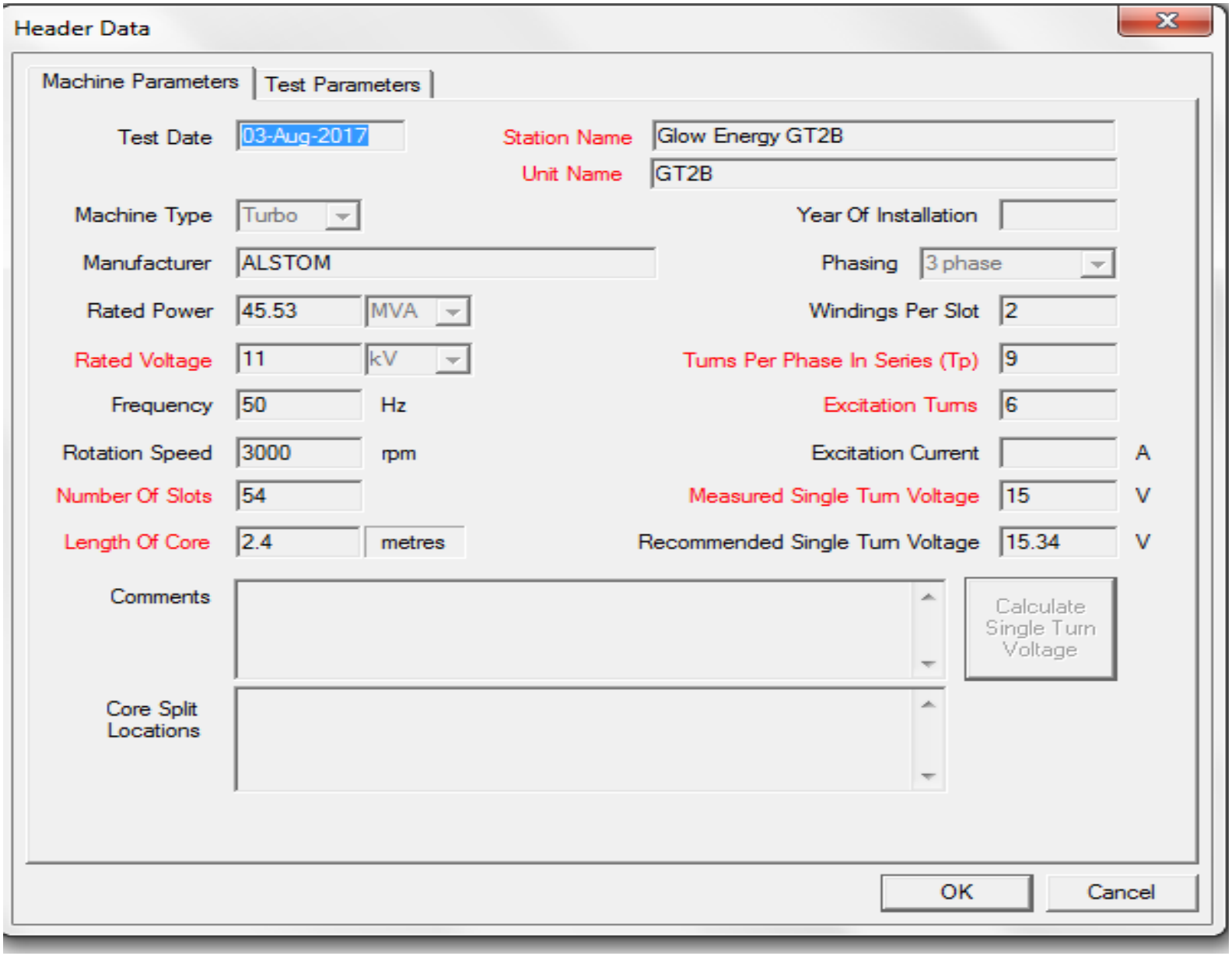
Genius Engineering & Service Co., Ltd.

ELECTRICAL SERVICE "TRUST OUR EXPERIENCE"

ELCID TEST GUIDELINES

Key Information and Concern

ELCID TEST GUIDELINES



8. Step-by-Step ELCID Test Quick Guide

1. **Prepare the machine**
   - Safety – ground the stator winding from one end only, do not shorten other end terminals
   - Safety – no metal object inside of stator
   - Mark damaged area, if any visible
   - Number the stator slots on both ends of the core

2. **Do the math**
   - Evaluate machine stator winding turn-per-phase in series:

   Tp=(Slots*Windings*Turns)/(3*Parallels*2)
   - Calculate single turn voltage (simplified formula):

   Vt(volts)=(12.56*Vp-p(kilovolts))/Tp
   - If winding details are not known use geometry method:

   Vt(volts)=0.226*Hz*l(meters)*d(meters)

   See Figure 17 in this manual or in ELAN software
   - Calculate ampere-turns approximate requirements:

   At=(2 to 25)*C, where C=π*(OD+SD)/2; OD – outer diameter of stator core; **SD** – diameter of stator core at bottom of the slot (Typical for medium to small-sized machines 8–12C; however in motors 25C can exist)
   - Estimate number of turns for excitation winding (keep in mind turbo excitation cable amperage: 4-6 turns @ 20A maximum, 2-3 turns @ 32A maximum)
   - Current in excitation winding **Iw=A-turns/Nw**; **Nw** – number of turns =>

   Nw=A-turns/Iw (a)

   Vw=Vt*Nw Needed excitation voltage (b)

   Decide on number of turns considering (a) and (b)

   Excitation power supply requirements: **VA=Vw*Iw**
   - Verify calculation using ELAN built-in calculator
   - Verify calculation by dividing Vt over stator core length in meters. Results should be in range:
   - Small - medium motors ~**0.7 to 2 V/m**
   - Medium – large two pole turbo generators ~ **4 to 6 V/m**
   - Hydro generators ~ **1 to 3 V/m**
   - Record the calculation

3. **Prepare and install the excitation system**
   - Use ropes and wooden support blocks to centre the windings

4. **Make all the connections (EL CID and power supply)** (see Section: Connection and Operation of EL CID Evolution)

5. **Turn on power supply and monitor Vt and Iw**

6. **Calibrate Chattocks or Y - axis (remember to set frequency in accordance with local frequency)**

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EL CID Test Quick Guide

7. Adjust Trolley to the stator bore curvature and slot span
8. Calibrate distance or X – axis, with reference signal available
9. Calibrate PHASE with Trolley in the core
10. Verify PHASE displayed value in few stator points:
    - Should be PHASE=lw/Nteeth+20÷30% (depends on slot/wedge width ratio and core material losses)
11. Connect computer
12. Measure length of the core and of the step iron
13. Set test parameters in software (see Section: ELAN EL CID Stator Test)
14. Trial test – do three slots and correct for distance offset, by re-calibrating distance or changing core length/trace length in test parameters
15. Do the test – create three separate files for exciter end step iron, turbine end step iron and for main core
16. Save and backup the test data
17. Review data and make sure that all traces are properly recorded.

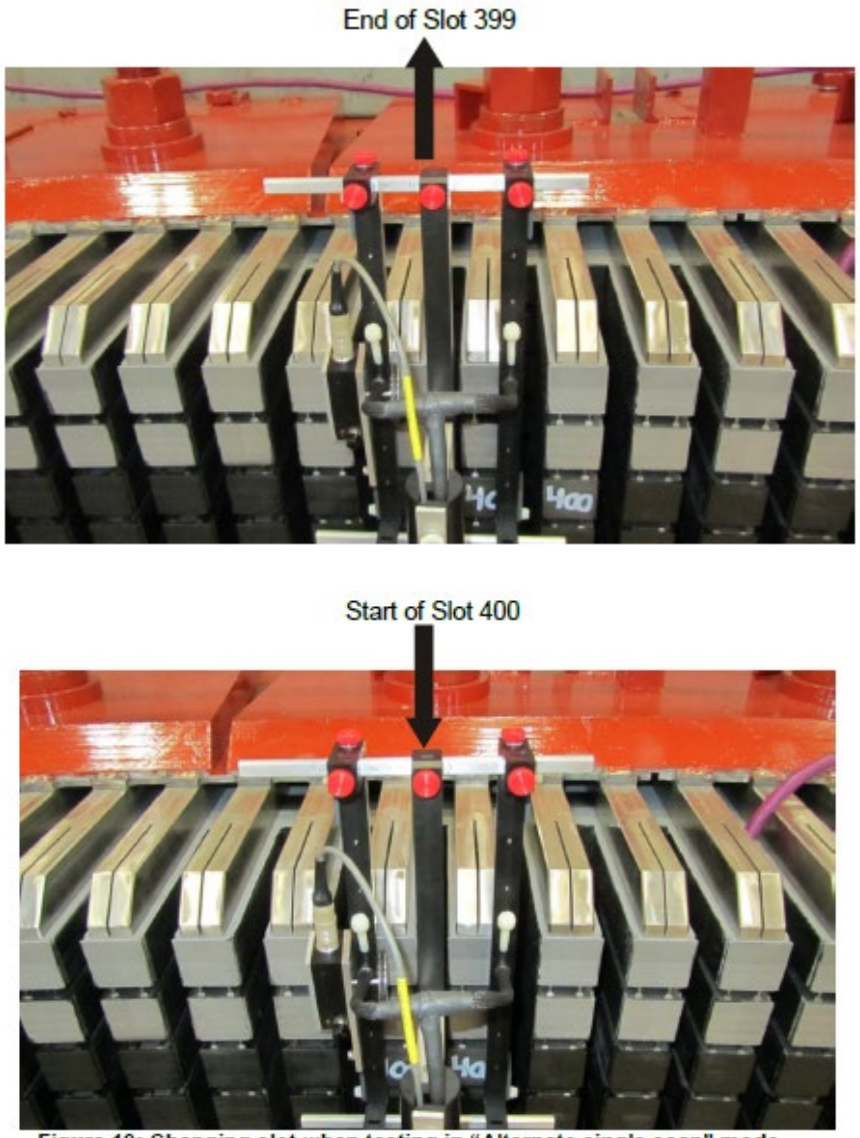

Figure 19: Changing slot when testing in "Alternate single scan" mode

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The measured current should be approximately equal to I_W/N plus ~20-30%.
where I_W = Total Ampere Turns through the winding.
and N = Number of stator teeth.

