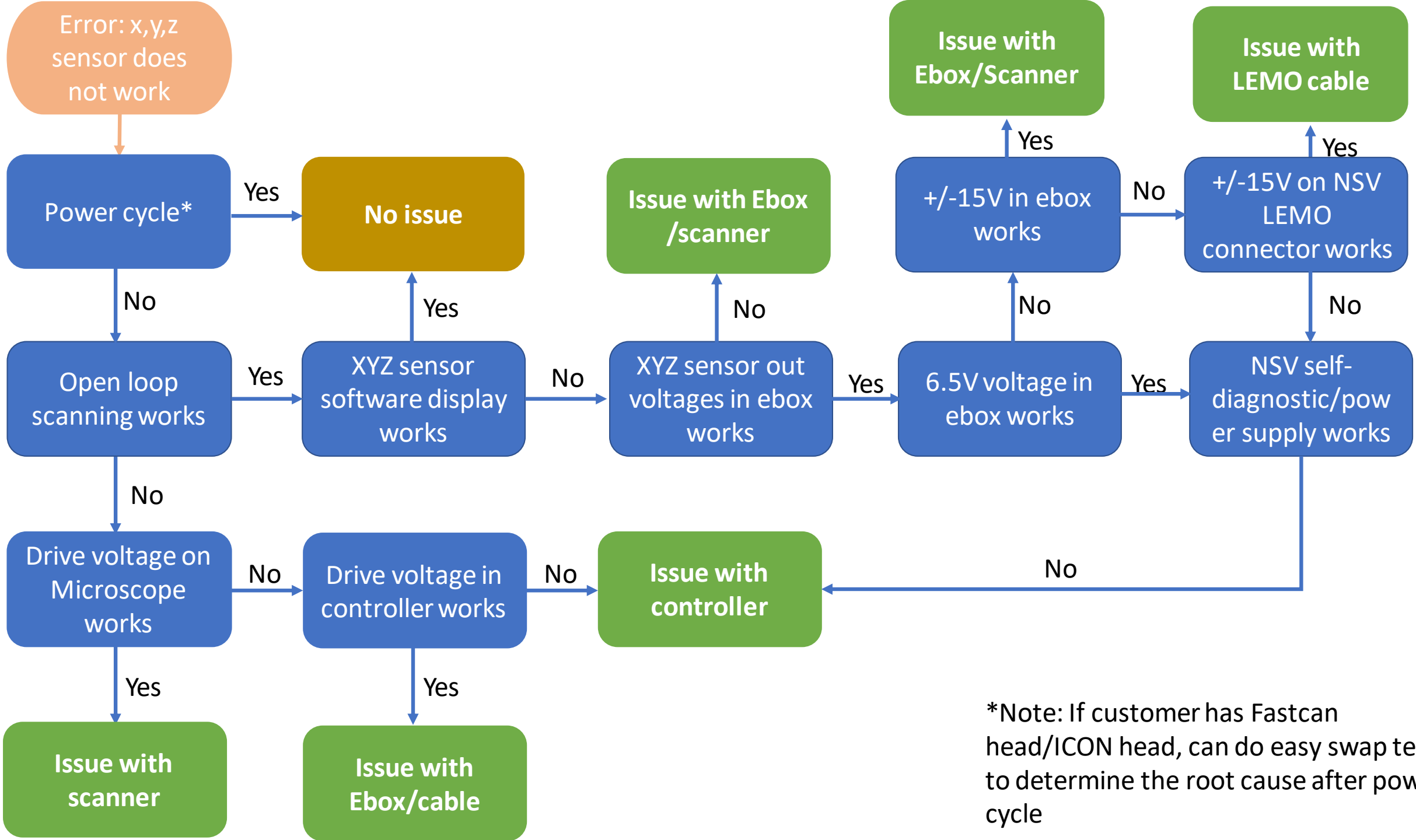


# Troubleshooting X,Y,Z sensor/nulling error in ICON

Linghan Ye, Igor Titushkin, Yueming Hua

- The purpose of this document is to collect as many data as possible from customer, please provide all the data collected and send to Bruker service Engineers.
- Please refer to following the documents for additional troubleshooting details if you have fundamental questions:
  - NBSB0143\_Scanner Closed-Loop Errors on NS5 Systems
  - TS guide Closed-loop Rev B\_r
  - Stargate Scanner Troubleshooting Guide
  - NS-V controller troubleshooting procedure
  - NBSB0003 NS5 Diagnostic System Tool
  - NBSB0016 Testing the HV Board and Supply on NS5 and BIO-II Controllers

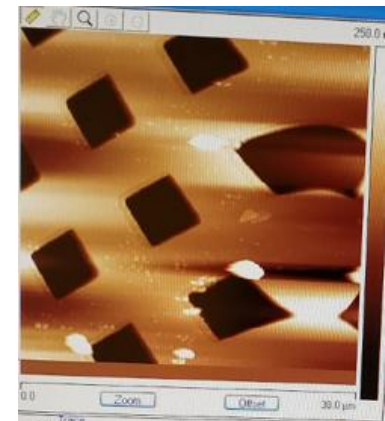


\*Note: If customer has Fastcan head/ICON head, can do easy swap test to determine the root cause after power cycle

# Power cycle and check open loop

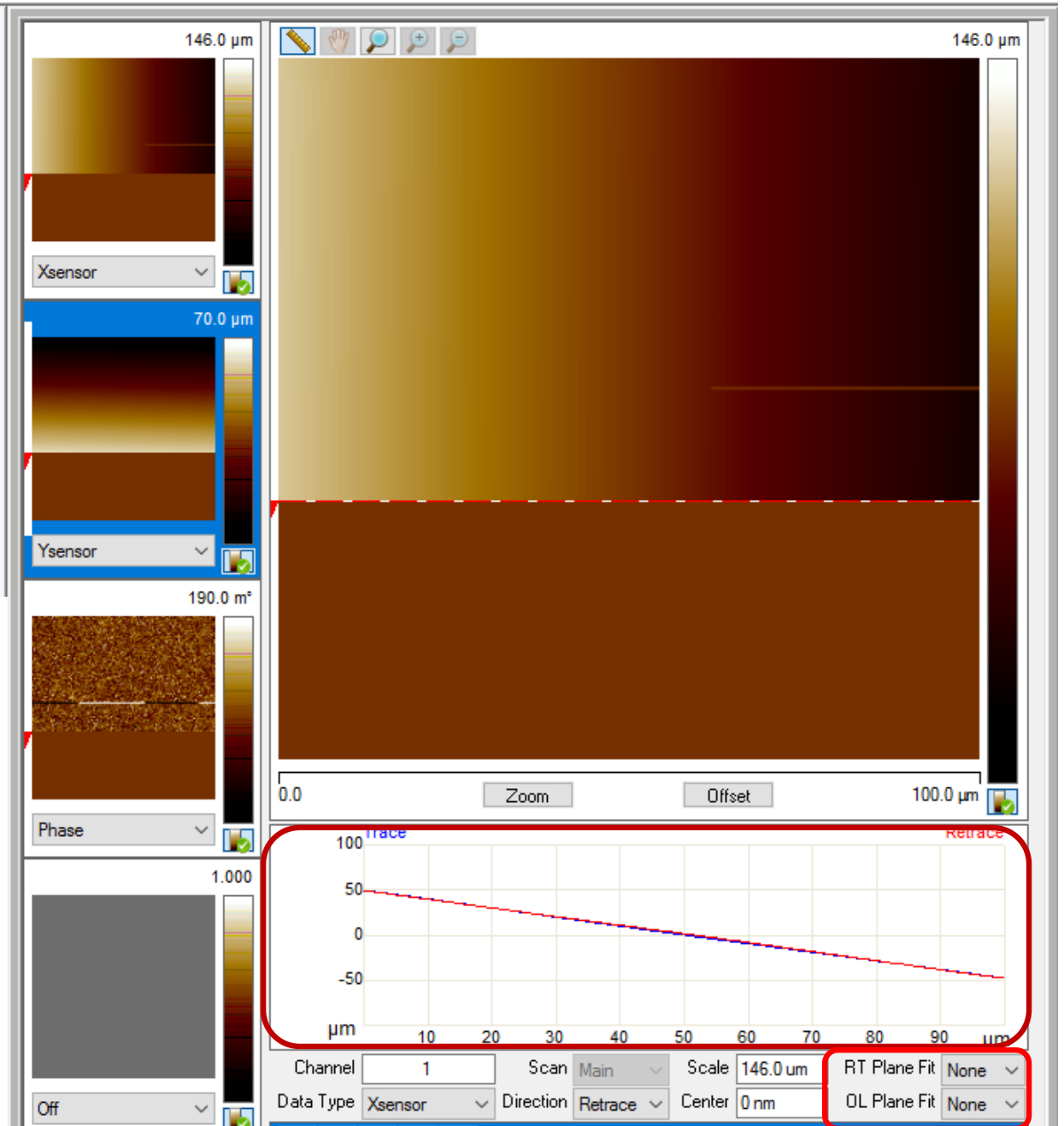
- First power cycle: close software>> controllers>> computer; then turn on computer>>controllers>>software and try to scan again
- Load contact/tapping mode, Put open loop(closed loop off), use Calibration grid sample to get a max scan size image, collect both **height and height sensor** channels. save the image and send to support team
- Check if tip is moving normally in the video image
  1. If open loop works, check slides 4- 13
  2. If open loop can't engage or the image is distorted, go to slides 16-22(check ICON scanner drive voltage). example of a distorted Open loop height image below:

