QN-100 NIR Moisture Sensor

Multipoint Calibration Guide

Linear regression calibration using multiple reference samples

For customers who require a higher level of calibration accuracy than the standard two-point method

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1. About This Guide

The QN-100 HMI supports a quick two-point calibration directly on the touchscreen (see the standard Calibration Guide for that procedure). For applications that demand tighter accuracy, a wider measurement range, or where the sensor's response isn't perfectly linear across your full process range, a multi-point calibration is recommended instead.

A multi-point calibration is standard practice across the NIR and process-analytics industry. Rather than relying on two reference points, you collect a series of reference samples spanning your process range and use linear regression (the least-squares method) to calculate the best-fit Span and Zero values across all of them. This produces a more robust calibration and gives you statistical confidence in the result, expressed as an R^2 (goodness of fit) value.

> *Before you start: you will need a set of reference samples — ideally 7 or more — with moisture values confirmed by an independent, traceable laboratory method. Samples should be spread as evenly as possible across your full process range, not clustered together.*

1.1 When to Use Multi-Point Instead of Two-Point

- Your product's moisture range is wide, or production regularly operates across a broad spread of values.
- You need documented statistical evidence of calibration accuracy (R^2, standard error) for quality or audit purposes.
- A previous two-point calibration has shown drift or inconsistent accuracy at the extremes of your range.
- You are commissioning a new product calibration and want the highest achievable confidence from the outset.

2. Step 1 — Collecting Reference Samples

The accuracy of a multi-point calibration depends entirely on the quality and spread of your reference samples. Follow these guidelines when selecting them:

Field	Description
Sample count	Use at least 5 samples; 7–10 is typical for a robust calibration. More samples improve statistical confidence.
Spread	Distribute samples as evenly as possible across your full operating range — avoid clustering several samples close together.
Traceability	Reference (lab) values should come from a method traceable to a recognised standard (ISO 9001 or equivalent).
Handling	Store and handle samples to prevent moisture loss or gain between lab analysis and sensor measurement.
Stability	Verify samples are stable (not actively drying out or absorbing moisture) both before and after analysis.

> *Note: Absorption Systems accepts no responsibility for the accuracy or traceability of customer-supplied reference samples. The quality of your calibration is only as good as the samples used to produce it.*

3. Step 2 — Recording Sensor Readings

For each reference sample, you need a matched pair of values: the known lab result and the corresponding live sensor reading.

1. On the HMI Main Screen, confirm the correct product calibration is loaded (see Section 3 of the standard Calibration Guide).
2. Present the first reference sample to the sensor and allow the reading to stabilise fully.
3. Record the live sensor reading (from the Main Screen or the Calibration → Calibrate tab Reading field) alongside the known lab value for that sample.
4. Repeat for every reference sample, keeping each lab/sensor pair together.

Use a table like the one below to keep your data organised:

Sample	Lab Reference (%)	Sensor Reading (%)	Notes
1			
2			
3			
4			
5			
6			
7			
8			

⚠ IMPORTANT

Always wait for the reading to stabilise before recording a sensor value. An unstable reading at any single sample point will reduce the accuracy of the whole calibration.

4. Step 3 — Using the QN-100 Calibration Calculator

The Calibration Calculator is available on the Absorption Systems website. Once you have your full set of matched lab/sensor pairs, enter them into the calculator to generate your report. It applies linear regression (least-squares fitting) to find the Span (slope) and Zero (intercept) that best fit your data across all samples.

Go to www.absorptionsystems.co.uk and select Calibration from the main menu. A downloadable HTML version of the same calculator is also available from the Downloads page, for use offline.

> *Note: Access to the website and the Downloads page is password protected. Contact Absorption Systems if you have not been issued with login details.*

1. Optionally, enter an Application or Product Name (e.g. "Potato Dough") — this will appear on the generated report.
2. Under Current Calibration, enter the sensor's existing Span and Zero values as the starting point. These can be read from the HMI Params tab (see Figure 1).

