
- Run a test

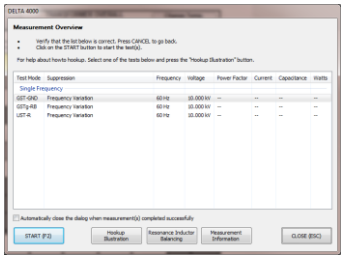
Connection and Measurement Screen same as Overall Test

Review measurement information

- Test can also be run using Delta Control

Measurement data will appear in PowerDB form when Delta Control is closed





Megger
Power on

Delta 4110/4310A – Overall Test ITC

Multiple Test ✔	TRANSFORMER OVERALL TEST SET UP						Hookup Diagram	Temp Corr. Table	TRANSFORMER OVERALL TEST RESULTS						Change Temp. Corr. Table	
Test No.	Insulation Tested	Test Mode	Test Lead Connections				TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
			HV	Red	Blue	Gnd				Measured	@ 20°C	Corr Factor	mA	Watts		
1	C_{HG} + C_{HL}	GST-GND	H	L		G	10.00									
2	C_{HG}	GSTg-RB	H	L		G	10.00	✖								
3	C_{HL}	UST-R	H	L		G	10.00	✖								

- Change Temp Corr. Table to ITC

Overall Individual Temperature Correction provides a correction factor specific to a particular transformer, which is more accurate than the temperature correction table

Megger
Power on

Delta 4110/4310A – Overall Test ITC

Multiple Test ✔	TRANSFORMER OVERALL TEST SET UP						Hookup Diagram	ITC	TRANSFORMER OVERALL TEST RESULTS						Set Individual Temp. Corr.	
Test No.	Insulation Tested	Test Mode	Test Lead Connections				TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
			HV	Red	Blue	Gnd				Measured	@ 20°C	Corr Factor	mA	Watts		
1	C_{HG} + C_{HL}	GST-GND	H	L		G	10.00									
2	C_{HG}	GSTg-RB	H	L		G	10.00	✖								
3	C_{HL}	UST-R	H	L		G	10.00	✖								

- Select Set Individual Temp. Corr

OIL VOLUME _____ GAL

OIL TEMP _____ °C

IMPEDANCE _____ %

DATE 10/29/2018

AMBIENT TEMP. _____ °F

HUMIDITY _____ %

Requires Oil Temp from Nameplate

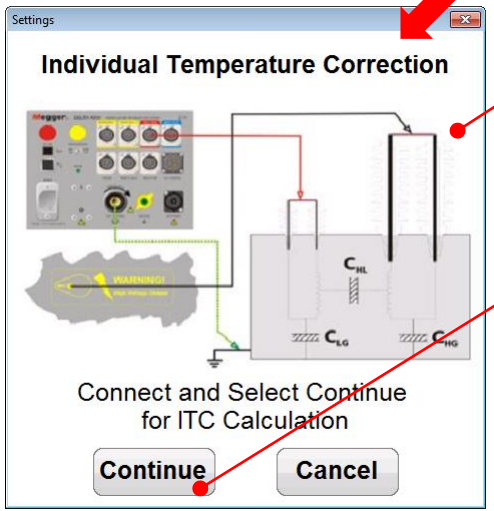
Requires Ambient Temp from Header

Ambient Temp gathered from Delta automatically if not populated

Megger Power on

Delta 4110/4310A – Overall Test ITC

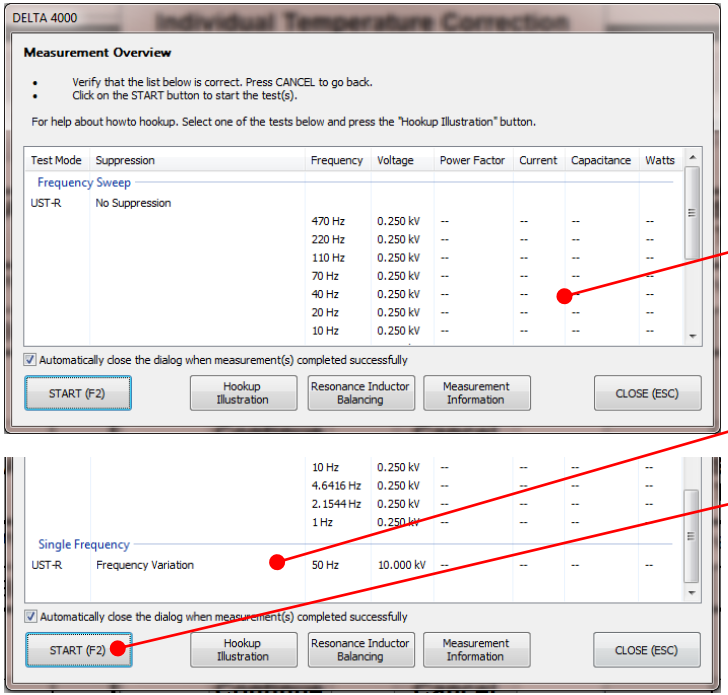
Multiple Test ✔	TRANSFORMER OVERALL TEST SET UP						Hookup Diagram	ITC	TRANSFORMER OVERALL TEST RESULTS					Set Individual Temp. Corr.		
Test No.	Insulation Tested	Test Mode	Test Lead Connections				TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIR		%VDF	IR
			HV	Red	Blue	Gnd				Measured	@ 20°C	Corr Factor	mA	Watts		
1	C_{HG} + C_{HL}	GST-GND	H	L		G	10.00									
2	C_{HG}	GSTg-RB	H	L		G	10.00	✖								
3	C_{HL}	UST-R	H	L		G	10.00	✖								



- Review Connection Diagram
- Click Continue

Megger
Power on

Delta 4110/4310A – Overall Test ITC



- Review Test Setup

ITC runs a DFR sweep on C_{HL}

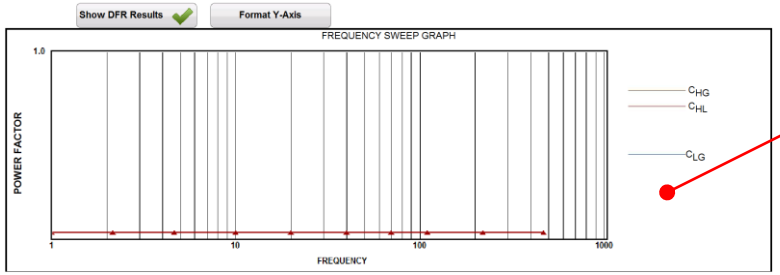
In addition, the overall test is conducted to save time

- Click Start

Megger
Power on

Delta 4110/4310A – Overall Test ITC

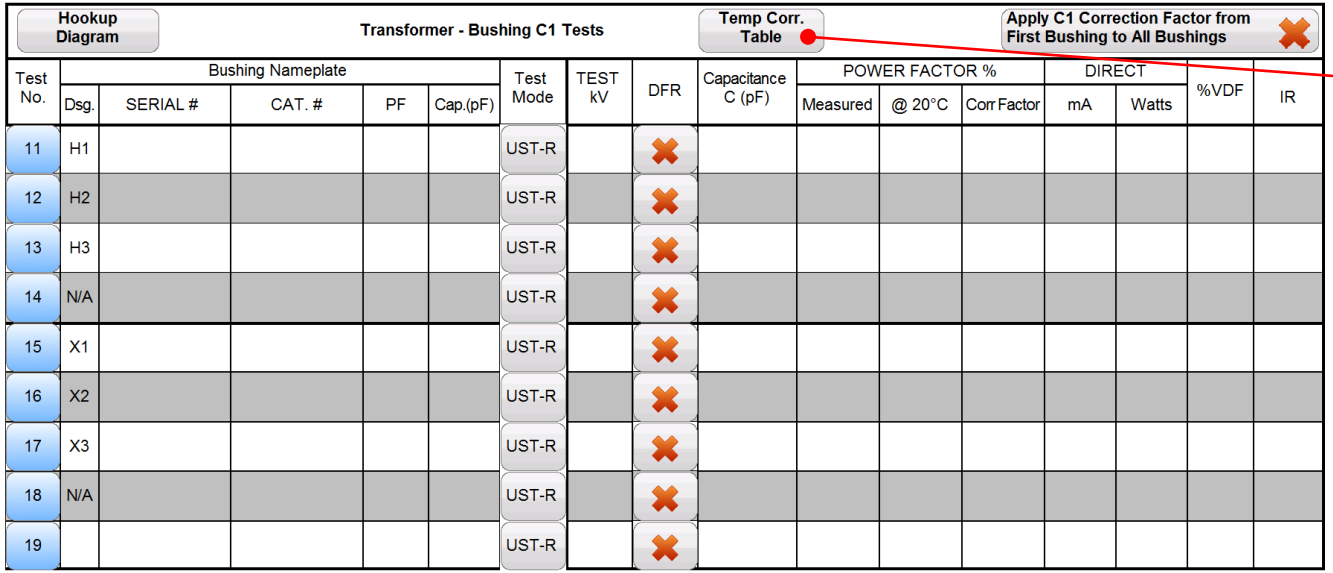
Multiple Test ✔	TRANSFORMER OVERALL TEST SET UP						Hookup Diagram	ITC	TRANSFORMER OVERALL TEST RESULTS						Set Individual Temp. Corr.	
Test No.	Insulation Tested	Test Mode	Test Lead Connections				TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
			HV	Red	Blue	Gnd				Measured	@ 20°C	Corr Factor	mA	Watts		
1	$C_{HG} + C_{HL}$	GST-GND	H	L		G	10.00					0.945				
2	C_{HG}	GSTg-RB	H	L		G	10.00	✖				0.945				
3	C_{HL}	UST-R	H	L		G	10.00	✔	6,743.00	0.33	0.31	0.945	21.1839	0.3527	1.00	G
4	C_{HL}'	Test 1 Minus Test 2														
5	$C_{LG} + C_{HL}$	GST-GND	L	H		G	10.00					0.945				
6	C_{LG}	GSTg-RB	L	H		G	10.00	✖				0.945				
7	C_{HL}	UST-R	L	H		G	10.00					0.945				



- When test completes:
  - Overall Corr. Factor populated with ITC for all rows
  - CHL results populated
  - DFR selected and results available in graph

Megger
Power on

Delta 4110/4310A – Bushing ITC

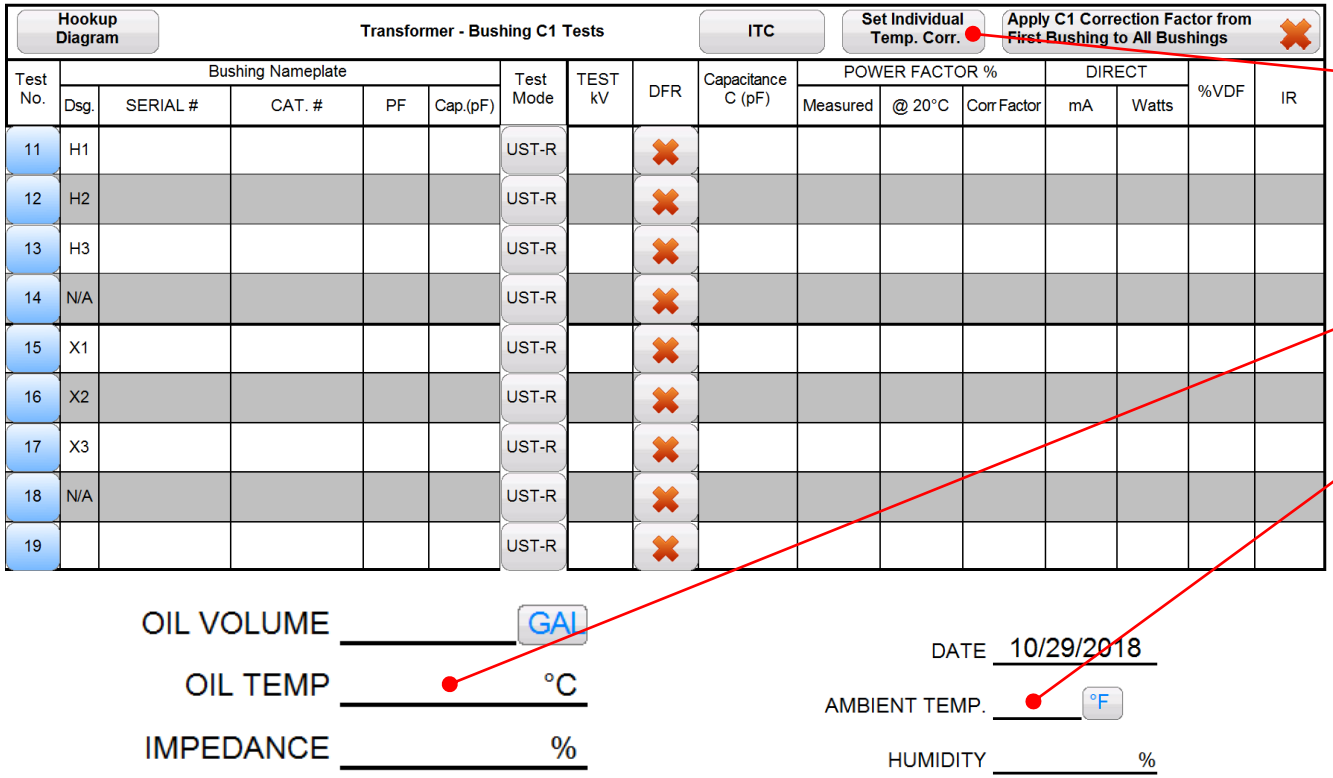


- Change Temp Corr. Table to ITC

Bushing Individual Temperature Correction provides a correction factor specific to a particular bushing, which is more accurate than temperature correction tables

Megger
Power on

Delta 4110/4310A – Bushing ITC



- Select Set Individual Temp. Corr

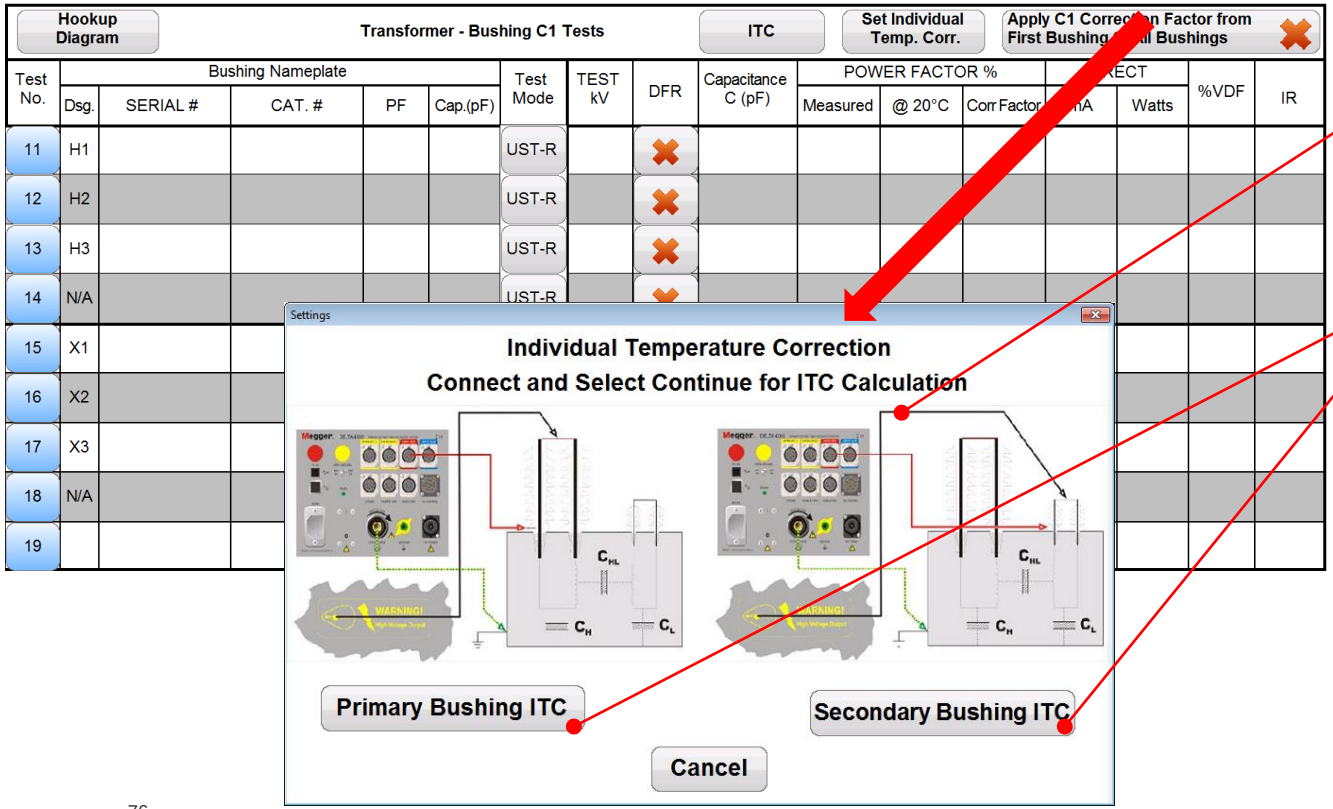
Requires Oil Temp from Nameplate

Requires Ambient Temp from Header

Ambient Temp gathered from Delta automatically if not populated

Megger
Power on

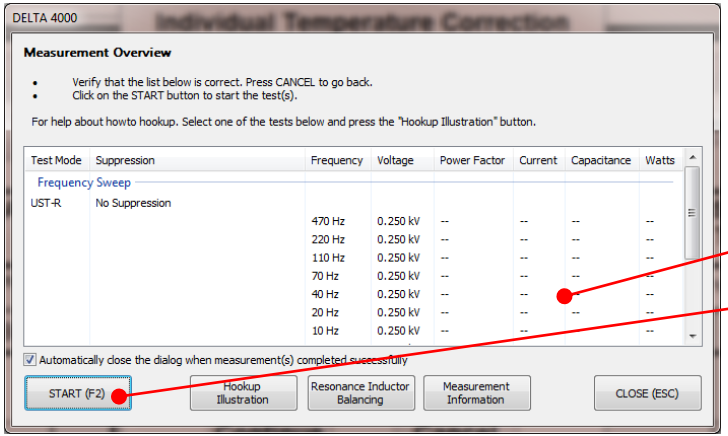
Delta 4110/4310A – Bushing ITC



- Review Connection Diagram
- Select Primary or Secondary Bushing ITC

Megger
Power on

Delta 4110/4310A – Bushing ITC



- Review Test Setup
- Click Start

Megger
Power on

Delta 4110/4310A – Bushing ITC

Hookup Diagram	Transformer - Bushing C1 Tests	ITC	Set Individual Temp. Corr.	Apply C1 Correction Factor from First Bushing to All Bushings ✔

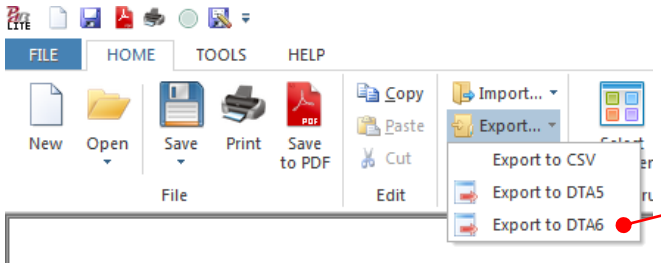
Test No.	Bushing Nameplate					Test Mode	TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			DIRECT		%VDF	IR
	Dsg.	SERIAL #	CAT. #	PF	Cap.(pF)					Measured	@ 20°C	Corr Factor	mA	Watts		
11	H1					UST-R		✖				0.970				
12	H2					UST-R		✖				0.970				
13	H3					UST-R		✖				0.970				
14	N/A					UST-R		✖				0.970				
15	X1					UST-R		✖				1.005				
16	X2					UST-R		✖				1.005				
17	X3					UST-R		✖				1.005				
18	N/A					UST-R		✖				1.005				

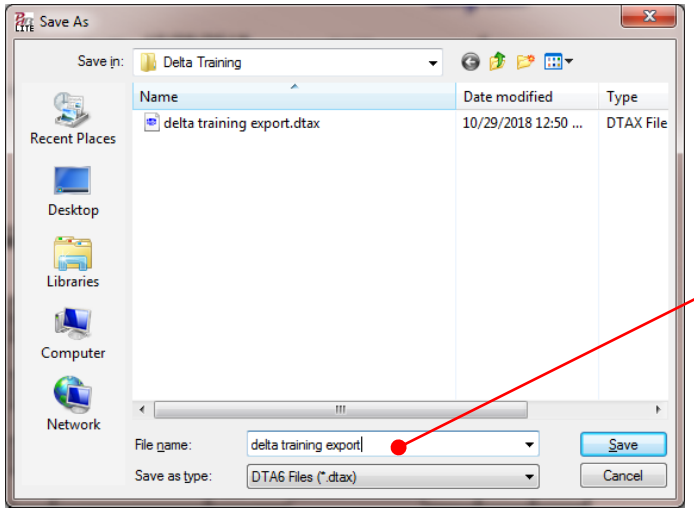
- When test completes:
  - Correction factor for primary bushings populated
  - Correction factor for secondary bushings populated