Scan	
Scan Size	99.8 $\mu\text{m}$
Aspect Ratio	1.00
X Offset	0.000 nm
Y Offset	0.000 nm
Scan Angle	0.00 $^\circ$
Scan Rate	0.996 Hz
Tip Velocity	199 $\mu\text{m/s}$
Samples/Line	256
Lines	256
Slow Scan Axis	Enabled
Scan Single Frame Number	1
XY Closed Loop	Off
Feedback	
Integral Gain	0.5000
Proportional Gain	5.000
Amplitude Setpoint	13.61 nm
Analog2	0 V
Drive Frequency	54.54381 kHz
Drive Amplitude	275.0 mV
Lock-In Phase	-40.63 $^\circ$
Lock-In BW	7.674 kHz
LP TM Deflection BW	2.500 kHz



# XYZ sensor software display: X sensor

Scan	
Scan Size	100.0 $\mu\text{m}$
Aspect Ratio	1.00
X Offset	0.000 nm
Y Offset	0.000 nm
Scan Angle	0.00 $^\circ$
Scan Rate	0.992 Hz
Tip Velocity	198 $\mu\text{m/s}$
Samples/Line	256
Lines	256
Slow Scan Axis	Enabled
XY Closed Loop	Off
Bidirectional Scan	Disabled
Feedback	
Integral Gain	0
Proportional Gain	0
Amplitude Setpoint	33.12 nm
Drive Frequency	227.0260 kHz
Drive Amplitude	149.8 mV
Lock-In Phase	-16.34 $^\circ$
Lock-In BW	15.97 kHz
Auto Amplitude Setpoint	Off



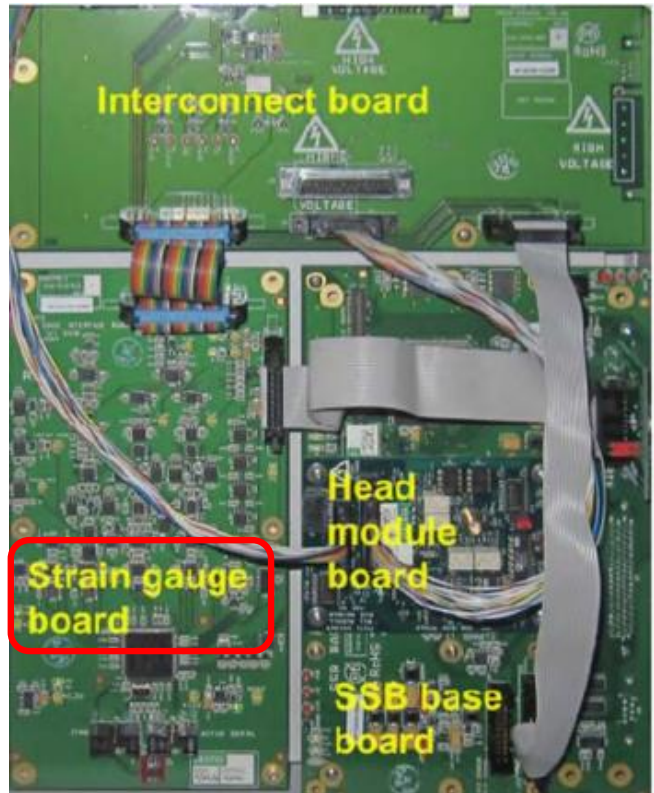
- Load contact/Tapping mode, Withdraw the tip twice to lift the tip, make sure XY closed loop is off; put “Igain” “Pgain” to 0;
- Click on to menu Microscope>>>>false engage;
- Set the Max scan size to 440V, scan angle 0 degree, open “X sensor channel”, set RT plane fit to “None” and OL plane fit to “None”, scan an image
- Right is a example of good x sensor image, take a screenshot and send yours to Bruce service team.



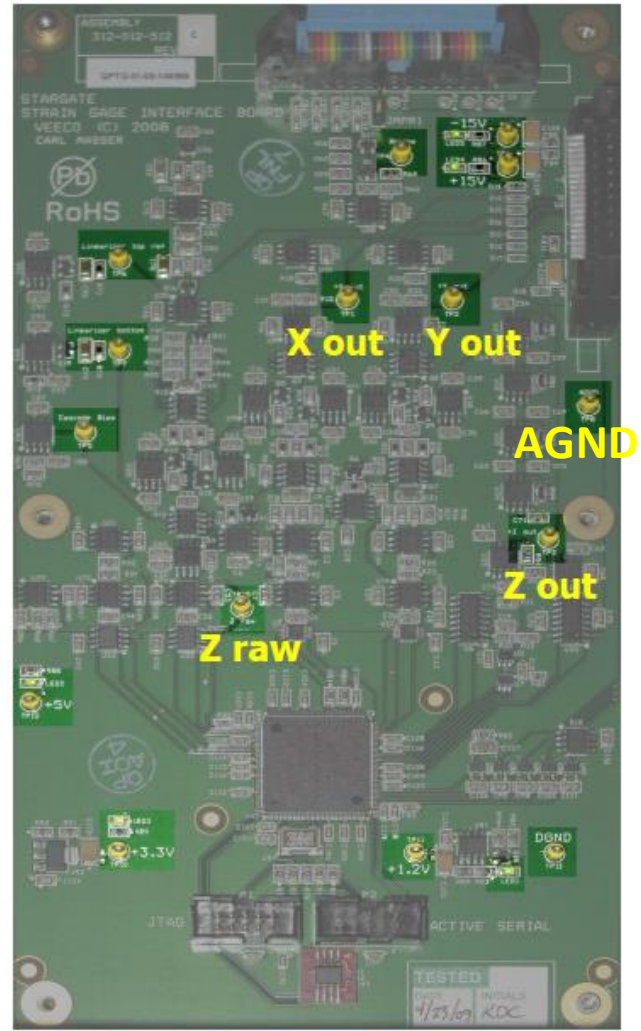
# Measure the +X out in the e-box(false engage)