DO NOT OVERTIGHTEN ANY NYLON SCREW!

THIS MAY DAMAGE THE CHATTOCK OR SCREW.

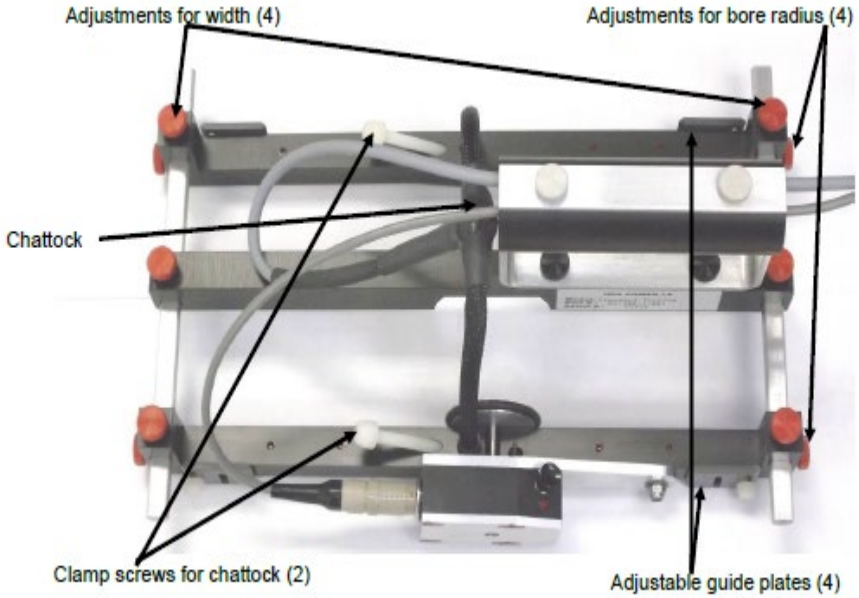

Figure 18: Assembly and Adjustments of Standard Trolley

Figure 18a: Step Iron Trolley adjustments

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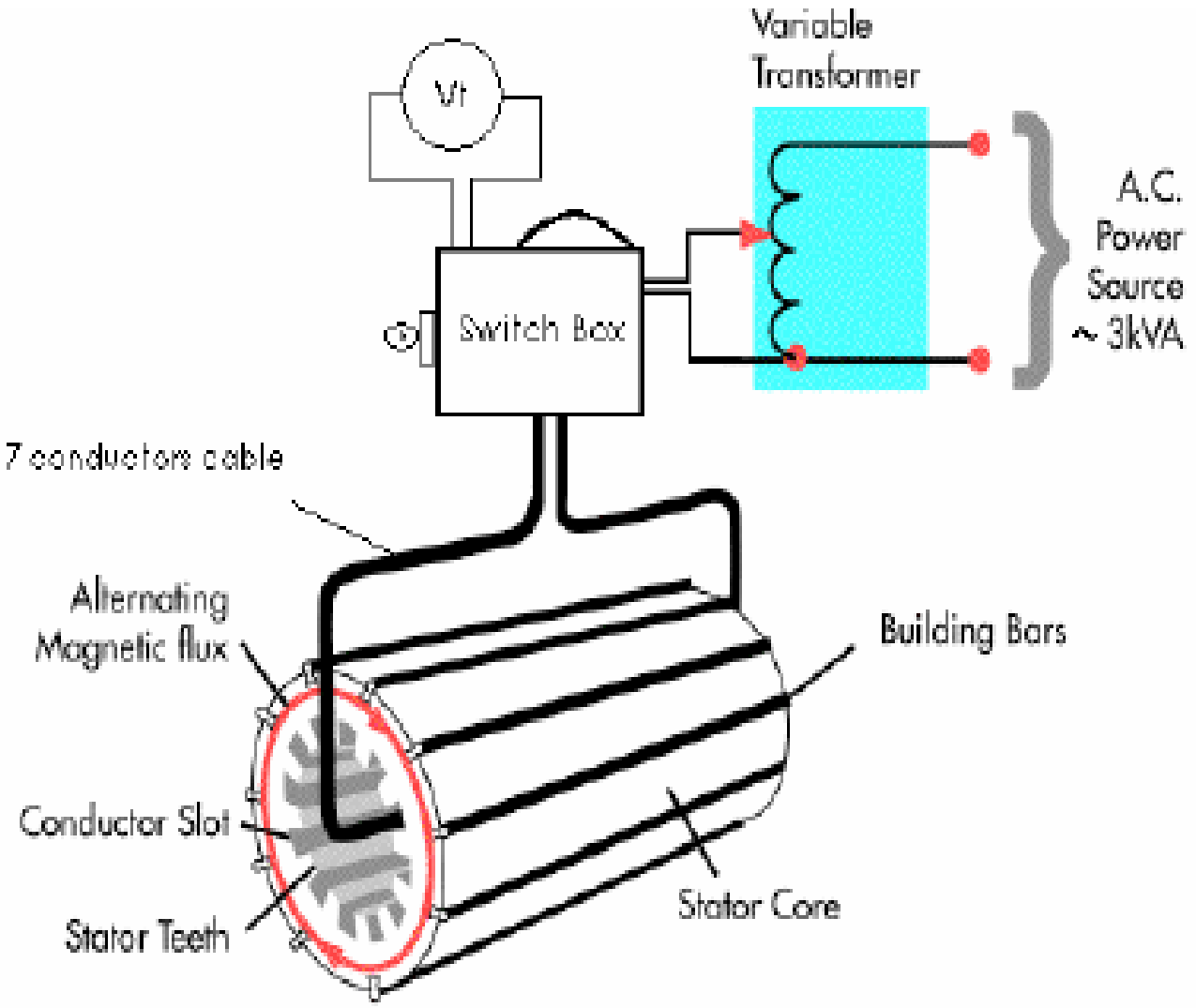

Chattock Calibration Connections

Figure 14: Calibration Connections

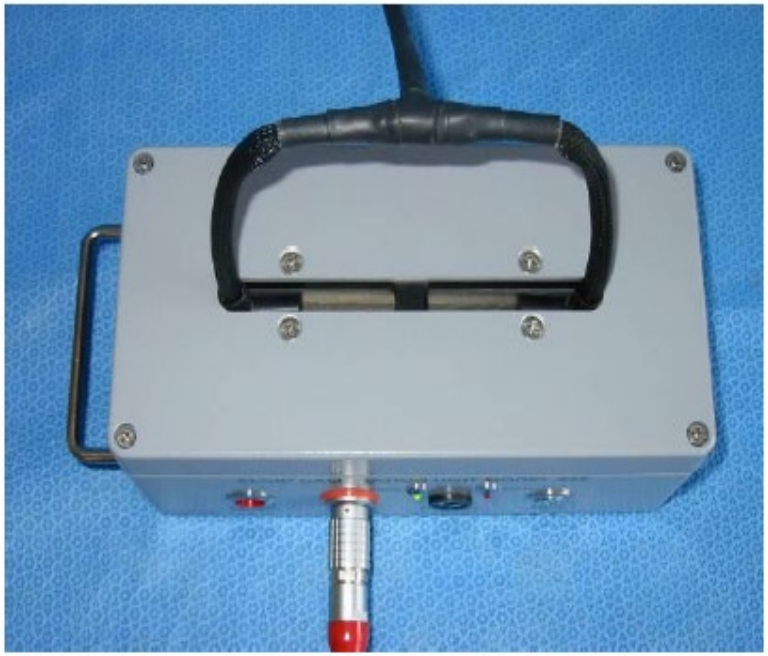

Figure 15: Right-angled Chattock Calibration

Figure 65: Excitation Control Box

The Box is connected in circuit with the supply and excitation cables as shown in Figure 66 below.

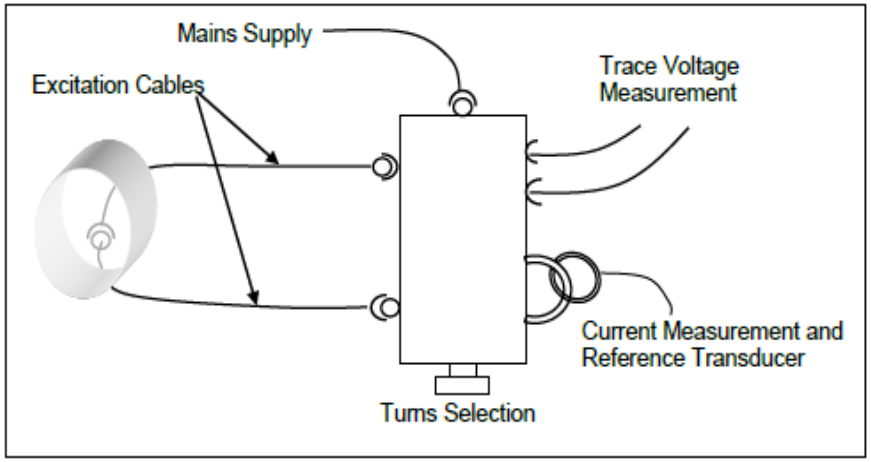

Figure 66: Excitation Control Box Connections

The switch box has a 5 way key operated switch to allow the number of excitation turns to be selected. The selection is:

Position	Connections (assuming one Excitation Cable turn around the stator core)
6	6 turns in series
5	5 turns in series
4	4 turns in series
3	3 turns in series, each being 2 wires in parallel
2	2 turns in series, each being 2 wires in parallel

13.17. Specifications

Maximum Mains Supply voltage	250Vac, 50-60Hz
Maximum Control Box Mains Supply current (switch positions 6, 5 & 4)	20A
Maximum Control Box Mains Supply current (switch positions 3 & 2 only)	32A
Maximum Extension Cable current	32A
Maximum Series Connection Box current	32A
Trace Voltage Winding insulation	3,750Vac
Maximum Trace Winding Output Voltage	250Vac
Trace Winding Output Impedance	1KΩ (one end connected to earth)
Excitation Cable conductor size	2.5mm²

Appendix 1: Principles and Theory of EL CID Testing

1. MAGNETIC FIELDS DUE TO CORE CURRENTS.

A light ring flux winding is used to excite the core to about 4% of its rated flux so that small fault currents flow through any damaged areas of the core.

