TRAX

Transformer & Substation Test System

Megger 2015-10-29

Simplicity challenge…

STANDARD TEST TYPES			MEGGER TEST SETS										
Component		Test	Delta	IDAX	MIT	FRAX	MLR	TTR	MTO	CBA LTC	MoM	OTS	KF
Windings		Resistance							X	X			
		Ratio/polarity						X					
		Excitation current	X	X				X					
		Short-circuit impedance				X	X						
		Frequency response analysis				X							
		Insulation resistance			X								
		Capacitance	X	X									
		Power factor/tan delta	X	X									
		Dielectric frequency response		X									
Bushings		Capacitance	X	X									
		Power factor/tan delta	X	X									
		Dielectric frequency response		X									
Insulating oil		Water content											X
		Dielectric strength										X	
		Power factor/tan delta	X	X									
Cellulose insulation		Moisture content		X									
Tap changers	Load	Resistance							X	X			
		Ratio						X					
		Continuity (make before break)							X	X			
		Dynamic resistance (DRM)								X			
	De-energized	Resistance							X	X			
		Ratio						X					
Core/Tank		Insulation resistance		X	X								
		Frequency response analysis				X							
		Ground test									X		

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TRAX – Overview

- Multi-function test system for transformer and substation testing
- State-of-art winding resistance and tap-changer testing functionality
  - Winding resistance measurements (100A/50V) with adaptive algorithm for fast and efficient core demagnetization
  - Tap-changer testing with true dynamic resistance measurements (patent pending), dynamic current (“ripple”) testing and dynamic voltage testing
  - Magnetic balance test
- High voltage ratio measurement (250 V and 2200 V output)
  - Optional switchbox for 3-phase/6-winding measurements
  - CT and VT testing
  - Optional unit for insulation testing
  - 12 kV internal generator
  - Tan delta and capacitance with external generator
  - 3-phase circuit-breaker timing with one analog transducer input and internal measurements of coil current and operating voltage
  - Single-phase relay and LV circuit breaker testing
  - 3-phase voltage and/or current measurements
- And more...

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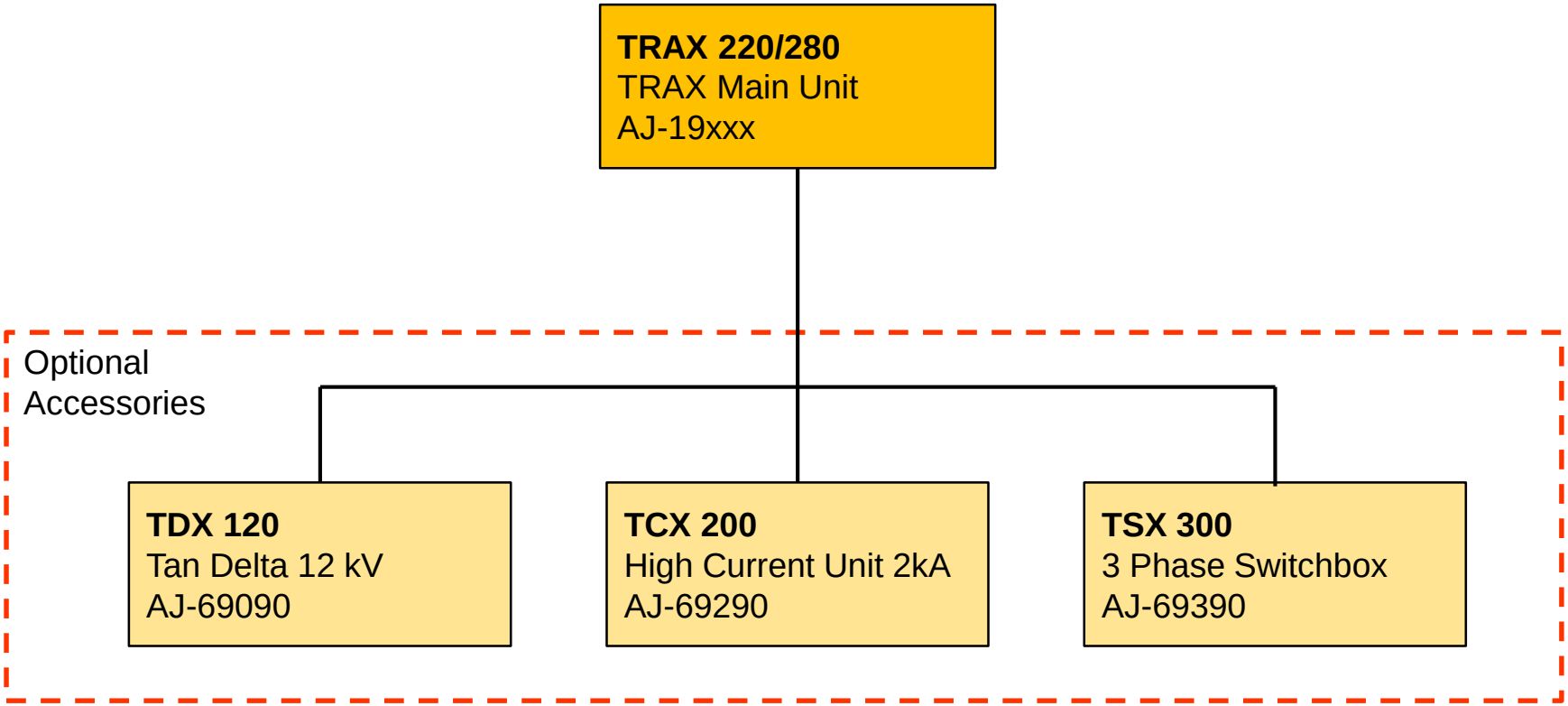
TRAX – General test system structure



TDX 120 – 12 kV Tan Delta Unit

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TCX 200
2000 A
High Current Box

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TSX 300 – Three phase switch box


