

FROM PERCENT SCREEN HEIGHT TO SIGNAL-TO-NOISE RATIO

Towards Unambiguous Measurement
Definitions in Eddy Current Inspection

A4A NDT Forum 2026, Tulsa, Oklahoma

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Rohmann GmbH



Wirbelstrom-Prüfgeräte und -Systeme

ROHMANN GMBH

Company Profile

Founded	1977 Rohmann GmbH
Founder	Jürgen Rohmann
CEO	Petra Rohmann
Address	Carl-Benz-Str. 23 67227 Frankenthal Germany
Sales Partners	32 independent sales agents worldwide
Employees	85
Fields of Business	Development, Production and Sales of Eddy Current Inspection Instruments, Sensors and Systems



ROHMANN GMBH

The history of our company

FOUNDATION

Founded by Jürgen Rohmann
with 3 employees

2nd COMPANY BUILDING

Rudolf-Diesel-Str. 13,
67227 Frankenthal
with approx. 15 employees

MORE THAN
50 EMPLOYEES

1977

1980

1985

1990

1995



1st COMPANY BUILDING
in Beindersheim



EXTENSION
of the 2nd company building



ROHMANN GMBH

The history of our company

HANDOVER

of the management to Petra Rohmann

2007



INAUGURATION

of the new 3rd building
Carl-Benz-Str. 23
67227 Frankenthal

2009



ROHMANN GMBH CELEBRATES 40 YEARS



2015

2017

MORE THAN
70 EMPLOYEES



Wirbelstrom-Prüfgeräte und -Systeme

ROHMANN GMBH

Headquarters at Frankenthal



- For more than 40 years we have been now developing, producing and marketing our technology as a medium-sized family-owned company based in Frankenthal, Germany.



ROHMANN GMBH

How to find us

Rohmann GmbH

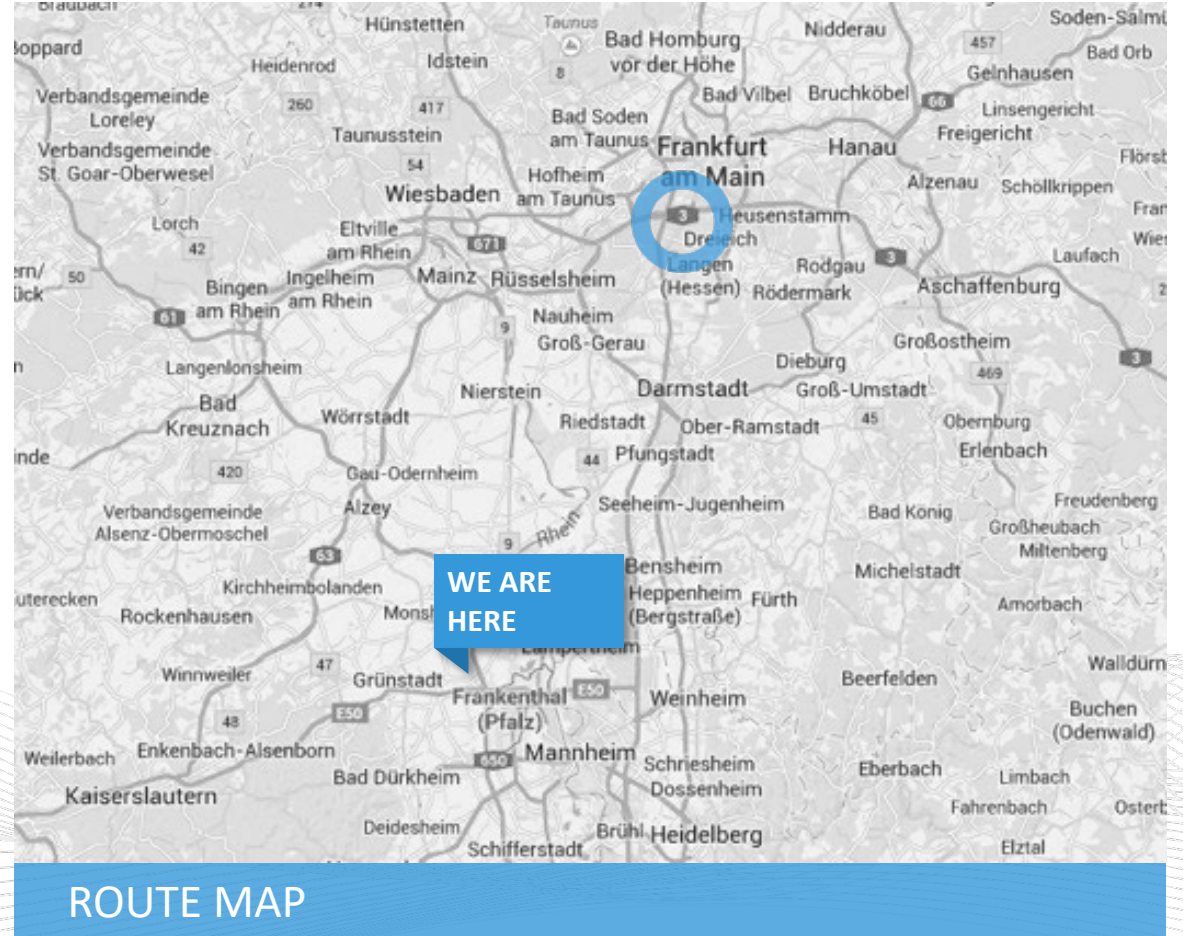
Carl-Benz-Str. 23
67227 Frankenthal
Germany

Directions:

Car: from Frankfurt follow A5, A67 until L523 at Frankenthal on the motorway A6, take exit 22 - Frankenthal-Nord, take Industriestraße and follow until Carl-Benz-Straße 23.

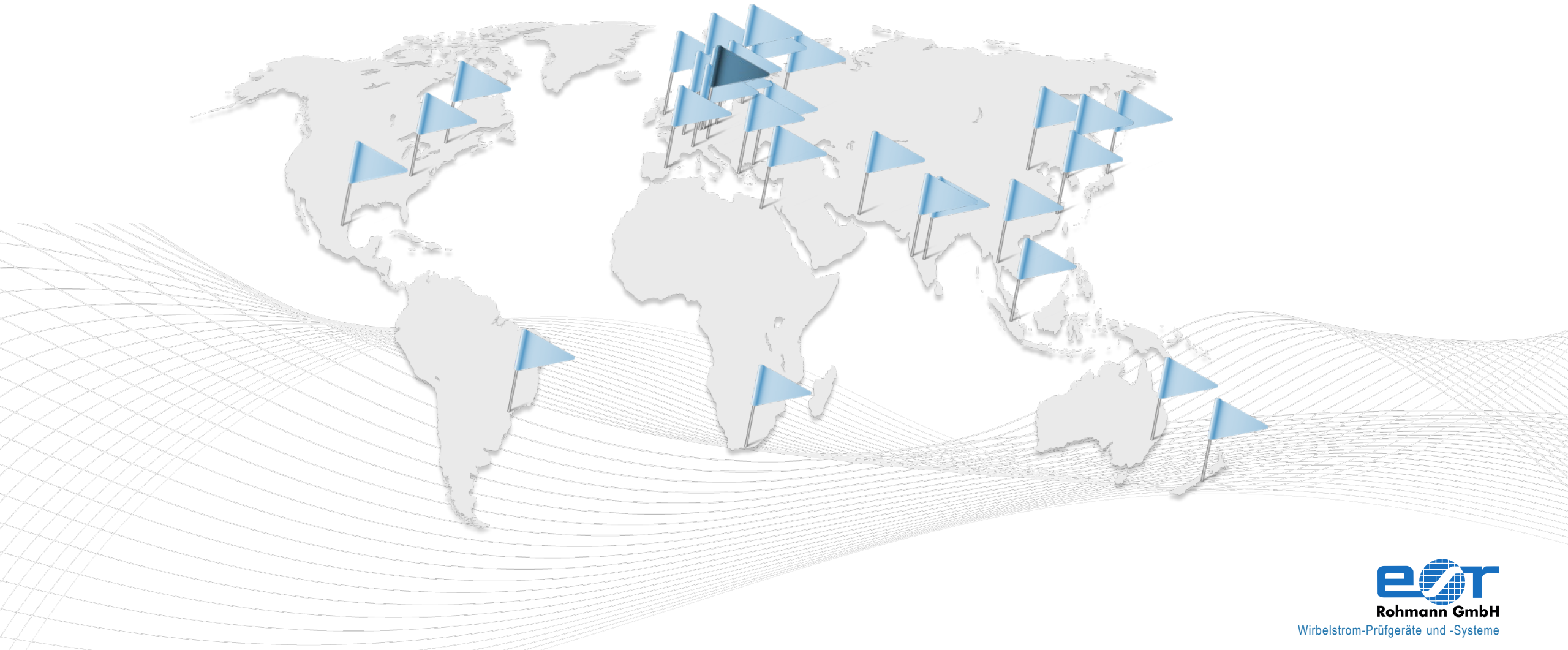
Public transportation: by train from FRA Airport to Frankfurt central station, from Frankfurt central station to Mannheim central station, then via regional train to Frankenthal *central station*, 2 km by cab from station to Rohmann GmbH, industrial area.