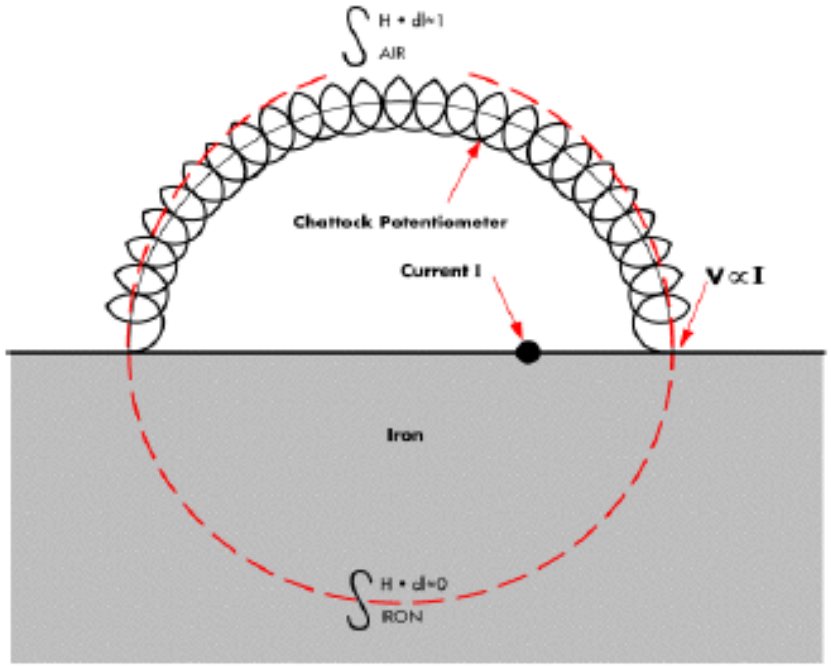

Figure A1.1: Magnetic Potential across Chattock Coil due to Current on Core surface.

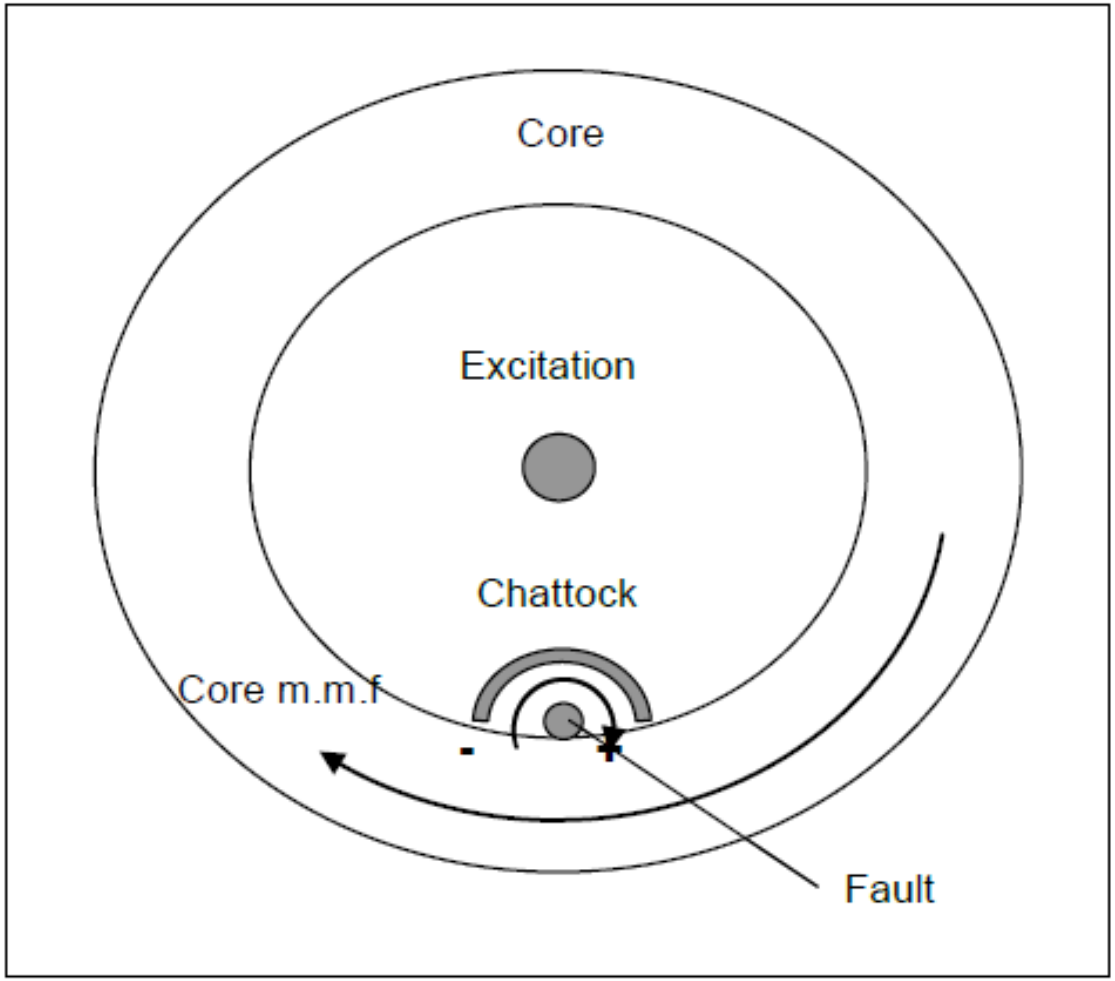

Figure A1.4: Excitation and Chattock relationship

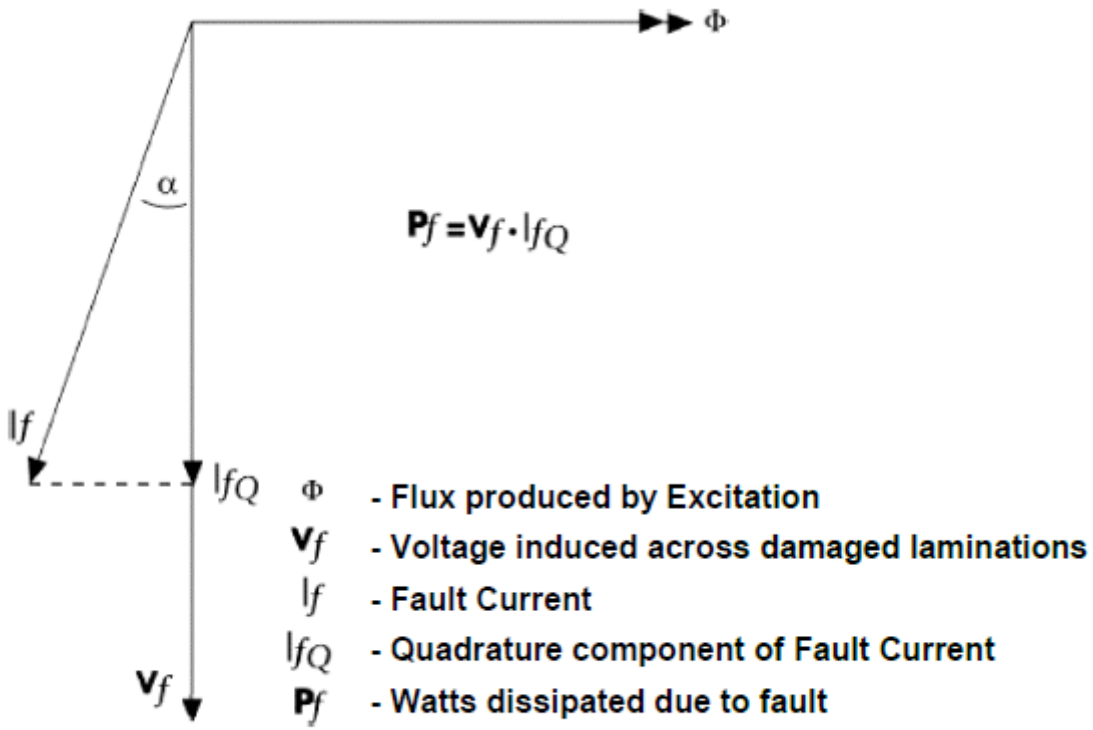

Figure A1.2: Fault Vector Phase Diagram.