COM
TRANS
CONTROL
TRIG IN
TIMING
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TRAX
Transformer Test System
SAFETY
INTERLOCK 2
STROBE
INTERLOCK 1
EMERGENCY
0-250 V
0-10A
R2
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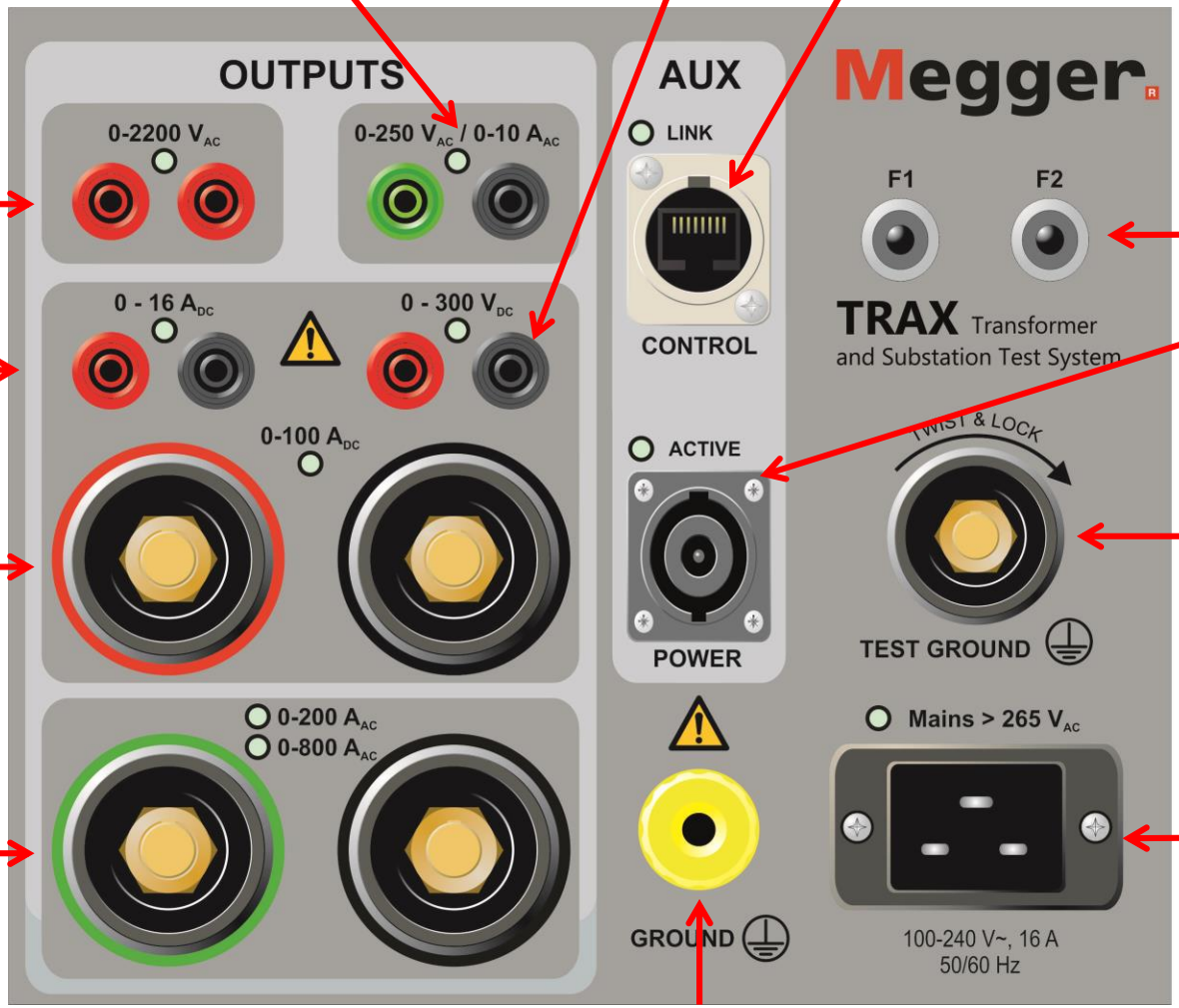
TRAX 220
Transformer and Substation Test System

TRAX Side Panel



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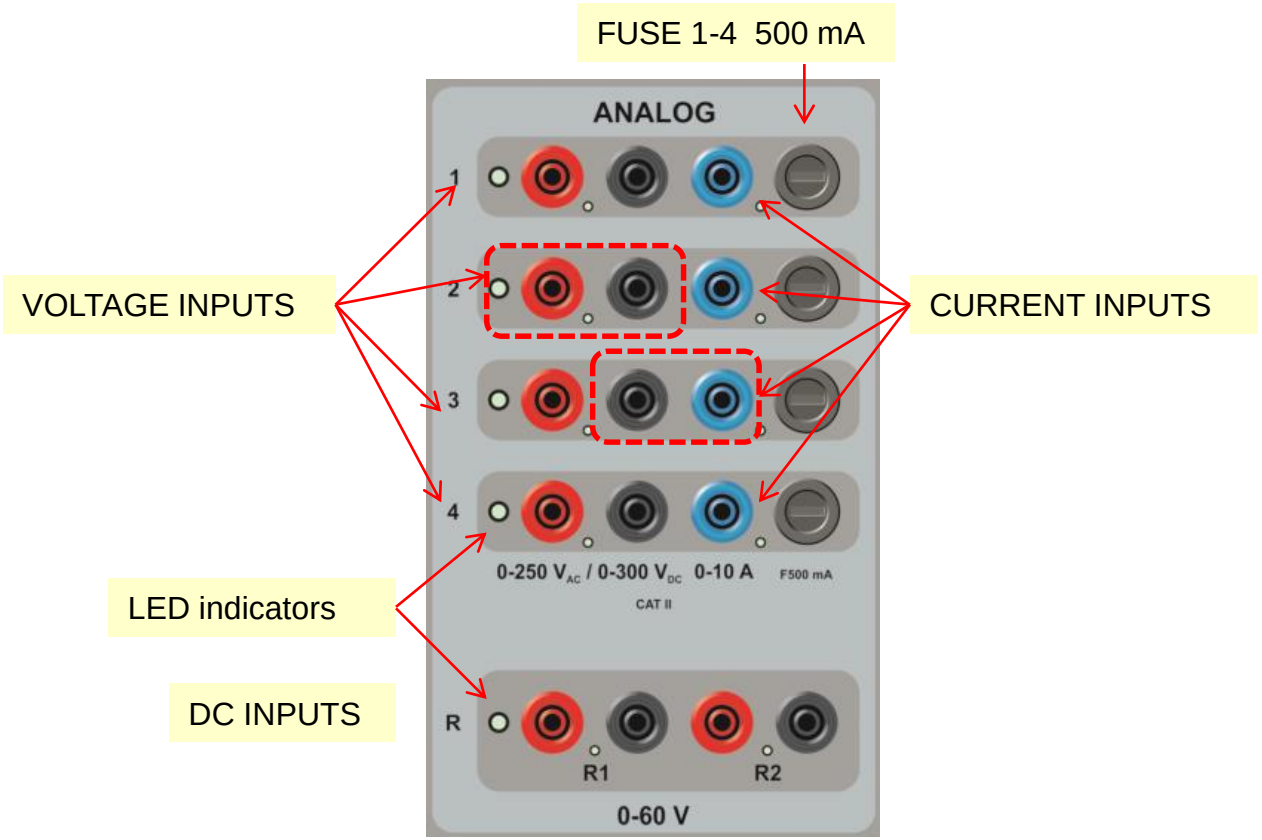
TRAX Top Panel