Closest airport: FRA Airport, 75 km distance to 67227 Frankenthal.



ROHMANN GMBH

Rohmann GmbH – global presence with 32 sales partners



OUR MARKET SEGMENTS

Non-destructive material testing in various fields

AUTOMOBILE

- Inspection of automatic gear boxes
- Inspection of bearing rings and rollers
- Inspection of cylinder blocks using image-based techniques
- Inspection of cam shaft
- Crack testing of ball pivots and ball joints
- Further specialist applications

AVIATION AND AEROSPACE

- Aircraft wheel inspection (EloWheel)
- Turbine inspection (EloScan)

ENERGY AND STEEL

- Components
- Semi-finished items
- Small parts
- Weld inspection of high-voltage cable jackets
- Inspection of large tubes using sensor arrays
- Eddy current testing of rods by means of a rotor system
- Wire inspection in the drawing line

RAILWAY AND RAIL SYSTEMS

- Inspection of rails and switches by means of an inspection trolley (EloRail) with data recording, analysis and documentation

MOTIVATION

Why are we talking about this boring stuff now...

Motivation

Why am I wasting your time...

- Operators are begging us manufacturers to make their live easier
- They want to translate what they see in the NTM procedure directly to their workflow
- They ask us to
 - Set threshold (alarm) values in Percent Screen Height
 - Add measurement functions to the instrument to get a numerical readout of signal amplitudes and phase angles in the units of measurement they need
- **When trying to do this, we find out that not everything is as well defined as everyone assumes!**

I would like to spark a discussion on these topics. I do not have a ready solution.

UNITS OF MEASUREMENT

For Eddy Current Signals

The Past: Analog Instruments

All started with a CRT Tube

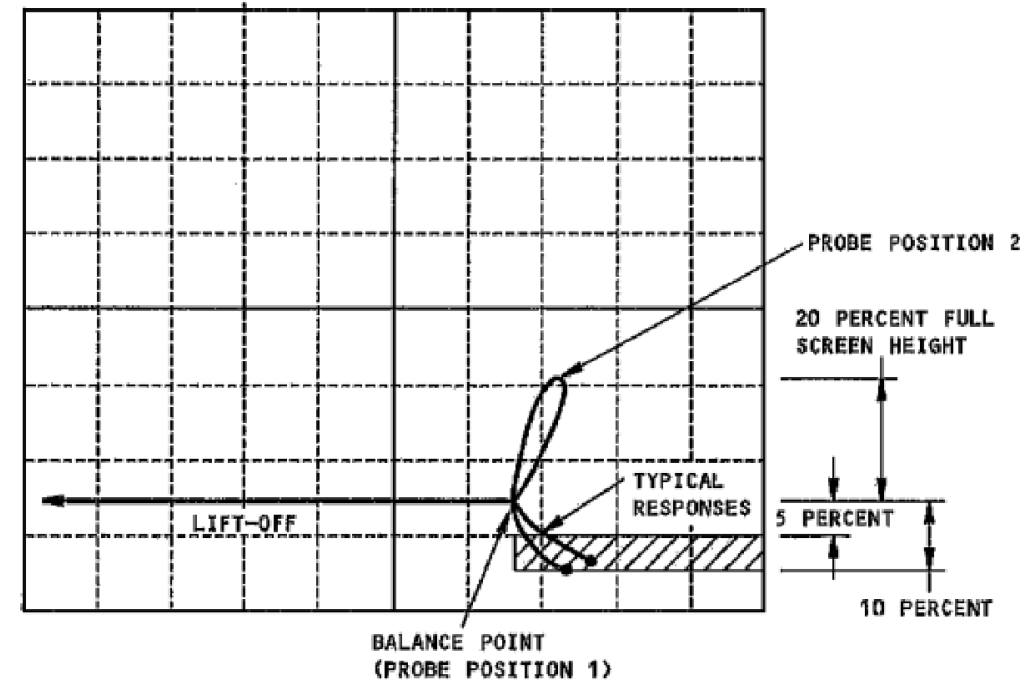
- Early “impedance plane” testers were based on oscilloscope technology
- A cathode ray tube (CRT) was used for impedance signal display
- It had an etched or printed „grid“ for reference, which could not be changed
- Common grids were 10 or 8 units over the full height (Full Screen Height, FSH)
- Origin (balance point) was moved using the „dot position“



Percent Screen height

For a physicist, this is truly a strange unit of measurement

- Eddy current signals are mainly „relative“ or comparative
- Amplifiers are adjusted to give a clear reading
- So, instructions look like this



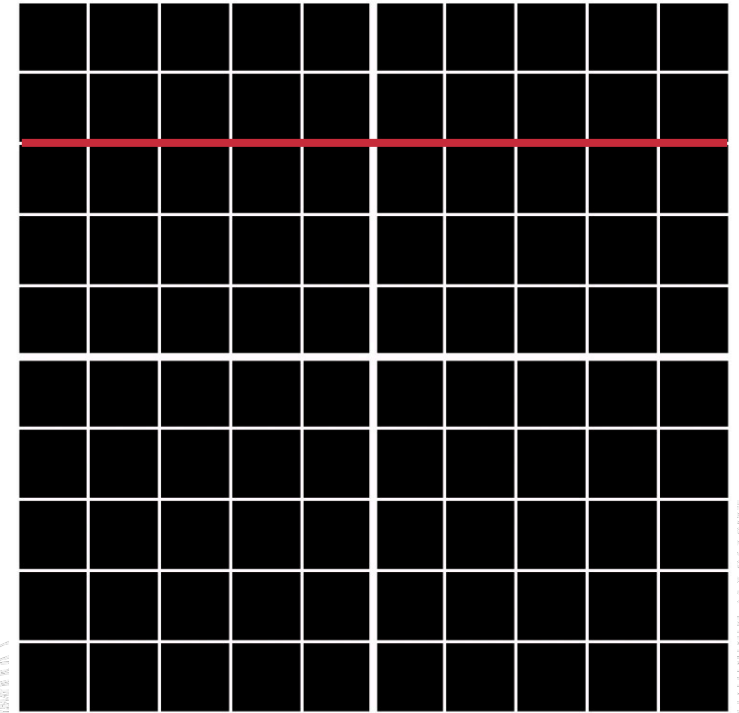
ACCEPTABLE RANGE FOR SINGLE LAYER IMPEDANCE PLANE RESPONSE
(PROBE POSITION 3)

thickness.

- E. Put the probe on a full thickness area of the reference standard, Figure 3, probe position 1.
- F. Balance the instrument. Refer to the instructions of the manufacturer. Use the vertical and horizontal position controls to move the balance point to the lower middle part of the screen. Refer to Figure 3.
- G. Adjust the phase/rotation control so that the signal moves in a horizontal direction and to the left when the probe is lifted off of the part. Refer to Figure 3.
- H. Move the probe to the area on the reference standard where there is a 10 percent decrease in the material thickness, Figure 3, probe position 2. Adjust the instrument sensitivity to get a signal which is 20 percent of the full screen height. Refer to Figure 3.
- I. Move the probe to an area where there is only the outer layer, Figure 3, probe position 3. The position of the signal of the instrument must be between 5 percent and 10 percent of the full screen height below the balance point. See Figure 3.