Requires running ITC twice to populate correction factors for primary and secondary bushings

Megger
Power on

Delta 4110/4310A – Export to DTA6

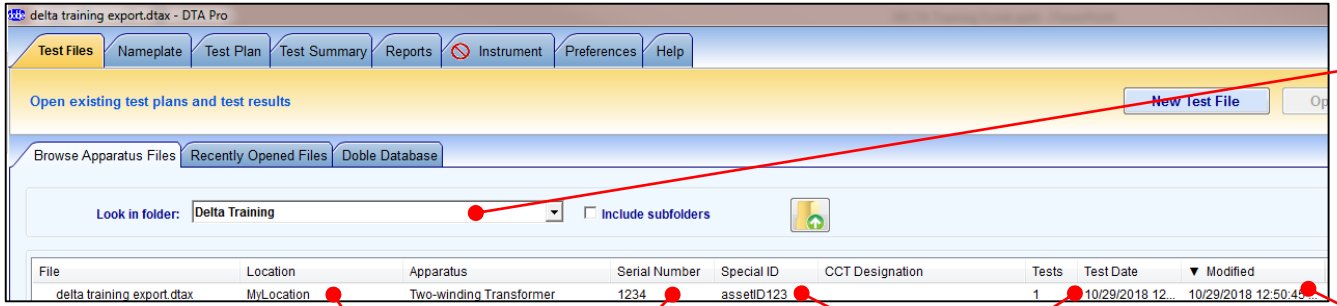


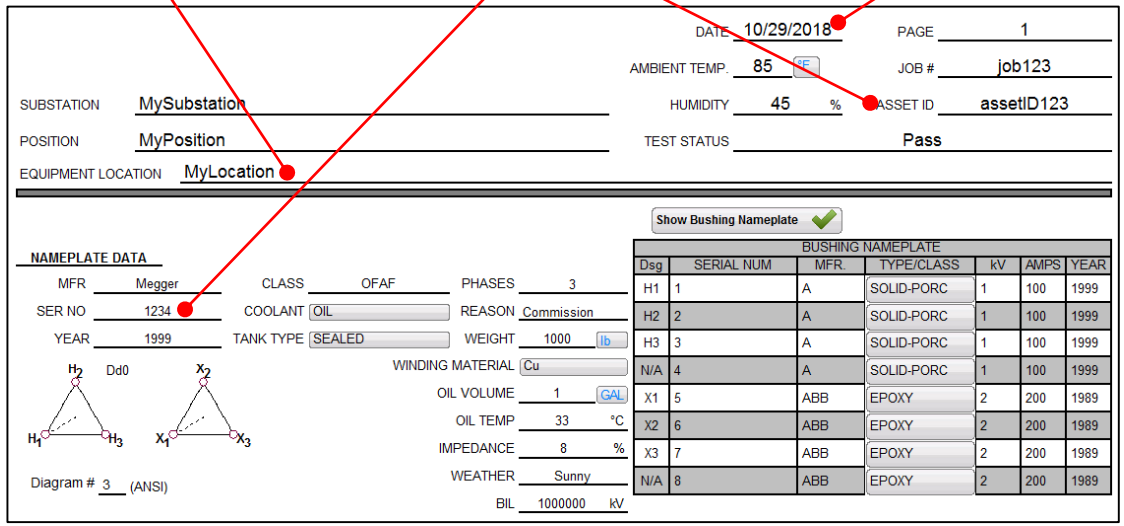


- After you have completed your tests, select Export to DTA6
- Give the file a name and click save

Megger
Power on

Delta 4110/4310A – Export to DTA6

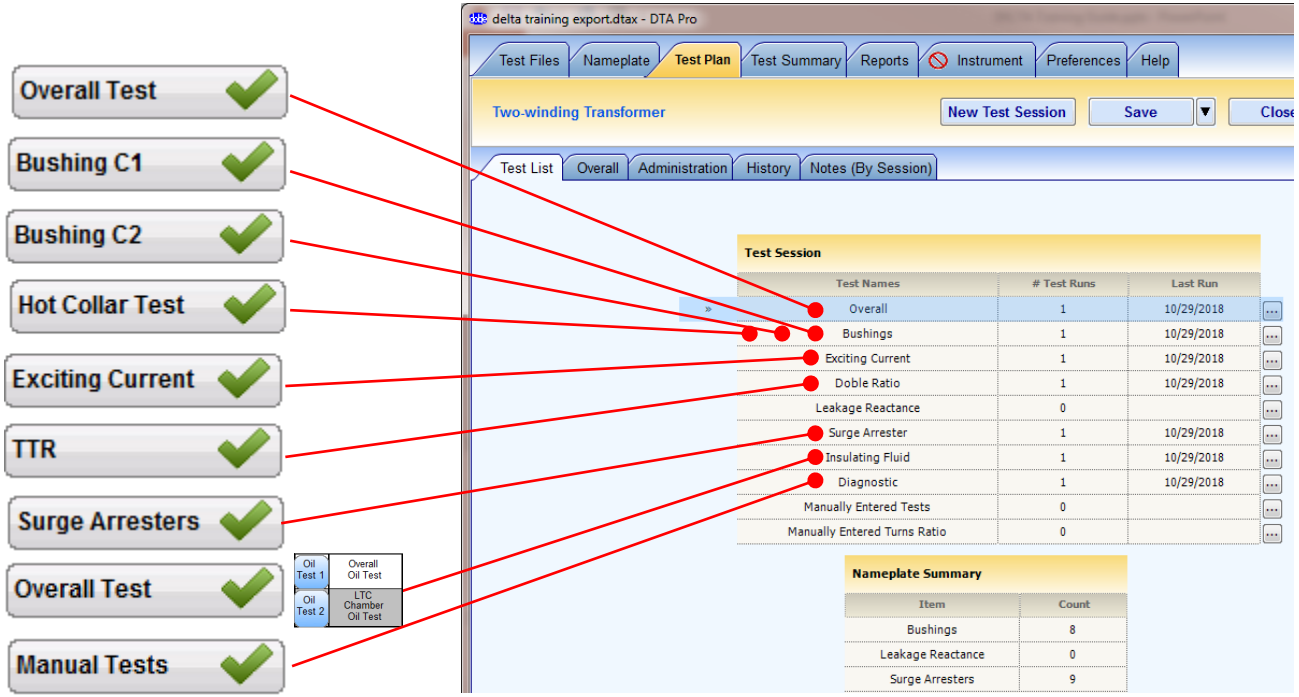




- In DTA6, select folder containing exported file
- The file will appear in the list
- Parameters will match exported file

Megger
Power on

Delta 4110/4310A – Export to DTA6



- Tests will be mapped to DTA6

Bushing contain C1, C2 and Hot Collar Tests

Overall Oil tests mapped to Insulating Fluid

Megger
Power on

Delta 4110/4310A – Export to DTA6

Multiple Test ✔ | TRANSFORMER OVERALL TEST SET UP | Hookup Diagram | Temp Corr. Table | TRANSFORMER OVERALL TEST RESULTS | Change Temp. Corr. Table

Test No.	Insulation Tested	Test Mode	Test Lead Connections HV	Red	Blue	Gnd	TEST kV	DFR	Capacitance C (pF)	POWER FACTOR % Measured	@ 20°C	Corr Factor	DIRECT mA	Watts	%VDF	IR
1	$C_{HG} + C_{HL}$	GST-GND	H	L		G	10.00		9,578.00	0.33	0.24	0.745	30.0903	0.4935	1.00	G
2	C_{HG}	GSTg-RB	H	L		G	10.00	✖	3,000.00	0.50	0.37	0.745	9.4249	0.2356	1.00	G
3	C_{HL}	UST-R	H	L		G	10.00	✖	6,743.00	0.33	0.25	0.745	21.1839	0.3527	1.00	G
4	C_{HL}'	Test 1 Minus Test 2							6,578.00				20.6654	0.2579		Invalid
5	$C_{LG} + C_{HL}$	GST-GND	L	H		G	10.00		9,578.00	0.33	0.24	0.745	30.0903	0.4935	1.00	G
6	C_{LG}	GSTg-RB	L	H		G	10.00	✖	3,000.00	0.50	0.37	0.745	9.4249	0.2356	1.00	G
7	C_{HL}	UST-R	L	H		G	10.00		6,743.00	0.33	0.25	0.745	21.1839	0.3527	1.00	G
8	C_{HL}'	Test 5 Minus Test 6							6,578.00				20.6654	0.2579		Invalid

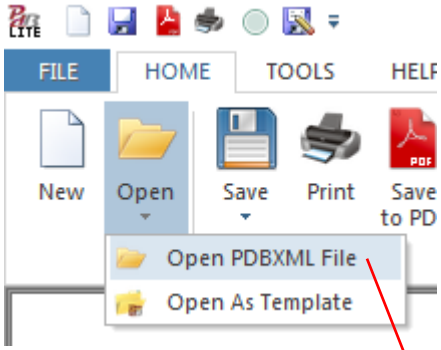
Overall Test Setup

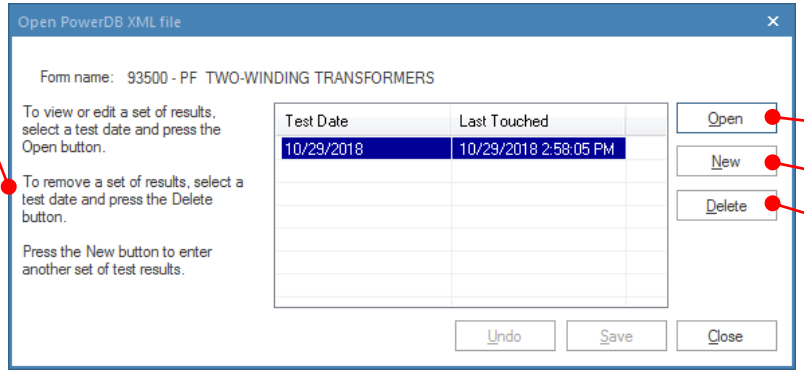
Connections #	HV Lead	Red Measure Lead	Blue Measure Lead	Insulation	Inputs Test kV	Corr. Factor	Test Results mA	Watts	PF (%)	PF Corr. (%)	Capacitance (pF)	Ratings Ask FRANK™	Manual
1	HV Winding	LV Winding	Unused	CH+CHL	10.000	0.75	30.090	0.493	0.328	0.244	9578.0		Good
2				CH	10.000	0.75	9.425	0.236	0.500	0.372	3000.0	U Unrated	Good
3				CHL(UST)	10.000	0.75	21.184	0.353	0.333	0.248	6743.0	U Unrated	Good
4	Test 1 - Test 2 (calculated)			CHL		1.00	20.665	0.258	0.125	0.125	6578.0		Unrated
5	LV Winding	HV Winding	Unused	CL+CHL	10.000	0.75	30.090	0.493	0.328	0.244	9578.0		Good
6				CL	10.000	0.75	9.425	0.236	0.500	0.372	3000.0	U Unrated	Good
7				CHL(UST)	10.000	0.75	21.184	0.353	0.333	0.248	6743.0		Good
8	Test 5 - Test 6 (calculated)			CHL		1.00	20.665	0.258	0.125	0.125	6578.0	U Unrated	Unrated

- Example of mapped Overall Test

Megger Power on

Delta 4110/4310A – Opening a file

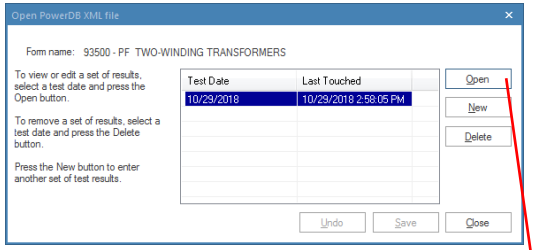


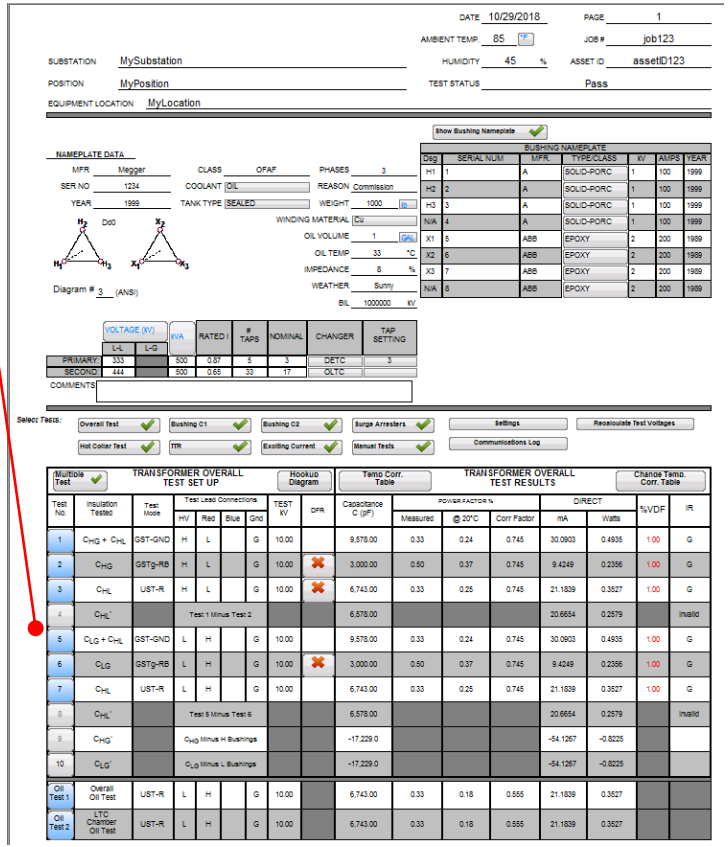


- When you open a saved file, you have multiple options:
  - Open
  - New
  - Delete

Megger
Power on

Delta 4110/4310A – Opening a file

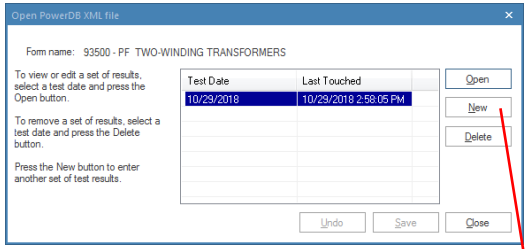


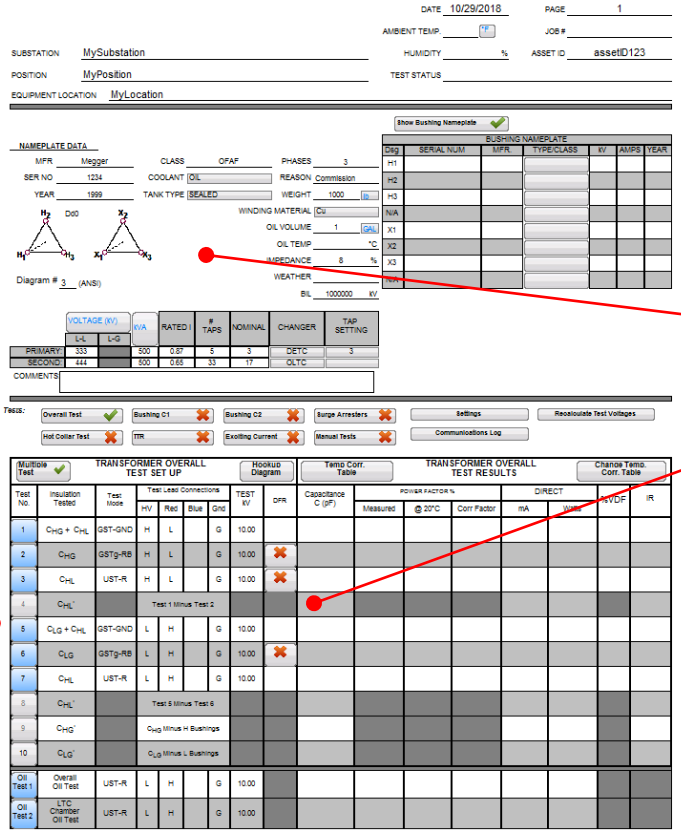


- Open allows you to view previous results and continue testing

Megger
Power on

Delta 4110/4310A – Opening a file





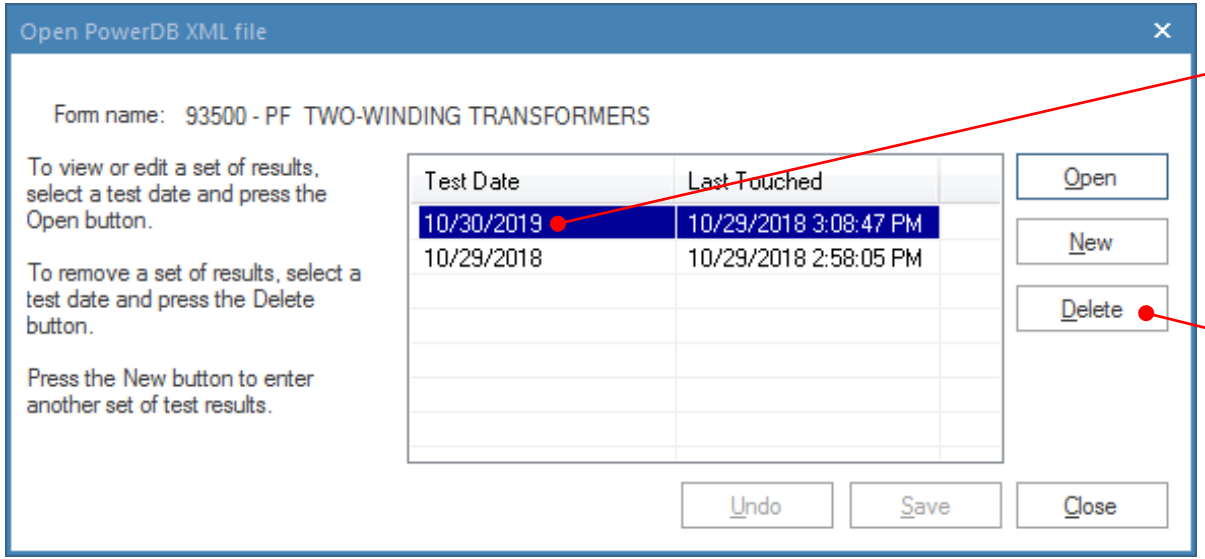
- New creates a new test date within the file

Nameplate information is copied over

Test data is blank, ready for a new set of results

Megger
Power on

Delta 4110/4310A – Opening a file



- After a new test is saved, it will show in the list when the file is opened
- Highlight a date and select Delete to remove it from the file

Megger
Power on

Delta 4110/4310A – PowerDB Pro

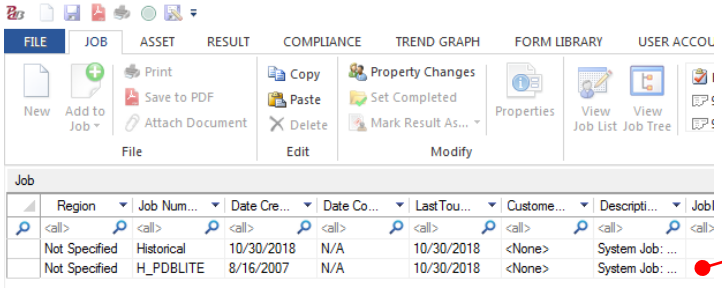
Basic functionality of PowerDB Pro will be covered in this section

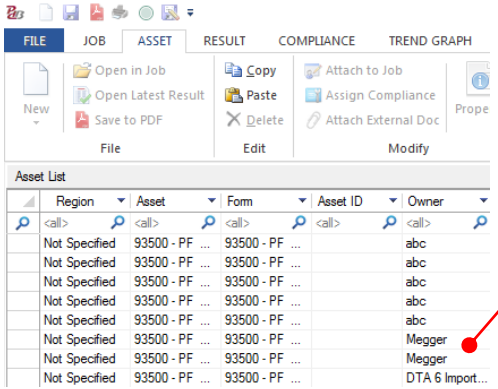
PowerDB Pro functions similar to PowerDB Lite,
but with a database backend

For more information about PowerDB Pro and its features, contact
Brad.Perry@powerdb.com or Mark.Meyer@powerdb.com