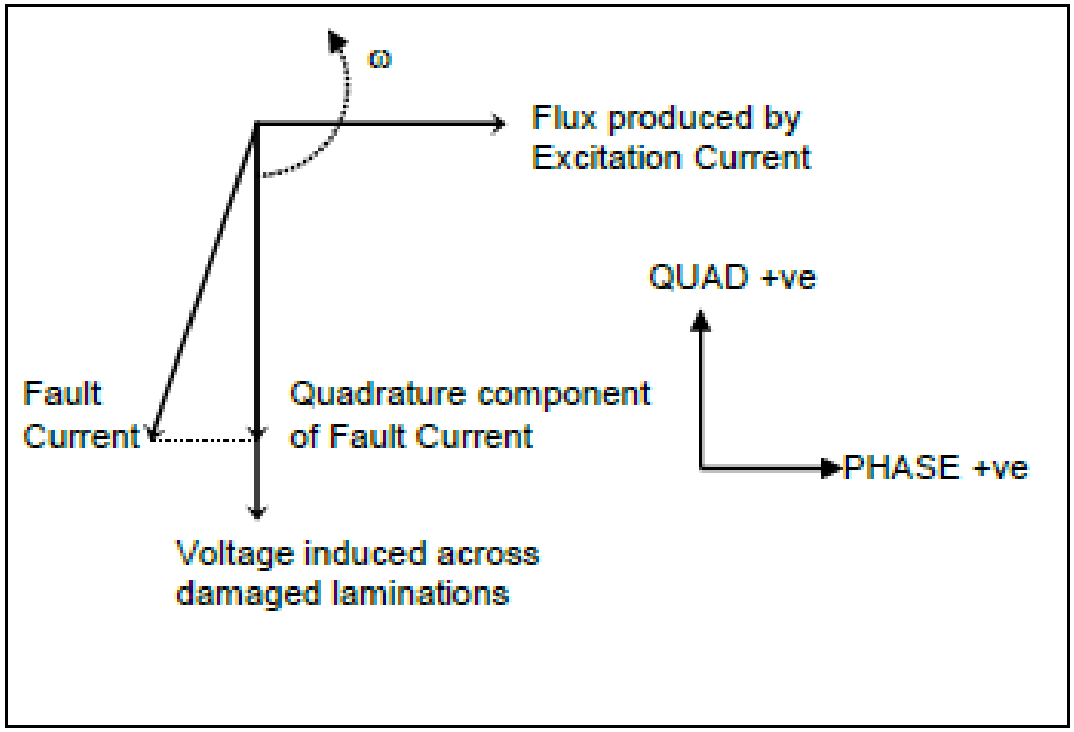

Figure A1.3: Basic vector diagram and P/Q axes

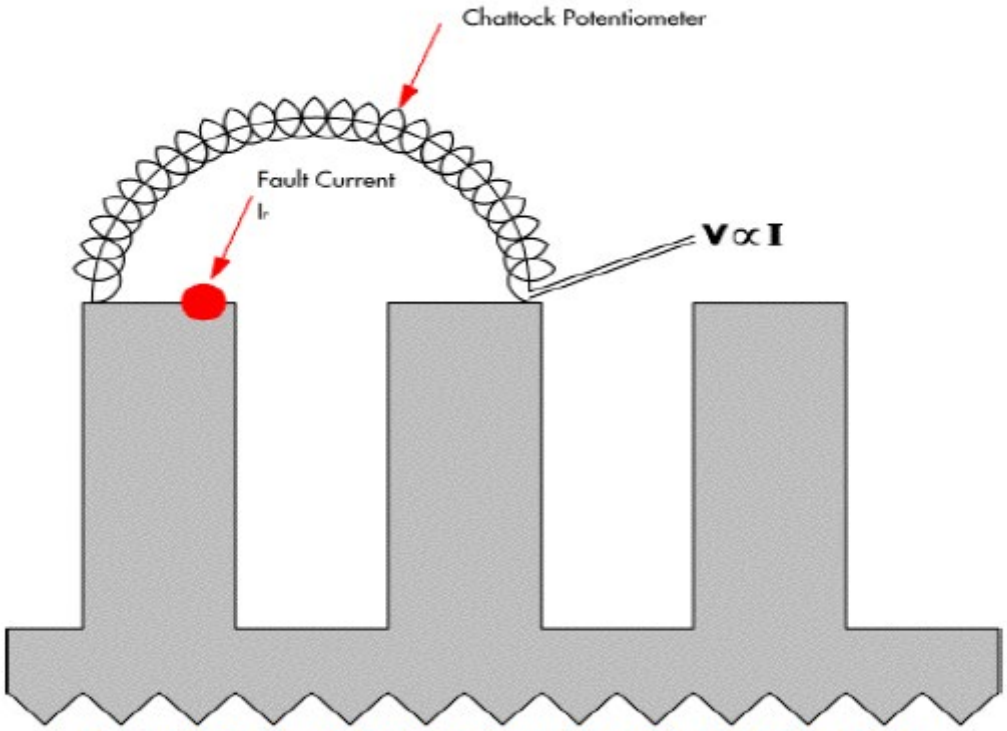

Figure 4: Chattock Potentiometer Position on Stator Teeth

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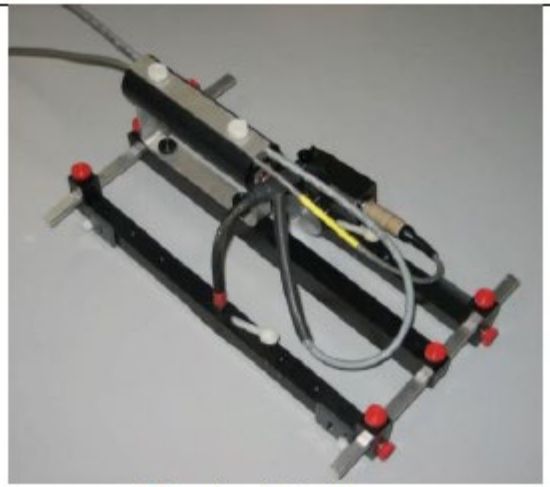

Standard Trolley

Step Iron Trolley

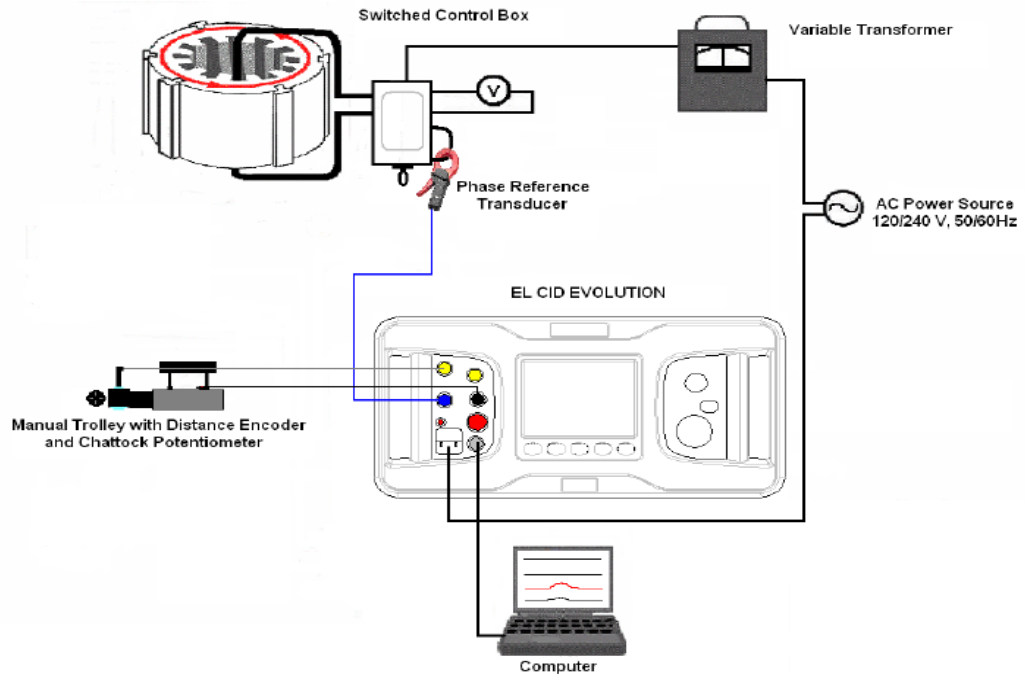

Figure 6: EL CID Evolution System Interconnections.

The cables should be connected as shown, and listed below:

First Chattock (yellow sleeve)	Signal Input 1
Second Chattock, if used (yellow sleeve)	Signal Input 2
Reference Sensor on excitation cable (blue sleeve)	Reference
Distance encoder Trolley/RIV (black sleeve)	X-Axis
PC (USB Cable – grey sleeve)	USB
AC Supply	Power