Slido Question

- The red alarm threshold in the picture is set to
 - A: 80% Screen height
 - B: 60% Screen height

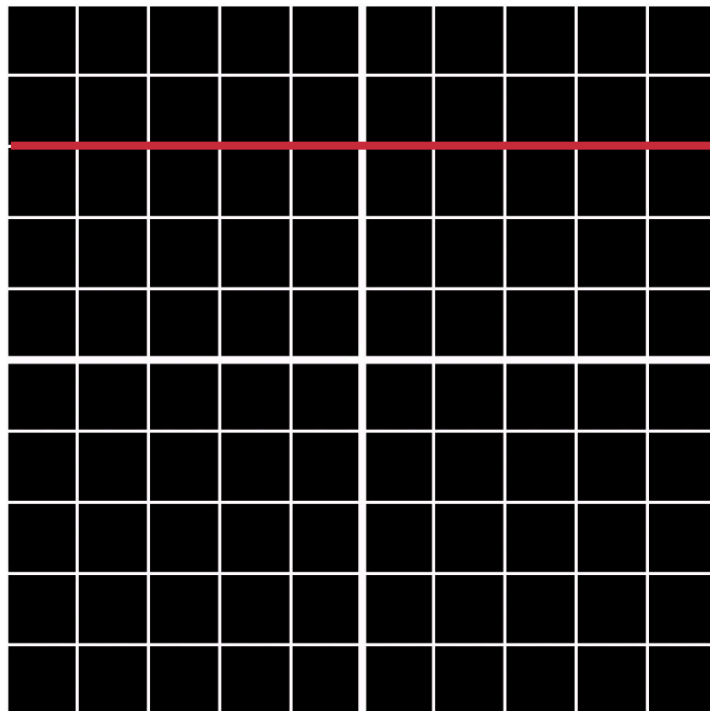
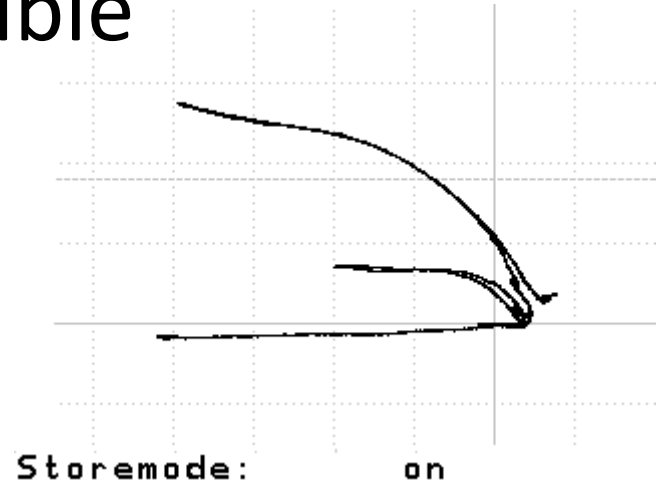


15

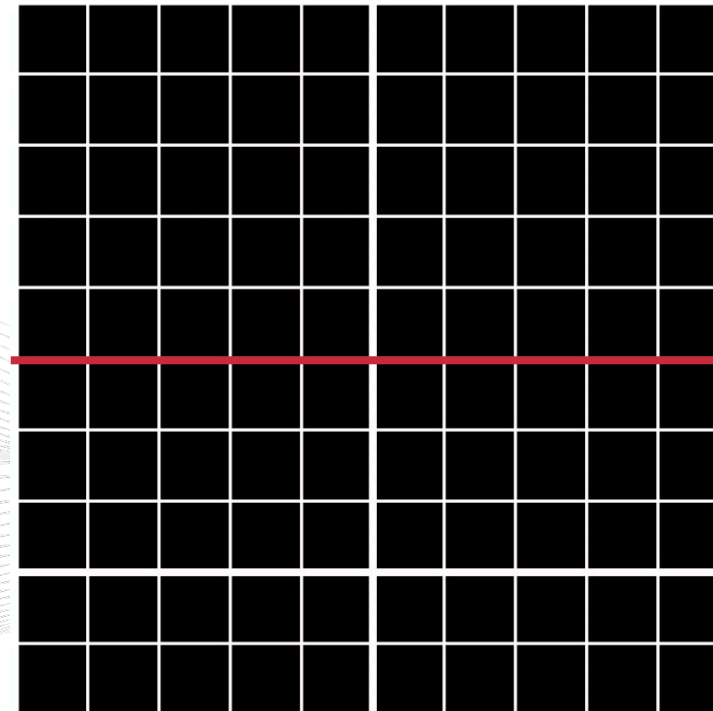
Newer Instruments: Grid Adjustments possible

Even with the partly anaogue ones

- Grid size and grid origin can be adjusted for all current instruments
- Balance point can stay on grid origin, but still the full screen can be used



Signal Y-Amplitude
90% Screen height
Alarm:
80% Screen height

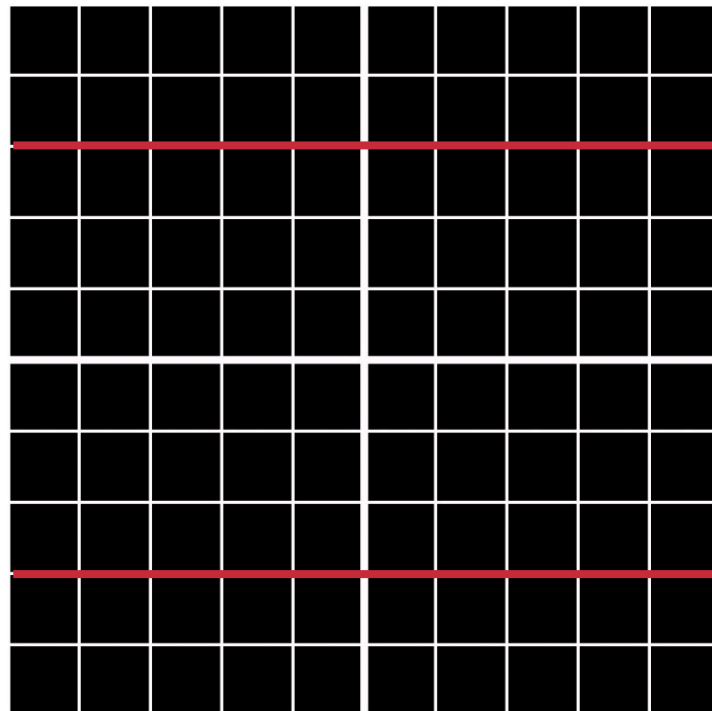
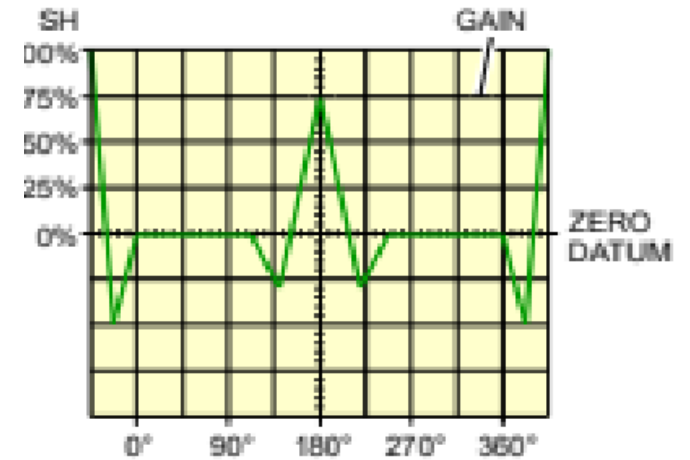
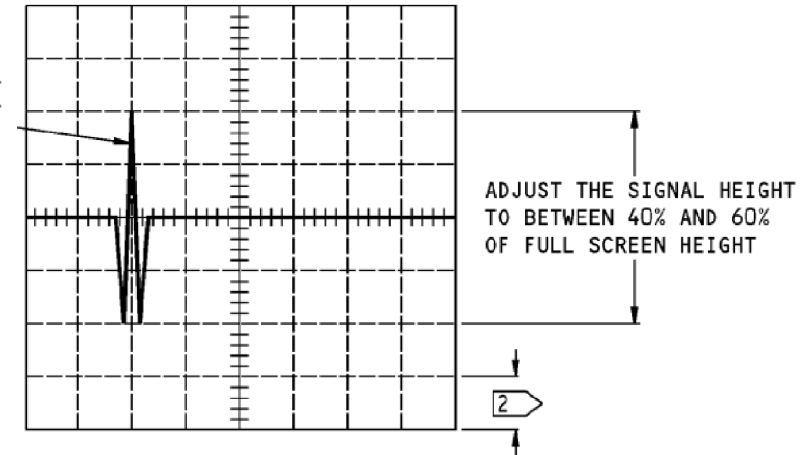


Signal Y-Amplitude
60% Screen height
Alarm:
50% Screen height

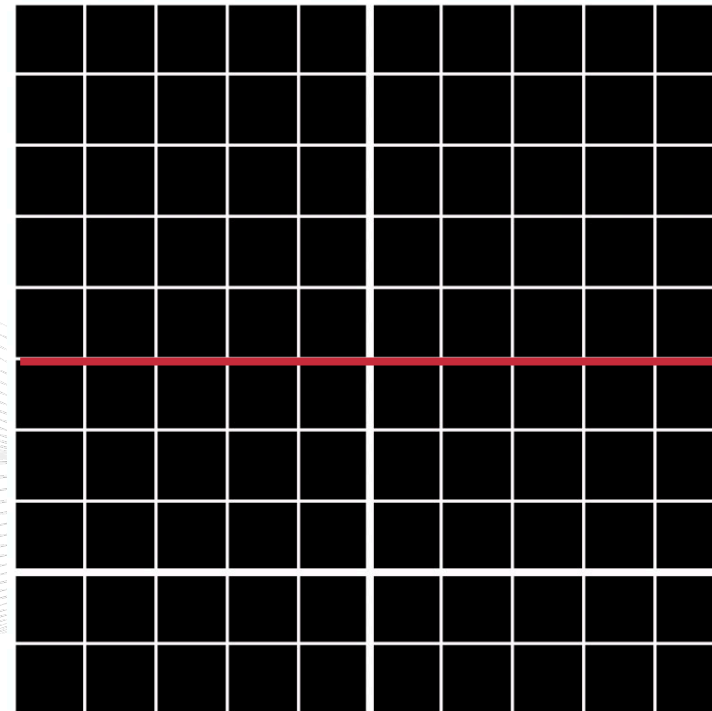
Only origin is shifted,
Same signal and alarm!
Signal Y-Amplitude
4 Volts
Alarm:
3 Volts