Megger
Power on

Delta 4110/4310A – PowerDB Pro





- Open a job

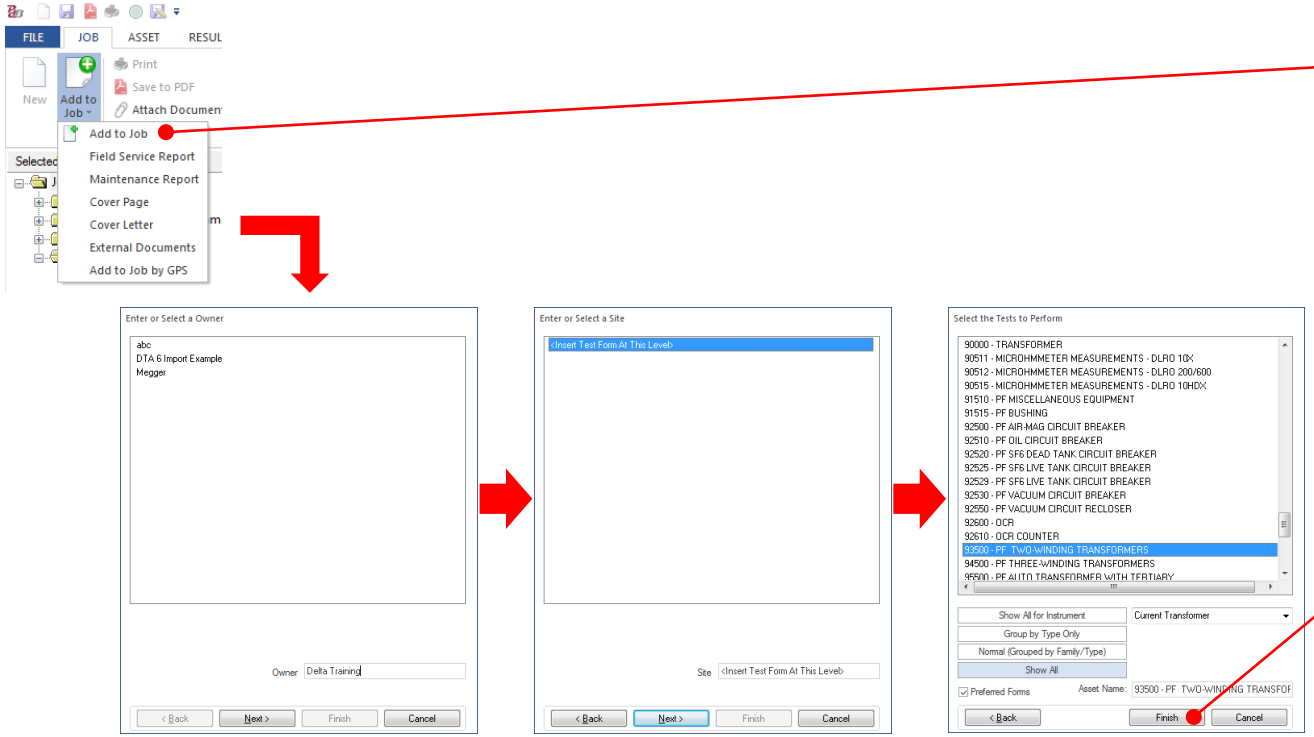
or

- Open an asset

Double click to open

Megger
Power on

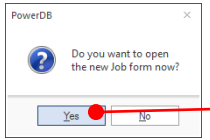
Delta 4110/4310A – PowerDB Pro

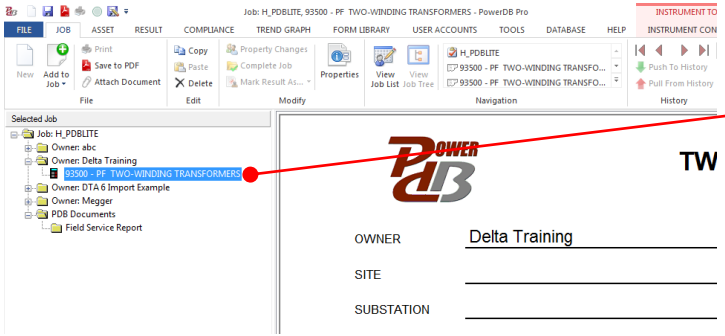


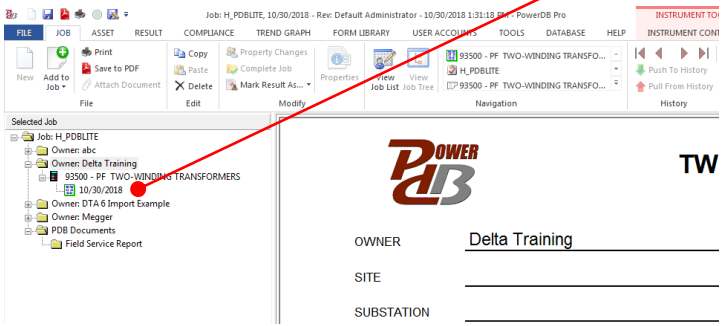
- Add to job
- Select Owner or enter new
- Select <Insert Test Form At This Level>
- Select form 93500 – PF Two-Winding Transformer
- Select Finish

Megger
Power on

Delta 4110/4310A – PowerDB Pro



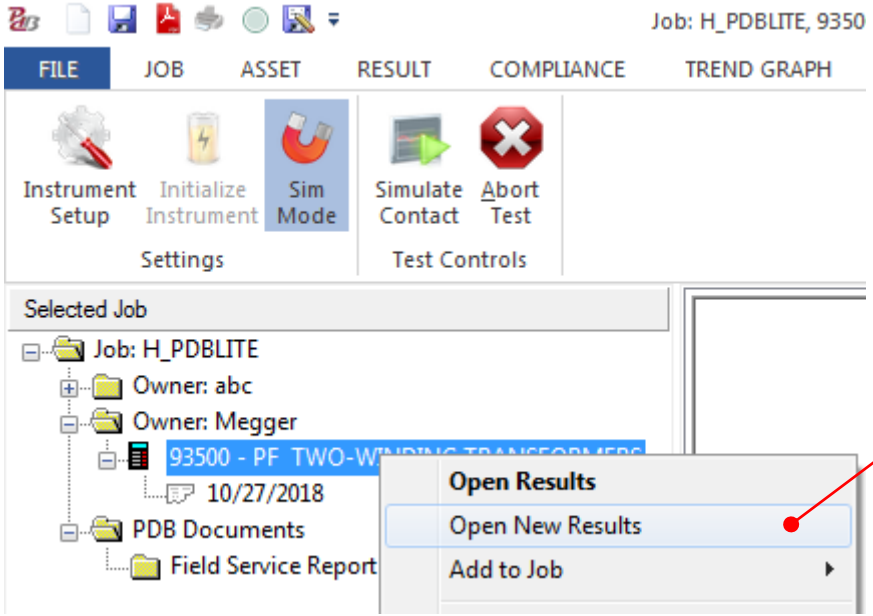




- Select Yes to open the form
- The form will appear in the list under the owner
- Saving the form will show the test date in the database

Megger
Power on

Delta 4110/4310A – PowerDB Pro New Result

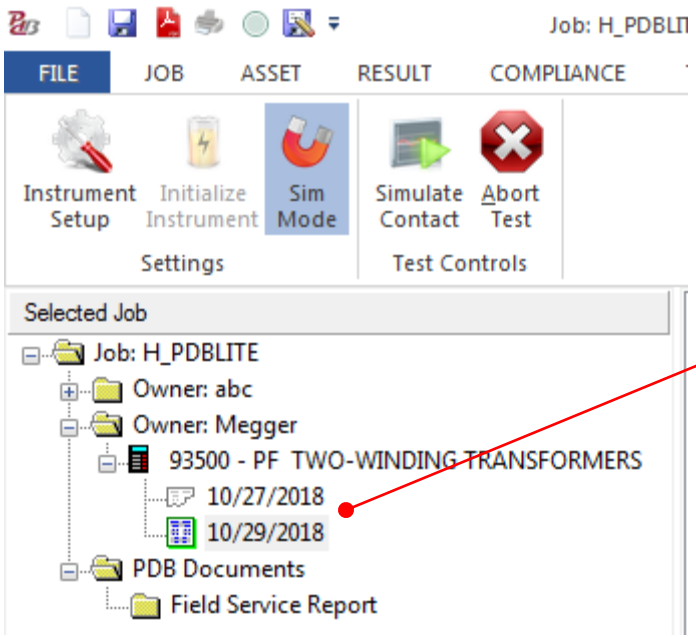


- To add new test data, right click on the form and select “Open New Results”

Similar to “New” in PowerDB Lite

Megger
Power on

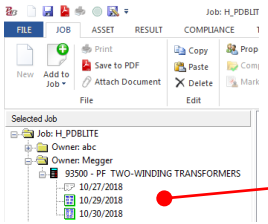
Delta 4110/4310A – PowerDB Pro New Result

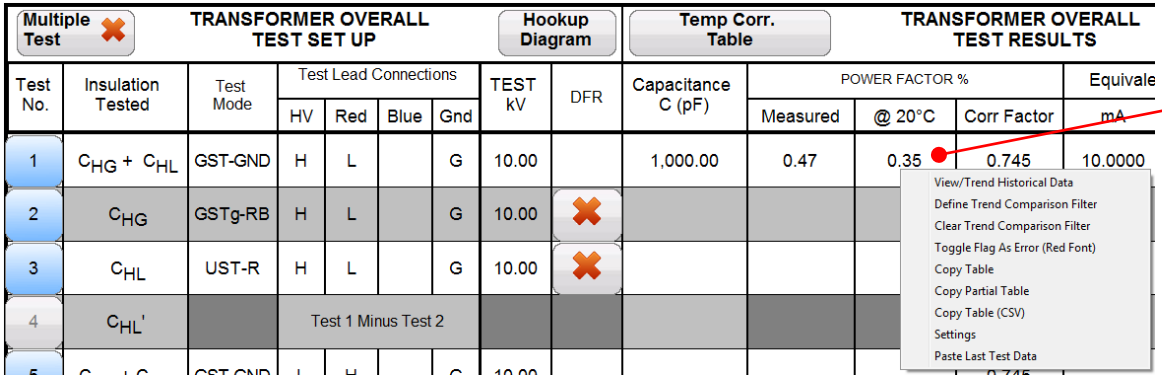


- After saving, two results will appear in the database

Megger
Power on

Delta 4110/4310A – PowerDB Pro Trending





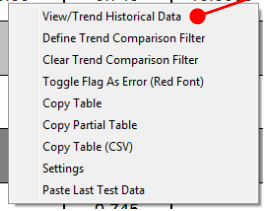
- To trend a result, you need multiple tests
- Open a result, find the test you want to trend, and right click

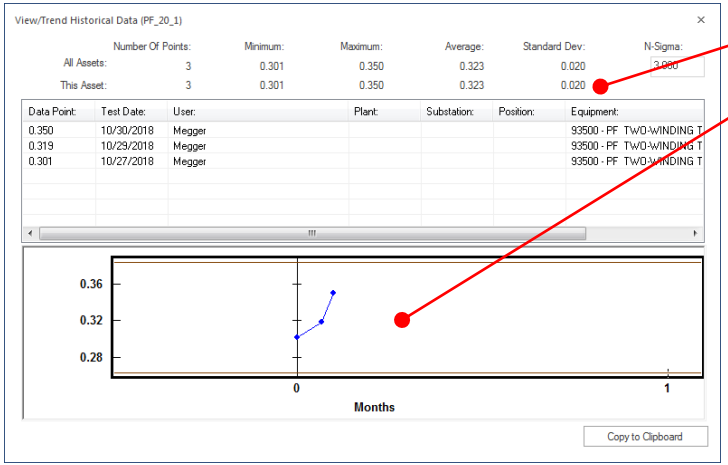
Megger
Power on

Delta 4110/4310A – PowerDB Pro Trending

Multiple Test | TRANSFORMER OVERALL TEST SET UP | Hookup Diagram | Temp Corr. Table | TRANSFORMER OVERALL TEST RESULTS

Test No.	Insulation Tested	Test Mode	Test Lead Connections HV	Red	Blue	Gnd	TEST kV	DFR	Capacitance C (pF)	POWER FACTOR % Measured	@ 20°C	Corr Factor	Equivale mA
1	C_{HG} + C_{HL}	GST-GND	H	L		G	10.00		1,000.00	0.47	0.35	0.745	10.0000
2	C_{HG}	GSTg-RB	H	L		G	10.00	✖					
3	C_{HL}	UST-R	H	L		G	10.00	✖					
4	C_{HL}'		Test 1 Minus Test 2										

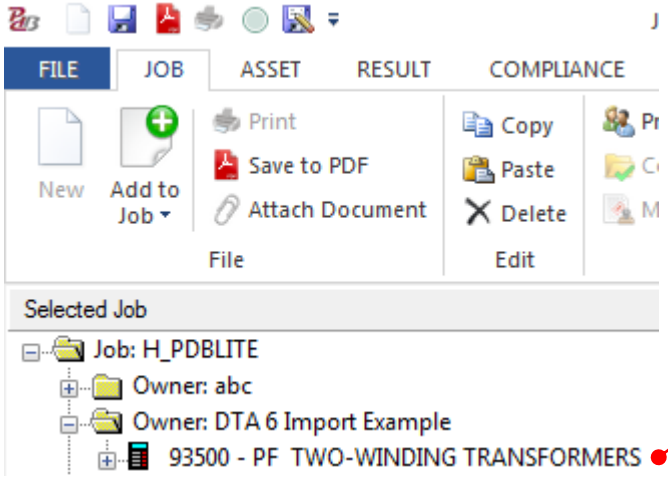




- Select View/Trend Historical Data
- Historical data for this test will be displayed, with a graph

Megger Power on

Delta 4110/4310A – PowerDB Pro DTA6 Import

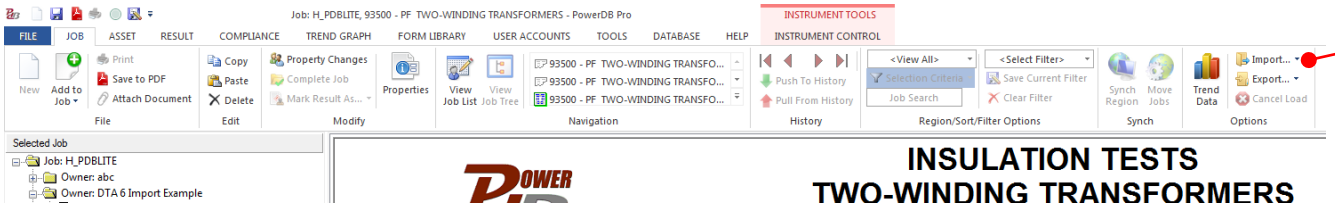


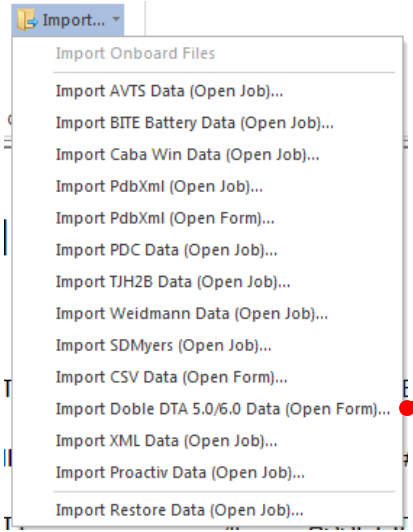
- Add a form that matches the asset to be imported

Two-winding
Three-widing
etc

Megger
Power on

Delta 4110/4310A – PowerDB Pro DTA6 Import

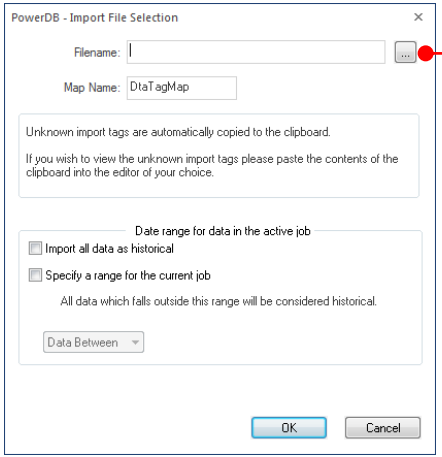


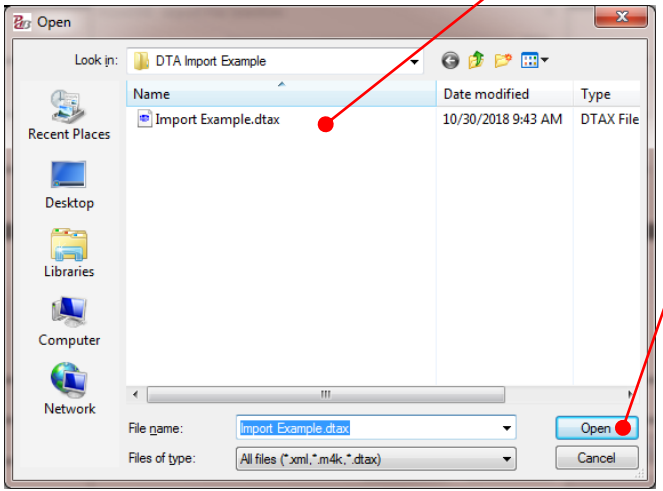


- With the form open, select Import
- Select Import Doble DTA 5.0/6.0 Data

Megger
Power on

Delta 4110/4310A – PowerDB Pro DTA6 Import

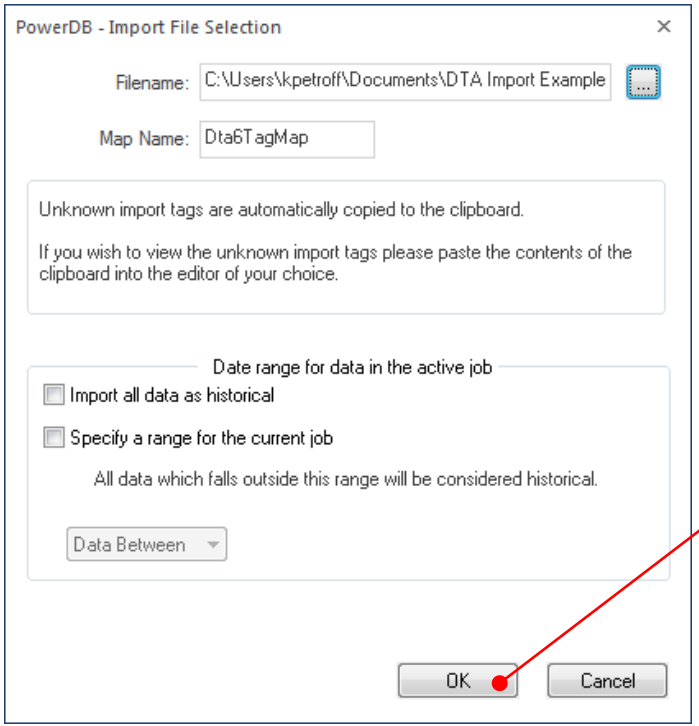




- Select the file you want to import
- Select Open

Megger
Power on

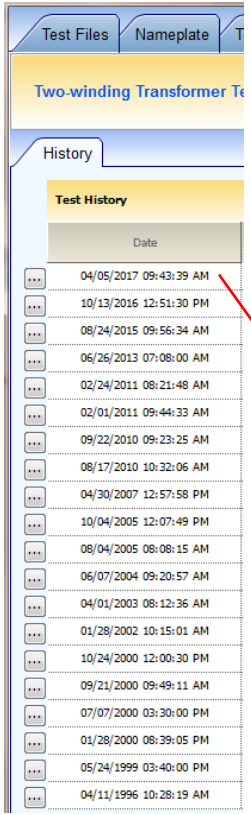
Delta 4110/4310A – PowerDB Pro DTA6 Import