Test Point	Reference	Function
TP1	+X OUT	+X sensor out signal

1. Find where the Strain gauge board located in ebox



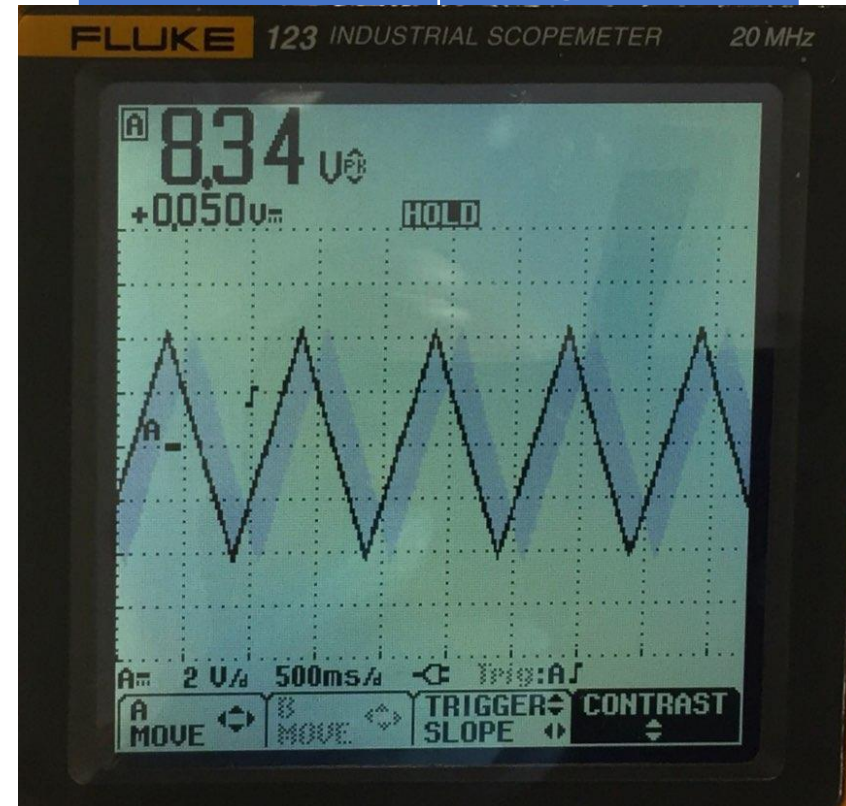
2. Find where +X out on strain gauge board



Strain gauge interface board

3. Use Oscilloscope to measure, use **AGND** as ground

**+X OUT**      **8~10 Vpp**  
**triangular wave**



# XYZ sensor software display: Y sensor(90°)

The screenshot displays the XYZ sensor software interface. On the left, a parameter list is shown with 'Scan Angle' set to 90.0° and 'XY Closed Loop' set to Off. The main area shows a large Y-sensor image with a color scale from 0.0 to 146.9 μm. Below the image is a trace plot showing a linear relationship between the X and Y axes, with a 'Trace' line in blue and a 'Retrace' line in red. The bottom right corner shows settings for 'RT Plane Fit' and 'OL Plane Fit', both set to 'None'.

Parameter	Value
Scan Size	98.9 μm
Aspect Ratio	1.00
X Offset	0.000 nm
Y Offset	0.000 nm
Scan Angle	90.0 °
Scan Rate	0.992 Hz
Tip Velocity	196 μm/s
Samples/Line	256
Lines	256
Slow Scan Axis	Enabled
XY Closed Loop	Off
Bidirectional Scan	Disabled

Parameter	Value
Integral Gain	0
Proportional Gain	0
Amplitude Setpoint	33.12 nm
Drive Frequency	227.0260 kHz
Drive Amplitude	149.8 mV
Lock-In Phase	-16.34 °
Lock-In BW	15.97 kHz
Auto Amplitude Setpoint Off	

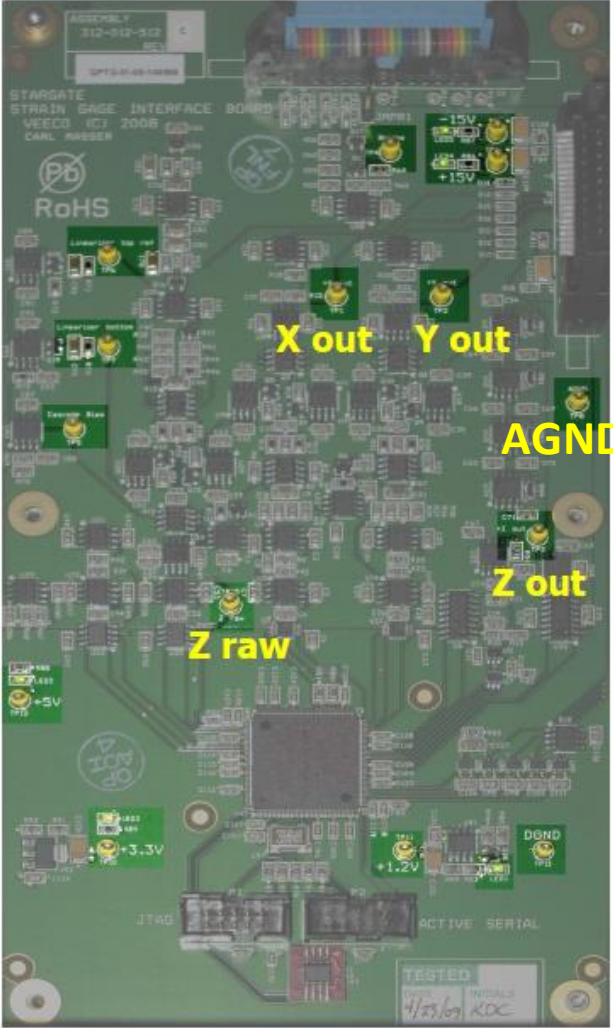
Channel	Scan	Scale	RT Plane Fit
1	Main	146.9 μm	None

Data Type	Direction	Center	OL Plane Fit
Ysensor	Retrace	0 nm	None

- Set the Max scan size to 440V, scan angle 90 degree, open Y sensor channel, set RT plane fit to “None” and OL plane fit to “None”, scan an image
- Right is a example of good Y sensor image

# Measure the +Y out (false engage, 90°)

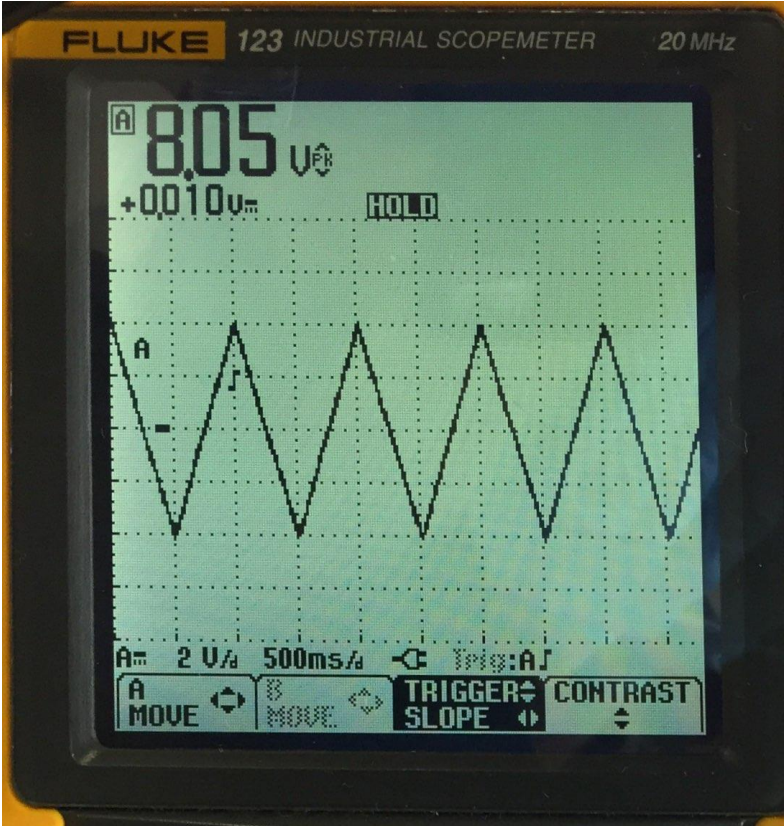
TP2	+Y OUT	+Y sensor out signal
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Strain gauge interface board

Use Oscilloscope to measure +Y out, use **AGND** as ground

+Y OUT	8~ 10 Vpp triangular wave
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# XYZ sensor software display: Z sensor

The screenshot displays the software interface for the XYZ sensor. The 'Workflow Toolbar' on the left has the 'Ramp' mode selected. The 'Ramp' settings panel shows the following parameters:

Ramp Output	Z
Ramp Size	15.51 $\mu\text{m}$
Ramp Position	5.169 $\mu\text{m}$
Ramp Rate	1.03 Hz
Forward Velocity	31.9 $\mu\text{m/s}$
Reverse Velocity	31.9 $\mu\text{m/s}$
Speed Increment Max	3.00 $\mu\text{m/s}$
Samples/Ramp	512
Hold Time	0.00 s
Retracted Delay	0.00 s
X Rotate	0.00 $^\circ$
Z Closed Loop	Off
Trigger Mode	Off

The 'Height Sensor' graph shows the sensor's output in  $\mu\text{m}$  versus the Z position in  $\mu\text{m}$ . The graph displays two linear data series: a red line representing the 'Height Sensor' and a blue line representing the 'Z' data type. Both lines show a positive linear correlation, starting near 0 at Z=0 and reaching approximately 7  $\mu\text{m}$  at Z=15  $\mu\text{m}$ .