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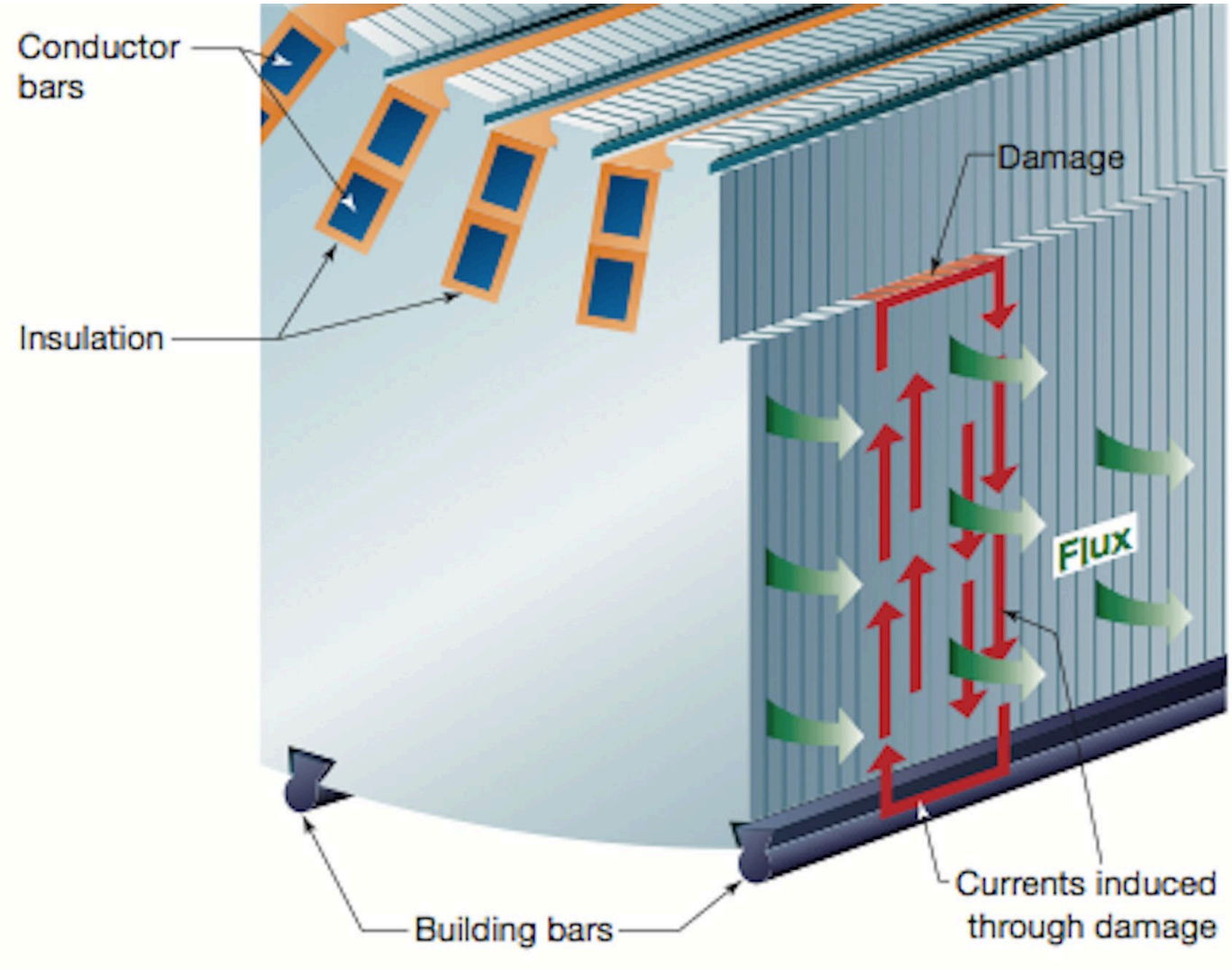
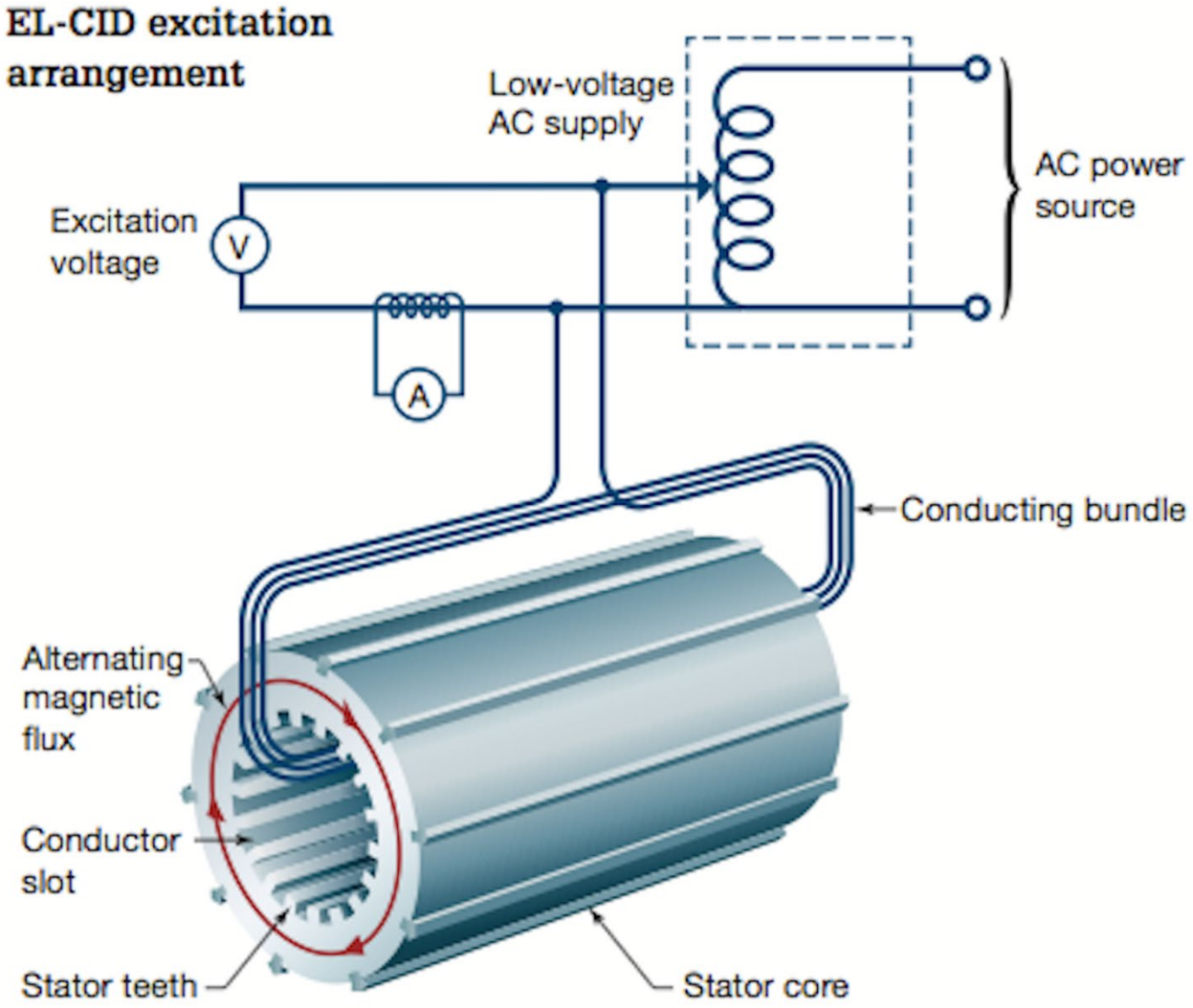



EL-CID excitation arrangement
Low-voltage AC supply
AC power source
Excitation voltage
V
A
Conducting bundle
Alternating magnetic flux
Conductor slot
Stator teeth
Stator core

Visual inspection red flags

When an operator inspects a generator, whether directly or via a video feed from a robotic vehicle, these are the issues they are looking for:

- **Foreign objects.** This could be either a build-up of general contamination or, in unusual cases, actual objects that have entered the generator. Examples of things that have been found include insects and plastic wrappers.
- **Damage to the stator core.** This might include dents or other evidence of impact to the lamination of the core.
- **Hotspots.** These are identifiable by discolouration of surfaces indicating unusually high levels of heat buildup.
- **Fretting dust.** This indicates movement of the coils, suggesting a problematic lack of tightness.
- **Blockages of the ventilation slots** in the rotor or stator, either through contamination or foreign objects.
- **Movement of rotor coil insulation.** The holes through the rotor coils should be perfectly aligned, and any misalignment indicates undesirable movement.
- **Any shifting of balance plugs.**

IMPORTANT
The supply MUST be connected as follows:

- **Live pole to the brown conductor,**
- **Neutral pole to the blue conductor,**
- **Earth to the green/yellow conductor.**

This allows that even if a user disconnects the excitation system when it is still erergized (which should NOT be permitted), that the live pole is connected to the socket contacts on the Excitation Cable connectors.

Add suitable monitoring for the excitation supply current and trace voltage as in section 4.8 above.

After determining that the system is safe to use, set the variable transformer to the zero setting and switch on the mains supply to the excitation system. Check that the current through the excitation winding and trace winding voltage are both essentially zero. Increase the variable transformer setting until the correct excitation voltage level is achieved. When a variable transformer is not being used, check the above current and voltage immediately after energising the system. If the current exceeds the safe supply limit or the excitation system ratings, turn off immediately and rearrange the excitation to increase the number of turns, even if this means that the desired trace voltage is not fully achieved.

Turn the variable transformer to the zero position and disconnect the power supply from the mains supply before disconnecting or re-arranging any plug or socket.

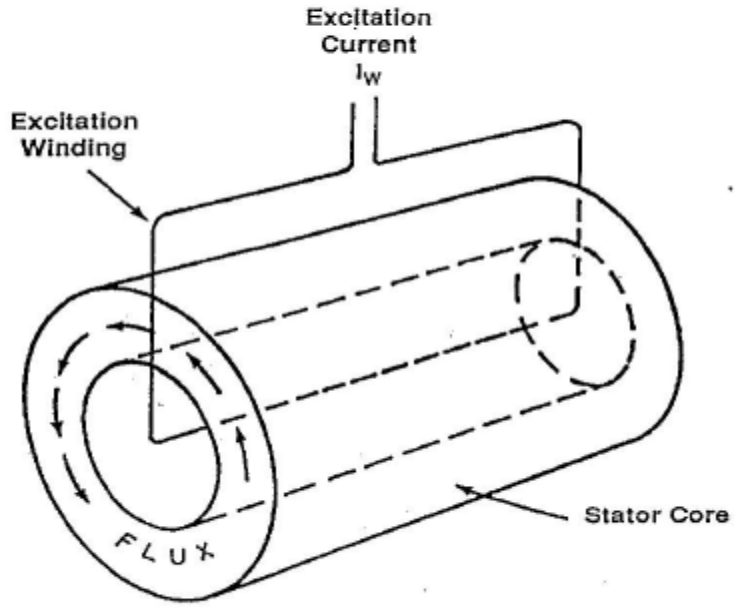
Required Excitation Levels

Loop Test

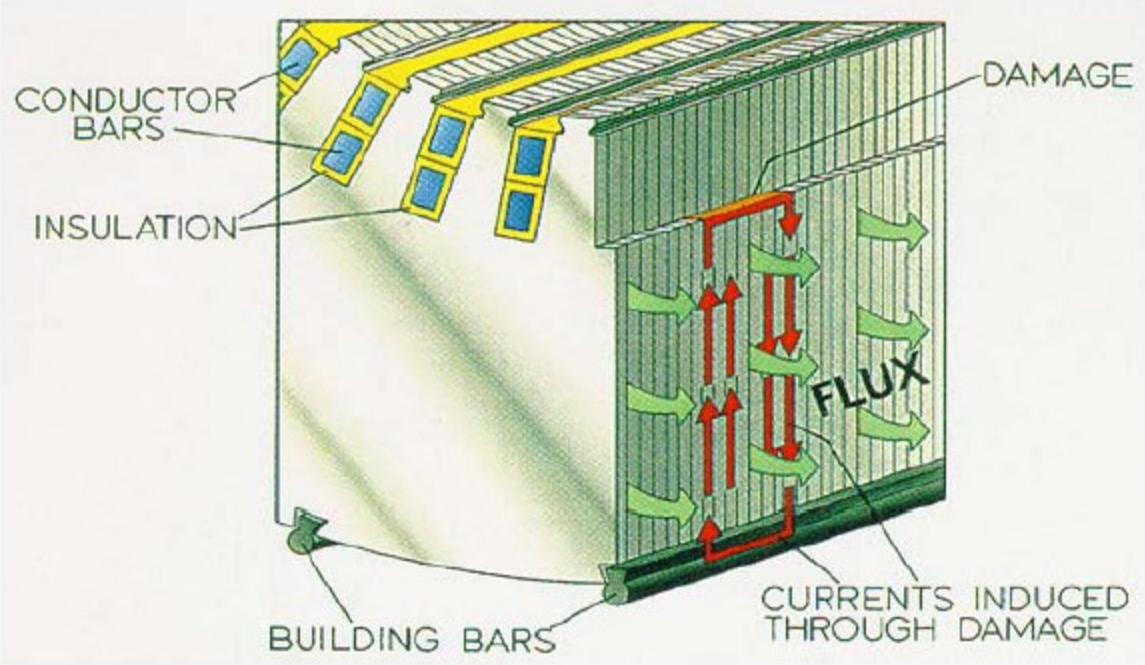
80-100%
(of rated flux density)