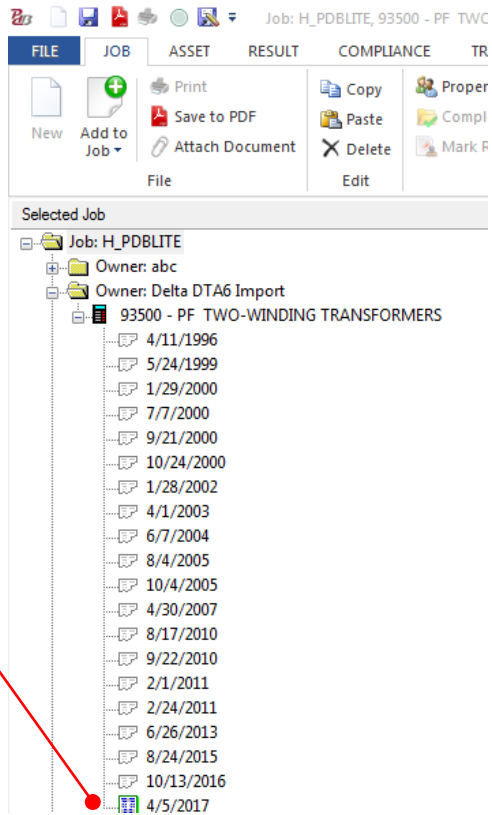


- Select OK
- Wait for import to complete

Megger
Power on

Delta 4110/4310A – PowerDB Pro DTA6 Import



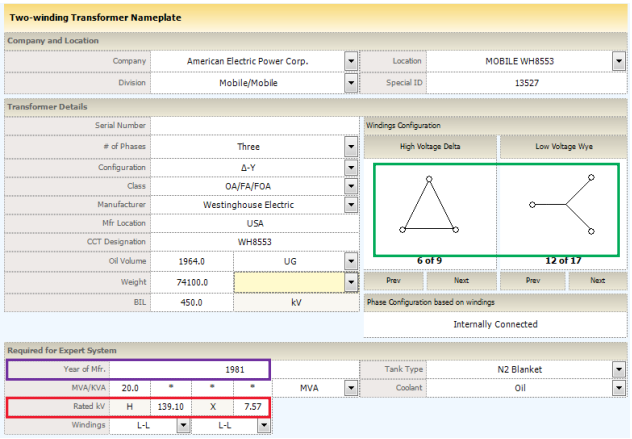


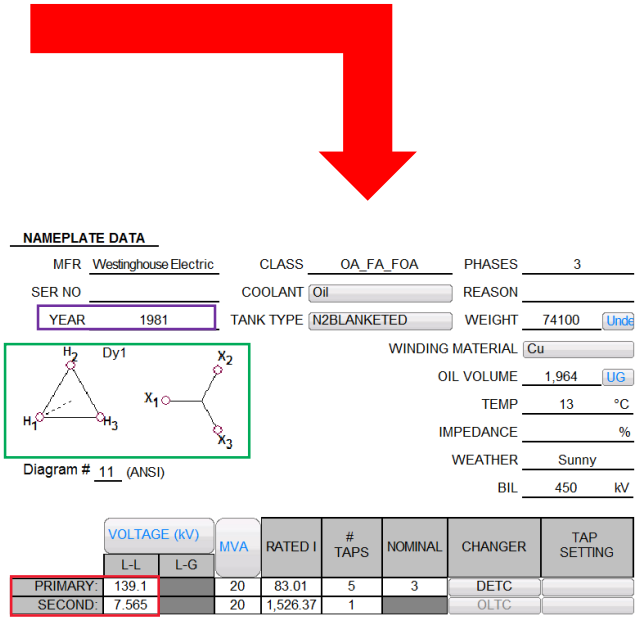
- Verify Test Dates were imported

PowerDB lists test dates in ascending order

Megger
Power on

Delta 4110/4310A – PowerDB Pro DTA6 Import

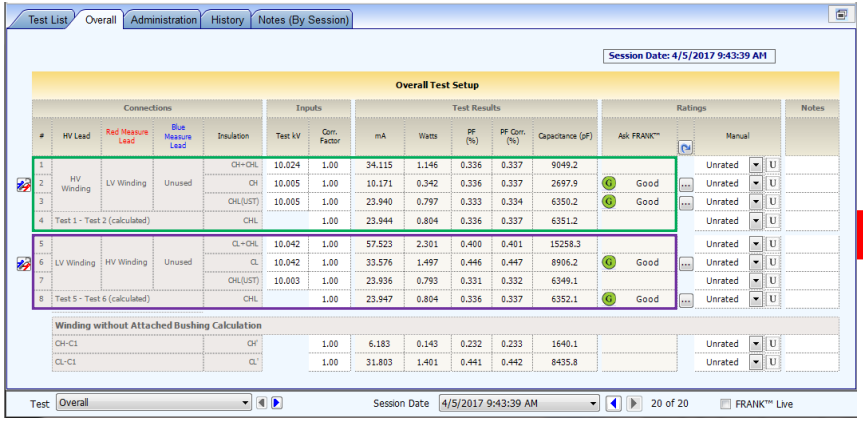




- Verify Nameplate Information

Megger
Power on

Delta 4110/4310A – PowerDB Pro DTA6 Import



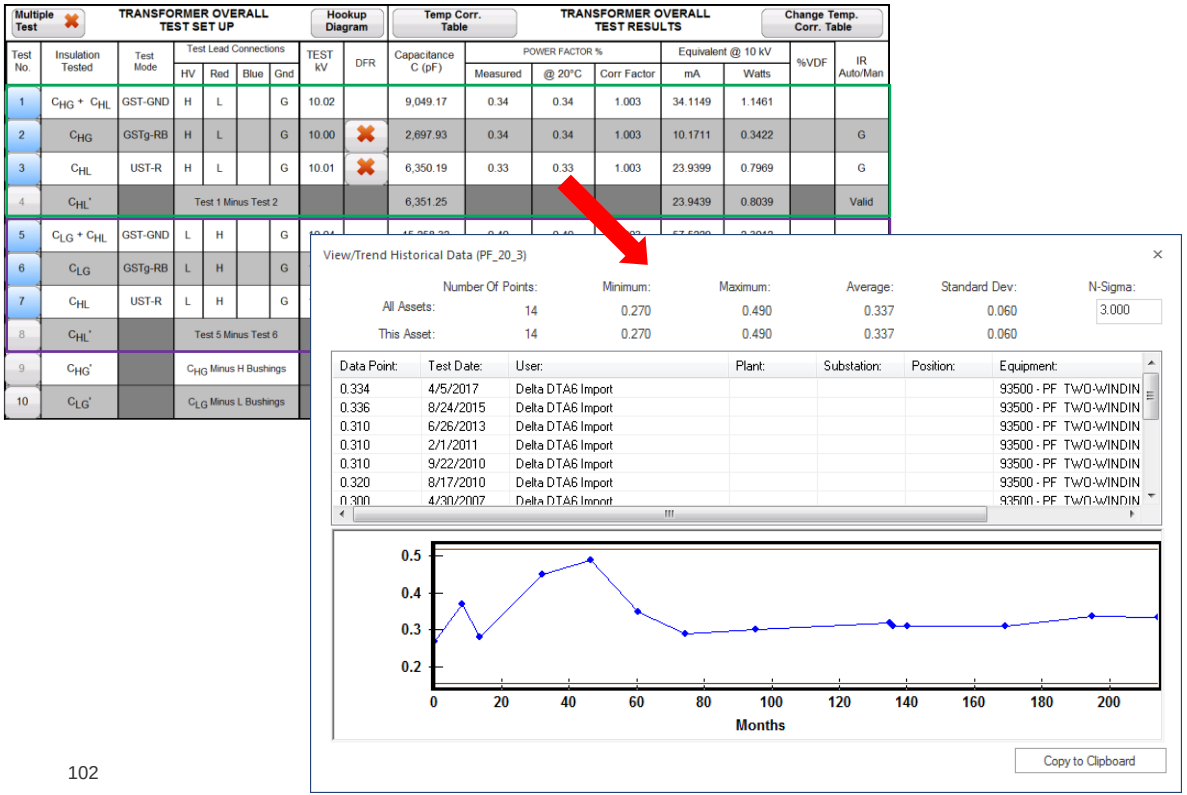
- Verify Test Data

Open corresponding dates in DTA and PowerDB to verify data imported correctly

Multiple Test	TRANSFORMER OVERALL TEST SET UP							Hookup Diagram	Temp Corr. Table	TRANSFORMER OVERALL TEST RESULTS						Change Temp. Corr. Table	
Test No.	Insulation Tested	Test Mode	Test Lead Connections				TEST kV	DFR	Capacitance C (pF)	POWER FACTOR %			Equivalent @ 10 kV		%VDF	IR Auto/Man
			HV	Red	Blue	Gnd				Measured	@ 20°C	Corr Factor	mA	Watts		
1	$C_{HG} + C_{HL}$	GST-GND	H	L		G	10.02		9,049.17	0.34	0.34	1.003	34.1149	1.1461		
2	C_{HG}	GSTg-RB	H	L		G	10.00	✖	2,697.93	0.34	0.34	1.003	10.1711	0.3422		G
3	C_{HL}	UST-R	H	L		G	10.01	✖	6,350.19	0.33	0.33	1.003	23.9399	0.7969		G
4	C_{HL}'		Test 1 Minus Test 2						6,351.25				23.9439	0.8039		Valid
5	$C_{LG} + C_{HL}$	GST-GND	L	H		G	10.04		15,258.32	0.40	0.40	1.003	57.5229	2.3012		
6	C_{LG}	GSTg-RB	L	H		G	10.04	✖	8,906.25	0.45	0.45	1.003	33.5762	1.4974		G
7	C_{HL}	UST-R	L	H		G	10.00		6,349.11	0.33	0.33	1.003	23.9358	0.7932		
8	C_{HL}'		Test 5 Minus Test 6						6,352.08				23.9467	0.8039		Valid
9	C_{HG}'		C_{HG} Minus H Bushings						1,640.09				6.1830	0.1434		
10	C_{LG}'		C_{LG} Minus L Bushings						8,435.84				31.8028	1.4010		

Megger
Power on

Delta 4110/4310A – PowerDB Pro DTA6 Import

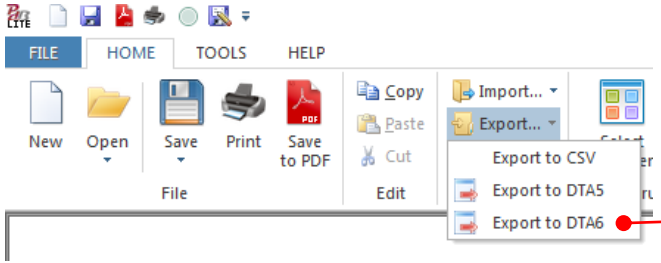


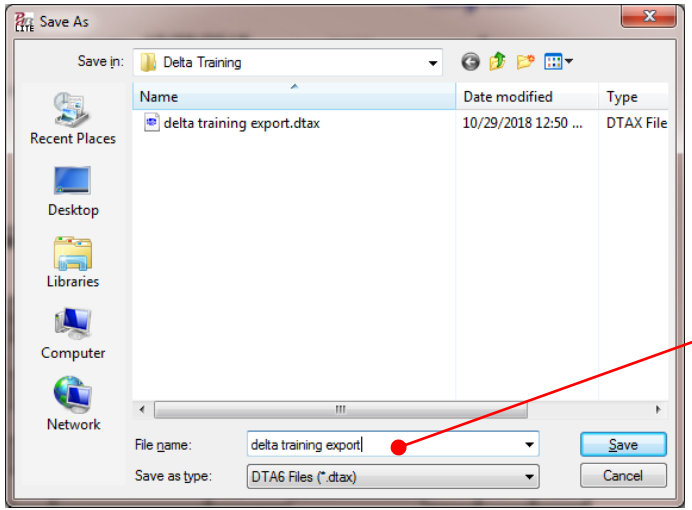
- Trending immediately available after import

Right click and select View/Trend Historical Data

Megger
Power on

Delta 4110/4310A – PowerDB Pro DTA6 Export





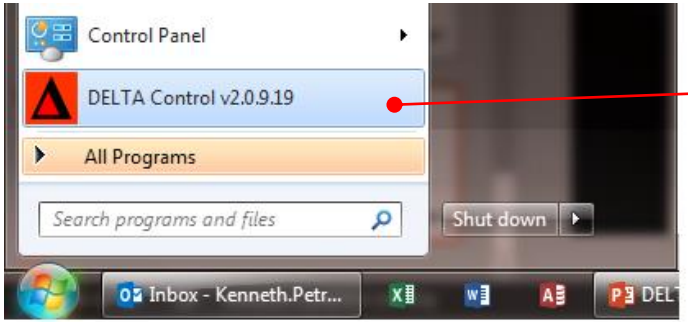
- Same as Lite

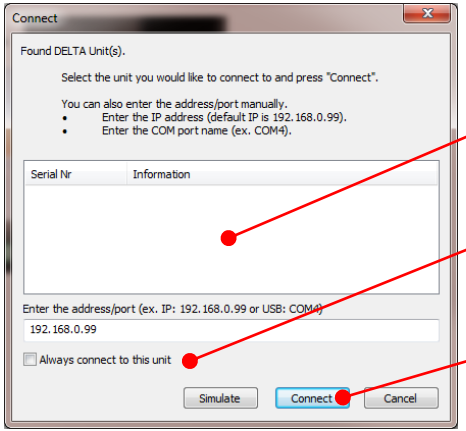
Contact PowerDB to have this feature enabled for your form

- After testing is complete, select Export to DTA6
- Give the file a name and click save

Megger
Power on

Delta 4110/4310A – Delta Control





- Open Delta Control
- Connect

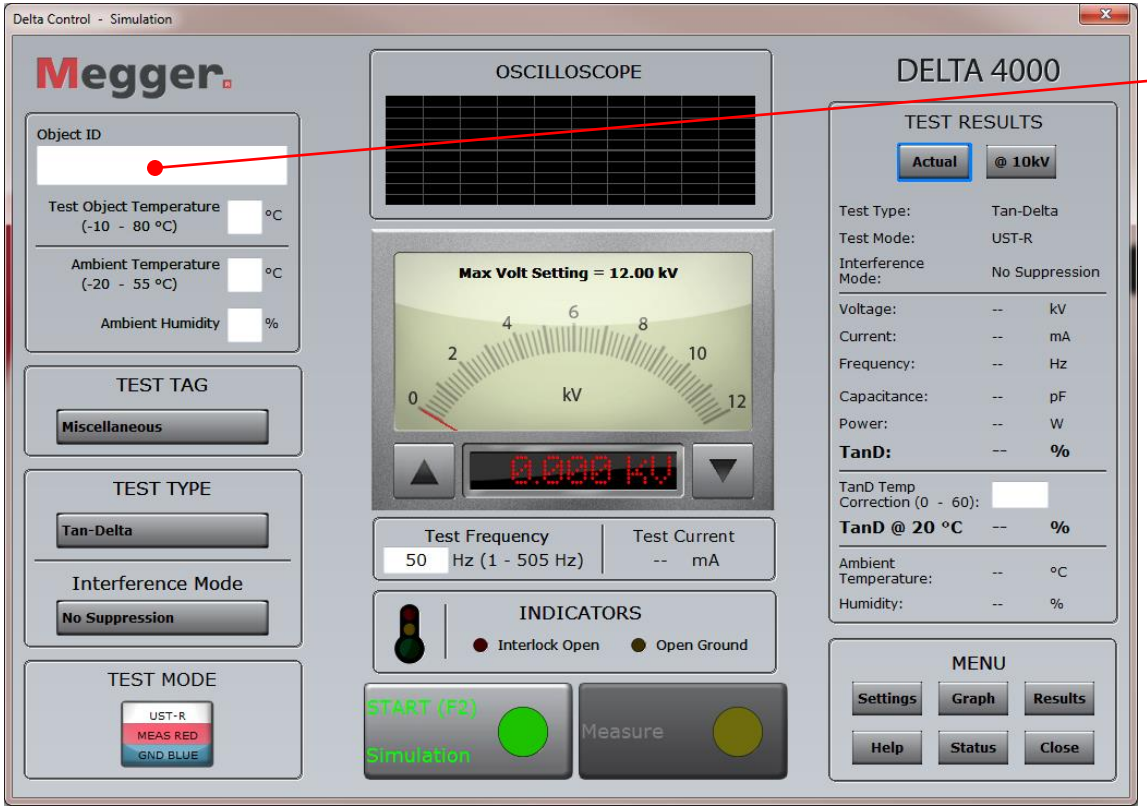
Serial Nr & information should automatically populate.

Select "Always connect to this unit" to skip connection step next time tests are run