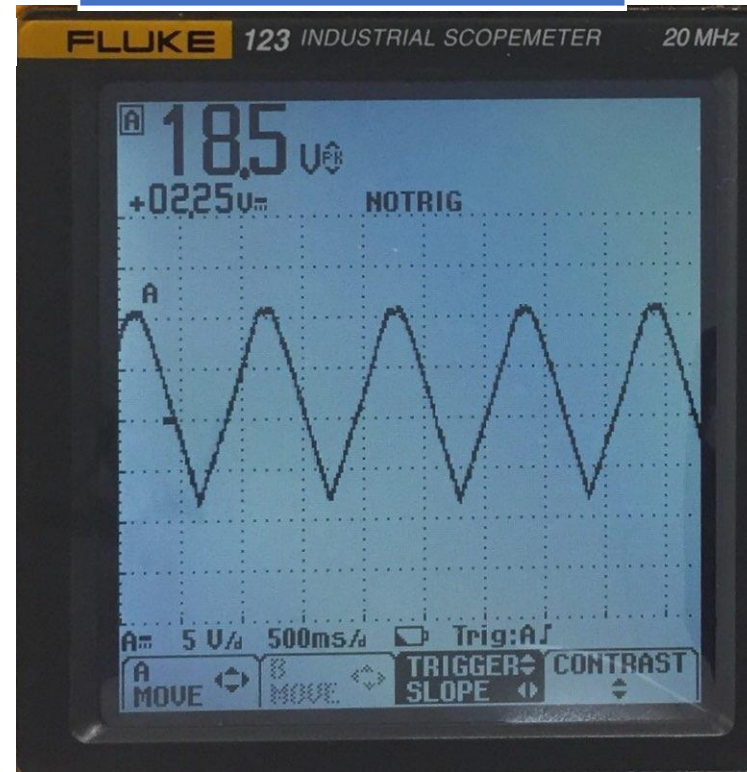
- Still false engage, Change to "Ramp" mode
- **Z closed loop off**, trigger mode off
- Set ramp output to "Z", Ramp Size to max, Data type to "height sensor" X data type "Z", then click continuous ramp icon, screenshot the ramp data
- Above is a good example of Z sensor



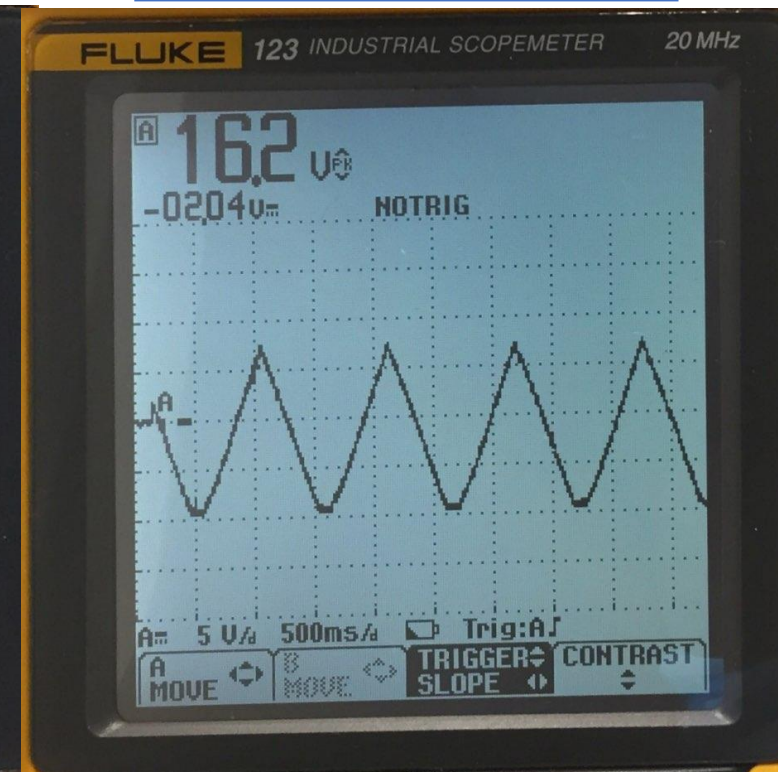
# Measure the +Z out/Z raw and use AGND as ground in ebox

TP3	+Z OUT	+Z sensor out signal
TP15	Z raw	Z sensor signal before selectable gain stage

+Z Raw(from scanner)



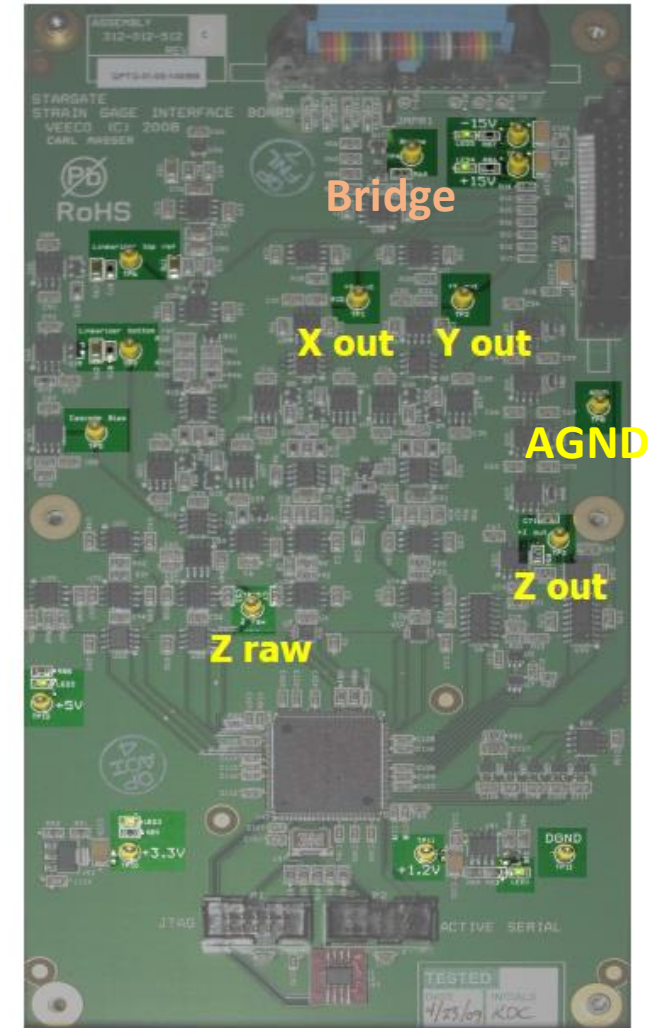
+Z OUT(to controller)