TRAX – Top Panel - Analog Inputs



TRAX – Top Panel – Transducer, Control, Trig, Timing

TRANSDUCER
INPUT

TRIG IN
External trig input

CONTROL
OLTC control

TIMING
3 binary inputs

TRAX - Top Panel Communication & Safety

COMMUNICATION Ethernet port

COMMUNICATION 3 x USB ports

COMMUNICATION Wifi antenna

COMMUNICATION Speaker

ON / OFF

Interlock 2 - Manual

External strobe input

Ground Loop Indicator

Safe and Active Indicator

Interlock 1 – Fixed

Emergency switch

TRAX 220 versions (200A, < 31 kg in transport case)

Main unit

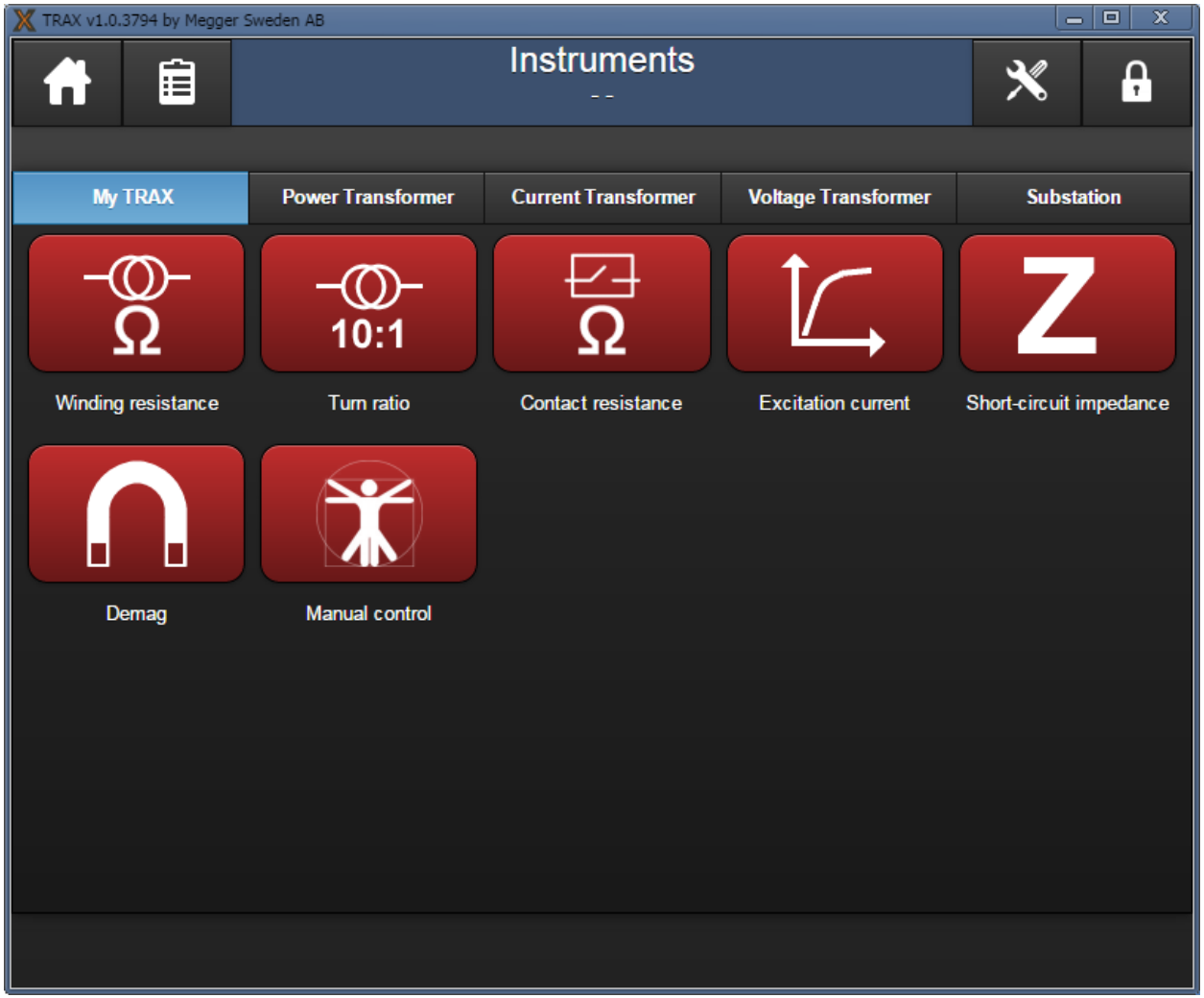
Transformer Basic Manual Control, TTR, WRM, Demag, EXC, SCI	Transformer Advanced (+MagBal, FRSL, OLTC, Tan Delta)	CT & VT package (Transformer Basic +Advanced + CT/VT)	Substation Package (All + Relay, Breaker, Phase Angle, Ground)
TRAX 220 26 kg / 31 kg 200A AC	TRAX 220 26 kg / 31 kg 200A AC	TRAX 220 26 kg / 31 kg 200A AC	TRAX 220 26 kg / 31 kg 200A AC

Optional

	TDX 120 23 kg Tan Delta Unit 12kV	TDX 120 23 kg Tan Delta Unit 12kV	TDX 120 23 kg Tan Delta Unit 12kV
TCX 200 18 kg, 2 kA Current Booster	TCX 200 18 kg, 2 kA Current Booster	TCX 200 18 kg, 2 kA Current Booster	TCX 200 18 kg, 2 kA Current Booster
	TSX 300	TSX 300	TSX 300

TRAX – Main menu

TRAX – Instrument view (”My TRAX”)



TRAX – Manual Control

Manual testing – Datasheet

- Voltage outputs
  - 0 – 250 V AC
  - 0-2200 V AC
  - 0-50 V DC
- Current outputs
  - 0-20 A AC
  - 0-200/800 A AC
  - 0-100 A DC
  - Optional 0-2000 A AC
- Measurement inputs
  - 2 DC 0-50 V
  - 4 multi-purpose AC/DC voltage/current 0-10A/0-300V
  - Internal measurements on analog and digital outputs
  - RMS, rectified average, frequence, DC
- Test modes
  - Manual, instant on, ramp, sequence
  - Measurement start on trig, manual or generator start
- Analysis
  - Impedance, phase, VA, inductance etc calculated from two analog inputs