Click Connect

Megger
Power on

Delta 4110/4310A – Delta Control

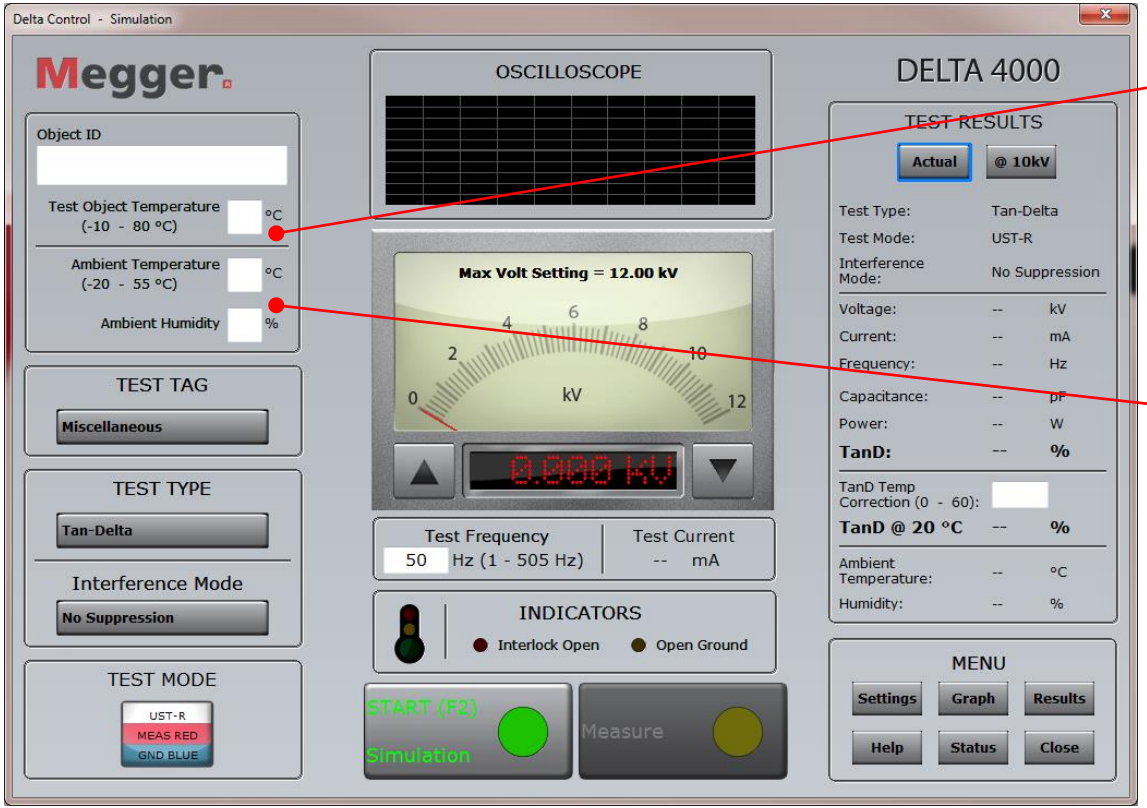


- Enter Object ID

aka Test ID

Megger
Power on

Delta 4110/4310A – Delta Control



- Enter Test Object Temperature

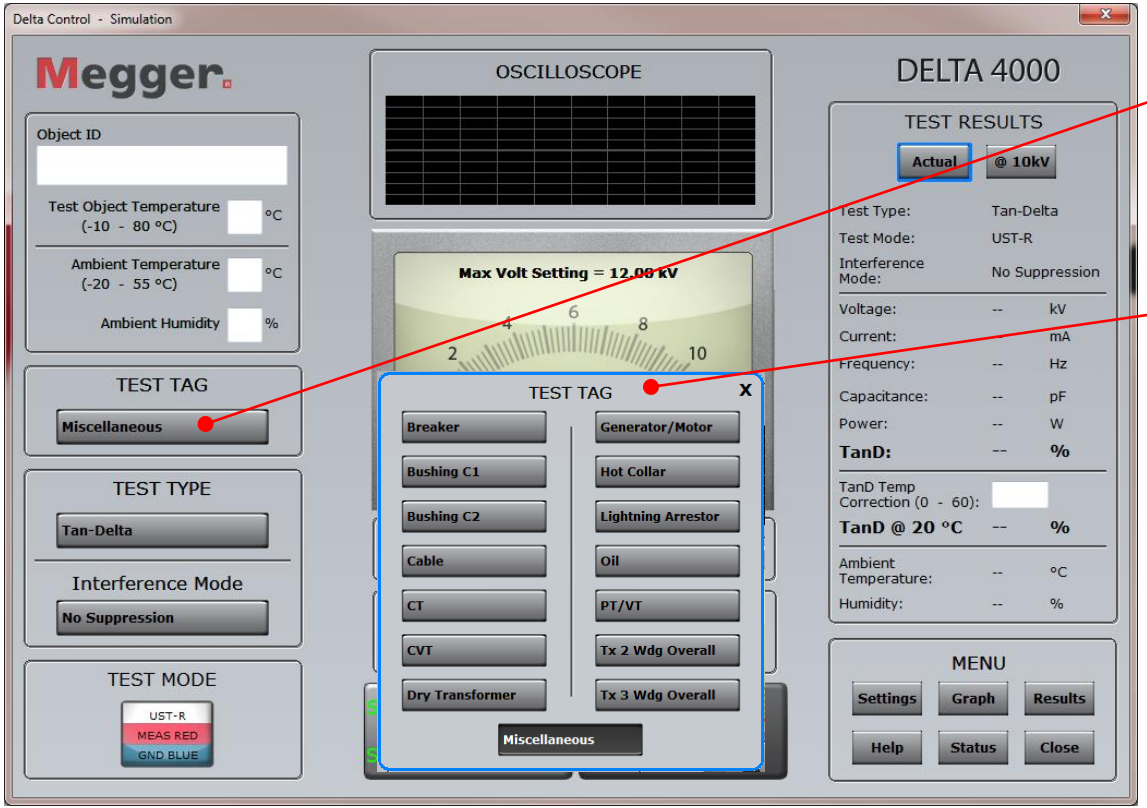
aka Oil Temp

- Enter Ambient Temperature and Humidity

Will populate automatically after running a test if blank

Megger
Power on

Delta 4110/4310A – Delta Control



- Click Test Tag
- Select Test Tag

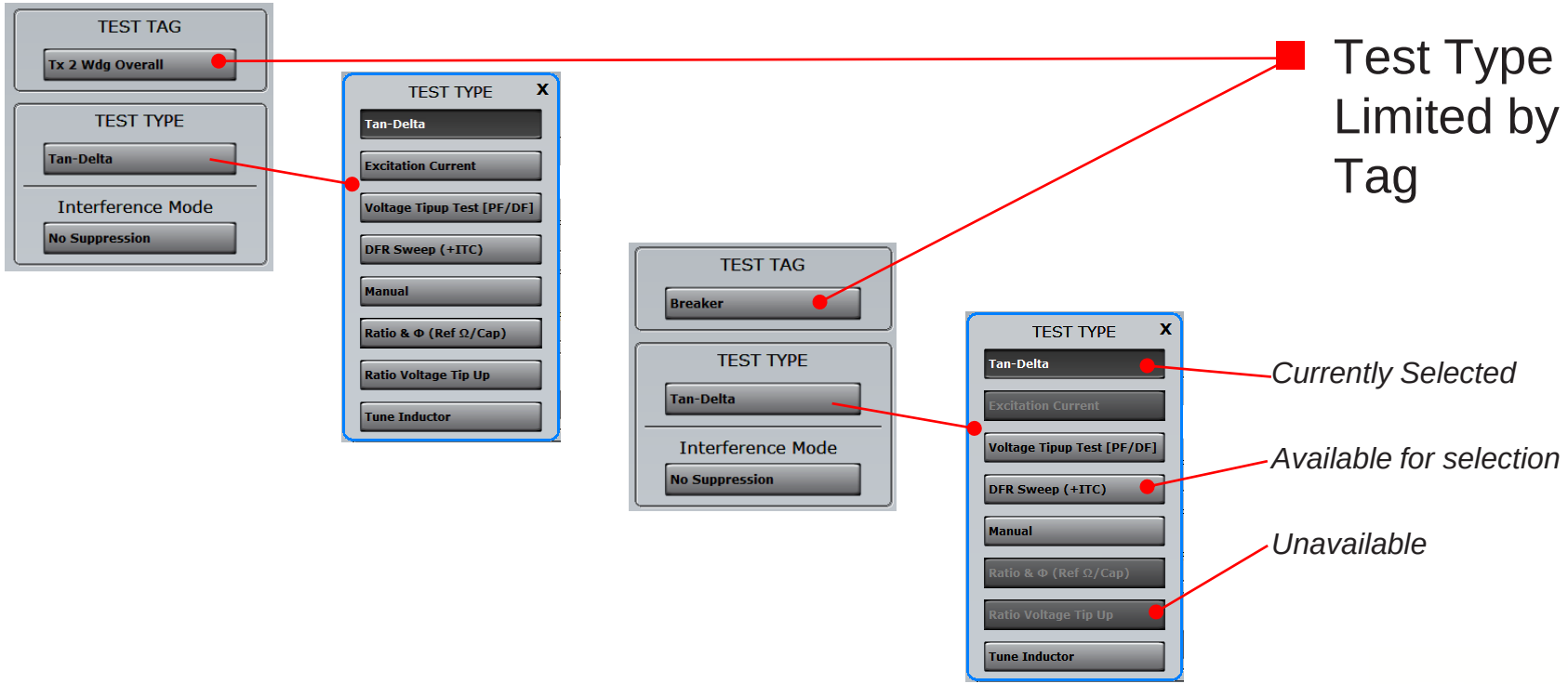
Megger
Power on

Delta 4110/4310A – Delta Control

- Click Test Type
- Select Test Type

Megger
Power on

Delta 4110/4310A – Delta Control



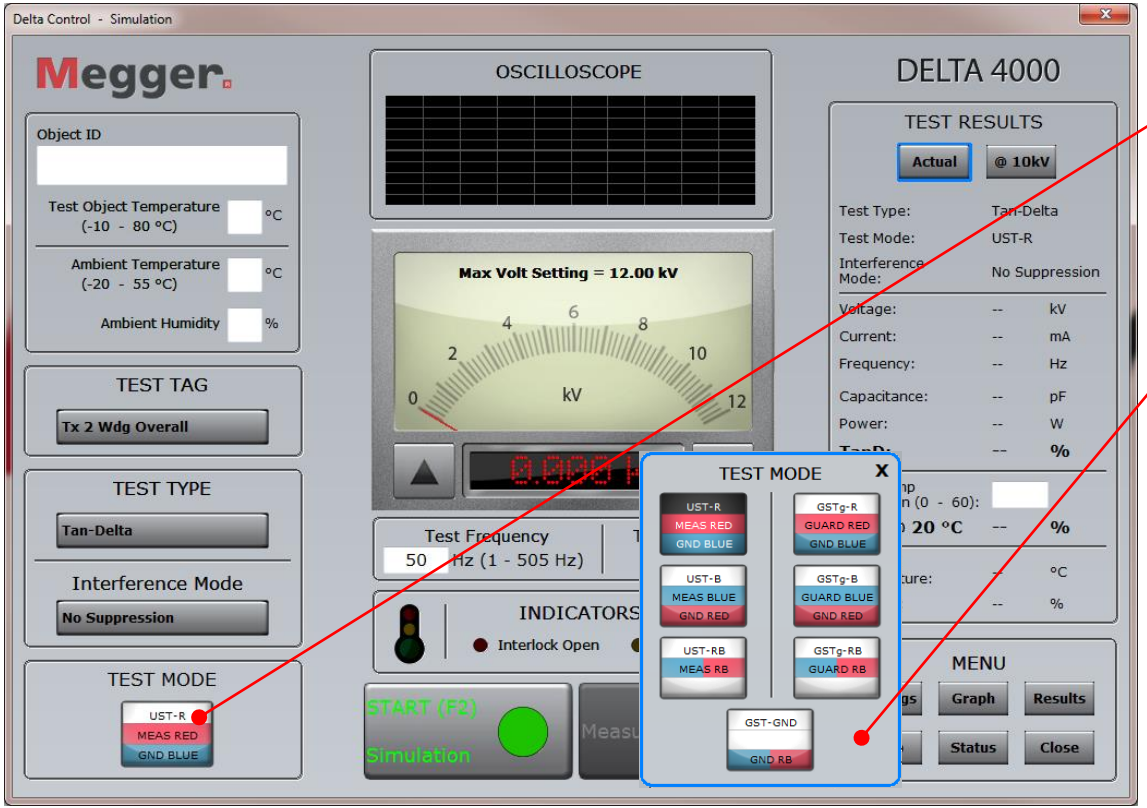
Megger
Power on

Delta 4110/4310A – Delta Control

- Recommended Interference Mode selected based on Test Type
- Cannot be changed for some Test Types

Megger
Power on

Delta 4110/4310A – Delta Control



- Click Test Mode
- Select Test Mode

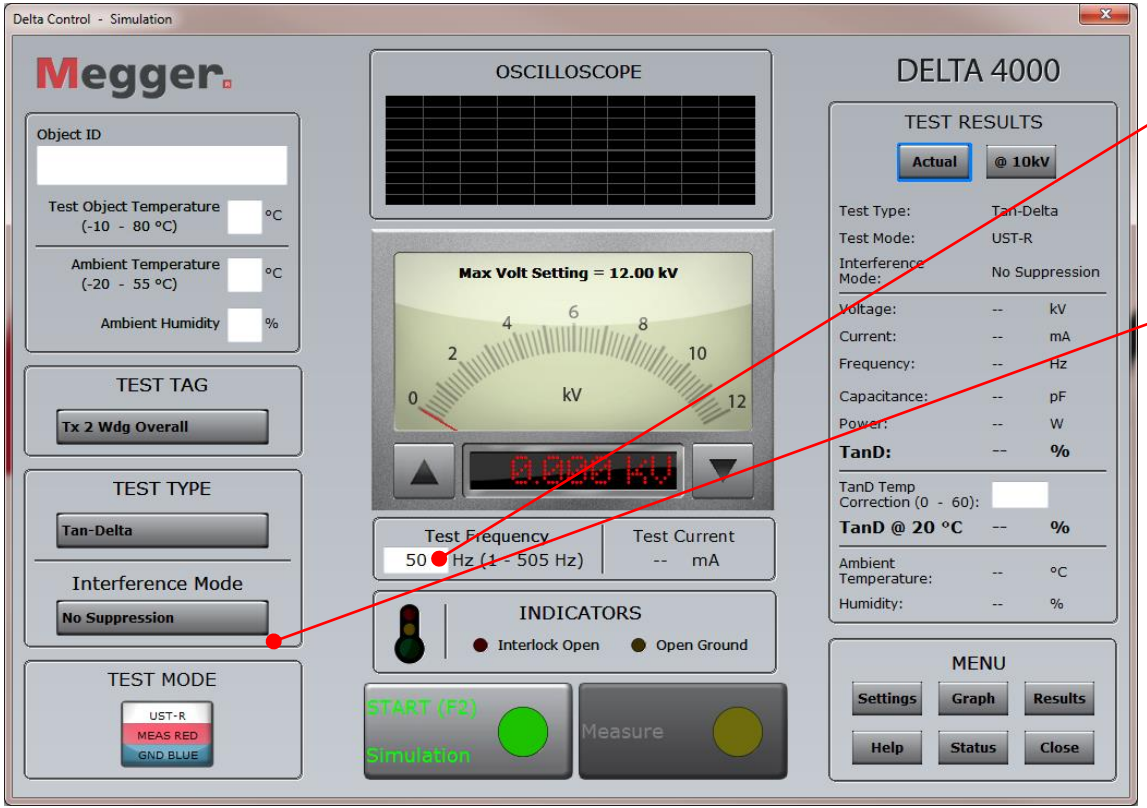
Megger
Power on

Delta 4110/4310A – Delta Control

- Set Test Voltage
- Limited by Max Voltage Setting

Megger
Power on

Delta 4110/4310A – Delta Control



- Set Test Frequency
- Not available in Frequency Variation Suppression mode

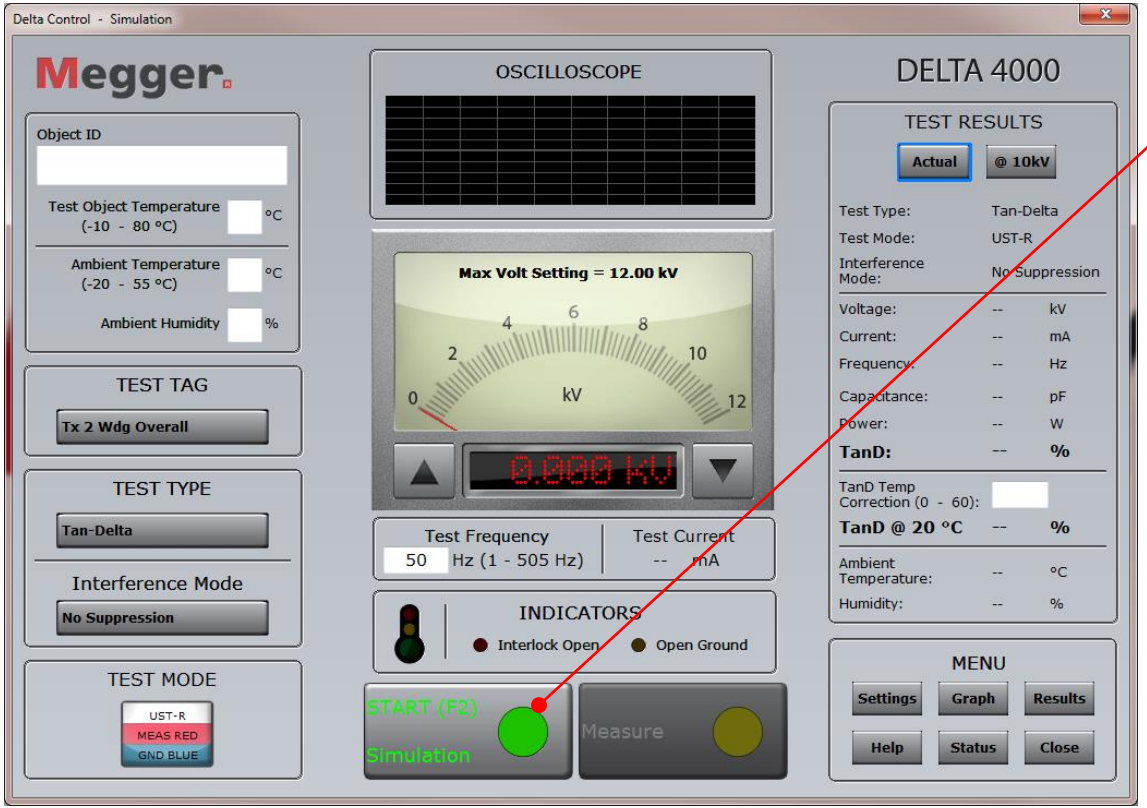
Megger
Power on

Delta 4110/4310A – Delta Control

- Check indicators

Megger
Power on

Delta 4110/4310A – Delta Control



Start Test

Megger
Power on

Delta 4110/4310A – Delta Control

- Waveform during test
- Output Voltage during test

Megger
Power on

Delta 4110/4310A – Delta Control

- Review Test Results

Megger
Power on

Delta 4110/4310A – Delta Control

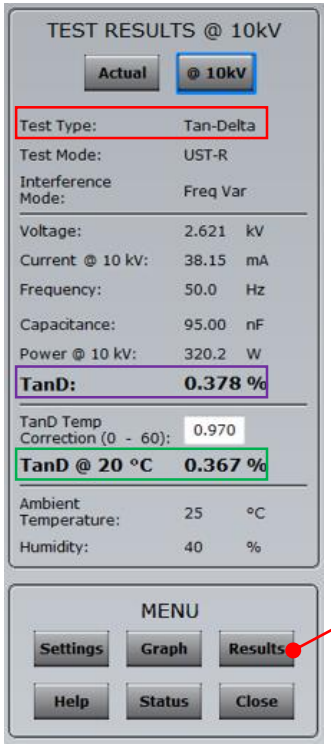
- View test results as measured or @ 10kV

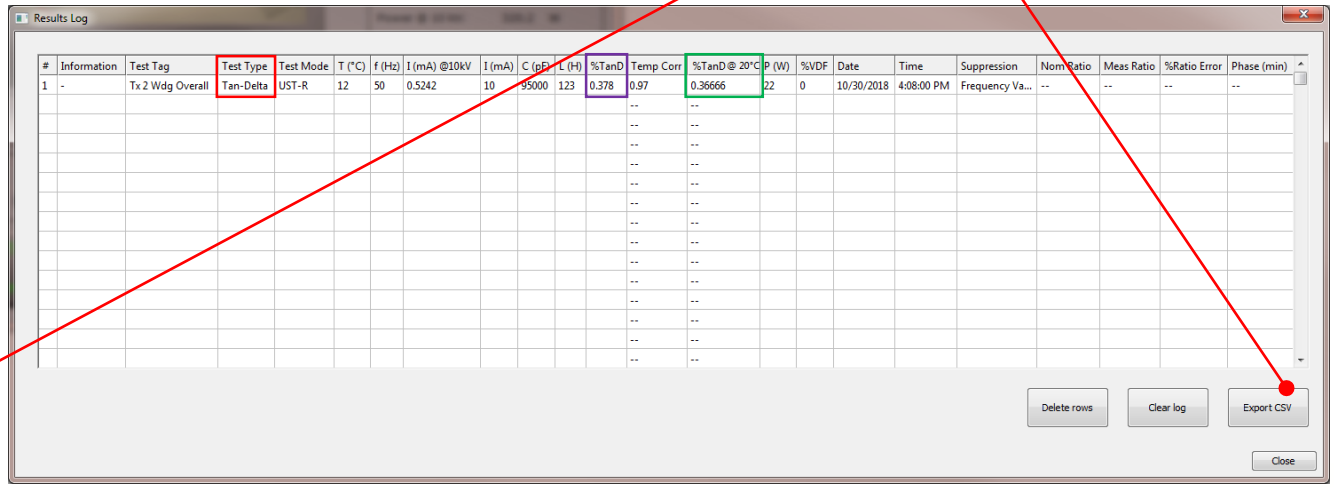
Current and Power @ 10kV

- Enter a temperature correction value

Megger
Power on

Delta 4110/4310A – Delta Control

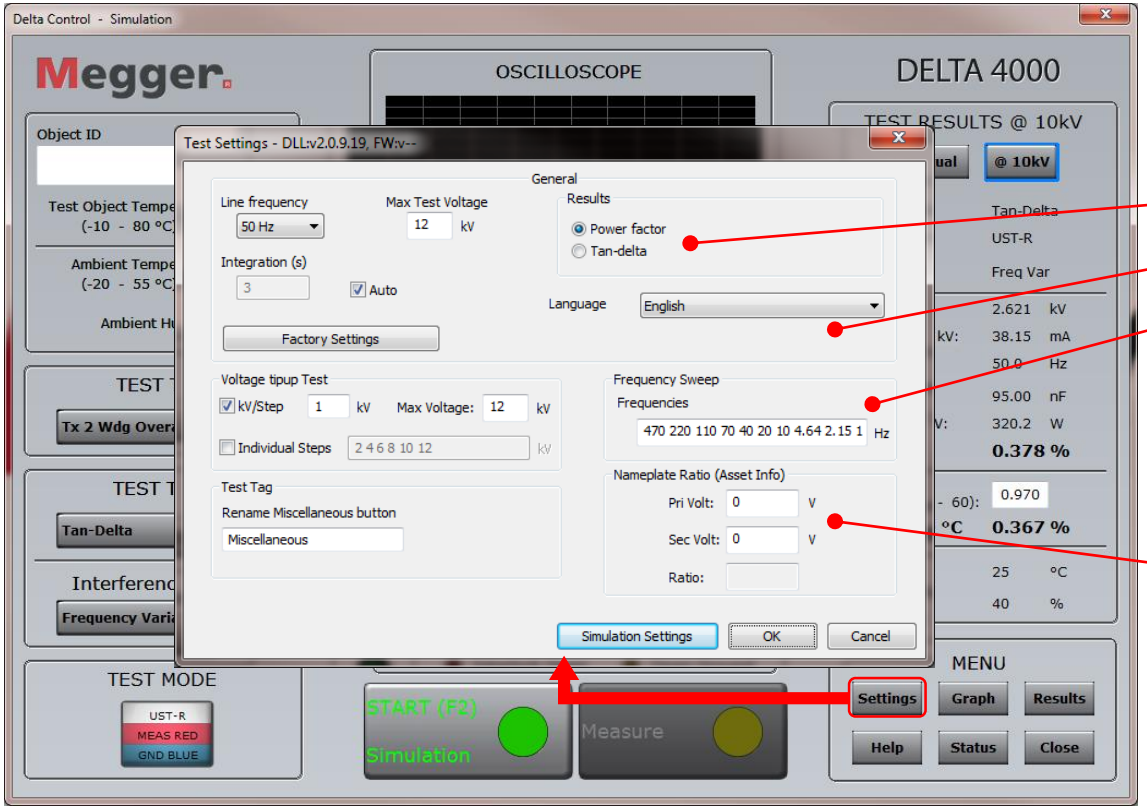




- View results in the log
- Export

Megger
Power on

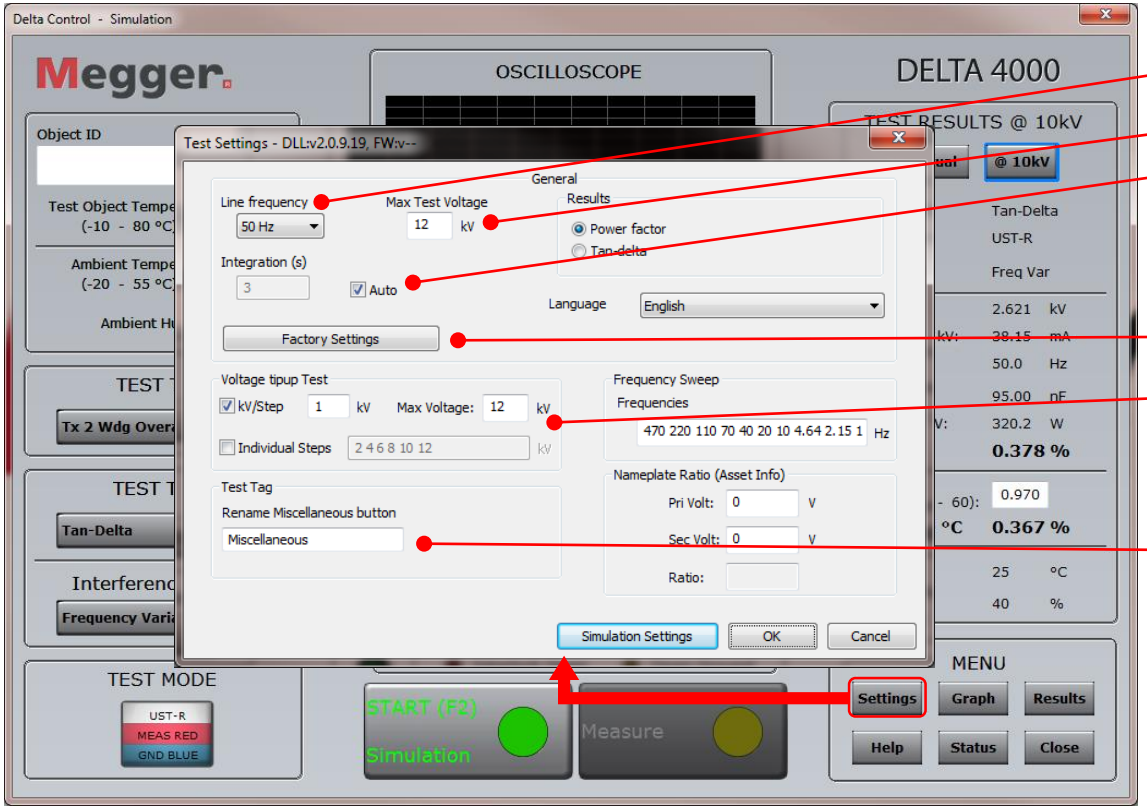
Delta 4110/4310A – Delta Control



- Settings can be adjusted
  - Results display
  - Language
  - Frequency Sweep Frequencies
    - *A certain range of frequencies is required for ITC. When in doubt, select Factory Settings to restore values.*
  - Nameplate Ratio
    - *Use when running ratio tests*