# measure TP4 +6.5 V DC and others in ebox

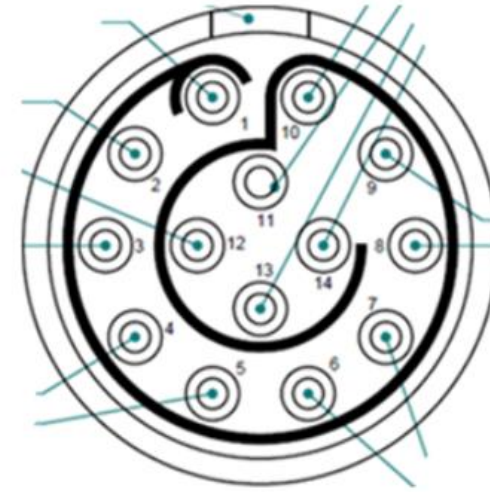
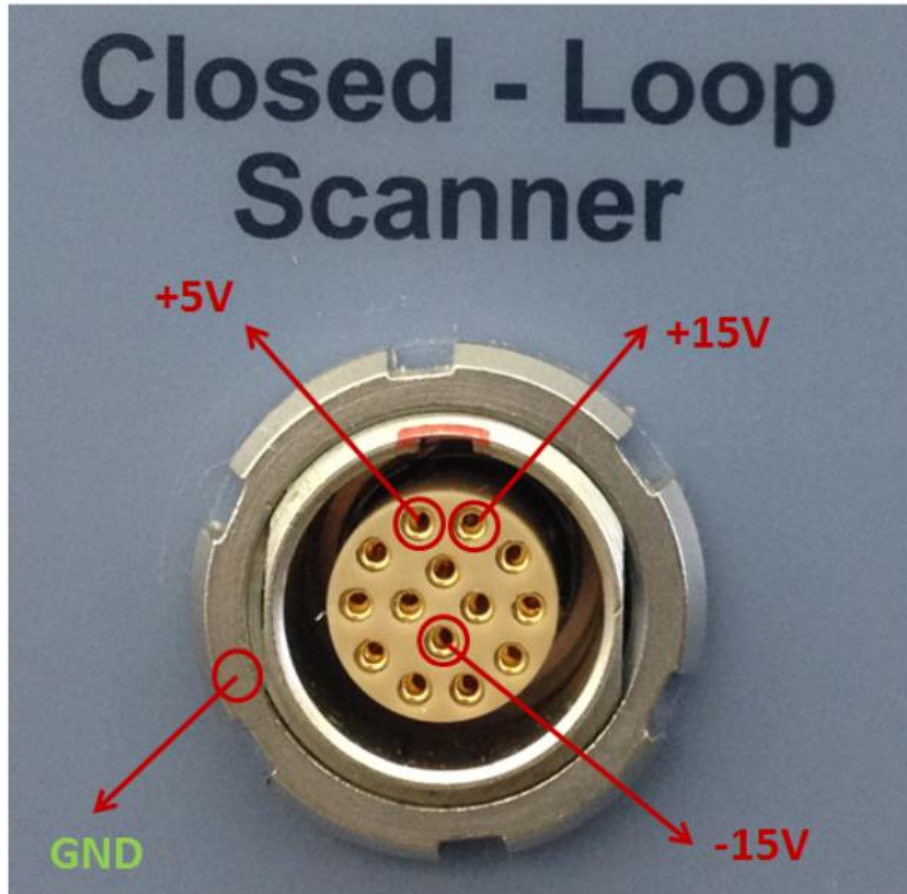
Please measure the voltages in the table below and send to Bruker service

Test point	Reference	function	Measurement condition
TP4	BRIDGE	+6.5V supply between BRIDGE(TP4) and AGND for head preamp board	With scanner connected
TP4	BRIDGE	+6.5V supply between BRIDGE(TP4) and AGND for head preamp board	Disconnect scanner cable from Microscope
TP9	-15V	-15V power supply in ebox	Disconnect scanner
TP14	+15V	+15V power supply in ebox	Disconnect scanner
TP12	+5V	+5V power supply in ebox	Disconnect scanner
CL connector NSV controller	see picture in next slide	LEMO cable connector on the NSV controller	Disconnect scanner



Strain gauge interface board

# Check voltage on NS-5 CL connector



- 1: +5V
- 10: +15V
- 13: -15V

- First please unplug the scanner, and check TP4 and TP14 in Ebox, see if now they reads correct voltage (+6.5V and +15V).
- If still not, then check what is the voltage reading on the +15V pin on NS5 controller front panel, please see the pin layout in following slide.
- If it reads abnormal, then the controller is the problem.
- If it has correct +15V, then check the resistance of each wire in the close loop cable, they should be only a few ohms of resistance for each wire.
- If the cable is confirmed good, then the problem is in the Ebox.

# NS5 Diagnostic Test

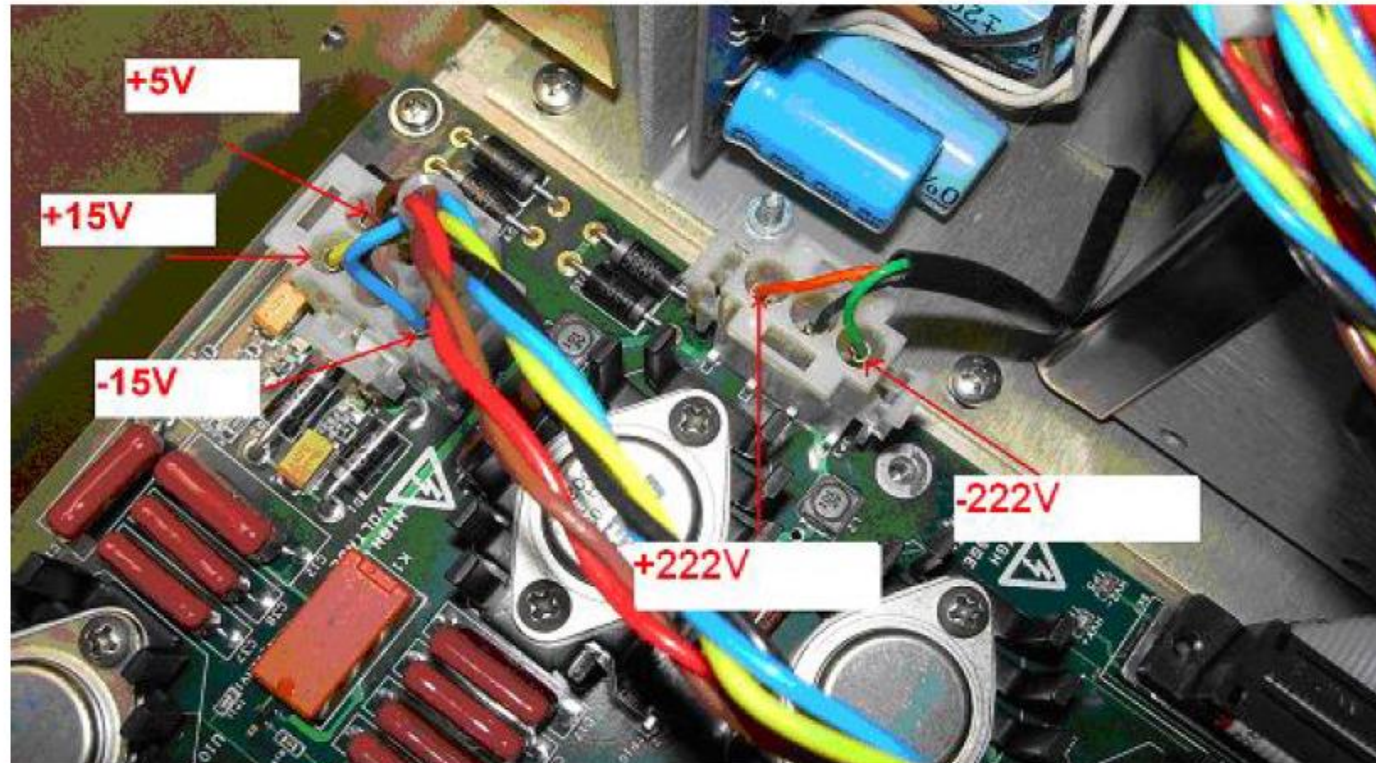
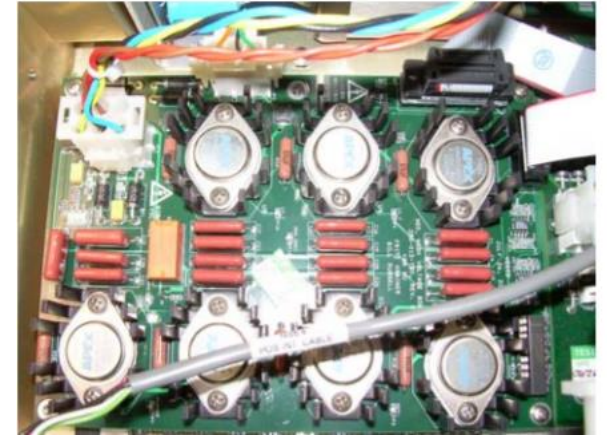
- 1. turn off **all the controllers**, computer can be on.
- 2. disconnect all the cables on front panel of NS5 controller
- 3. turn on the power of NS5 controller
- 4. Do NS5diagnostics test, download below if can't find in the D drive(D>> program files>>Bruker>>self diagnostic)