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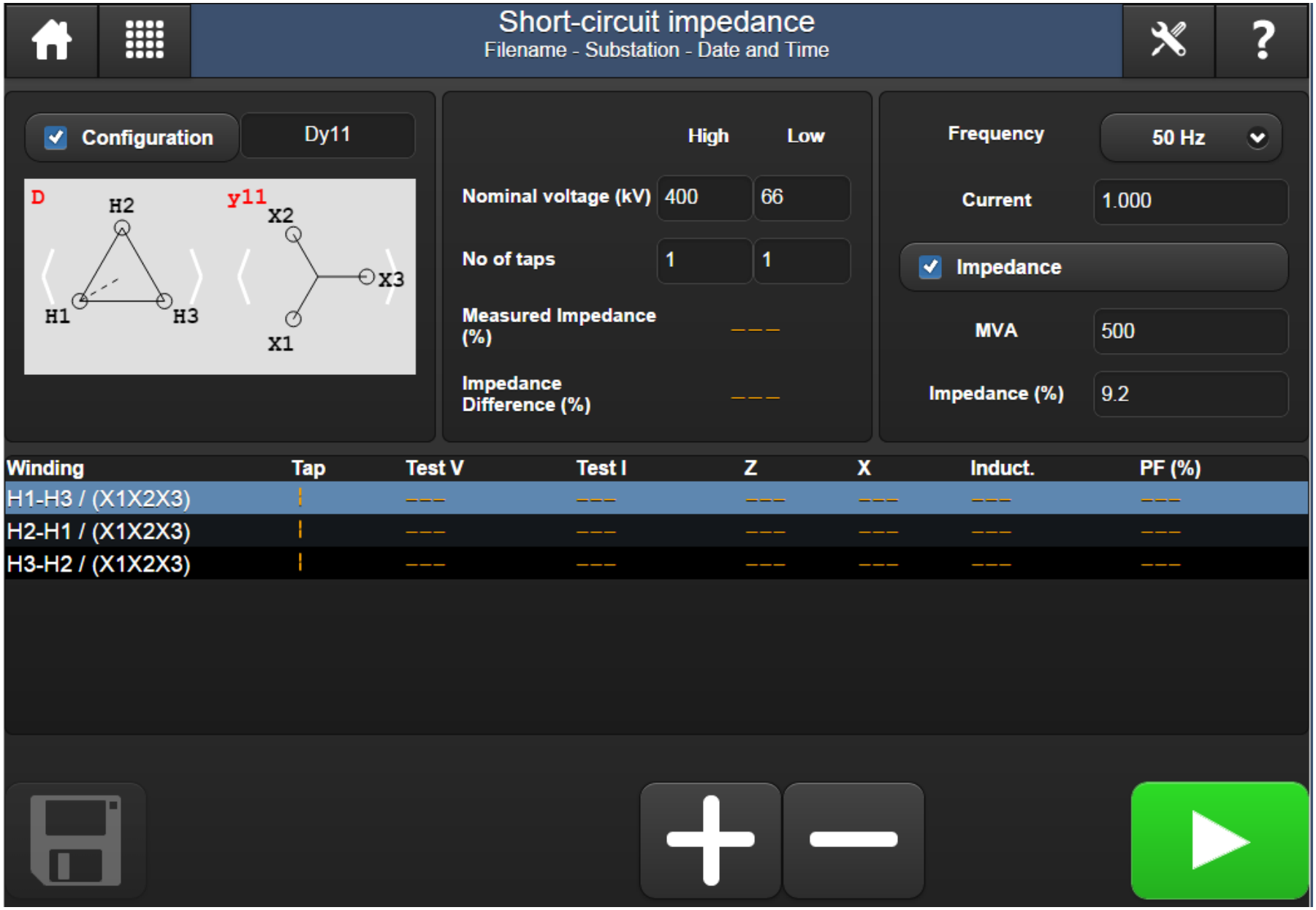
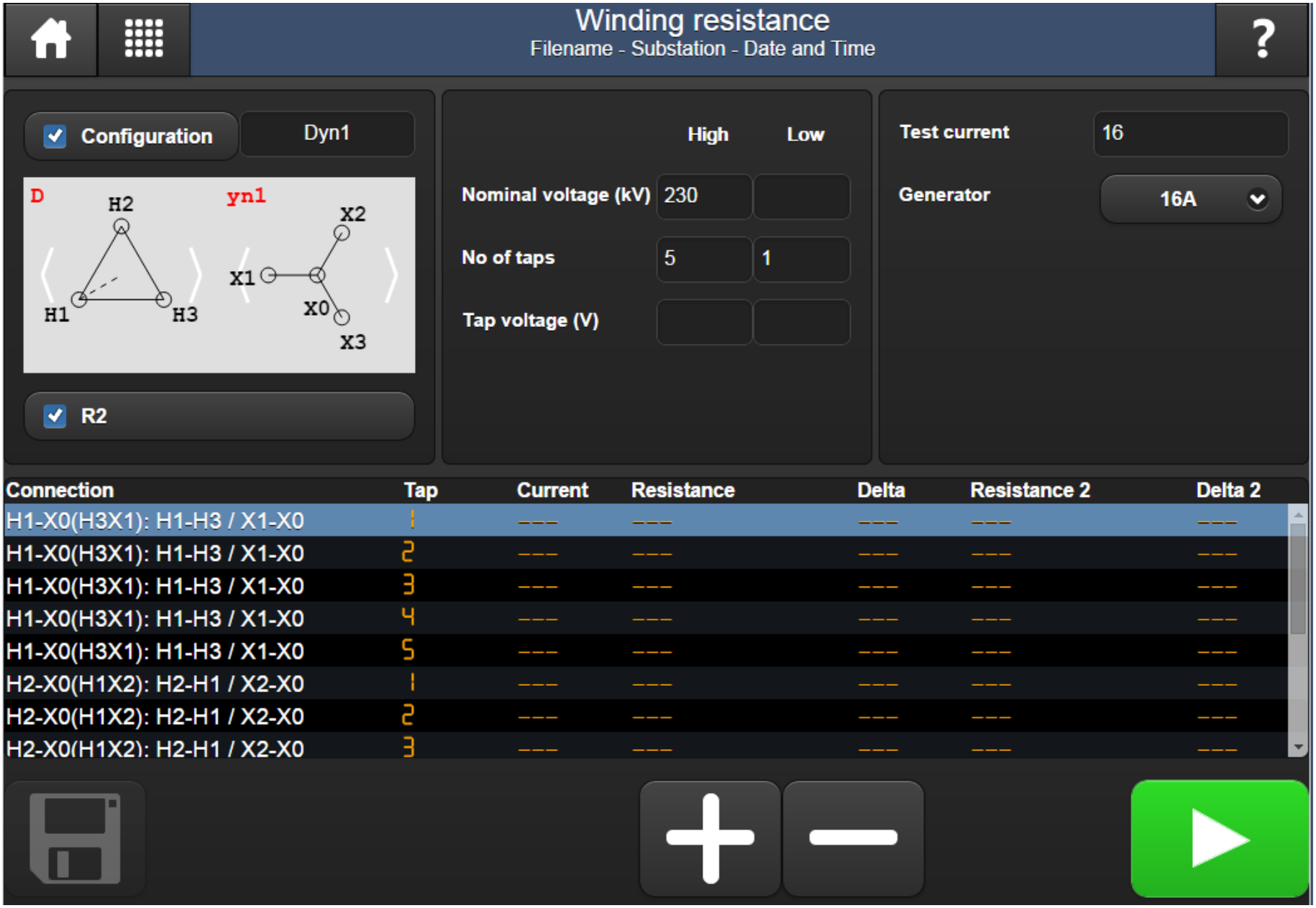
TRAX – Resistance (contact resistance)