EL CID

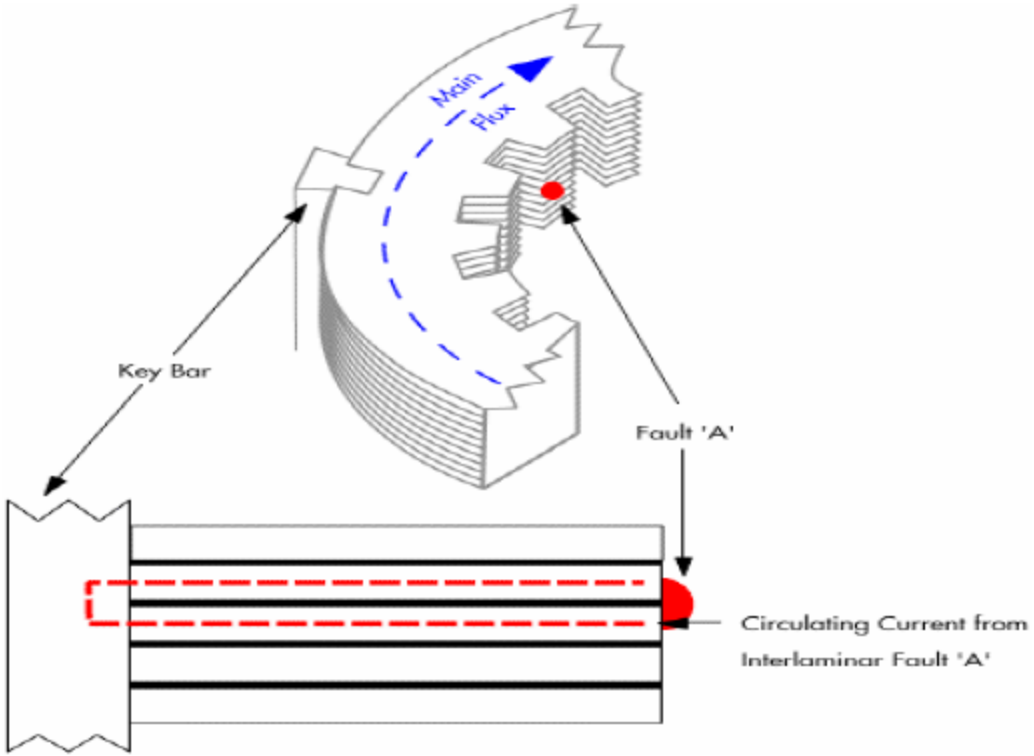
4%



Fault Current



Fault Current



ELCID Excitation Calculation

MANUFACTURER INFORMATION								
Manufacturer	GE	Excitation Turns	6			V/m		
Length of core (m)	2.08	Excitation Current (A)	1.3			3.7		
Rated Power KVA	46212	Single Turn Voltage (V)	7.7					
Rated Power KV	11	Tractor Scan Length (m)	2.08					
Wyn Connected	x	Delta Connected						
Number of slot	108	No. of Windings (Bars or Coils) per Slot	4	No. of Parallel Circuits/phase	4		No. of Series Turns/Coil	1
Number of phases	3	Volt (line to line)	11,000	Percent excitation	4%			

ELCID EXCITATION CALCULATION	
Volts per Turn Excitation V/t	Number of Turns in Series per Phase (tp)
7.7	18
Output Voltage required from variac using 6 turns	Variac Recommended (i.e. 120 ac or 240 ac)
46.2	120

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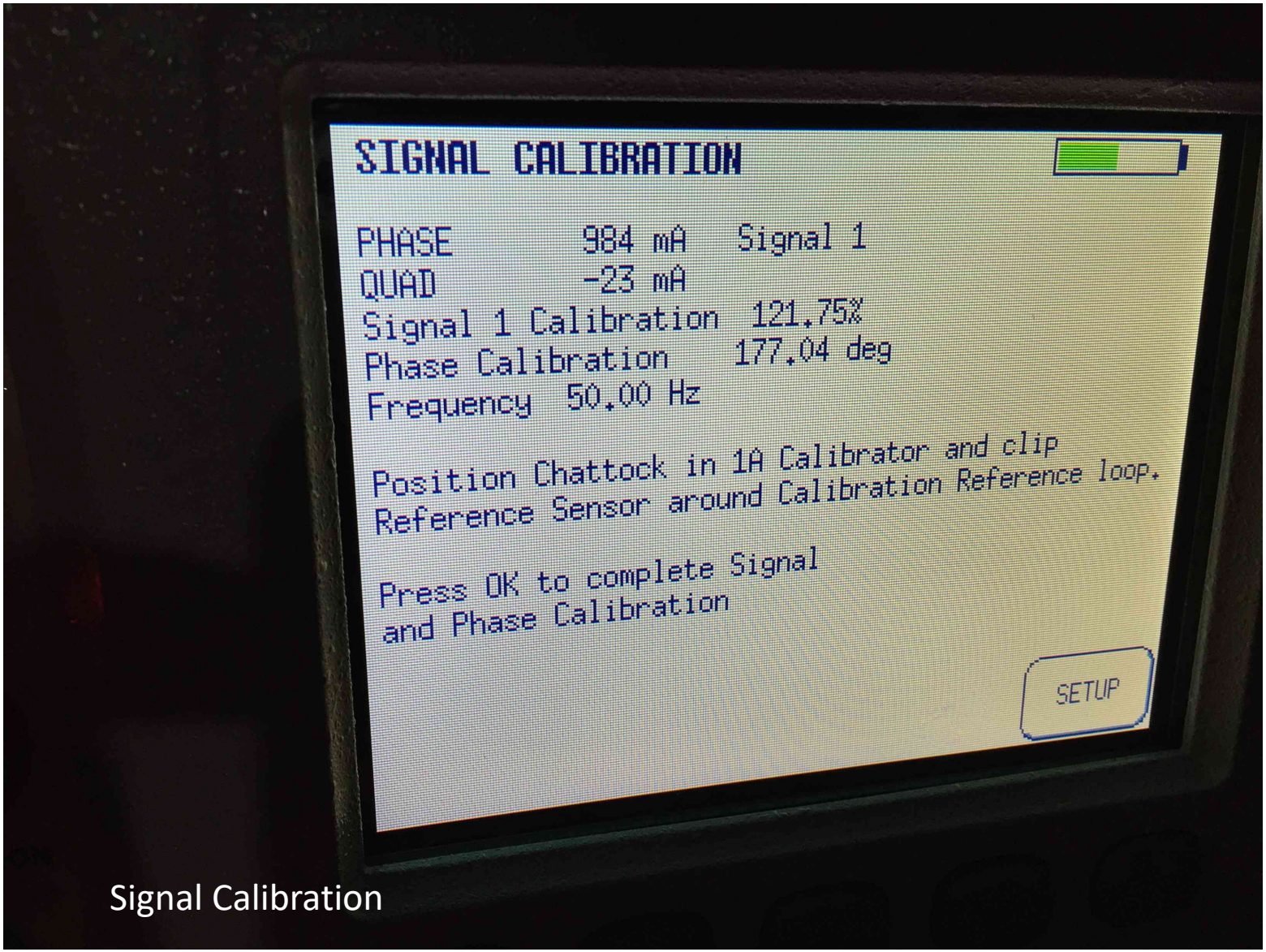
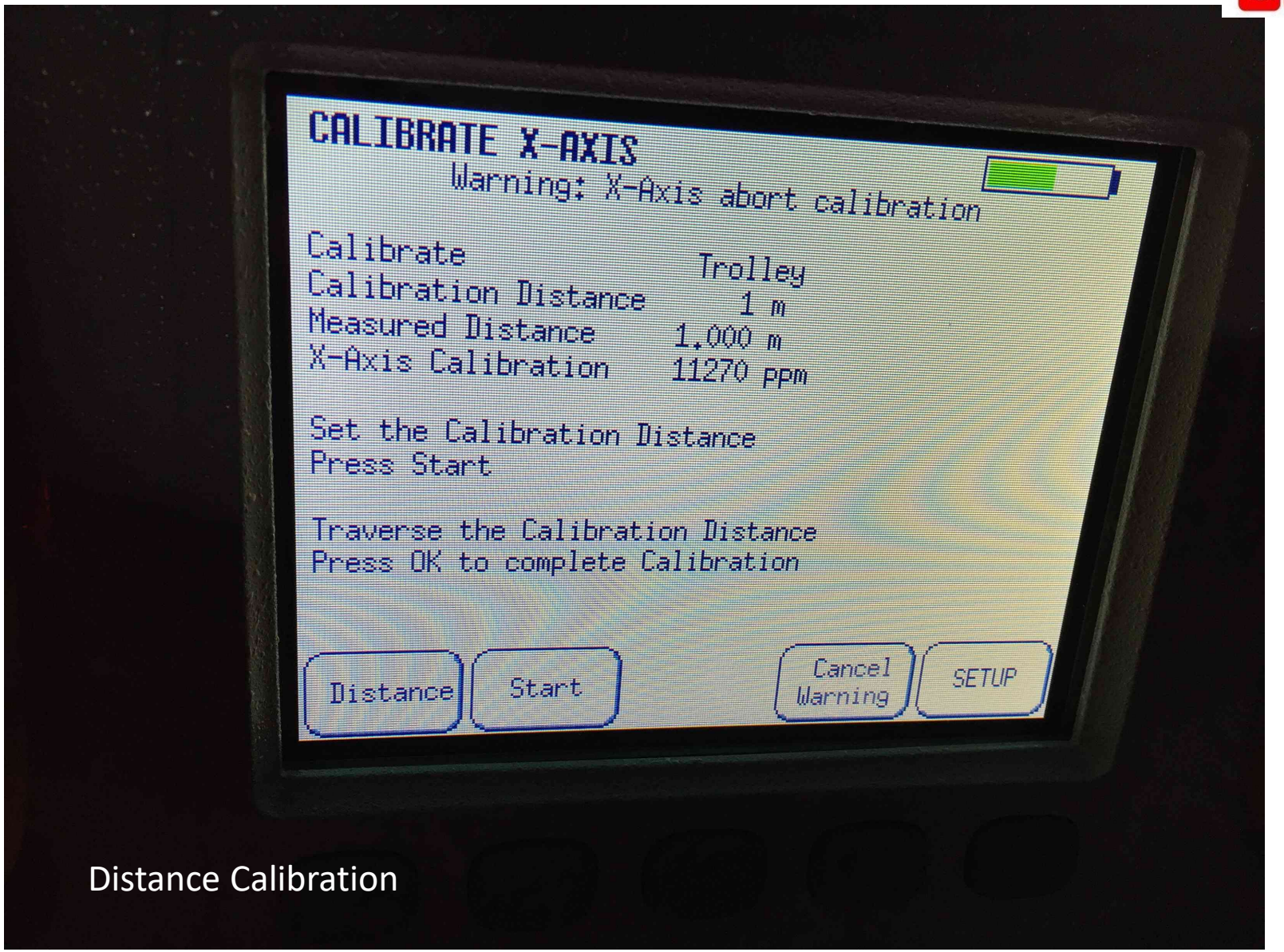
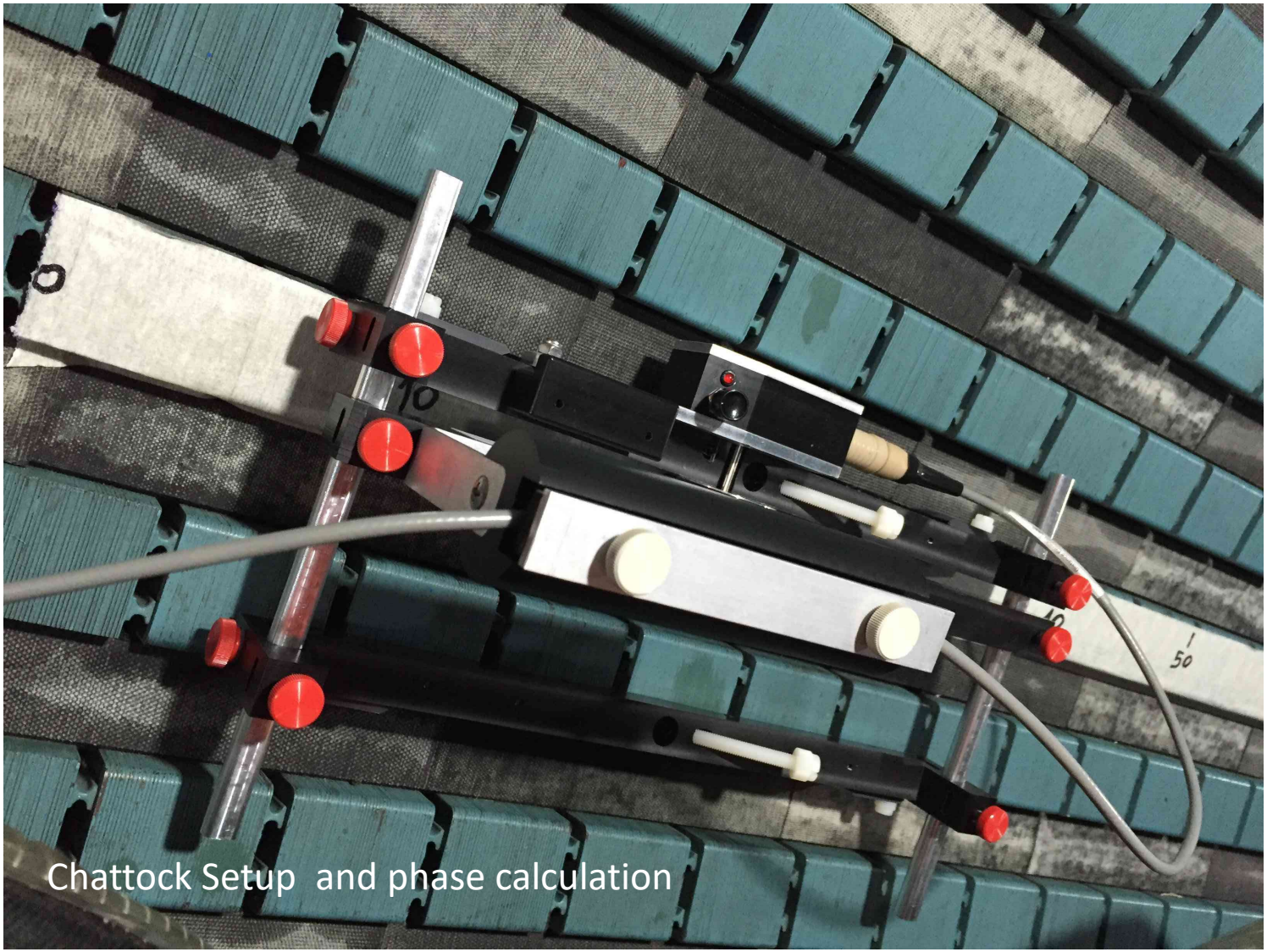