<ftp://anonymous@sboftp.bruker-nano.com/outgoing/GPTech/Linghan/NS5DiagnosticSystemInstaller.zip>

Follow: [NBSB0003 NS5 Diagnostic System Tool](#)

- 5. Need to restart this test if can't run, usually takes 20 min.
- 6. If fail, test the power supply of the controller (NBSB0016) next slide

# Check POWER SUPPLY in the NSV controller (NBSB0016)



open loop does not work tests

# Test drive voltage on Microscope

- Unplug the scanner, and measure the piezo drive signal from microscope (procedure in next slide)
- Need to bypass I2C below.
- If old version software, add the bypass I2C line in system.par (for example 8.15);
- if it's very old software, can't add the bypass I2C, then no need to unplug the scanner, skip this test.

## 1. Bypass I<sup>2</sup>C:

- a. Close NanoScope software
- b. Go to folder: D:\Program Files\Nanoscope\8.15xxx
- c. Double click file "system.par"
- d. Set "\Bypass Faulty Scanner I2C: Yes"

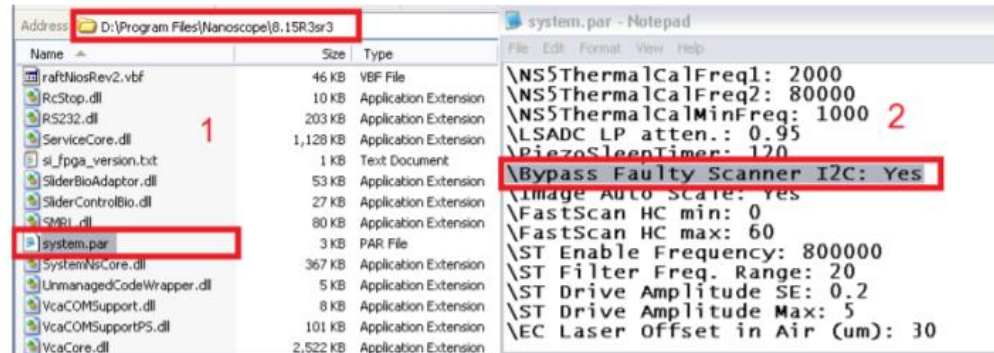
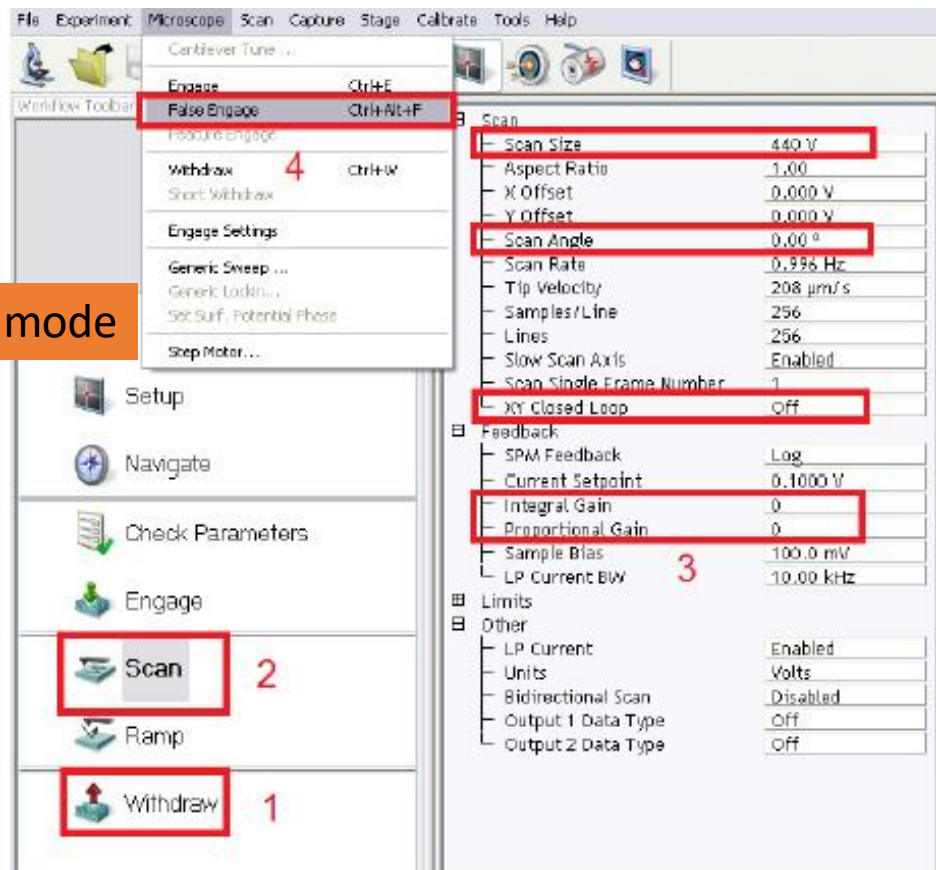


Figure 14. Bypass I<sup>2</sup>C in system.par



contact mode



- Scanner cable connector of micros



X: pins 4 and 5  
Y: pins 19 and 20  
Z pins 6 and 21



Figure 15. Pin layout of the scanner connector

1. Load contact mode, do "alt~", go to "stage control", turn crash protection off; Click "withdraw" twice
2. Click "scan", set the "scan size" to 440V, " scan angle 0 degree", "Closed loop off", "Integral gain 0" and "Proportial gain 0"
3. Click the Miscroscope on the top menu>>> false engage
4. Measure the XYZ voltage shown above
5. If see a 440 V triangular wave, then issue with scanner; If not, go to the next test
6. **Remember to put crash protection on when finish all the troubleshooting!!!!**



# Test drive voltage in controller

when scanner is removed:

- Set Bypass I2C to yes
- alt ~, stage control; crash protection off
- Check controller
- **Remember to put crash protection on once done!!!!**

## 1. Bypass I<sup>2</sup>C:

- Close NanoScope software
- Go to folder: D:\Program Files\Nanoscope\8.15xxx
- Double click file "system.par"
- Set "\Bypass Faulty Scanner I2C: Yes"