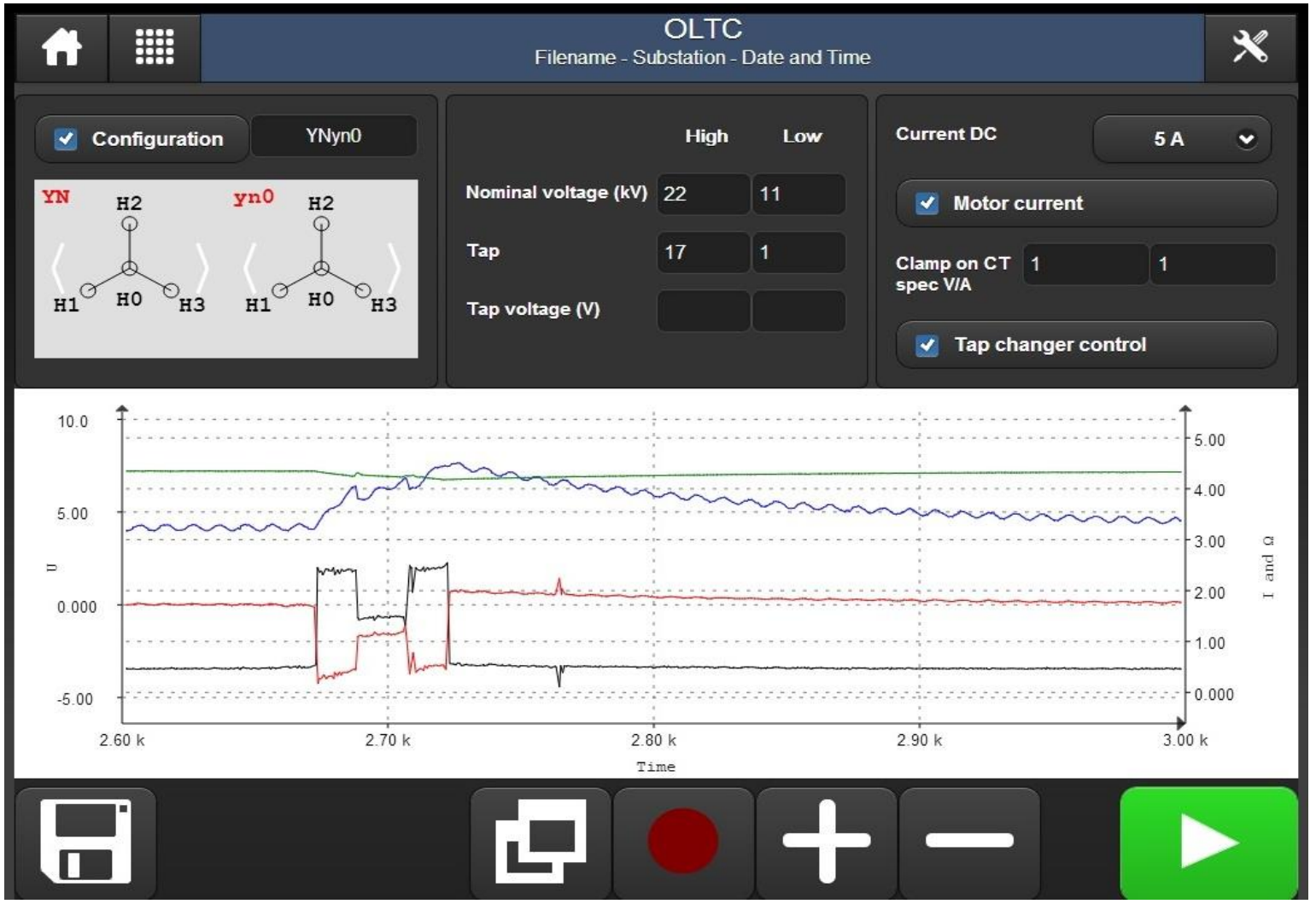
TRAX – Impedance



TRAX – Winding resistance



TRAX – OLTC DRM