The Sign Problem

Setting alarms in Percent Screen Height



Alarms
20% Screen height
80% Screen height
3V and -3V

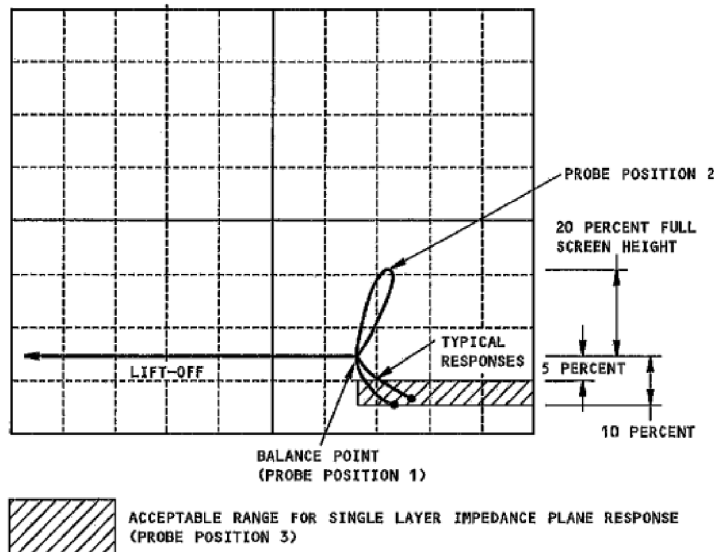


Pros and Cons of using Percent Screen Height

It is used for a reason...

Pros

- Can be used for every instrument
- Measurement with respect to visible dynamic range (an 80% screen height signal is always clearly visible)



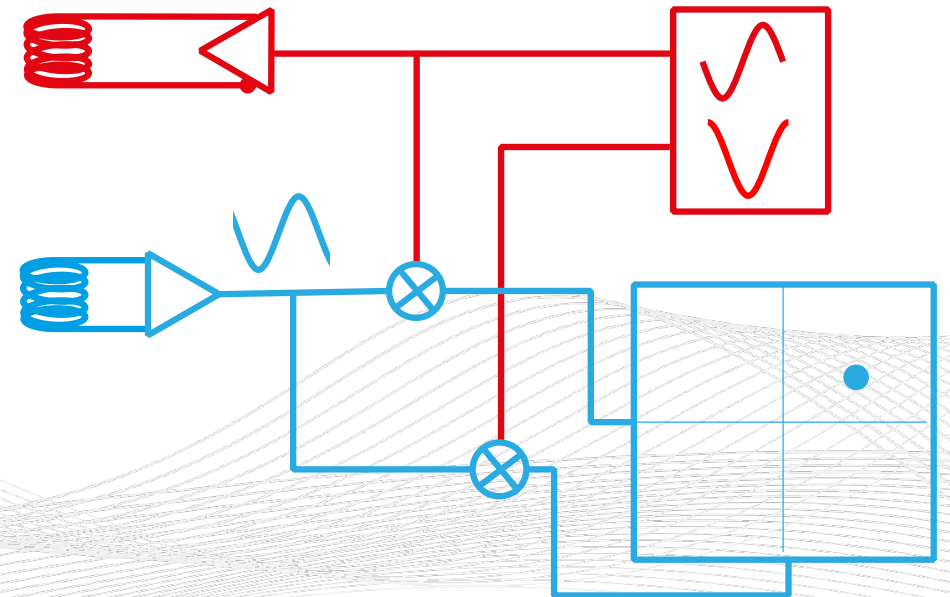
Cons

- Difficult to measure when
 - With Grids with 8 instead of 10 divisions
 - When balance point is not on a grid division
 - For symmetric signals
- Calculations have to be made
- No reference to true instruments dynamics and noise levels
- What do do with negative values?

Using Volts

The only logic thing to do for a physicist

- Why do we measure eddy current signals in Volts?
- All boils down to measuring changes in voltage of the receiving coil.
- Due to demodulation and balancing, we measure:
 - The voltage difference and the phase shift of the receiver voltage with respect to the driving field zeroed on a good patch of material
 - Because the difference is very small, we use amplifiers (Pre Amp and Main Amp) to amplify this.
 - An output signal of 1V at 40 dB total amplification means that the actual coil voltage changed 10 mV.
- To be fair, in most (older) instruments, there are hidden gains, so absolute voltage is not always 100% correct.



Pros and Cons using Voltage

Besides calming down the physicist in the room

Pros

- Nothing needs to be changed when grid origin or size are changed
- Can give an idea about absolute signal strength (when amplification is taken into account)
- Can easily referenced against noise levels also measured in volts
- Works well with signed signals (such as differential signals)
- Can be used for off screen data and thresholds

Cons

- Actual dynamic range of the instrument needs to be taken into account
- No direct reference to signal size on the screen
- Due to hidden gains not completely transferable from instrument to instrument