Signal Calibration



Distance Calibration



Chattock Setup and phase calculation

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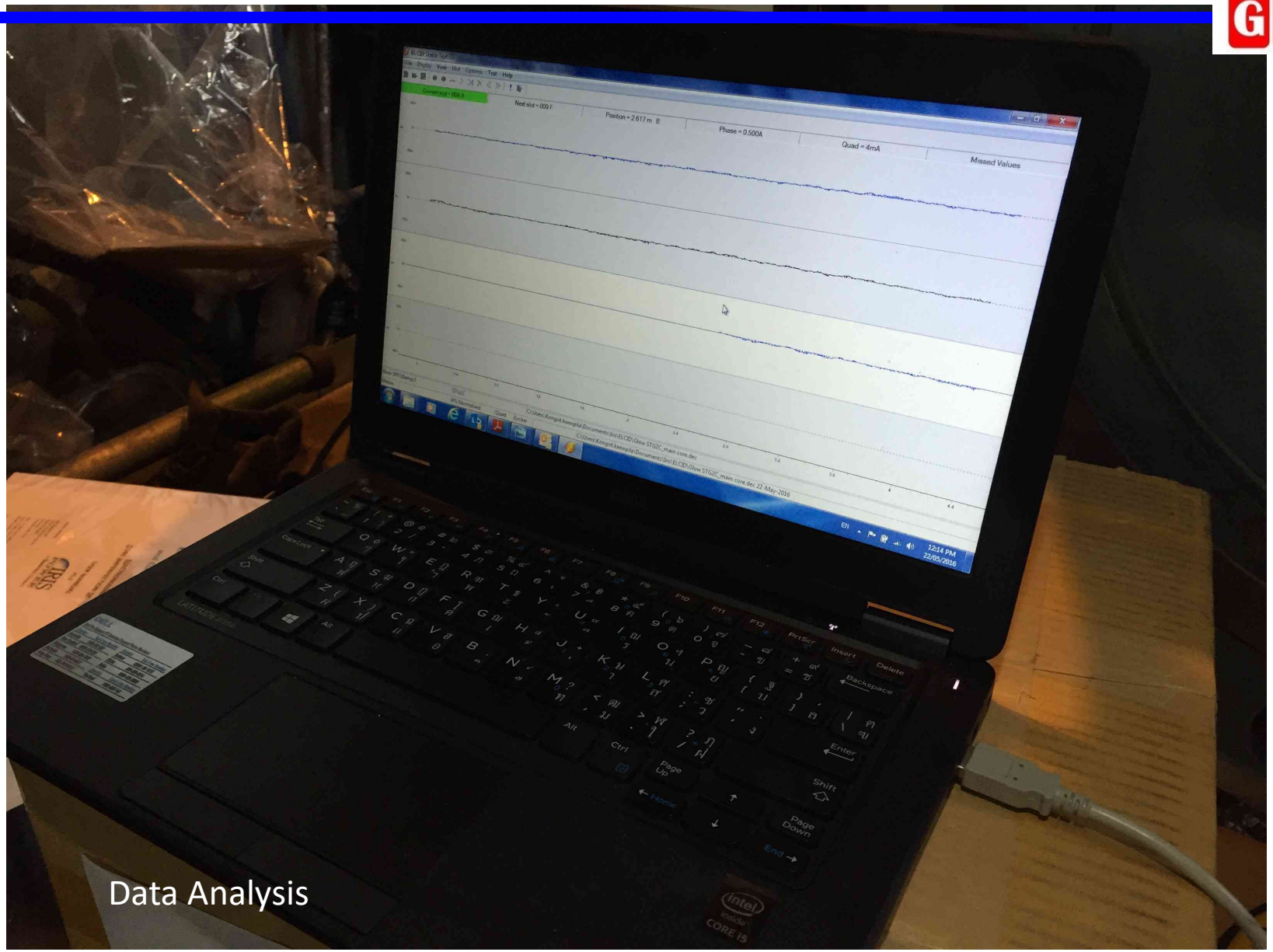