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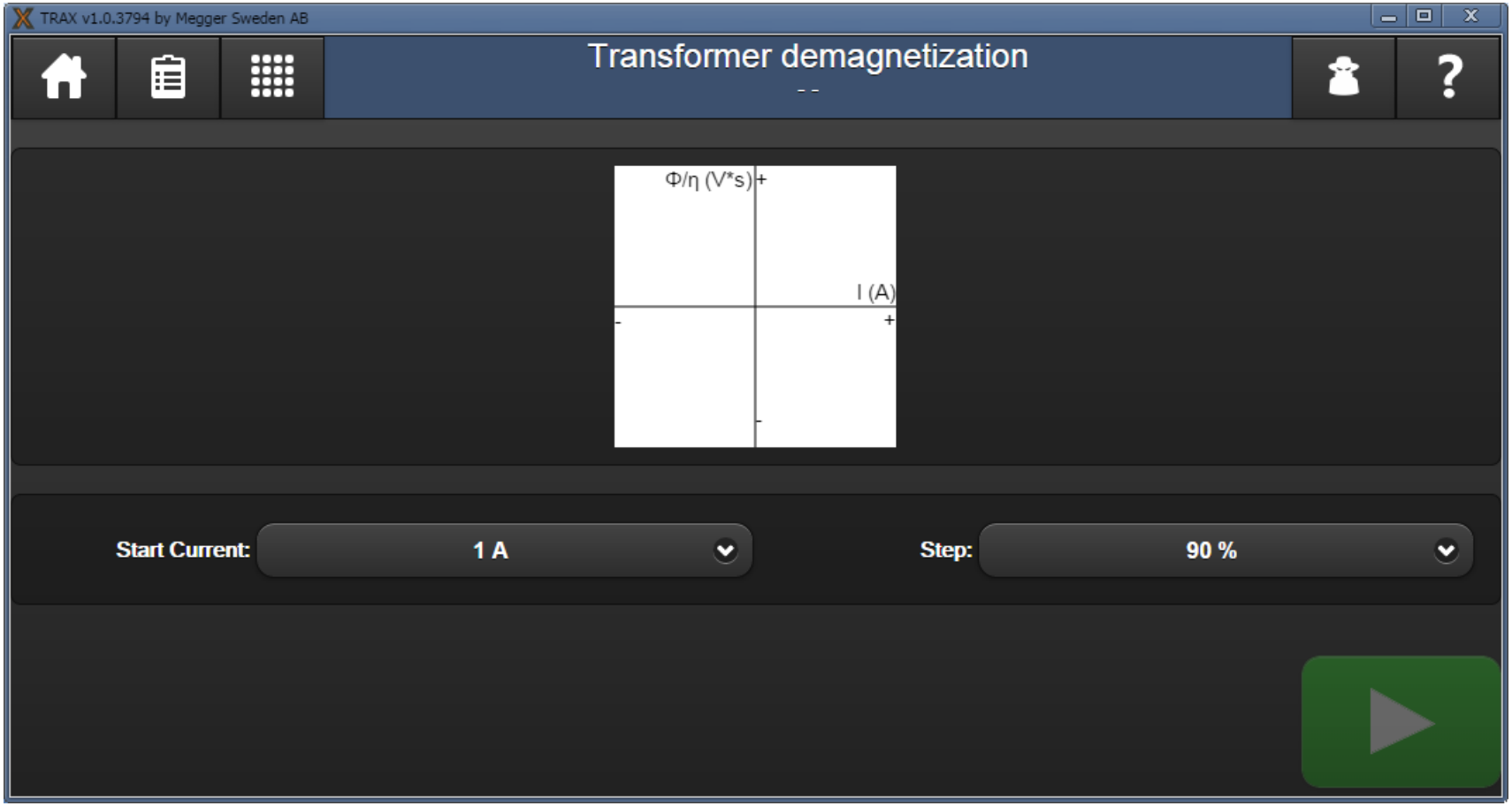
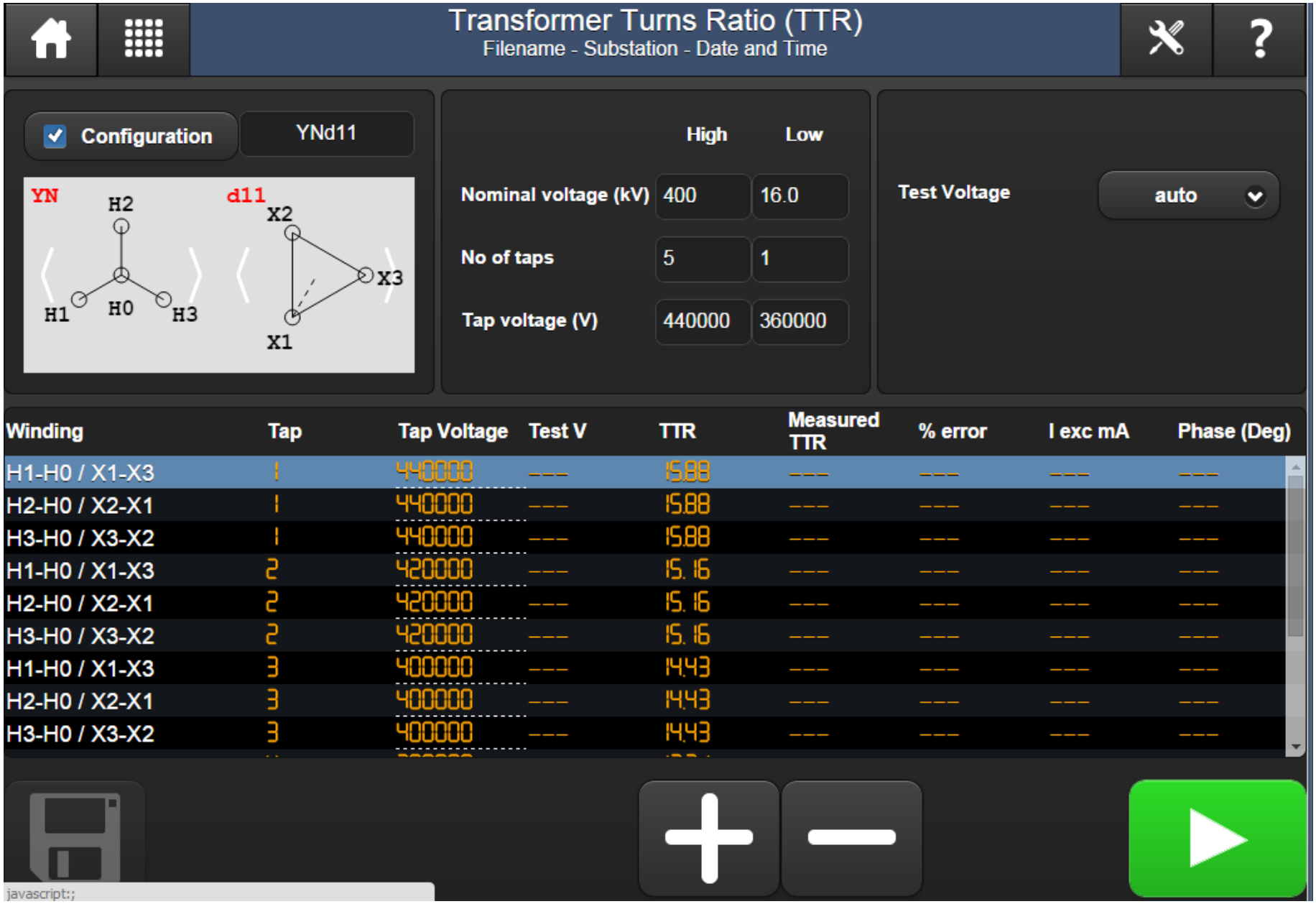
TRAX – Demagnitization