Megger
Power on

Delta 4110/4310A – Delta Control



- Set line frequency
- Set Max Test kV
- Set Frequency Variation Integration
  - *# of steps in measurement. Set to Auto when in doubt*
- Reset Settings
- Voltage tip up options
  - *Individual Steps can be any voltage values below Max Test Voltage*
- Rename Miscellaneous test button

Megger
Power on

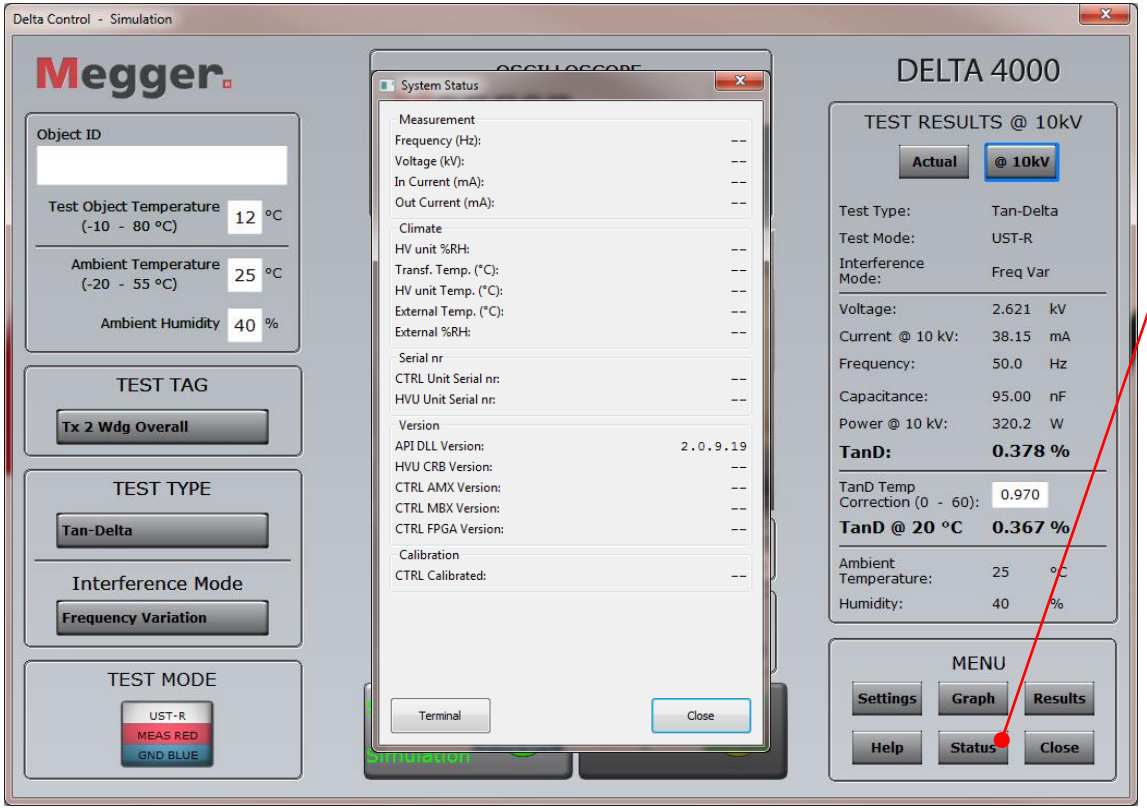
Delta 4110/4310A – Delta Control

- Help

Review Delta Control Help

Megger
Power on

Delta 4110/4310A – Delta Control

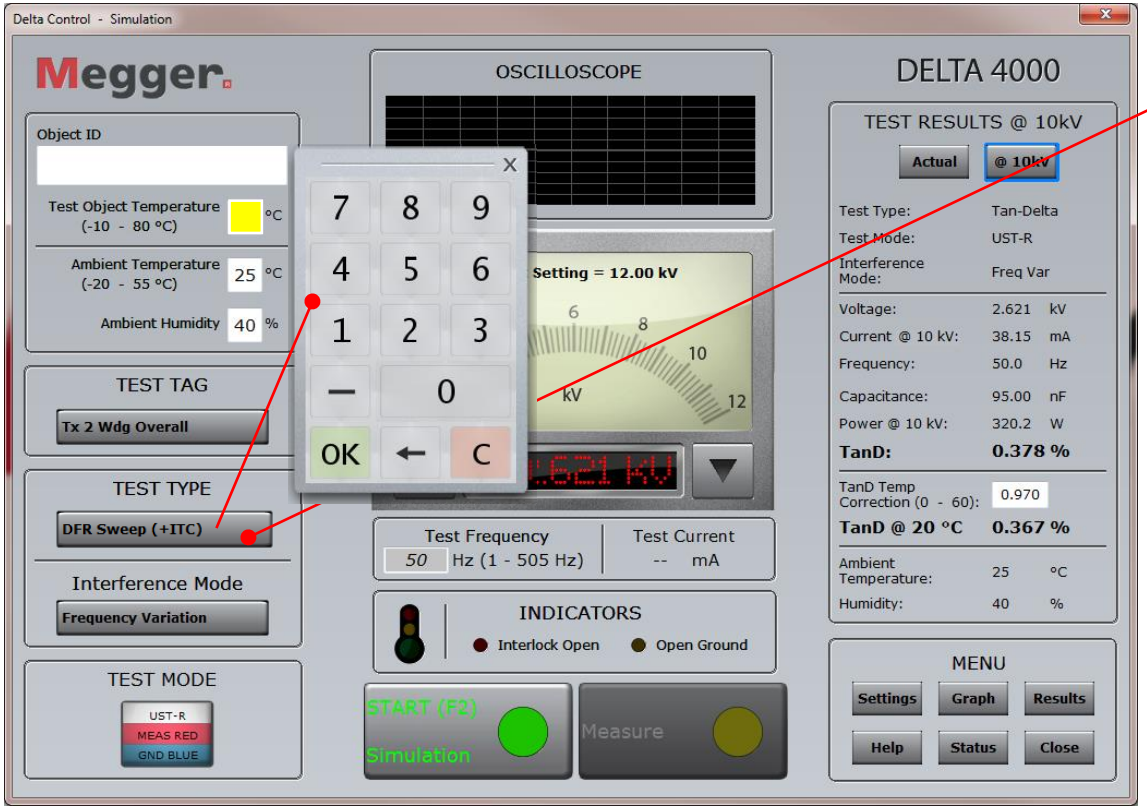


- Status

View live information about the Delta

Megger
Power on

Delta 4110/4310A – Delta Control



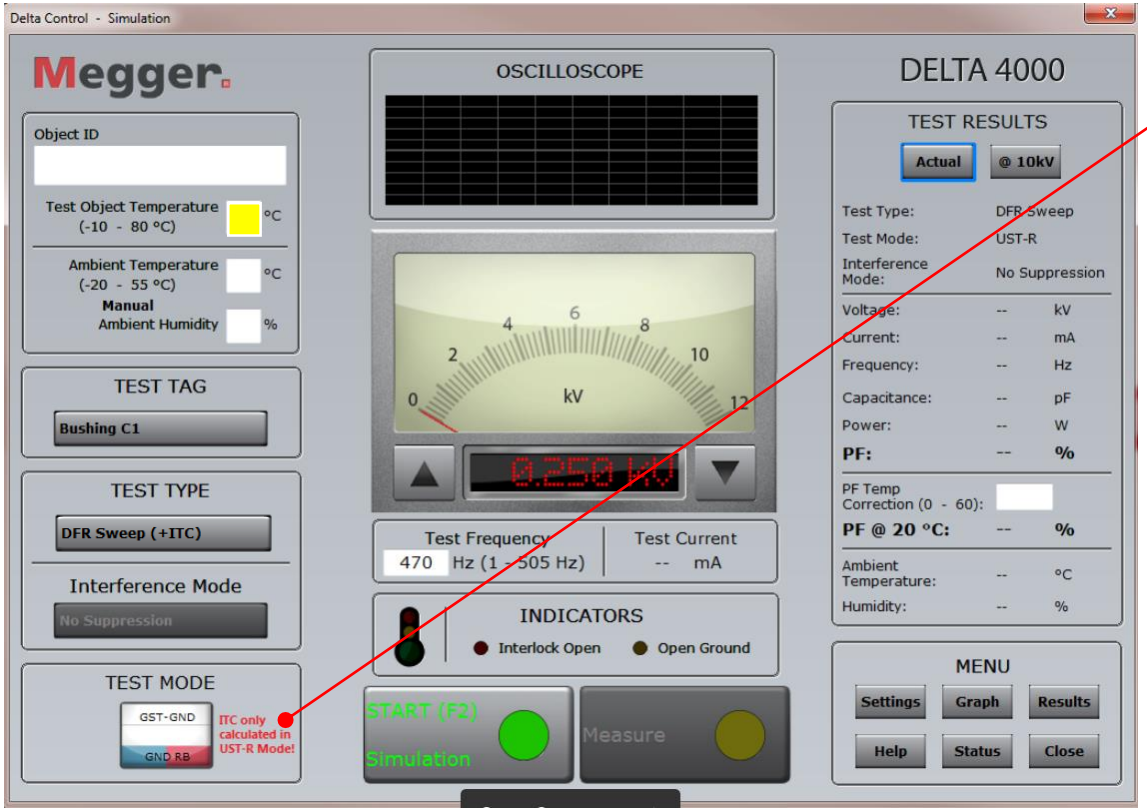
- DFR Sweep + ITC

Test object temperature required for ITC.

Pop-up will appear if Test Object Temperature is blank after selecting DFR Sweep (+ITC) test type

Megger
Power on

Delta 4110/4310A – Delta Control



- ITC can only be calculated with UST-R Test Mode!

If a different test mode is selected, a message will appear that ITC only calculated in UST-R Mode!

Megger
Power on

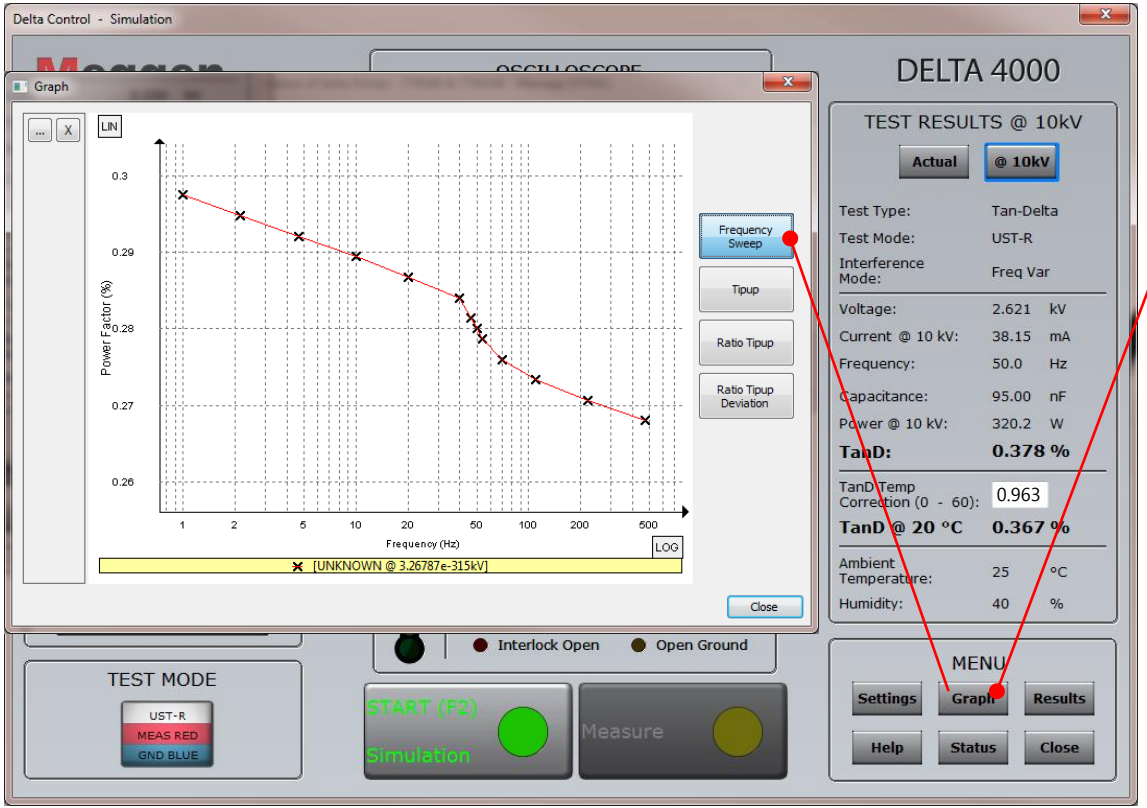
Delta 4110/4310A – Delta Control

- ITC Calculated

When the frequency sweep completes, ITC will be populated.

Megger
Power on

Delta 4110/4310A – Delta Control



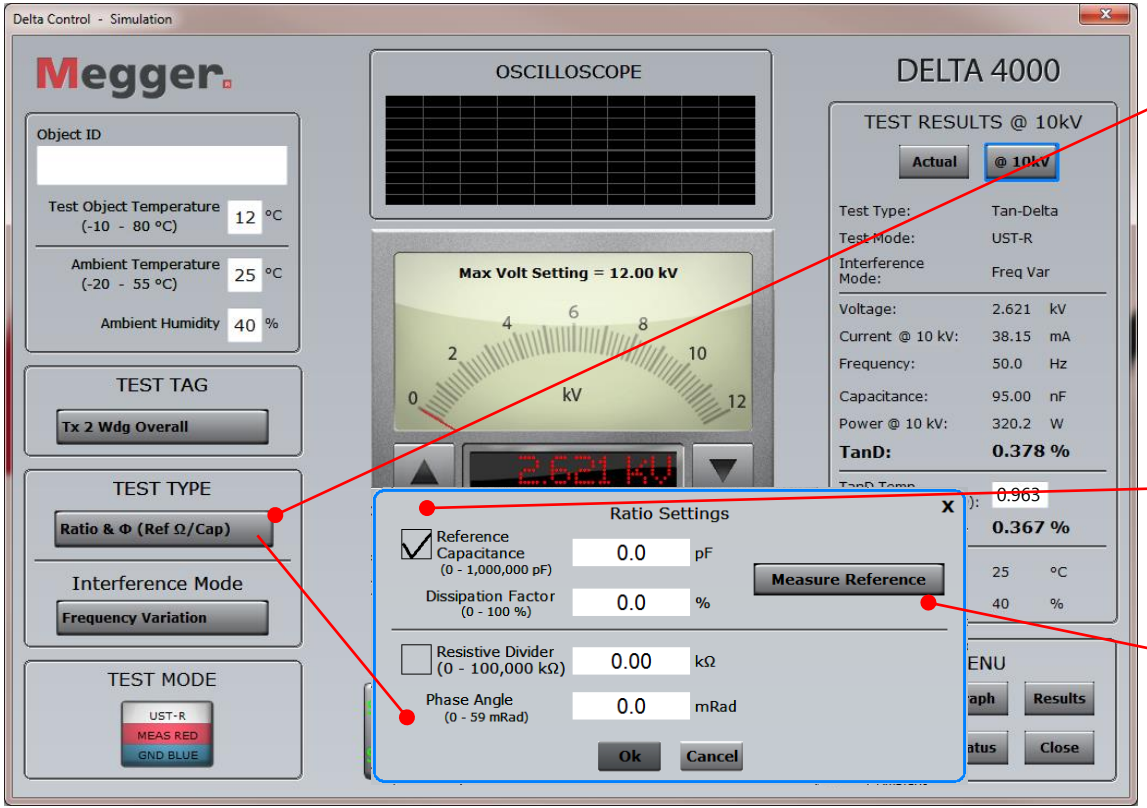
- DFR Sweep Graph

Select Graph to view the DFR Sweep graph

Can be viewed during the test

Megger
Power on

Delta 4110/4310A – Delta Control



- Ratio & Ø (Ref Ω/Cap)

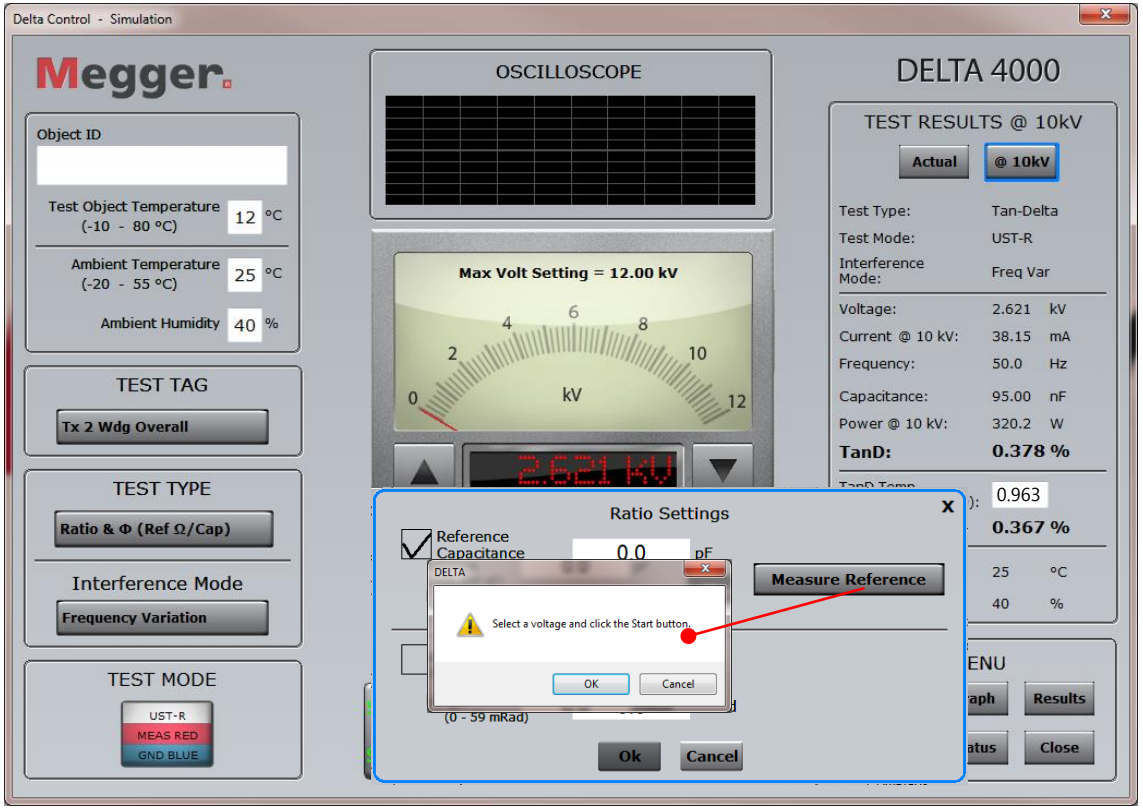
After selecting Ratio & Ø (Ref Ω/Cap) a pop up will appear asking for the values of the Reference Capacitor or Resistive Divider