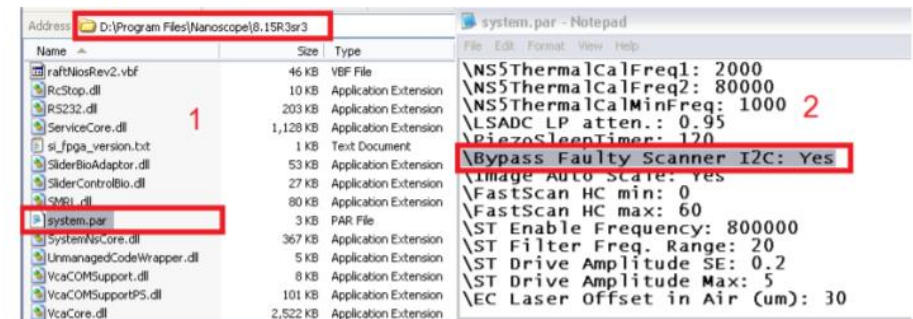


Figure 14. Bypass I<sup>2</sup>C in system.par

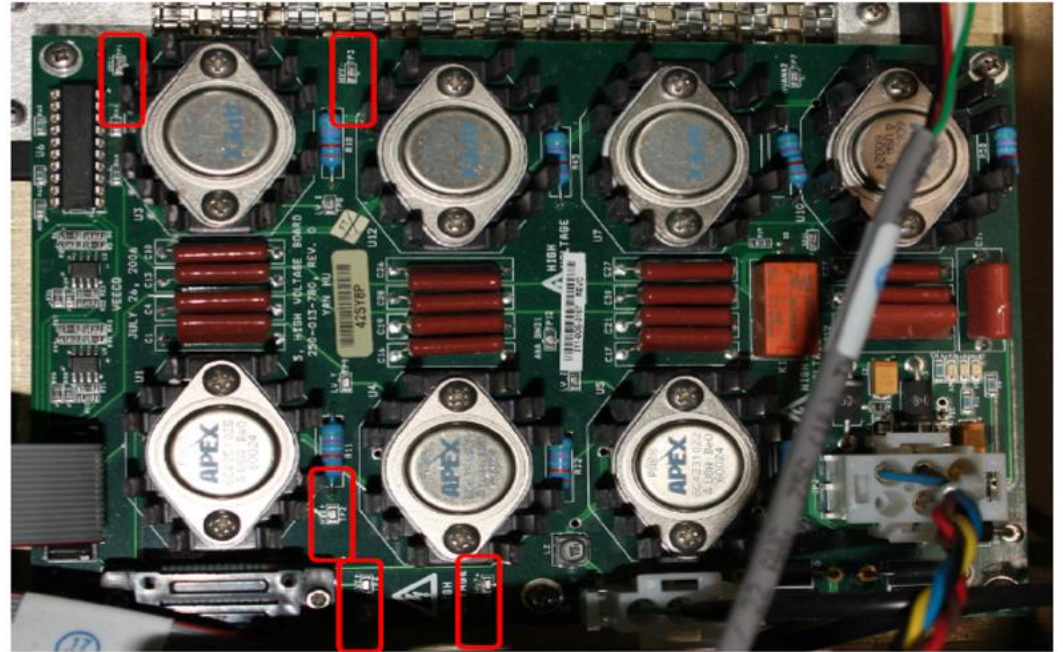
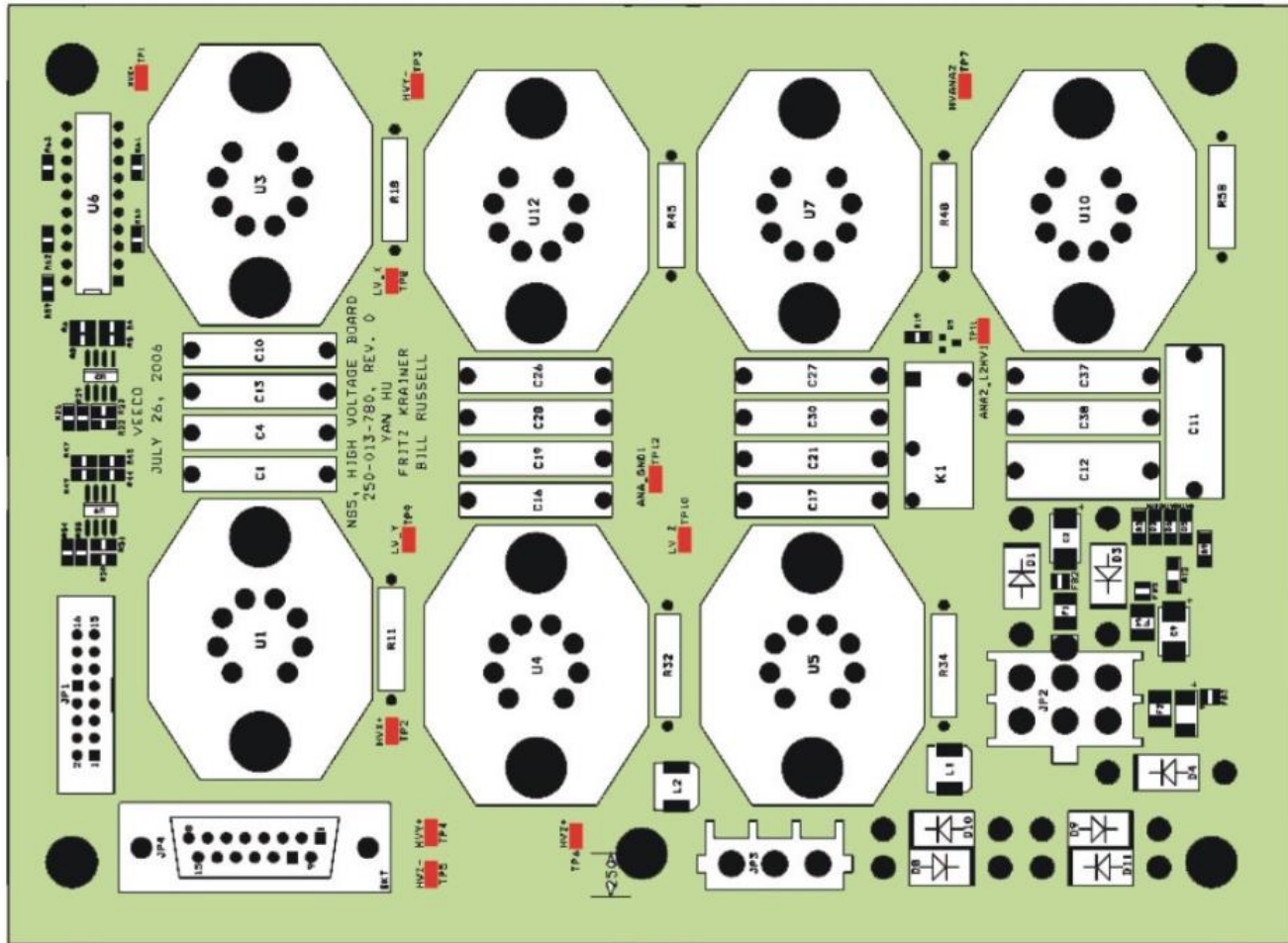
# Test X drive voltage in controller

- Setup the oscilloscope to read properly. Put scan size 440 V, gain to 0, **closed loop off**,
- Go to microscope menu in the software >> false engage
- Locate the HV\_X test point on the in the controller. (All test points are shown next page)

The image shows a software interface with a 'Workflow Toolbar' on the left and a 'Scan' parameters panel on the right. The toolbar includes icons for 'Contact in Air', 'Setup', 'Navigate', 'Check Parameters', 'Engage', 'Scan', 'Ramp', and 'Withdraw'. The 'Scan' panel lists various parameters, with several highlighted in red boxes: 'Scan Size' (436 V), 'Scan Angle' (0.00 °), 'XY Closed Loop' (Off), 'Integral Gain' (0), and 'Proportional Gain' (0). Other parameters include Aspect Ratio (1.00), X Offset (0.000 V), Y Offset (0.000 V), Scan Rate (0.992 Hz), Tip Velocity (196 µm/s), Samples/Line (256), Lines (256), Slow Scan Axis (Enabled), Bidirectional Scan (Disabled), and Deflection Setpoint (0.6000 V).