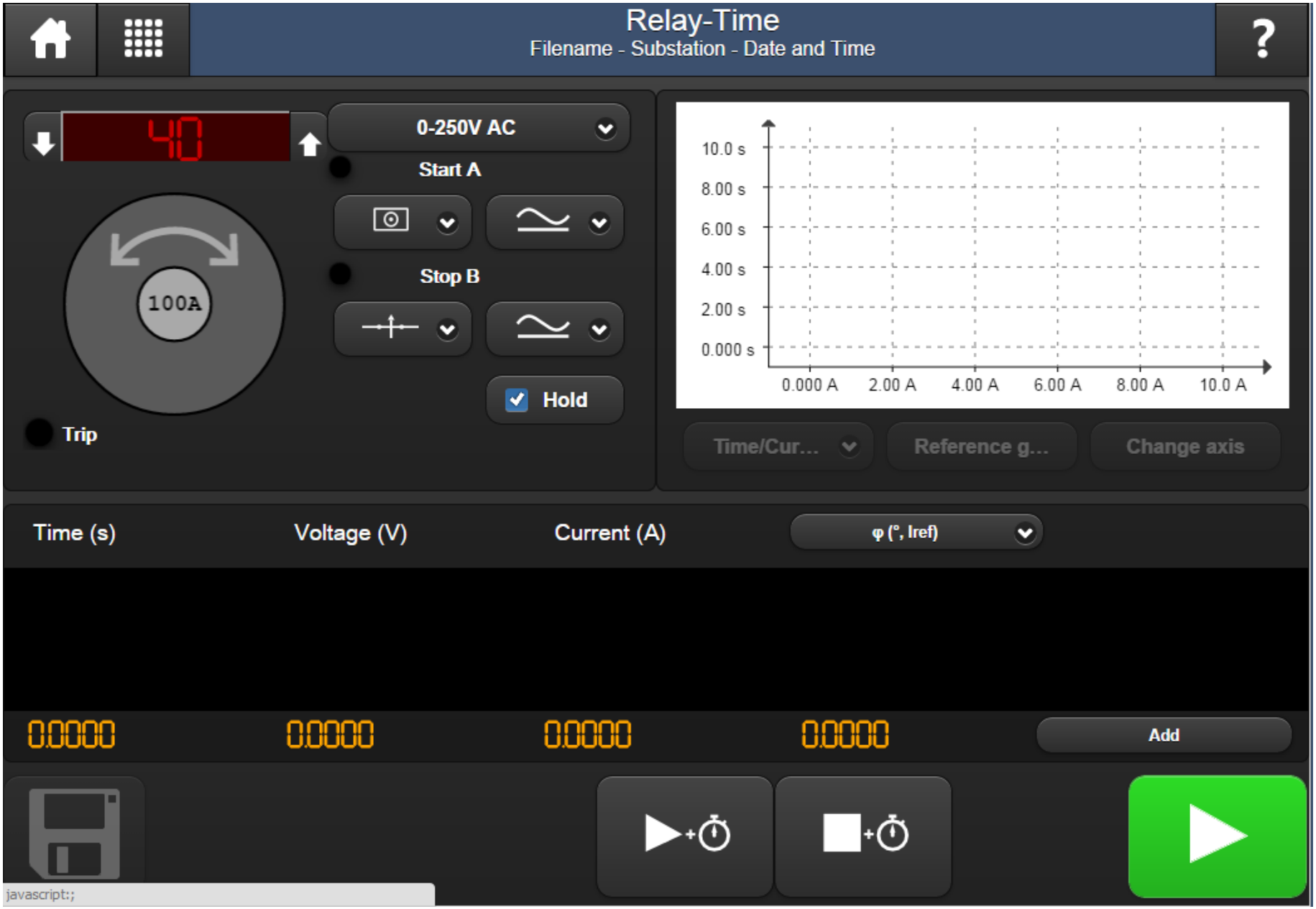


TRAX – TTR


Transformer Turns Ratio (TTR)
Filename - Substation - Date and Time
Configuration
YNd11
YN
H2
H1
H0
H3
d11
X2
X3
X1
High
Low
Nominal voltage (kV)
400
16.0
No of taps
5
1
Tap voltage (V)
440000
360000
Test Voltage
auto
Winding
Tap
Tap Voltage
Test V
TTR
Measured TTR
% error
I exc mA
Phase (Deg)
H1-H0 / X1-X3 1 440000 --- 15.88 --- --- --- ---
H2-H0 / X2-X1 1 440000 --- 15.88 --- --- --- ---
H3-H0 / X3-X2 1 440000 --- 15.88 --- --- --- ---
H1-H0 / X1-X3 2 420000 --- 15.16 --- --- --- ---
H2-H0 / X2-X1 2 420000 --- 15.16 --- --- --- ---
H3-H0 / X3-X2 2 420000 --- 15.16 --- --- --- ---
H1-H0 / X1-X3 3 400000 --- 14.43 --- --- --- ---
H2-H0 / X2-X1 3 400000 --- 14.43 --- --- --- ---
H3-H0 / X3-X2 3 400000 --- 14.43 --- --- --- ---
javascript:;

TRAX – Tan Delta

TRAX – Relay/timing



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Unique features and pending patents

