



Sensor Calibration Procedures and Certificates

PTC-BASED TEMPERATURE SENSORS: SS3-103
SS3-104
SS3-105

NTC-BASED TEMPERATURE SENSORS: SS3-106
SS3-110
SS3-116

CURRENT METERS: SS3-617-30
SS3-617-100
SS3-617-200

Temperature Sensor Factory Traceable Calibration (SS3-103, SS3-104, SS3-105, SS3-106, SS3-110, SS3-116)

Temperature sensors from Swift Sensors are calibrated to Traceable NIST standards, ensuring the published accuracy is compliant with NIST. Swift Sensors calibration uses individualized test data for any offset compensation, along with reference testing involving NIST-certified equipment. Since these sensors take spot measurements every inspection rate period (60s-30min), calibration is performed as follows:

1. **Step 1 Factory Testing Offset Calibration:** Each sensor has a test record from an ideal resistance measurement. The documented measurement is then calculated and applied as Calibration factor C1 (ex. The Sensor Test fixture will test against an ideal 10k +/- 0.01% resistance, with the measured value applied).
2. **Step 2 NIST Traceable Reference Calibration:** Sensing elements of Swift Sensors and NIST certified reference devices are placed in a stable medium. Five (5) Measurements are made @ 1-minute intervals, and then averaged. Reference Devices are then averaged together for an ideal temperature reading. The Swift Sensor is then given a calibration factor C2 which will compensate for any other imperfections not corrected from factory testing offset calibration.

Both Calibration Factors C1 and C2 are then summed together for a final, applied calibration factor. Due to the use of high quality precision components, the calibration factor is generally between 0.998-1.002 (+/-0.02%) for models using an NTC (SS3-103, 104, 105), and between 0.98-1.02 (+/-2%) for models using a PTC (SS3-106,110,116). PTC elements are much lower in resistance and higher in sensitivity, thus exhibit more variation prior to calibration.

Reference Equipment:

1. 2x Fluke T3000 with active NIST Certificate
2. Swift Sensors temperature sensors with active NIST Certificate

Current Meter Factory Calibration (SS3-617-30/100/200)

Three steps are taken to ensure proper calibration of any SS3-617 current meter.

- 1. Current Meter Characterization:** Each current meter offered by Swift Sensors has been characterized so that every meter follows the same response curve to within 1%. This was achieved with large-scale testing up to 250Arms testing across unit lots. Current testing was done at TenX Precision LLC- using an amplified 60Hz Sine Wave of <1% THD.
- 2. Offset Calibration:** Similar to temperature testing, individual sensor test data is used to inform an ideal measurement. This gives each unit a calibration factor between 0.995 and 1.005 (+/- 0.5%).
- 3. Unit Verification:** Once final assembly is completed, current measurements are verified at 3 points; 10%, 20%, and 40% of current meter range. This may inform the final calibration factor.

These steps then ensure a total accuracy of +/-1.5% maximum (+/-1% nominal) from 20-100% of the current meter range. Below 10% of the measurement range, accuracy is stated on each SS3-617 datasheet (+/-0.1Arms below 3Arms for SS3-617-30, +/-0.25Arms below 10Arms for SS3-617-100, and +/-0.3Arms below 10Arms, +/-0.2Arms 10-30Arms for SS3-617-200).

Reference Equipment:

- 1. Characterization:** Kyoritsu 2002PA Clamp Meter
- 2. Unit Verification/Offset:** Fluke 323 Clamp Meter, Klein Tools CL800 Clamp Meter

Calibration Certificates:

Customers who require calibration certificates specific to their purchased sensors have two options:

1. **NIST Calibration Certificate** – Customers who require sensors calibrated to NIST standards at an independent laboratory can [purchase this service](#) directly from Swift Sensors. Calibration is performed at a NIST-accredited lab and is valid for 1 year and can be renewed (requires the customer to ship their sensors to a NIST-accredited lab of their choice for re-calibration)
2. **Swift Sensors Factory Calibration Certificate** – Customers who require documentation can request a certificate specific for their purchased sensors (model and hardware ID) through Swift Sensors. [Requests can be made through swiftsensors.com](https://www.swiftsensors.com).

Sample Certificates (Attached)



CERTIFICATE OF CALIBRATION

This certifies that the following temperature sensor model:

Models SS3-104/104/105/106/110/116

Has been calibrated by Swift Sensors against laboratory standards which are traceable via international agreement to all major National Standards, including NIST, to the following specifications:

Measurement Range: -40°C to $+125^{\circ}\text{C}$

Accuracy: 0.15°C

Precision: 0.01°C

With:

Fluke T3000 with active NIST certificate

For more information, refer to the Swift Sensors Detailed Calibration Procedures document on swiftsensors.com

Issue Date

Calibration is considered accurate 1 year from the date above.

A handwritten signature in black ink that reads "Ray Almgren".

Ray Almgren, CEO



CERTIFICATE OF CALIBRATION

This certifies that the following current sensor model:

SS3-617-30

Has been calibrated by Swift Sensors against laboratory standards which are traceable via international agreement to all major National Standards, including NIST, to the following specifications:

Measurement Range: 0 – 30 Arms
Accuracy: +/- 1% 3-30 Arms, +/- 0.1 Arms @3Arms
Precision: 0.001 AAC

With:
Kyoritsu 2002 PA Clamp Meter
Fluke 323 Clamp Meter
Klein Tools CL800 Clamp Meter

For more information, refer to the Swift Sensors Detailed Calibration Procedures document on swiftsensors.com

Issue Date

Calibration is considered accurate 1 year
from the date above.


Ray Almgren, CEO