Select Reference Capacitance or Resistive Divider and enter the values

If the values are unknown, click Measure Reference

Megger
Power on

Delta 4110/4310A – Delta Control

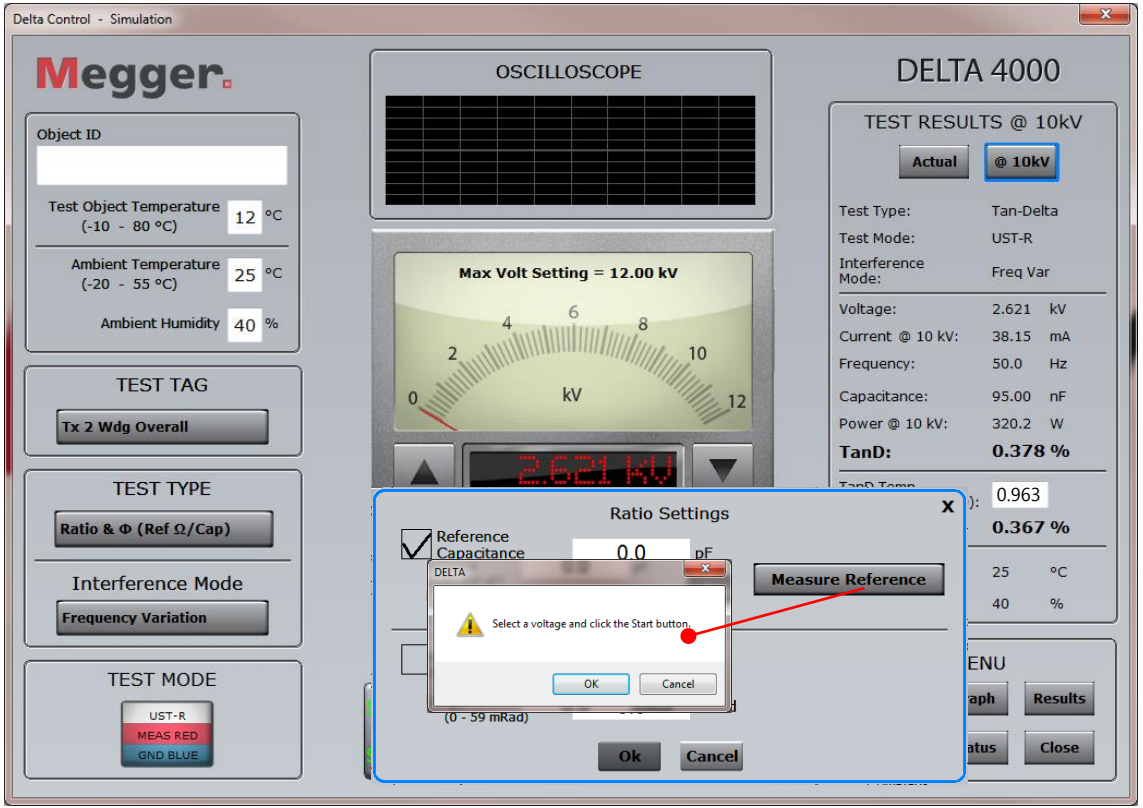


- Ratio & Ø (Ref Ω/Cap)

Click OK

Megger
Power on

Delta 4110/4310A – Delta Control



- Ratio & Ø (Ref Ω/Cap)

Click OK to the pop up that appears after clicking Measure Reference

Megger
Power on

Delta 4110/4310A – Delta Control

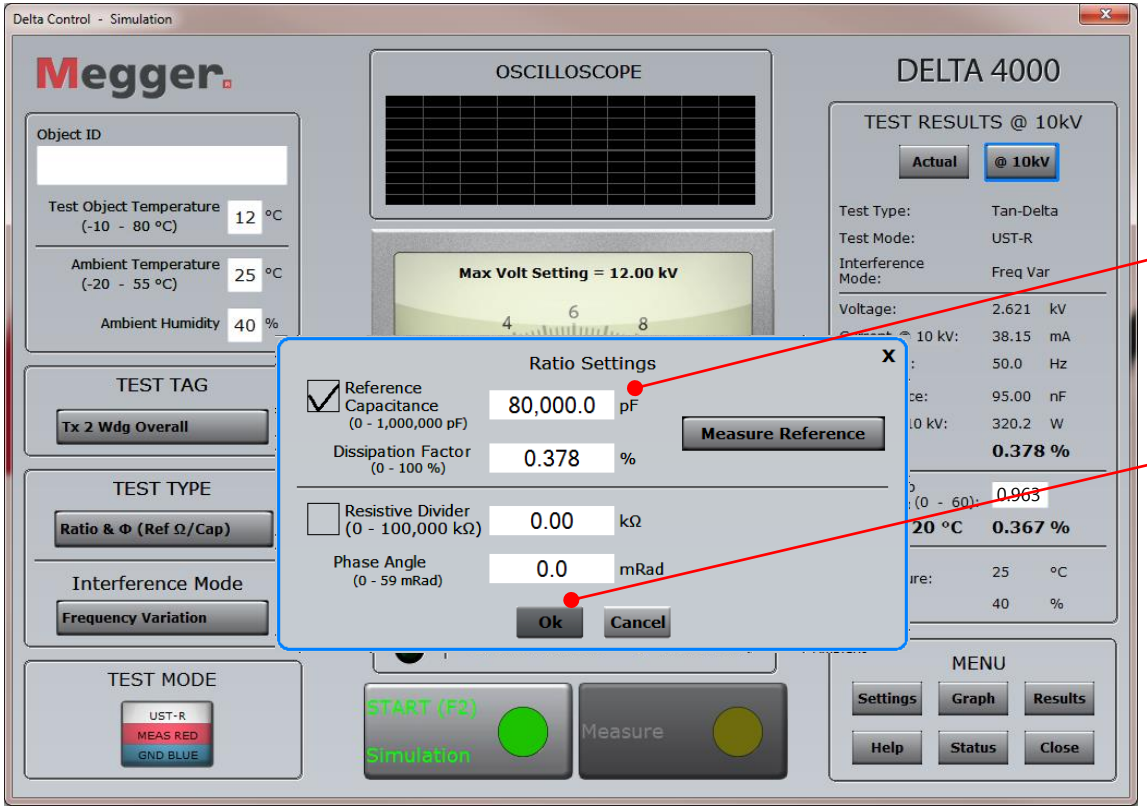
- Ratio & Ø (Ref Ω/Cap)

Set a test voltage to test the reference capacitor or resistive divider

Run the test on the reference capacitor or resistive divider

Megger
Power on

Delta 4110/4310A – Delta Control



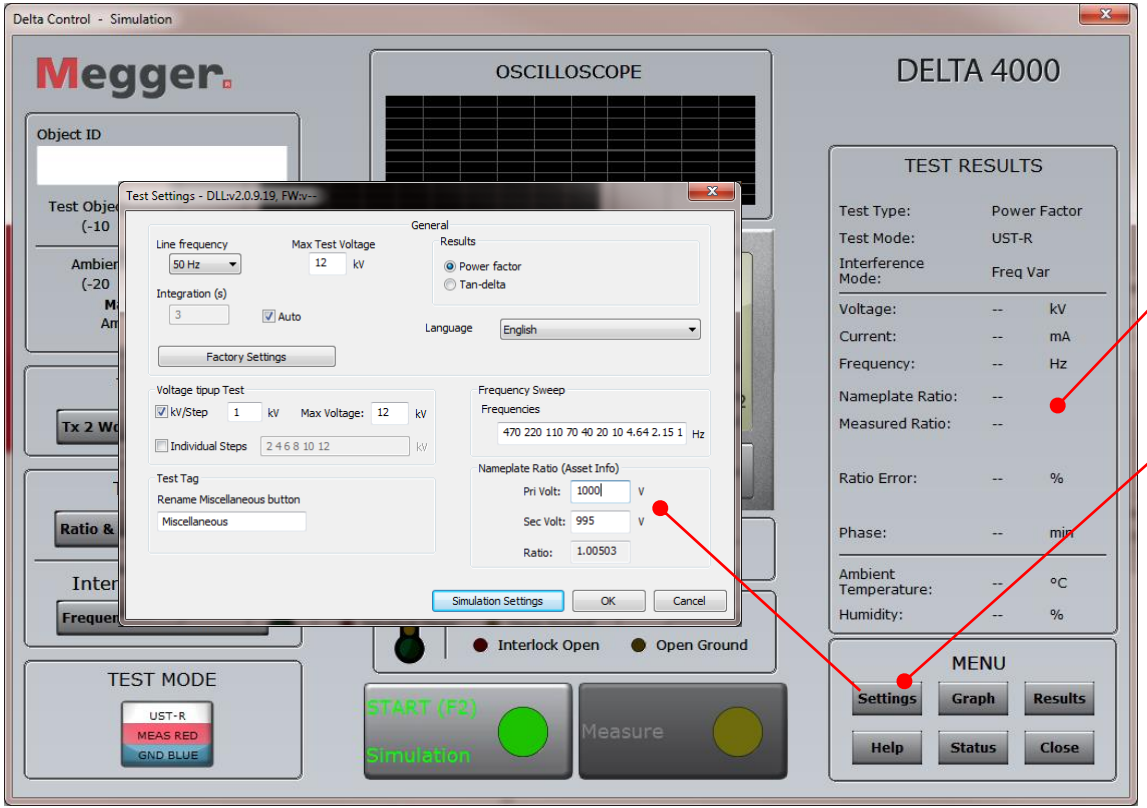
- Ratio & Ø (Ref Ω/Cap)

After the test completes, the values of the reference capacitor or resistive divider will be displayed.

Click OK

Megger
Power on

Delta 4110/4310A – Delta Control



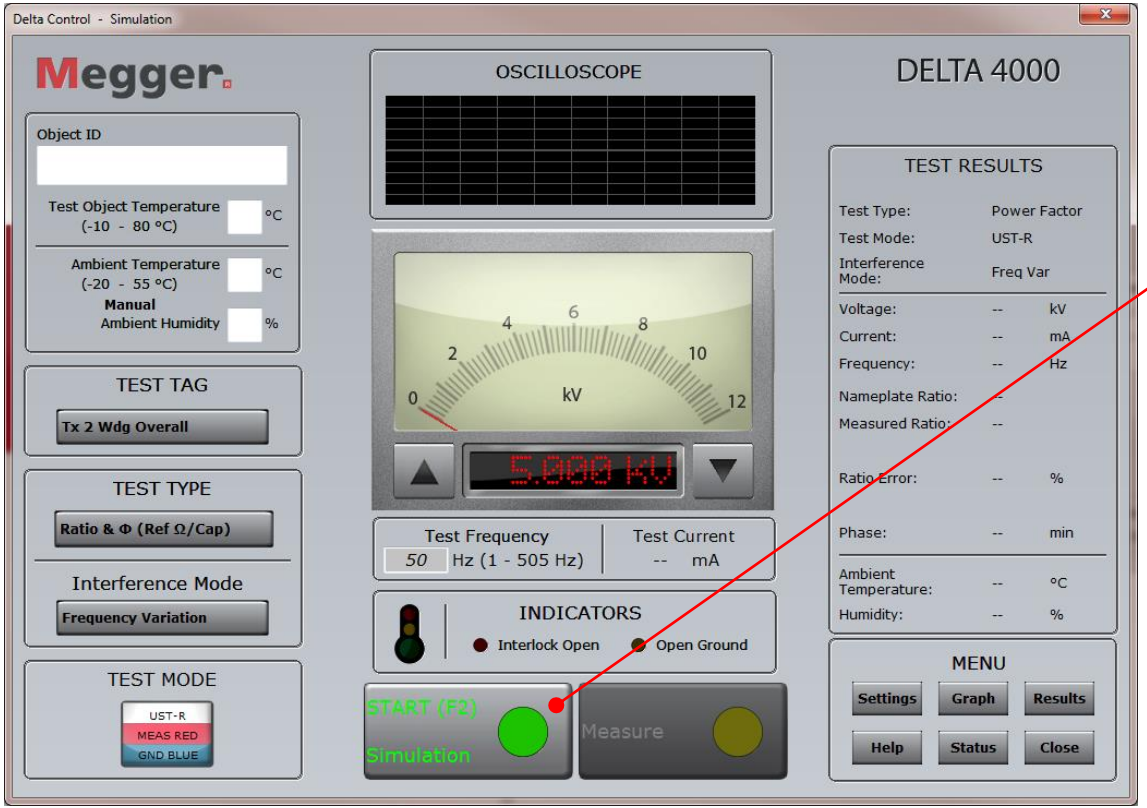
- Ratio & Ø (Ref Ω/Cap)

*Note that the Test Results have been updated to display Ratio & Ø (*Ref Ω/Cap) results

Enter Tap voltages under settings if they have not been set. Used to calculate Nameplate Ratio and Ratio Error

Megger
Power on

Delta 4110/4310A – Delta Control

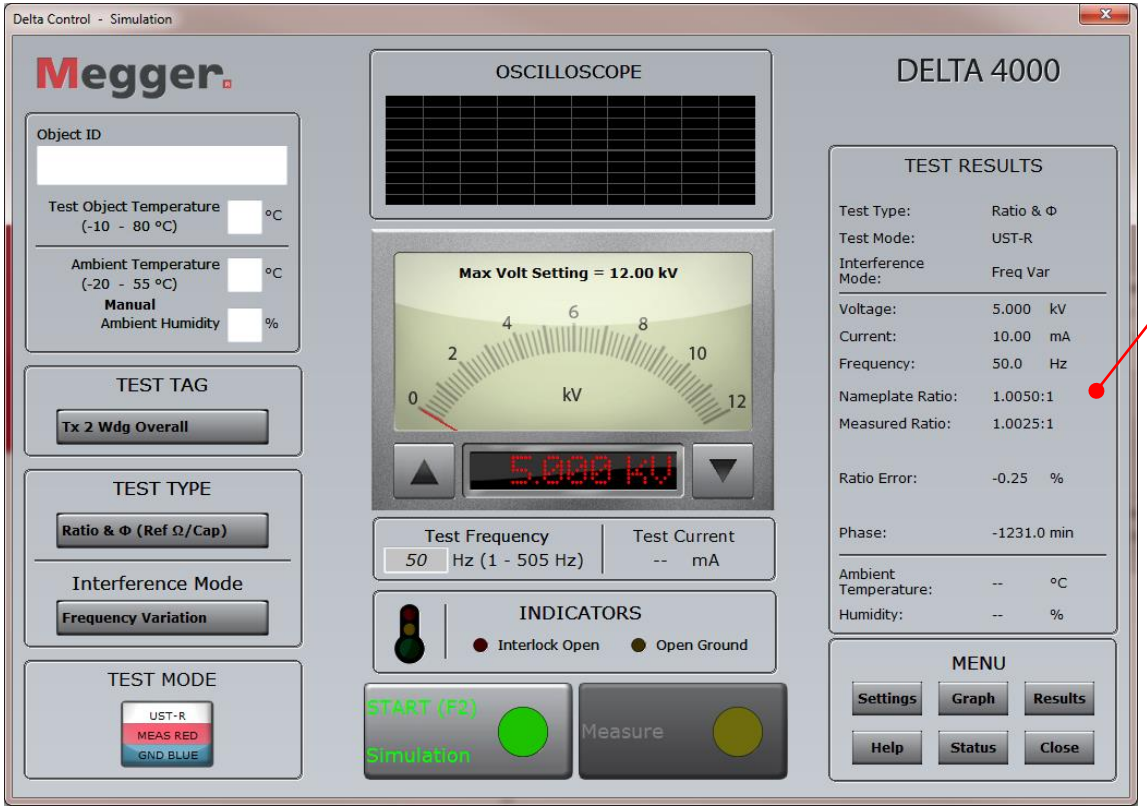


- Ratio & Ø (Ref Ω/Cap)

Run a test

Megger
Power on

Delta 4110/4310A – Delta Control

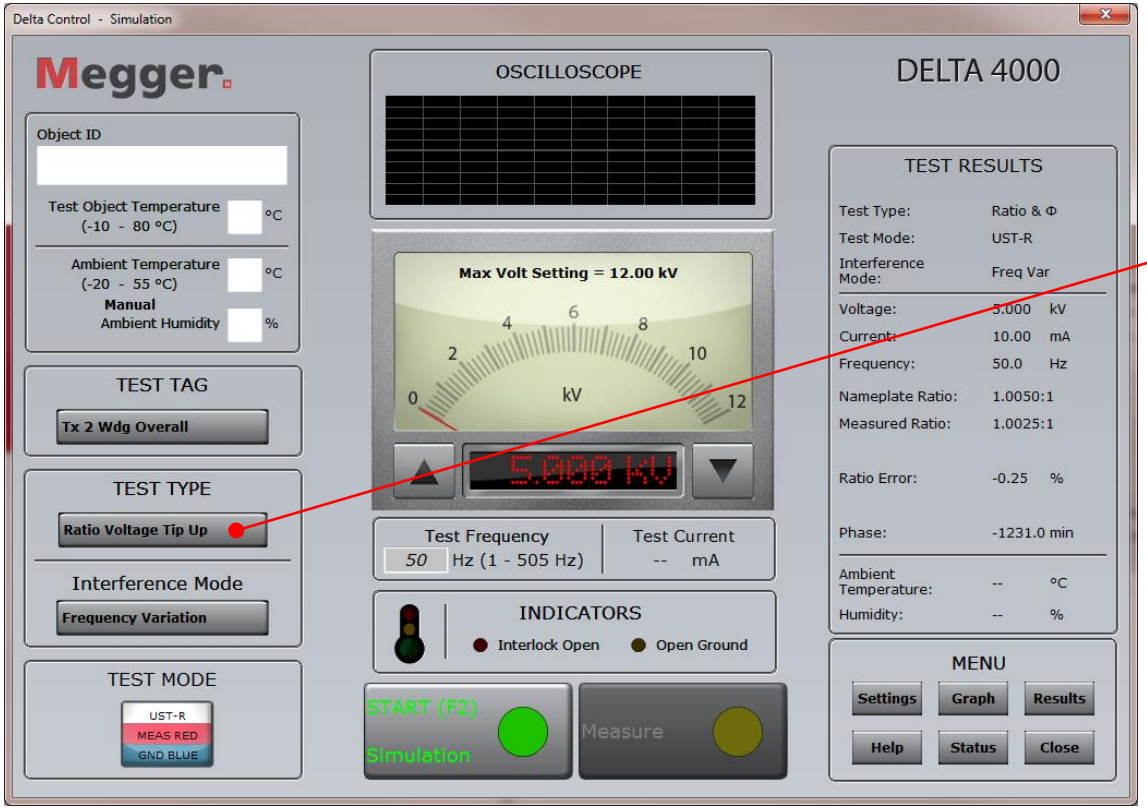


- Ratio & Ø (Ref Ω/Cap)