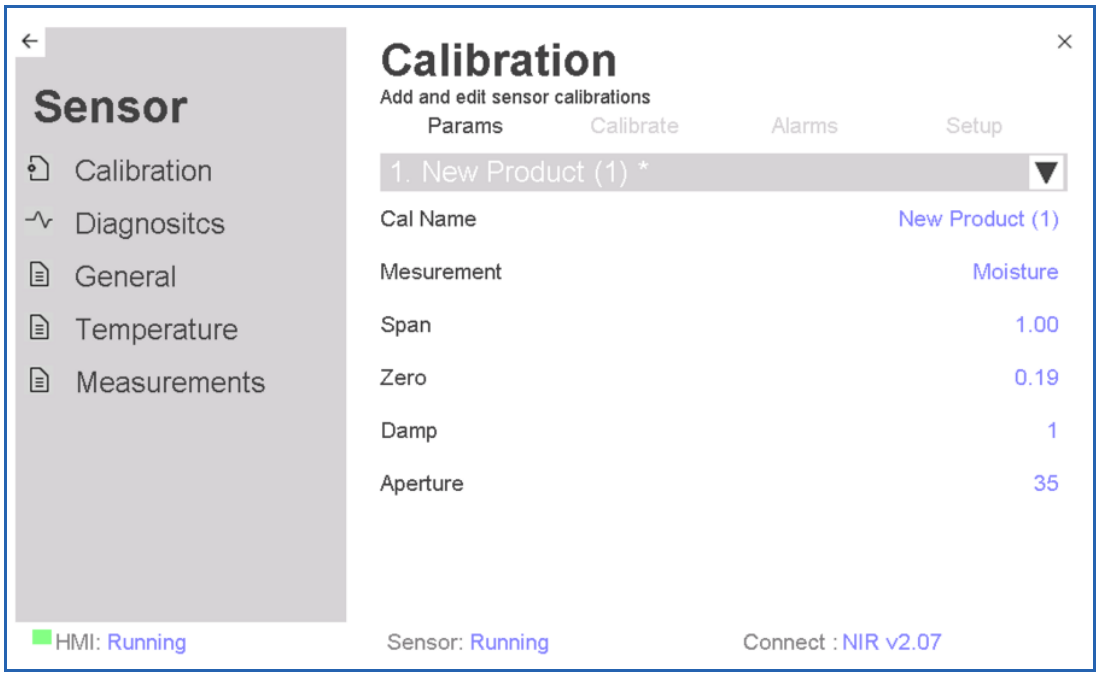

Figure 1 — Calibration Params Tab, showing the current Span and Zero

3. Under Reference Sample Data, tap + Add Sample for each reference sample and enter its Lab Reference (%) and Sensor Reading (%). The Deviation for each sample updates as you go.
4. Once all samples are entered, the calculator automatically produces the Calibration Results:

Field	Description
New Span Coefficient	The recalculated Span value to apply to the sensor.
New Zero Offset	The recalculated Zero value to apply to the sensor.
R^2 Coefficient	How well the straight-line fit matches your sample data (0–1.00). Closer to 1.0 is better.
Standard Error	The typical remaining deviation between lab and sensor readings, in % moisture (RMS).
Sample Count	The number of reference points included in the analysis.

The Quality Assurance panel shows an overall Validation status (e.g. EXCELLENT, GOOD, POOR) against the R^2 thresholds in Section 5, and the Calibration Visualization chart plots your samples against the fitted trend line so you can spot outliers or an uneven spread before applying the result.

5. Tap Generate & Download Report to produce a PDF calibration report — this is the document to keep on file for traceability (see Section 7).

5. Step 4 — Interpreting the Results

Before applying a new calibration, check the R^2 value against the quality thresholds below. These reflect standard industry practice for regression-based calibration.

Rating	R^2 Range	Meaning
Excellent	$R^2 > 0.95$	Production ready

Good	$0.90 < R^2 \leq 0.95$	Acceptable confidence
Fair	$0.80 < R^2 \leq 0.90$	Usable — monitor performance closely
Poor	$R^2 \leq 0.80$	Recalibration recommended — review sample quality and spread

If your result falls into the Fair or Poor range, review your reference sample data before proceeding:

- Check for a mislabelled or transposed lab/sensor pair.
- Look for a single outlier sample with unusually high error — consider re-measuring it.
- Confirm samples are spread across the full range rather than clustered together.
- Verify the sensor reading was fully stable before each value was recorded.

> *Example: a calibration with 7 samples, $R^2 = 0.975$ and Standard Error of 0.191% would be rated Excellent and considered production ready.*

6. Step 5 — Applying the New Calibration

Once you're satisfied with the result, the New Span and New Zero values from the calculator report need to be entered into the sensor via the HMI.

1. On the HMI, go to Menu → Sensor → Calibration and select the correct product calibration.
2. On the Params tab, tap the Span field (shown in blue) and enter the New Span value from your calibration report.
3. Tap the Zero field and enter the New Zero value from your calibration report.
4. Confirm the values have been accepted — the Params tab will display the updated Span and Zero.

> *Note: Unlike the two-point Calibrate tab, there is no Calculate button for a multi-point result. Because the regression is performed in the Calibration Calculator, the New Span and New Zero values are entered directly as calibration parameters.*

7. Step 6 — Verifying the Calibration

After applying the new Span and Zero, verify the calibration is performing as expected before returning to normal production.

- Present two or three of your original reference samples to the sensor again.
- Compare the live sensor reading against the known lab value for each.
- If readings are consistent with the calculated Standard Error, the calibration is confirmed. If not, review your data and consider repeating the process.

Keep a copy of the Calibration Report on file — it provides a documented, traceable record of the calibration for quality or audit purposes.

8. Quick Reference Checklist

Use this checklist as a quick reminder each time you run a multi-point calibration:

✓	Step	Notes / Recorded Value
☐	Collect at least 5–7 traceable reference samples, spread evenly across your process range.	

☐	Present each sample to the sensor, wait for stabilisation, and record the paired lab/sensor values.	
☐	At www.absorptionsystems.co.uk → Calibration, enter the current Span/Zero and add each sample pair.	
☐	Review the R^2 and Standard Error — confirm the result is Good or Excellent before proceeding.	
☐	Investigate and address any outlier samples if the fit quality is Fair or Poor.	
☐	Generate & Download the PDF calibration report from the calculator.	
☐	Enter the New Span and New Zero into the HMI Params tab for the correct product.	
☐	Re-verify with two or three known samples before returning to production.	
☐	File the Calibration Report for traceability and quality records.	

8.1 Where to Find the Calculator

Field	Description
Web tool	www.absorptionsystems.co.uk → Calibration
HTML version	www.absorptionsystems.co.uk → Downloads → Calibration Calculator
Access	Both the website and Downloads page require a password — contact Absorption Systems if you need access.

> *Need help? If your calibration results are inconsistent or you're unsure how to interpret the report, contact Absorption Systems' applications team before applying the new values to your sensor.*

Revision History

Rev	Date	Description	Author
1.0	Jul 2026	Initial release.	Applications Engineering
1.1	Aug 2026	Re-referenced from AS-PRD-WI-003 to MAN series; house font changed to Aptos. No technical content changes.	Applications Engineering
1.2	August 2026	Excel offline calculator replaced by downloadable HTML tool (same as the website).	Applications Engineering

9. Approval

Role	Name / Signature	Date
Prepared by	Applications Engineering	August 2026
Approved by	Applications Engineering	August 2026