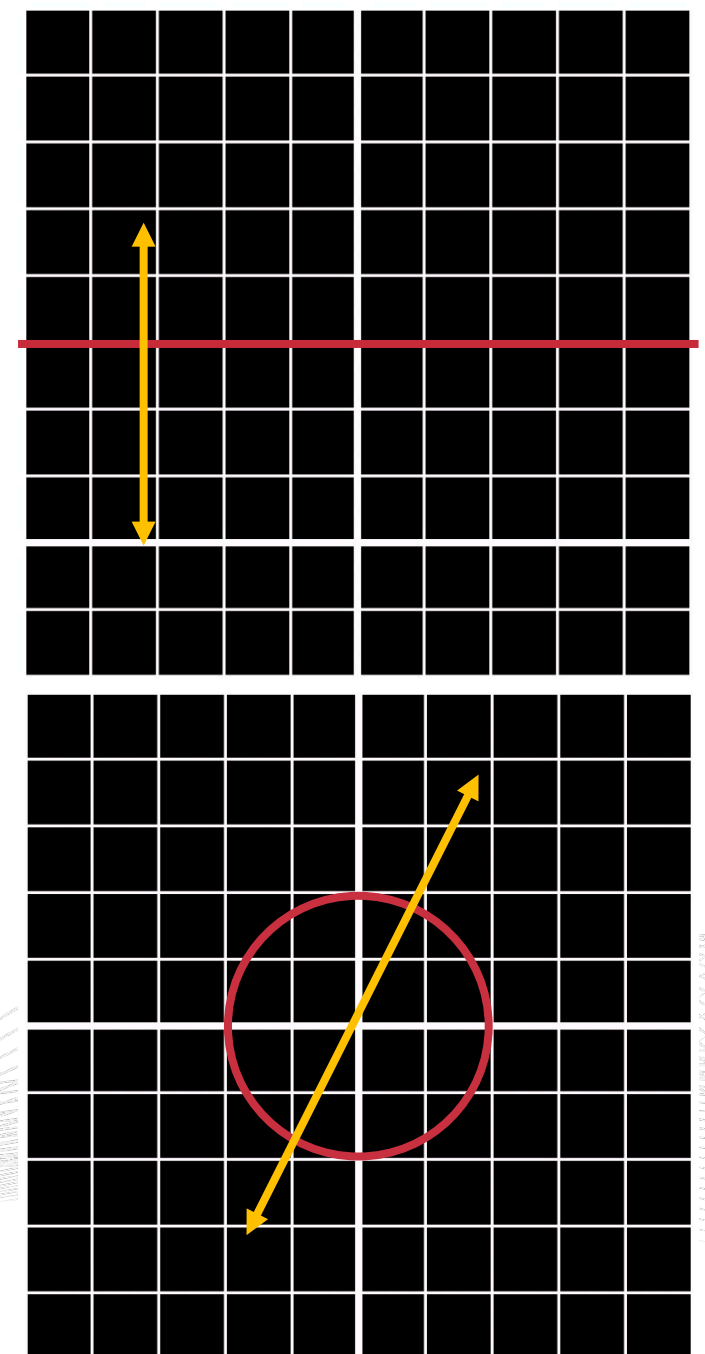
OTHER QUESTIONS ABOUT SIGNAL AMPLITUDE

Even in Volts

Using Vector Length or Y-Amplitude

That depends

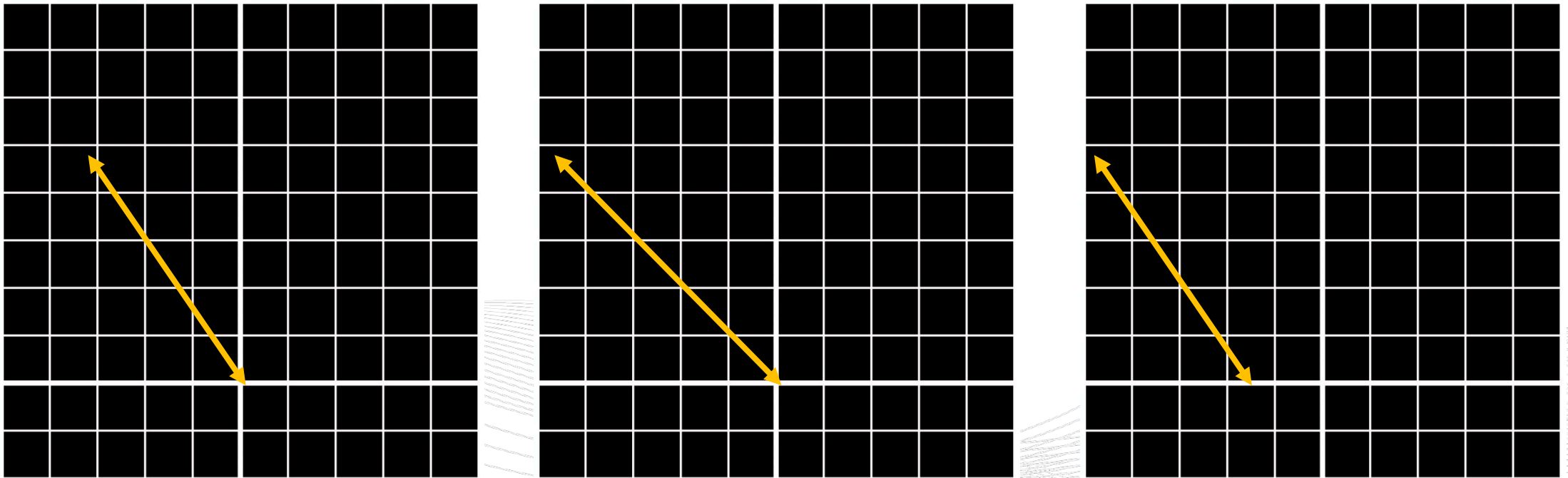
- Very common:
 - Liftoff is put on negative Y-Axis
 - Only the Y-Amplitude of the signal is interpreted
 - Advantages
 - Liftoff variations do not alter results (in a certain range)
 - The displayed phase angle is referenced to the liftoff direction
- Using vector length
 - Very common in industrial applications
 - No need for phase adjustment
 - Circular alarm gates are used
 - Back to „non impedance plane“ instruments



The Origin Reference Point

For Amplitude and Phase Angle measurement

- Assuming Vector Length „Mode“, absolute sensor, liftoff to negative x-axis



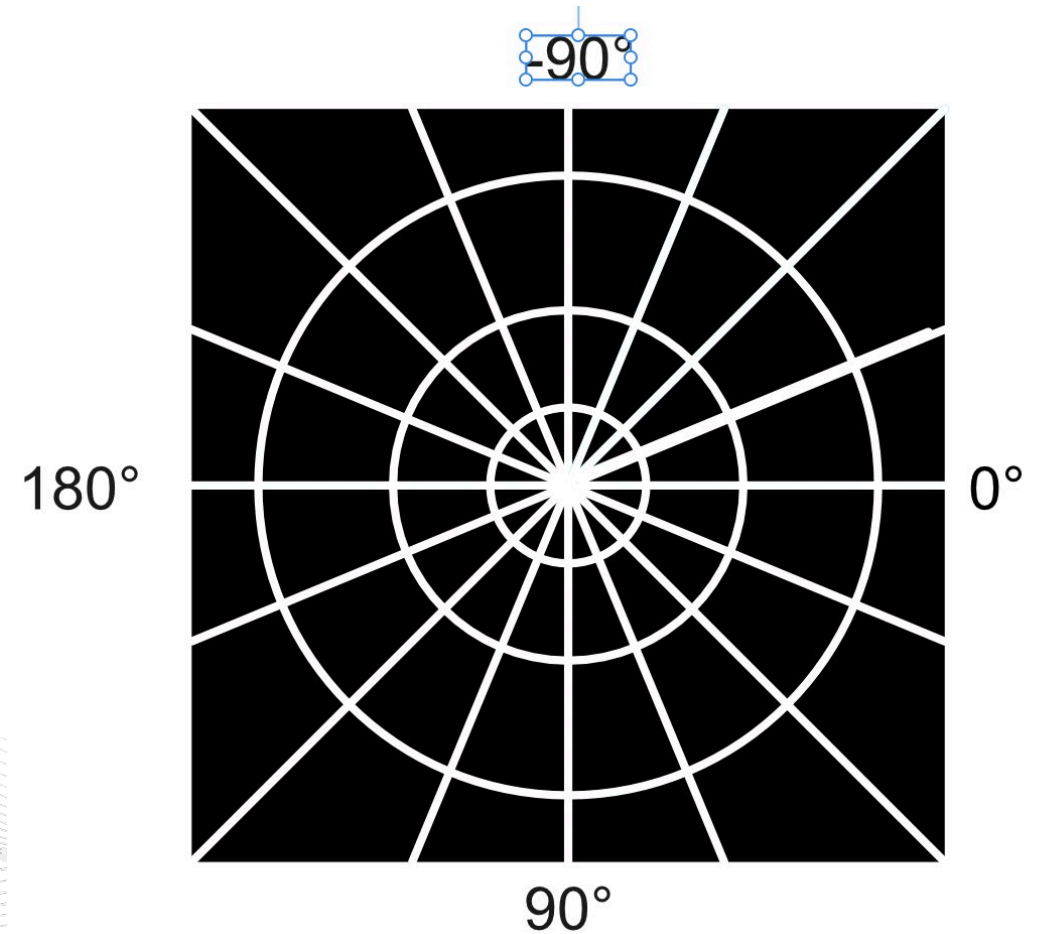
PHASE MEASUREMENTS

That's why we do full impedance plane!

Phase measurement in eddy current inspection

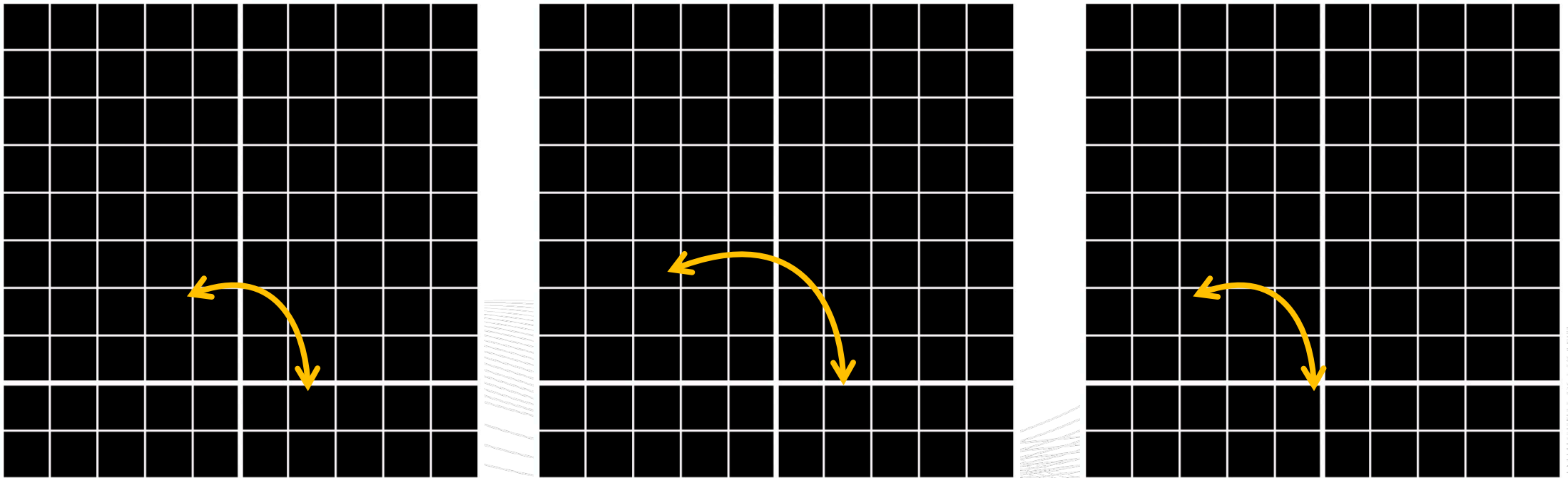
Zero Axis and Sense of Rotation

- Most common in Eddy Current
 - Zero degree on X-Axis
 - Liftoff to 180°
 - Counterclockwise
- Variations
 - 0° on Y-Axis
 - Clockwise
 - Negative Angles
- Important: specify what coordinate system to use!