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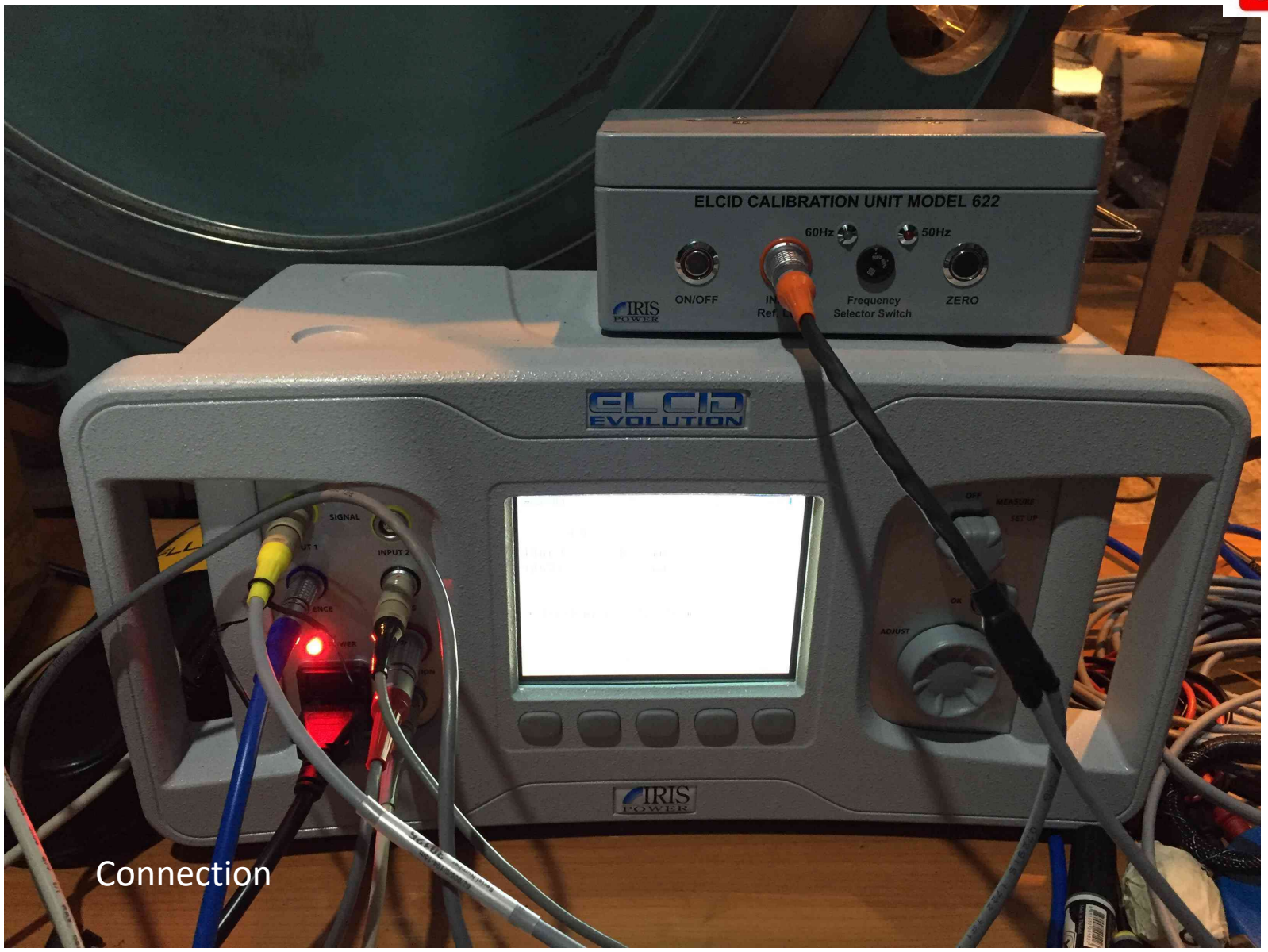

Connection

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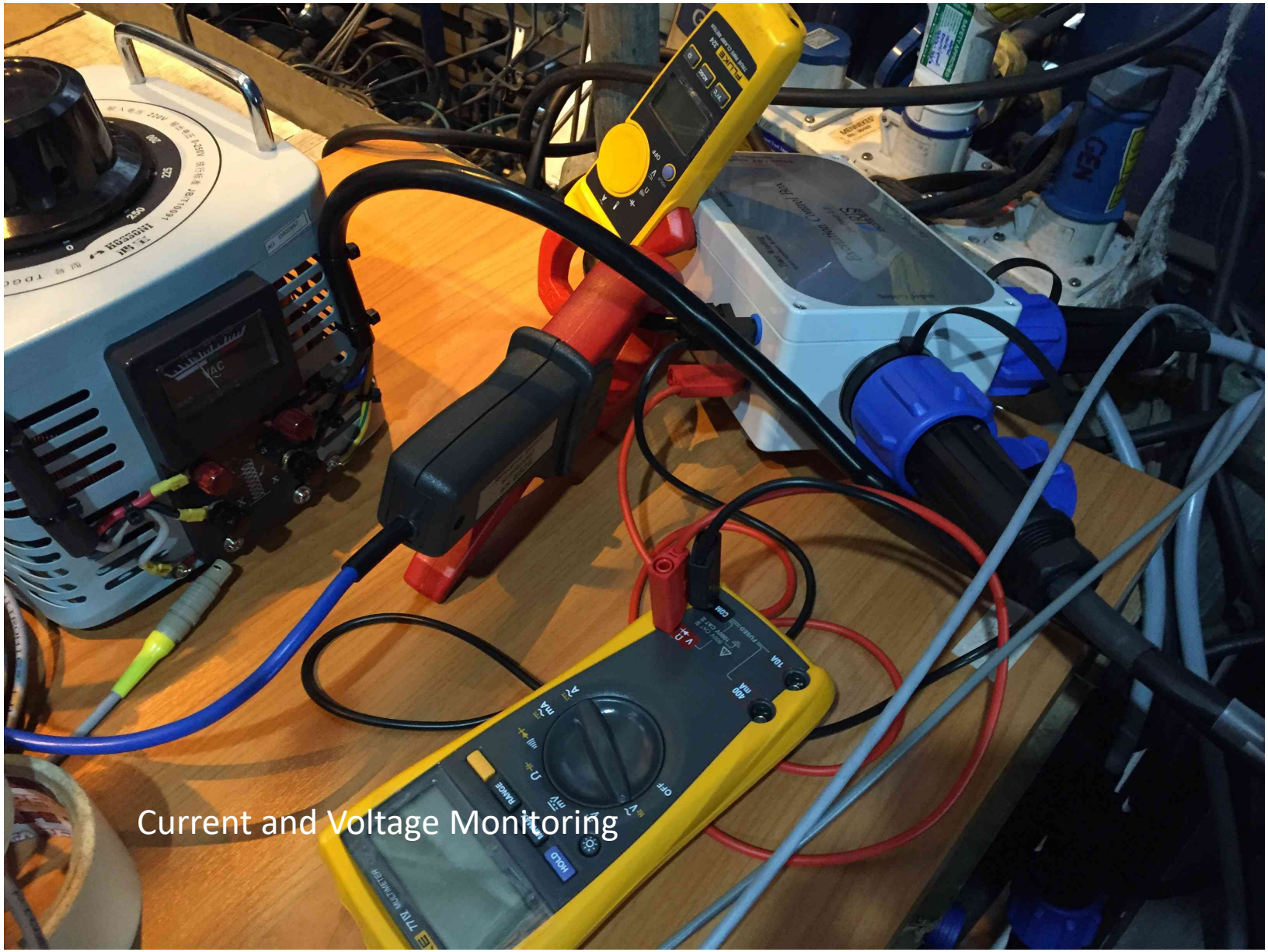

Current and Voltage Monitoring

Current and Voltage Monitoring

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Test data monitoring

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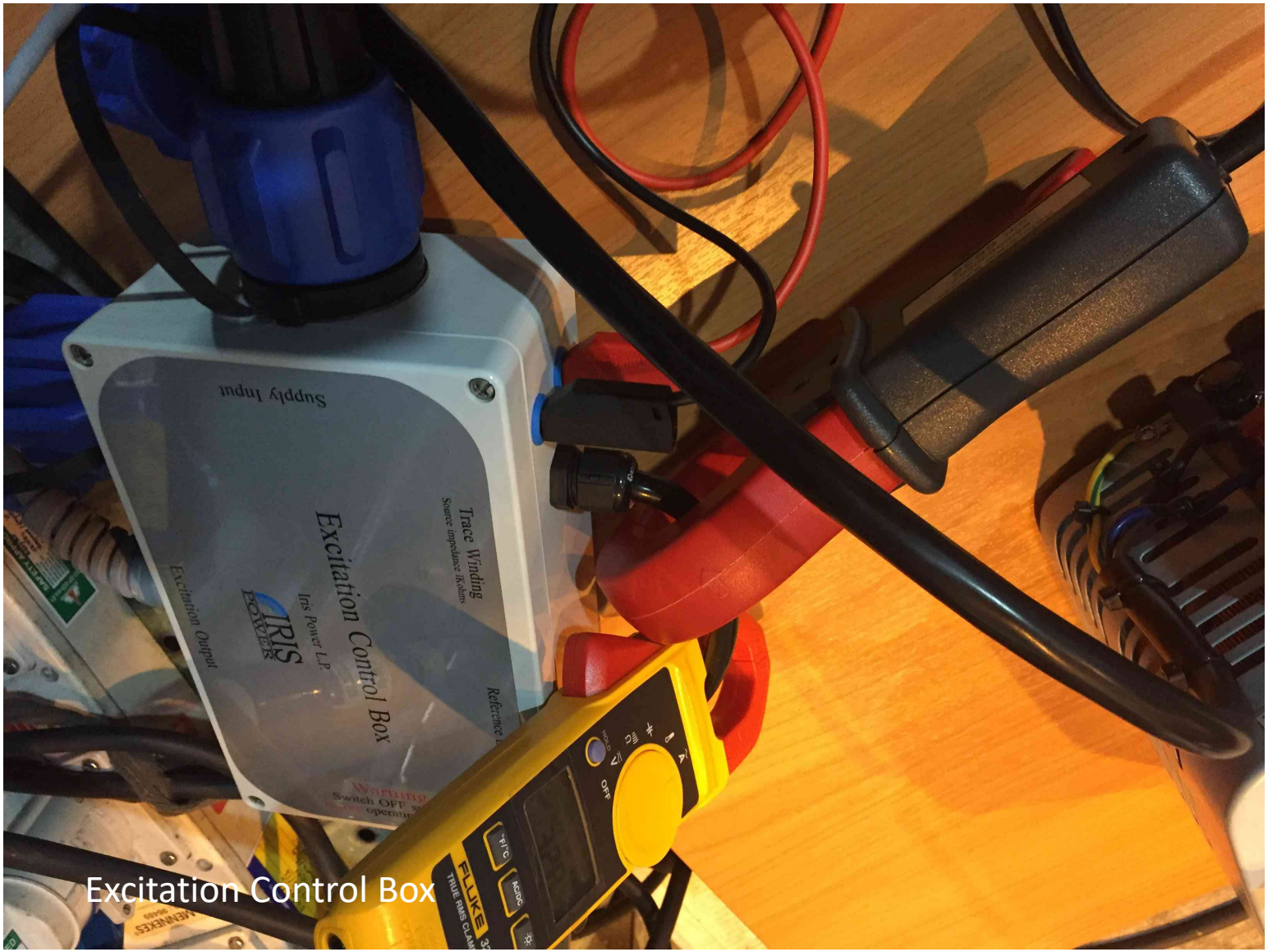

Excitation Control Box

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Excitation Control Box – Over all connection

ELCID Evolution User Manual

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Tel. 089-549-3277