Review results

Megger
Power on

Delta 4110/4310A – Delta Control

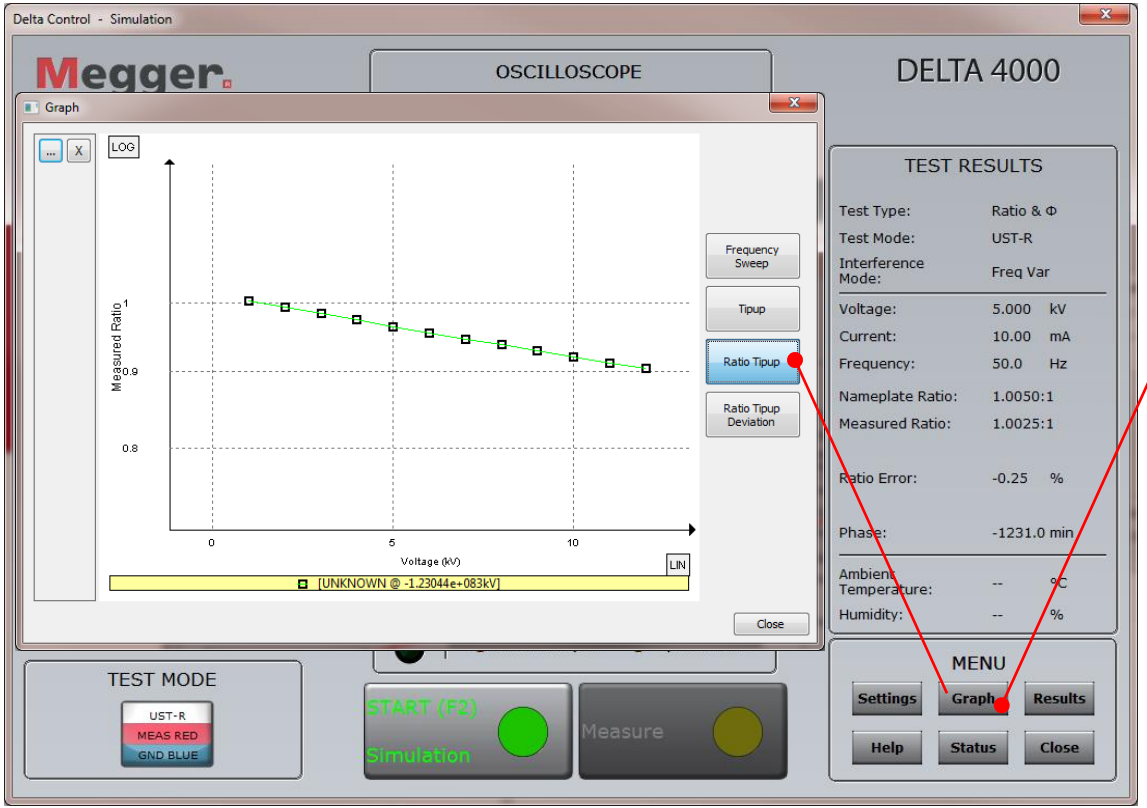


- Ratio Voltage Tip Up

Similar to Ratio & Ø (Ref Ω/Cap), but over tip up voltages set in settings

Megger
Power on

Delta 4110/4310A – Delta Control

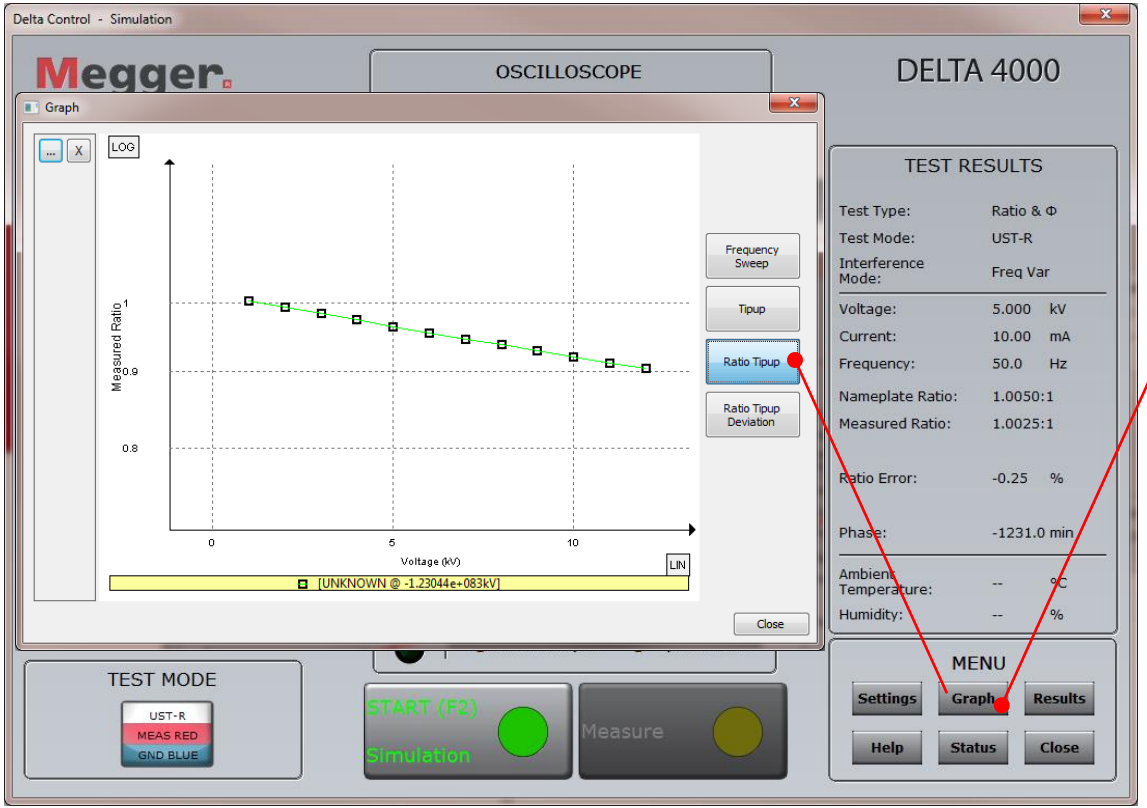


- Ratio Voltage Tip Up

During testing and after the test is complete, you can view the graph

Megger
Power on

Delta 4110/4310A – Delta Control

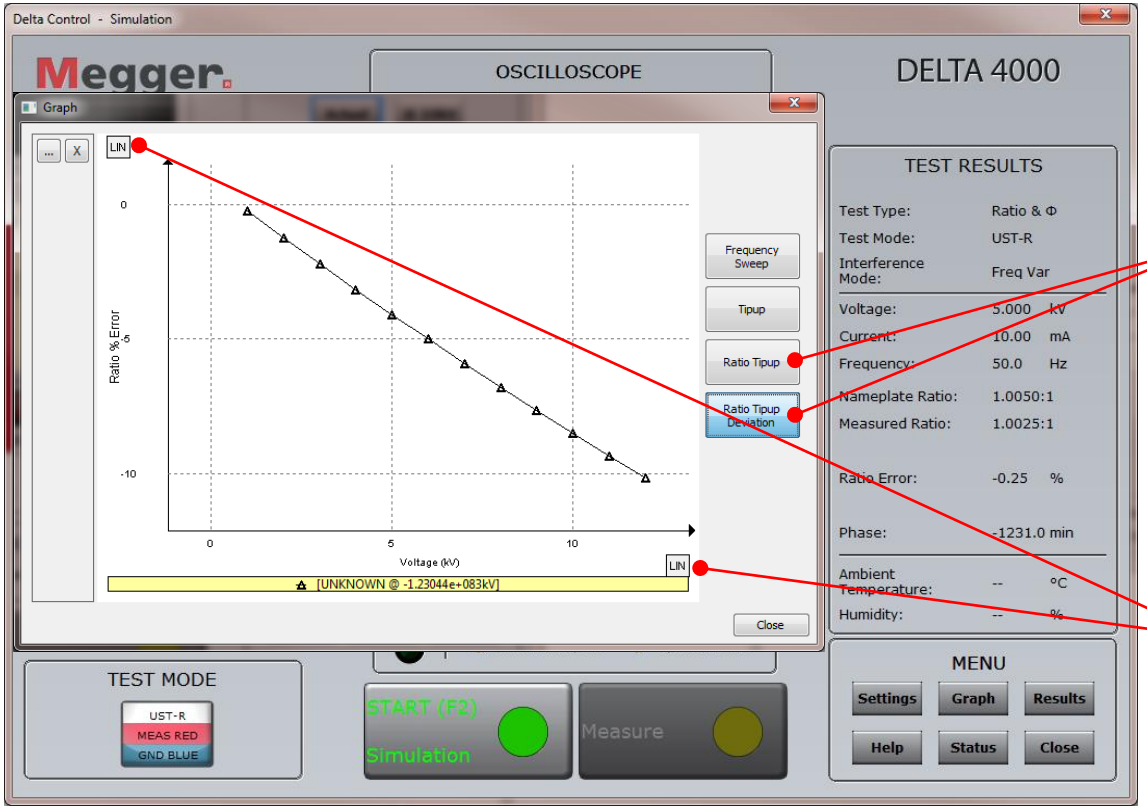


- Ratio Voltage Tip Up

When testing is complete, you can view the graph

Megger
Power on

Delta 4110/4310A – Delta Control



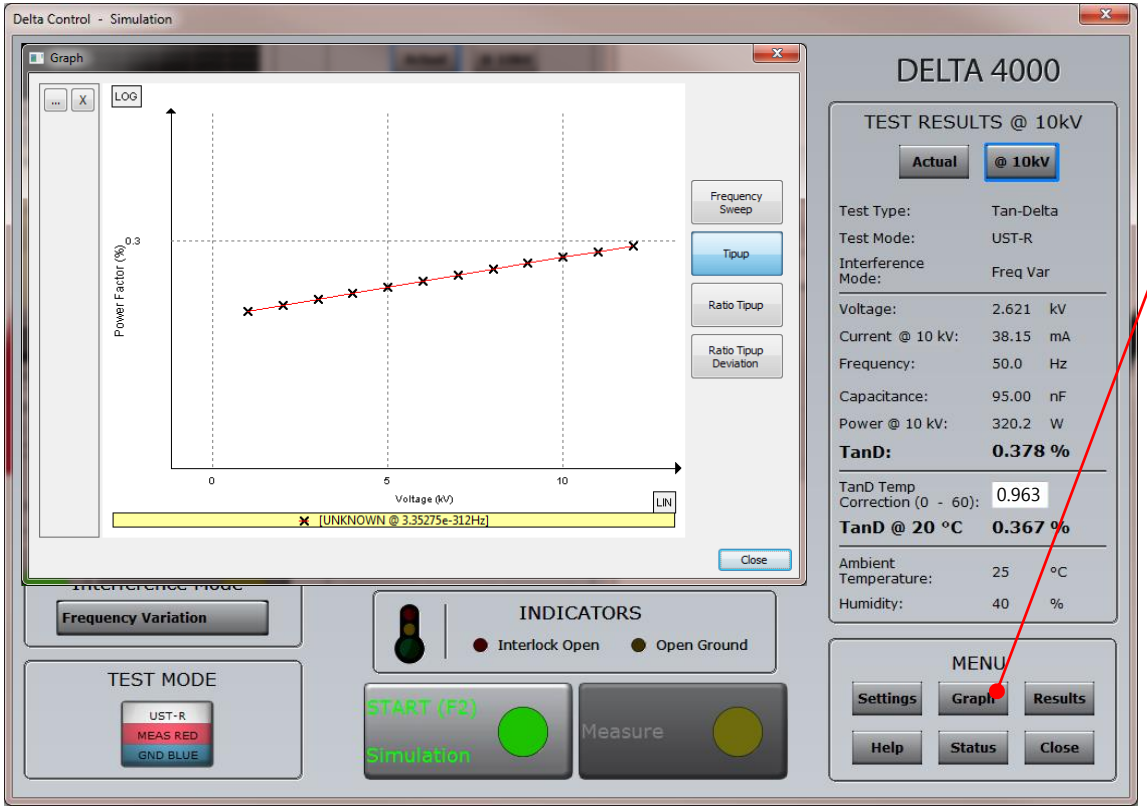
- Ratio Voltage Tip Up

Two graphs are available for Ratio Voltage Tip Up, Ratio Tipup and Ratio Tipup Deviation

Choose LIN/LOG to manipulate the X or Y Axis

Megger
Power on

Delta 4110/4310A – Delta Control



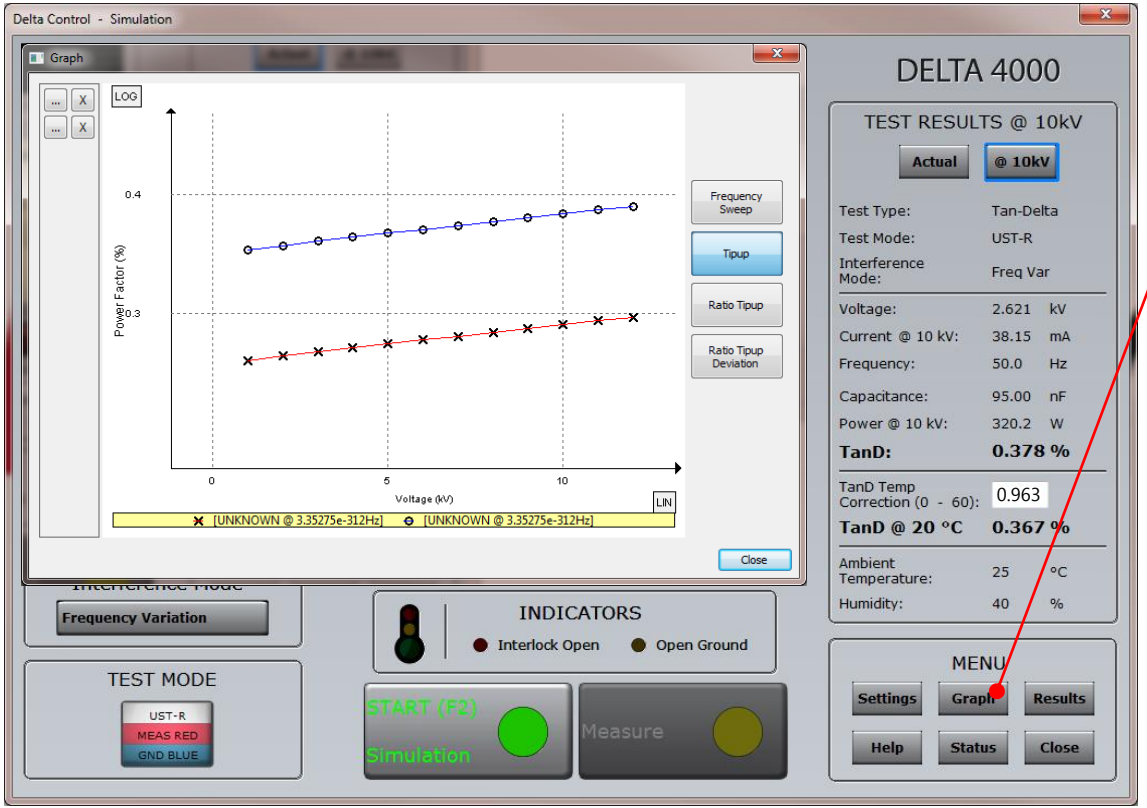
Tipup Graph

Graphs are available for Voltage Tipup Test [PF/DF]

Can be viewed during the test

Megger
Power on

Delta 4110/4310A – Delta Control

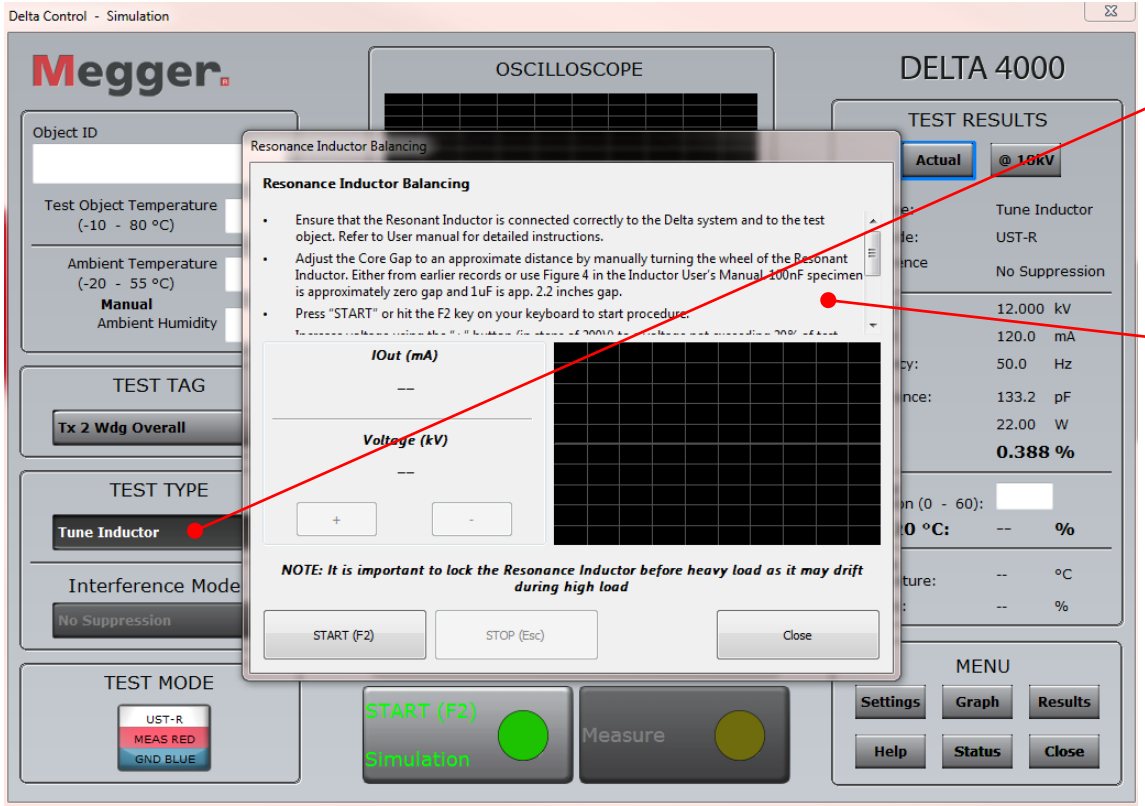


- Tipup Graph

Multiple Tipups and sweeps will be presented on the graph if run during the same instance of Delta Control

Megger
Power on

Delta 4110/4310A – Delta Control



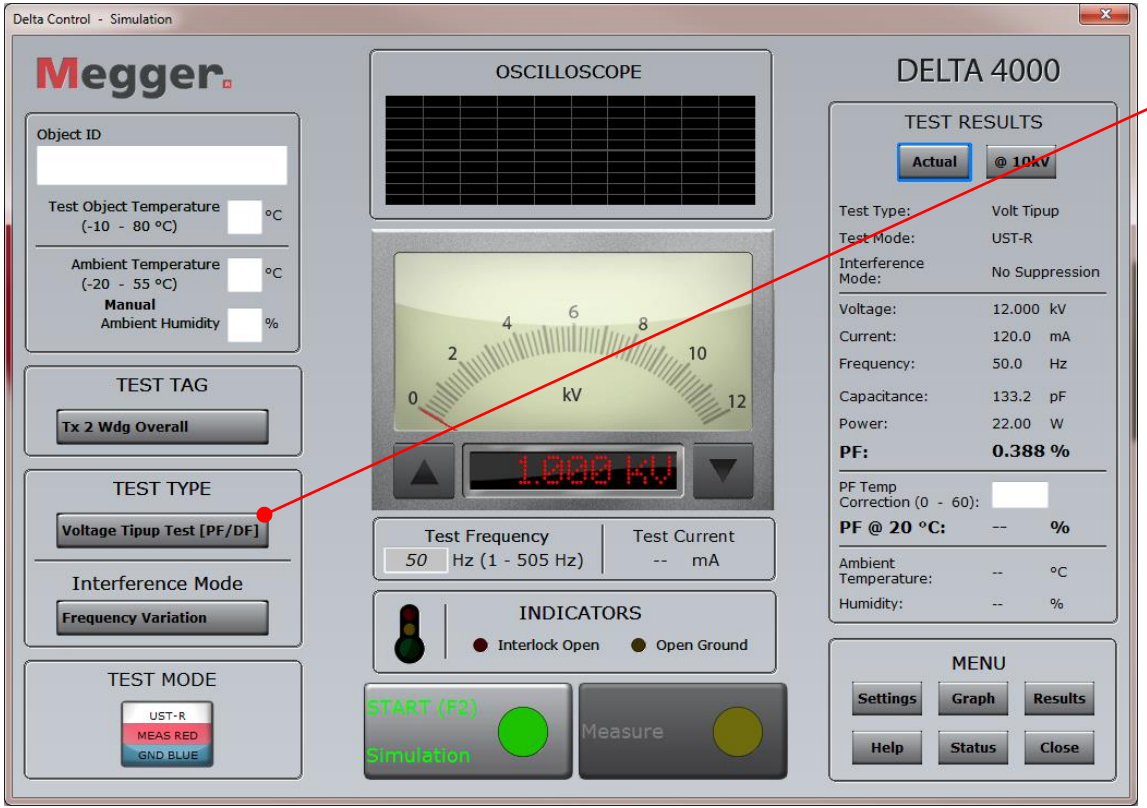
- Tune Inductor

Selecting Tune inductor brings up the Resonance Inductor Balancing

Follow the procedure in the Text Box

Megger
Power on

Delta 4110/4310A – Delta Control



- Tune Inductor

After tuning the inductor is complete, the Test Type will be set to Voltage Tipup Test

Megger
Power on