Phase reference point

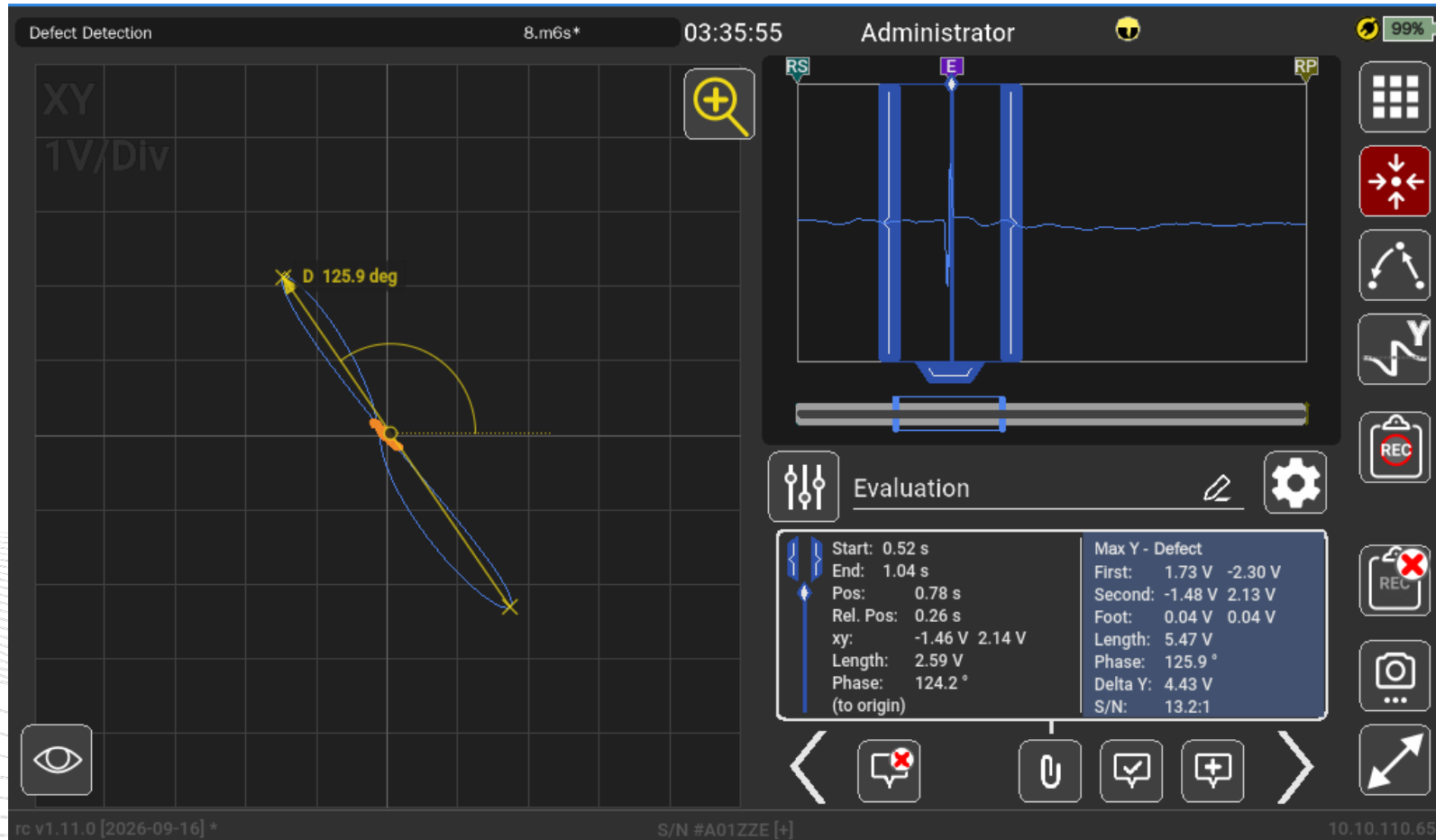
What is the phase angle of the signal?



Differential Signals

Resolving the direction ambiguity adds one more question

- Straight line between the two lobe maxima
- Need to specify: From the first to the second lobe or from the second to the first
 - Phase angle flips 180° when going over the defect in the other direction



SIGNAL-TO-NOISE RATIO

The most important value?

Definition of SNR

The signal amplitude divided by the noise amplitude, that's easy, isn't it?

- The Signal-to-Noise Ratio is the ratio between
 - The amplitude of the measured signal and
 - The Noise amplitude
- So, what are those?
 - For the signal, all the discussed topics apply
 - Y-Amplitude or Vector length?
 - What is the basepoint to measure from
 - For the Noise Amplitude
 - Which part of the signal is considered noise?
 - Which component (X, Y, Vector Length) of the noise signal is to be used?
 - How is the noise of this component measured?

What is the Origin of the Noise?

There are several noise contributions

- Electronic Noise
 - What you get when you put the sensor in air on on the workpiece and do not move it
 - Can be reduced using the Lowpass Filter
 - But be careful not to reduce the wanted signals
- Liftoff/Geometric Noise
 - Signal contributions coming from non-constant liftoff, sensor tilting or surface undulations
 - Can be reduced by better sensor guidance, eg. using rigs or jigs
- Part intrinsic noise
 - Surface quality (roughness)
 - Microstructure
 - Non-uniform residual magnetism

Which part of the Signal to use for Noise assessment

That depends...

- If you want to assess overall noise, impeding detection sensitivity
 - Take care to make your noise sample large enough to include all relevant noise contributions
 - Take care not to include parts of the defect indication
- If you only want to specify the noise performance of your equipment
 - Take care to NOT include noise components from the movement and part generated noise

I can not count how many times I had to discuss that „your instrument is too noisy“ is not the point when all the relevant noise comes from the part itself!

Noise contributions add up, but geometrically. So smaller contributions are almost totally masked by smaller ones. When surface noise is 2 V, electronic noise of 5 mV is not the issue!

Which Signal Component to Use for Noise Assessment?

That's an easy one!

- Always use the component you use for your signal assessment
 - When using only the Y component for your alarms and signal assessment, use only the Y-Component of your noise to measure the noise
 - Otherwise, Lift-off variations will unnecessarily degrade your SNR!
 - When using circular alarms and vector length measurements, use the noise of the vector length for noise assessment

Now, How to Measure Noise?