Parameter	Value
Scan Size	436 V
Aspect Ratio	1.00
X Offset	0.000 V
Y Offset	0.000 V
Scan Angle	0.00 °
Scan Rate	0.992 Hz
Tip Velocity	196 µm/s
Samples/Line	256
Lines	256
Slow Scan Axis	Enabled
XY Closed Loop	Off
Bidirectional Scan	Disabled
Integral Gain	0
Proportional Gain	0
Deflection Setpoint	0.6000 V

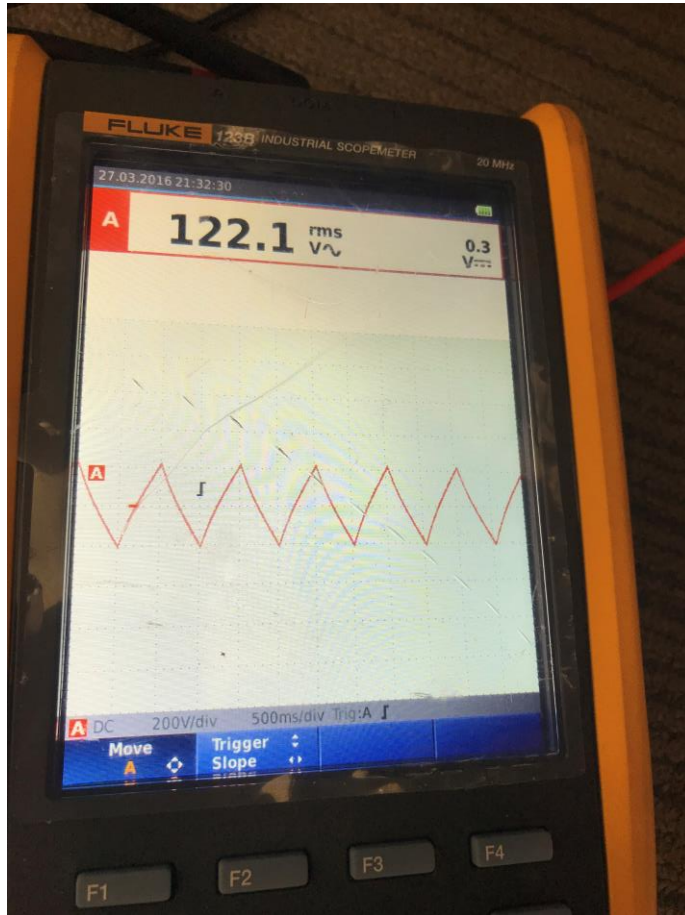
# Drive voltage test points for Controller (need to update right side controller picture)



**TEST POINTS MARKED IN RED**

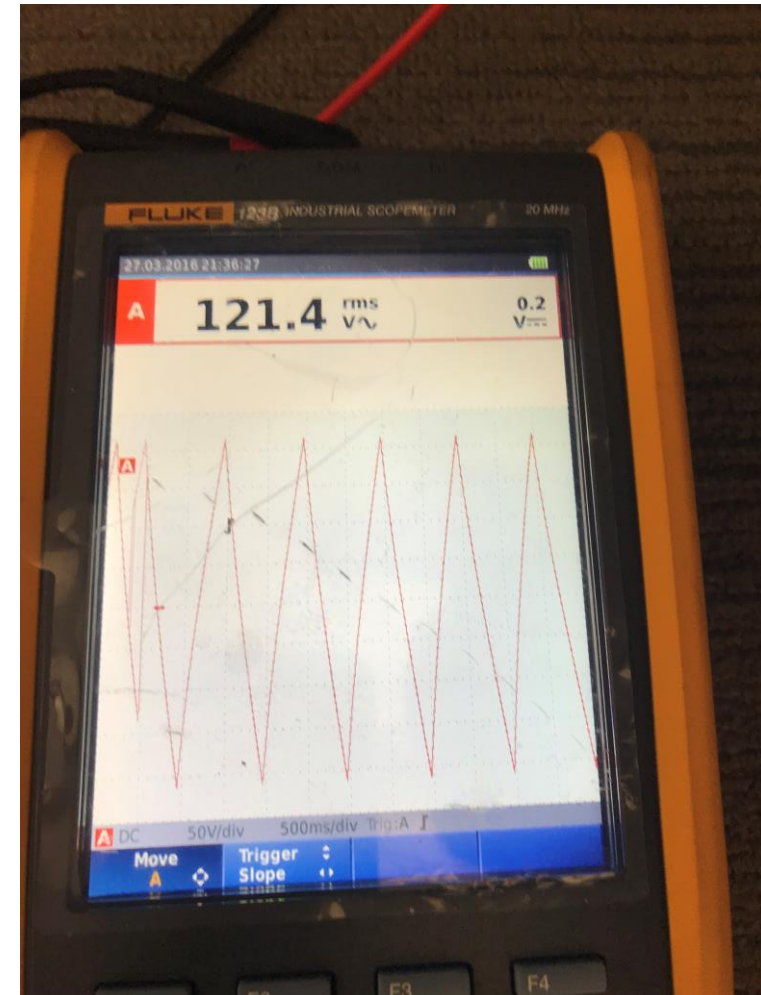
TEST POINT	REFERENCE VOLTAGE
TP1	HV X-
TP2	HV X+
TP3	HV Y-
TP4	HV Y+
TP5	HV Z-
TP6	HV Z+

- scan at 0Deg, scan size is 440V test HV\_X: triangular waveform at 1HZ, image shown below



HV X

- Change scan angle to 90 Deg, scan size is 440V test HV\_Y: triangular waveform at 1HZ, image shown below



HV Y

# Test Z drive voltage

- While still false engaged hit the ramp view in the left hand screen. Change the ramp parameter list as shown
- Click the continuous curves button.
- Use the oscilloscope to test HV\_Z- test point.
- 330V triangular waveform on the HV test points.

The screenshot shows a software interface with a workflow toolbar on the left and a parameter list on the right. The toolbar includes buttons for 'Contact in Air', 'Setup', 'Navigate', 'Check Parameters', 'Engage', 'Scan', 'Ramp', and 'Withdraw'. The 'Ramp' button is highlighted. The parameter list on the right is expanded to show the 'Ramp' section, which includes the following parameters:

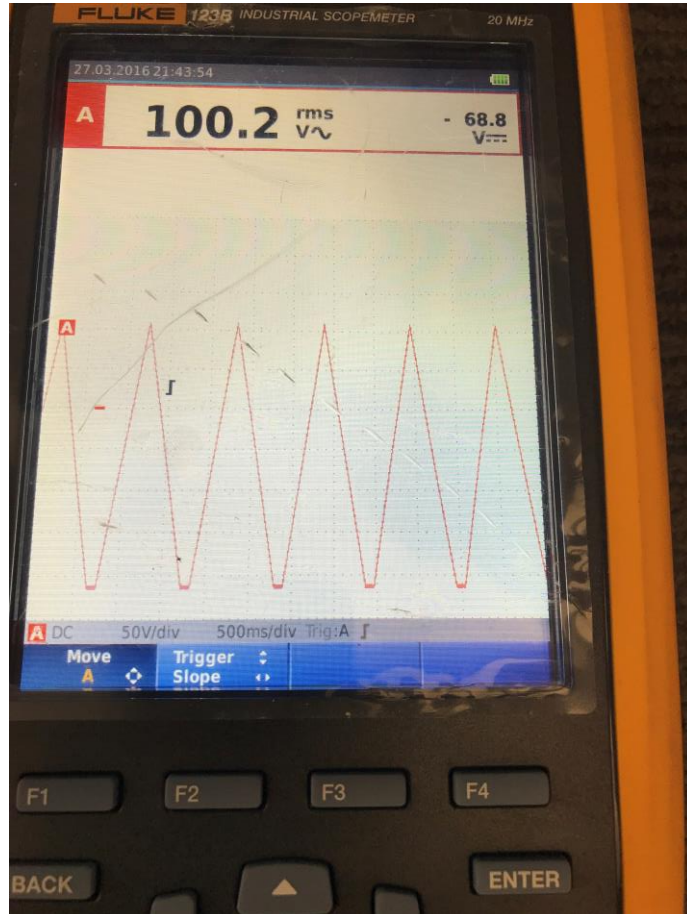
Parameter	Value
Ramp Output	Z
Ramp Size	330.0 V
Ramp Position	110.0 V
Ramp Rate	1.03 Hz
Forward Velocity	680 V/s
Reverse Velocity	680 V/s
Speed Increment Max	3.00 $\mu\text{m/s}$
Samples/Ramp	512
Retracted Delay	0.00 s
X Rotate	0.00 $^\circ$
Z Closed Loop	Off

Below the 'Ramp' section, the 'Trigger' section is also expanded, showing the following parameters:

Parameter	Value
Trigger Mode	Off

The 'Surface Controls' section is also visible, including 'XY Scan', 'Force Analysis', and 'Other' parameters.

Z voltage, HV\_Z-(HV+Z has no voltage)



HV Z-