Adaptive demagnetization

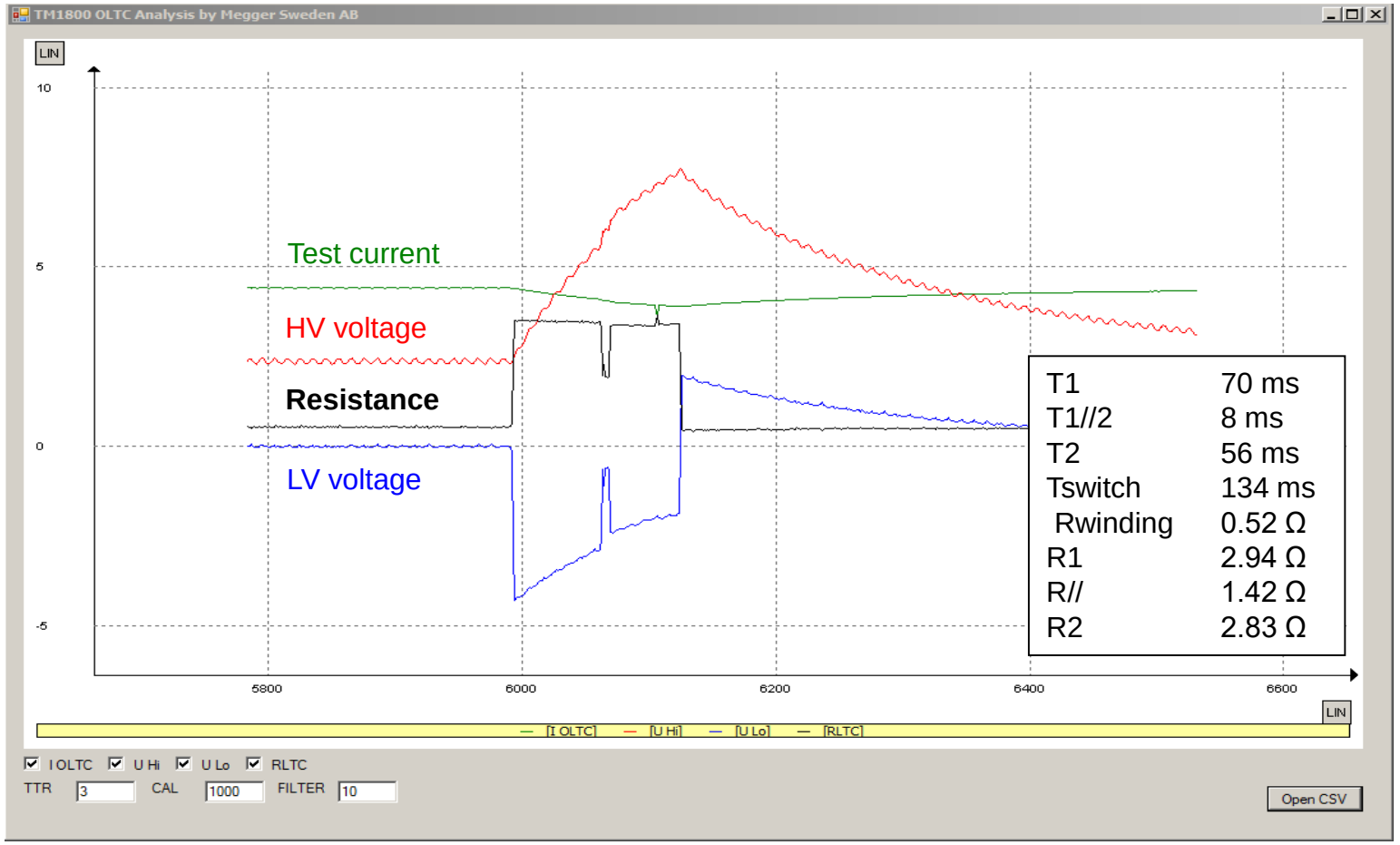
- Measure/calculate voltage-time integral (V*s) at high current (above saturation current)
- Create demagnetization cycles by reducing Vs value (typically 10% reduction/step)
- Effective
  - Verified against true AC demagnetization. Similar results in excitation current and magnetic balance verification measurements

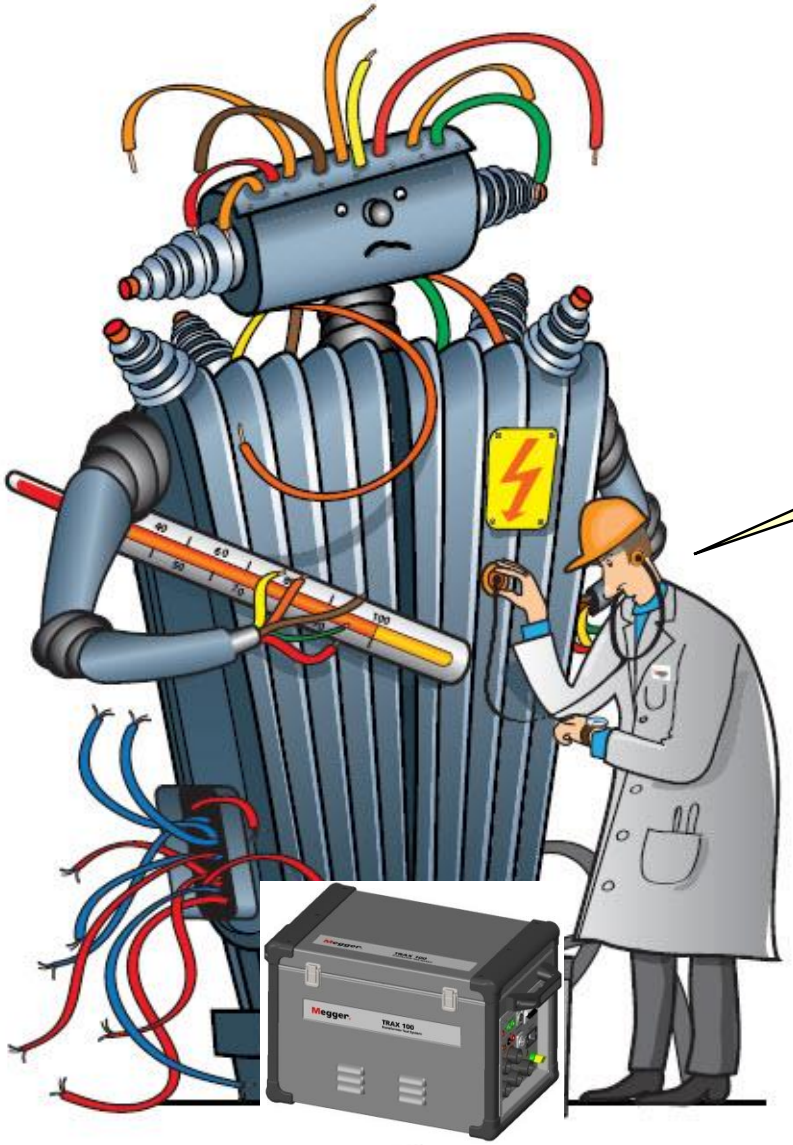
Magnetic balance after AC demag a-n			Magnetic balance after adaptive demag a-n		
a-n	b-n	c-n	a-n	b-n	c-n
100%	68%	31%	100%	68%	31%
50%	100%	50%	50%	100%	50%
32%	67%	100%	31%	68%	100%

- Fast
  - Significantly faster than static demagnetization algorithms for smaller transformers (40 cycles demagnetization in less than 1 minute for 0.5 MVA transformer)

Dynamic analysis – Patent pending

Utilizing new method for calculating diverter resistor values





Questions?

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