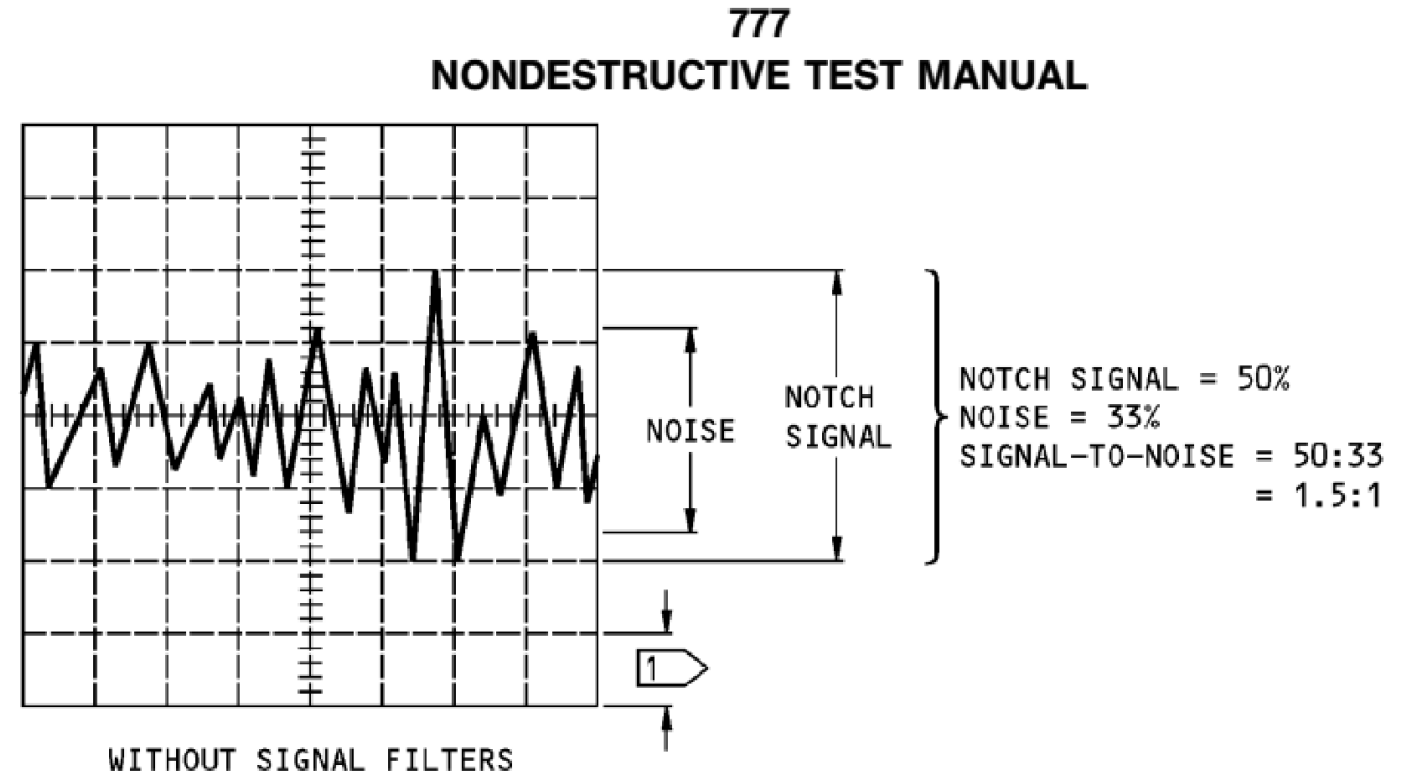
Once you decided on the definition

- So, we know
 - Which data to include
 - Which component to use
- What we can measure
 - Peak-To-Peak Noise
 - Peak-Noise
 - RMS Noise
 - Standard Deviation

Peak-To-Peak Noise

Very common

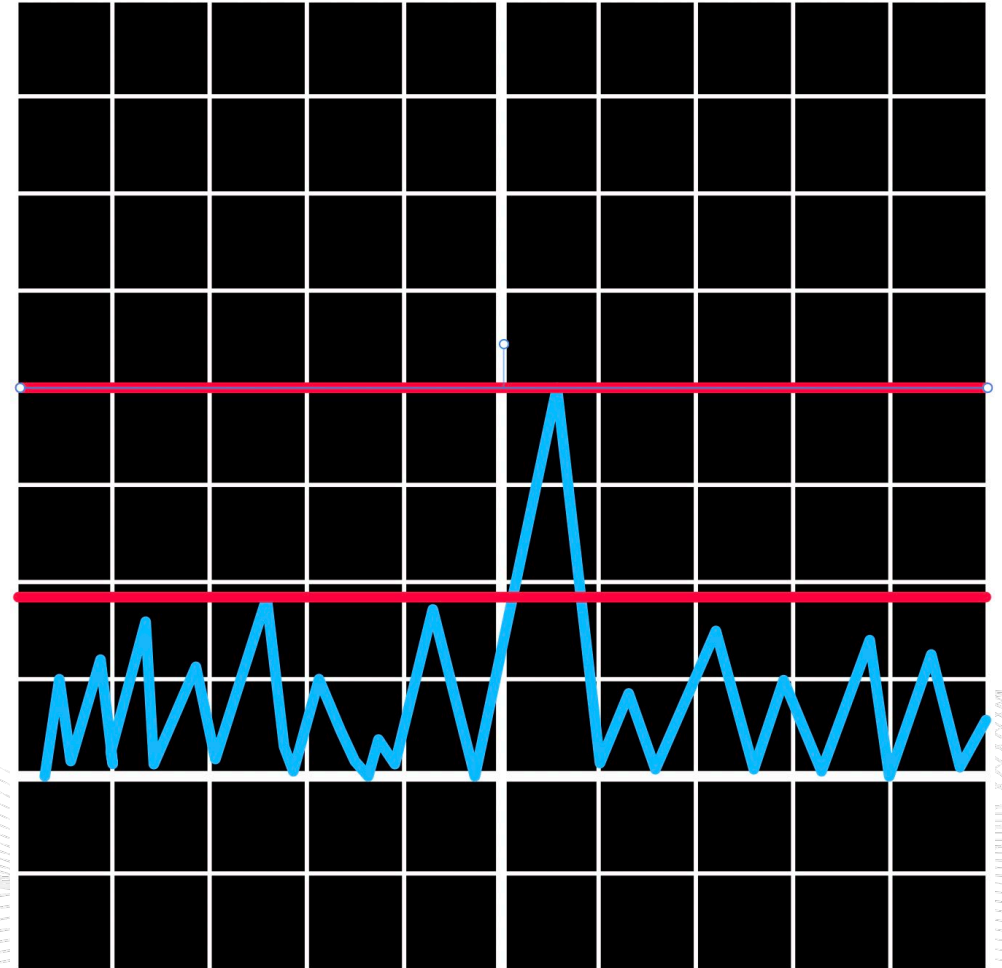
- Useful for signed signals like the Y-Component
- Peak-to-Peak Noise: The difference between the highest sample value and the lowest sample value in the data selected as noise data



Peak Noise

- Usable for Vector length data, which is always positive
 - The highest value (of the vector length) in the data selected for noise assessment. The lowest values is assumed to be zero, since vector length can not be negative

Signal (Vector length)
4 V
Peak Noise
1.9 V



Root-Mean-Square Noise

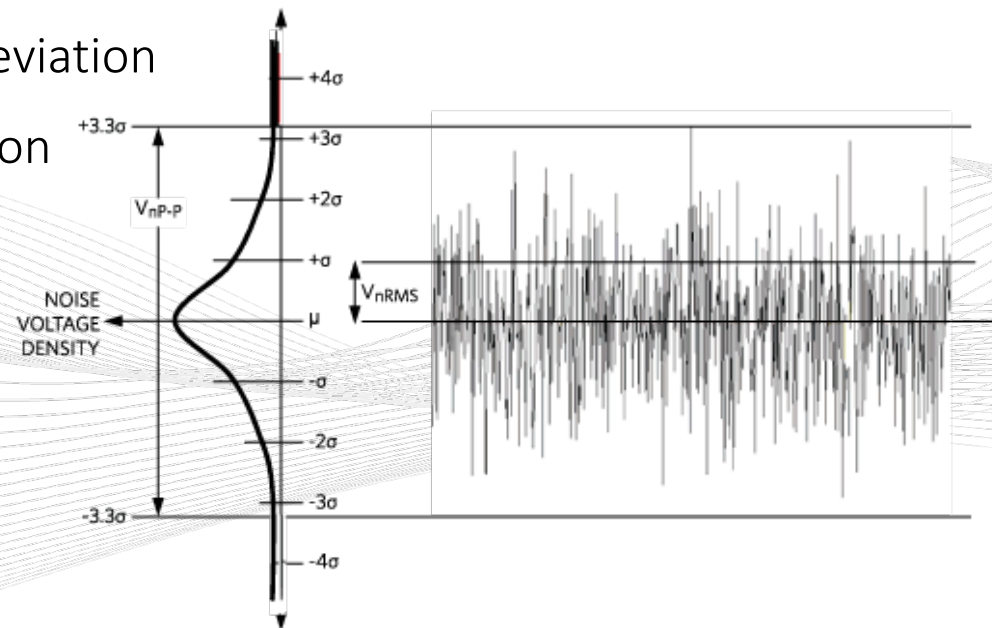
A statistical Figure

- The RMS (Root-Mean-Square) of a given dataset is defined as
 - The square root of the average of the squared values of a noise signal over time

$$x_{\text{RMS}} = \sqrt{\frac{1}{n} (x_1^2 + x_2^2 + \dots + x_n^2)}.$$

- This is usable as a noise figure if the noise is centered around the origin
- In this case it is the same as the standard deviation
- Assumes Gaussian Noise Density Distribution

Source: **Managing Noise in the Signal Chain,
Part 1: Annoying Semiconductor Noise,
Preventable or Inescapable?**
Analog Devices, Online Article



INSTRUMENT ASSISTED MEASUREMENTS

With the ELOTEST M6

Measurement Setup

You select what to measure

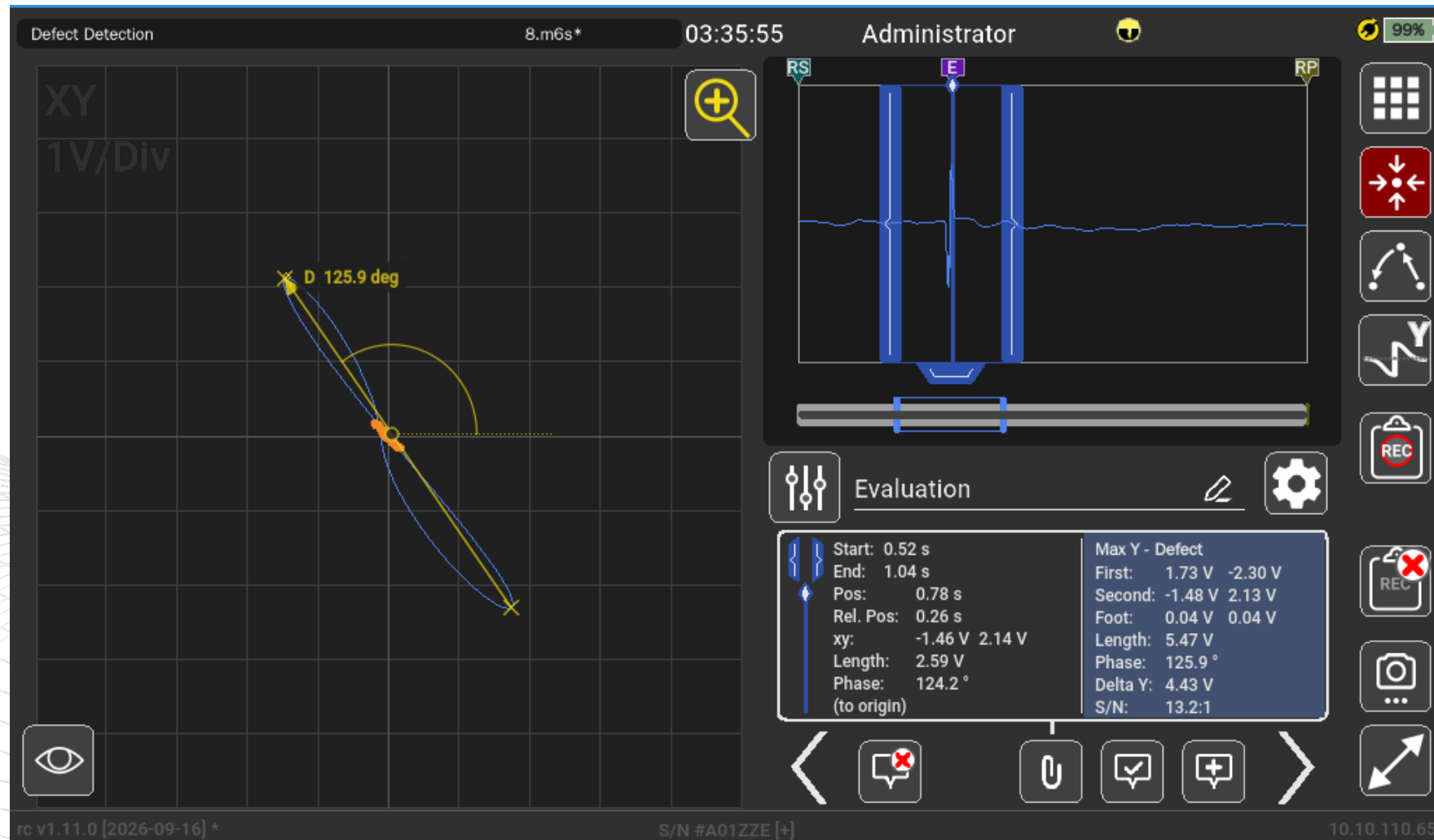
Defect Detection 8.m6s 03:34:41 Administrator 99%

Noise Mode	☐ Peak-to-Peak	☒ RMS	
Signal Type	☐ Absolute	☒ Differential	
Baseline Reference	☐ Origin	☐ Shifted X-Axis	☒ Parallel X-Axis
Reference Origin	☒ Origin	☐ Footpoint	

Cancel Ok

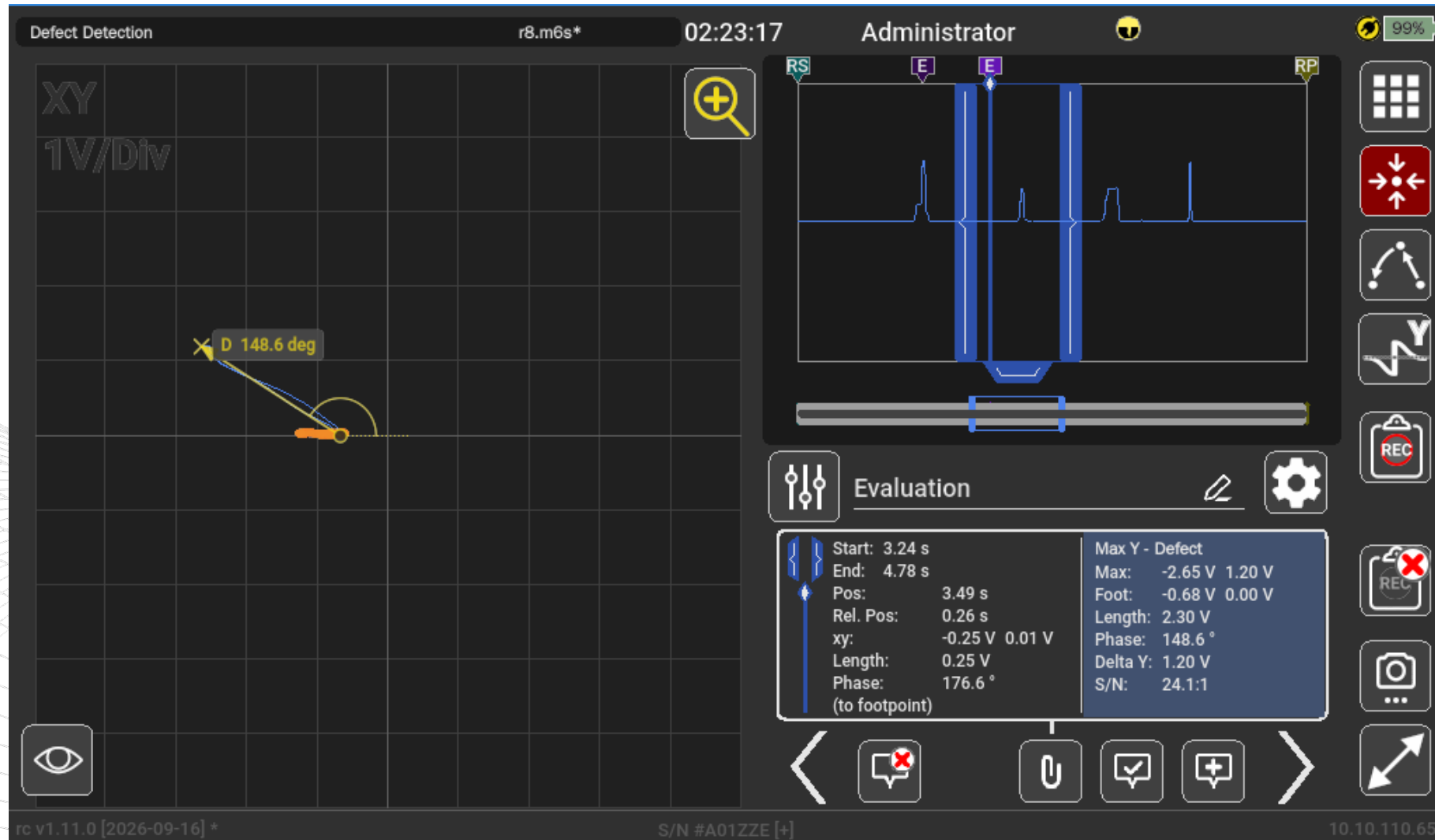
Example: Differential Signal

Y-t Mode



Example: Absolute Signal, Y Amplitude

Liftoff shifted origin



DISCUSSION POINTS AND SUGGESTIONS

Conclusion and Discussion

What to take away from this presentation

- For new procedures, try to be clear about what to measure and how
- To enable the inspectors to use new features of present day instruments, consider
 - Moving away from percent screen height as unit of measurement
 - Give more leeway with regards of using dot-position or changing the grid origin position
- What would be great: Standardization!
 - Wouldn't it be nice to be able to write "signal-to-noise ratio as defined in ISO EN XXXXX, Type 3 should not be lower than 3:1"?
 - Could be industry standard agree upon by all OEMs
 - Could be international ISO standard
 - Could be part of training and certification

Thank you for your attention!

Meet us at booth #25



The banner is split into two main sections. The left section shows a photograph of the Tulsa 66 sculpture at sunset, with a large 'TULSA' sign and a glowing '66'. The right section is a white overlay with text and logos. At the top, it features the 'eor' logo, the 'Airlines for America' logo, and the 'NDT NONDESTRUCTIVE TESTING FORUM' logo. Below these is the text 'Rohmann LLC'. The main title 'A4A NDT FORUM' is in large, bold, black letters. Underneath, it says 'Hyatt Regency Tulsa Downtown Hotel' and 'September 21-23, 2026'. At the bottom, there is a green button that says 'REGISTER NOW >>' and the text 'BOOTH #25' in large, bold, blue letters.

eor
Rohmann LLC

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Hyatt Regency Tulsa Downtown Hotel
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