METROLOG CONTROLES DE MEDIÇÃO LTDA
INSTRUMENTOS DE MEDIÇÃO PARA CONTROLE DIMENSIONAL
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Application Note AN140912A

(technician use only)

Description

This document details setup instructions on how to connect a new LVDT sensor to a SD20 device, adjust oscillator and gain resistors, create calibration data and update the device.

Connector pinout and components

A Din DB15 Male connector should be used to interface the LVDT sensor to the SD20 device accordingly to pinout diagram shown in **Figure 1**.

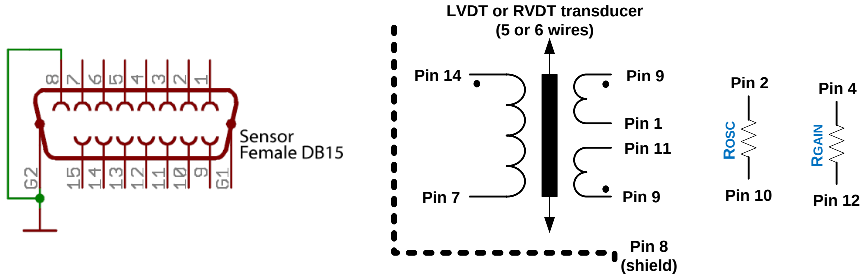

Figure 1 - Connection Diagram – SD20-LVDT model

Two 1% tolerance resistors must be added directly to the connector pins, ROSC on pins 2-10 and RGAIN on pins 4-12. If these resistors are not known proceed to *ROSC and RGAIN resistors* section before continuing.

If long cables are used (above 15 meters), 2 additional 100uH signal inductors should be added, in series, to pin 14 and pin 7.

After complete connector assembly, run **SD20 ConfDiag** utility for sensor setup and calibration.

ROSC and RGAIN resistors

NOTE: This procedure is only required if a new LVDT model will be interfaced with the SD20 conditioner. Once defined, update the ROSC and RGAIN table values and use as reference for future connector assembly.

To define the proper ROSC and RGAIN values for a new LVDT model:

1. Connect the LVDT wires accordingly to **Figure 1** and install a 500k trimmer potentiometer between pins 2-10 (ROSC) and a 50k trimmer potentiometer between pins 4-12 (RGAIN).
2. Plug the connector to a powered SD20 device and with a DMM measure VAC(RMS) between pins 1-11. Move the sensor plunger from full extended to full contracted positions and stop where the maximum voltage is detected. Adjust the ROSC trimmer potentiometer to set the voltage to 2VRMS (oscillator amplitude). This value is adequate for most LVDT models and offers the best SNR. In some special LVDTs, if required, this value can be set between 1 and 3.5VRMS. For open core LVDTs, position the core until it reaches the body extremities (keeping the entire core inside). (Note: make sure a DMM with RMS capability and VAC bandwidth grater than 10kHz is used).
3. Run **SD20_ConfDiag** utility and click **"Open configuration file"**. Select the supplied **SD20_<serial>.sd20** file that matches the serial number printed on the device label. This file contains the basic device configuration and will be used as a template for the remaining settings.
4. Click on **"Linearization curve / Noise Analysis"** button.
5. On the Linearization window click on **"Start communication"** > **"SD20 Conditioner (USB)"**. If more than one device is detected, a selection list will appear; otherwise the software will automatically connect to the only available SD20 unit. Notice the A/D readout (in volts). It shows the actual Analog to Digital converter input signal and will be used to set the RGAIN value:

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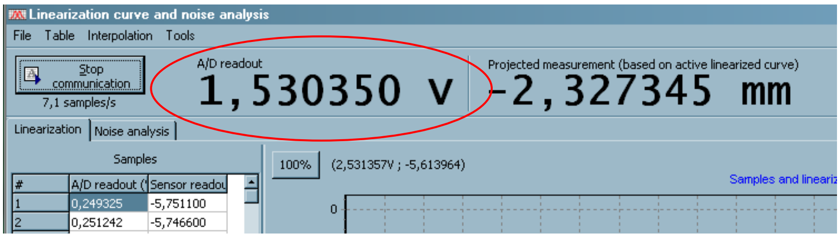

6. The A/D readout can vary from 0 to 2.5V. Below or above these values saturation will occur. In most cases the A/D should not saturate at any LVDT position, even when the plunger is outside the typical measurement range. To find the proper RGAIN value, change the RGAIN trimmer potentiometer and move the sensor plunger from full extended to full contracted positions. If properly set, full plunger displacement should result in a variation from 0.2V to 2.3V (A/D readout should not reach 0 or 2.5V saturation points). Higher RGAIN values could be used to result in a full A/D range for small displacements. In most cases, however, this will not improve effective resolution because the SNR degrades with higher amplification values.
7. At this point remove both trimmer potentiometers and measure their values. Find the closest commercial 1% tolerance resistor available (use resistors in parallel or series, if necessary) and install them directly to the connector. Proceed to calibration.

As simple reference, list of some LVDTs, ROSC and RGAIN value and wiring color

LVDT Model	ROSC (1% tolerance)	RGAIN (1% tolerance)	Pin 9 (A)	Pin 1 (B)	Pin 11 (C)	Pin 9 (D)	Pin 14 (E)	Pin 7 (F)	Pin 8 (shield)
LBB315PA-200	49k9	10k	white	yellow	yellow	green	blue	red	shield
LBB315PA-100	49k9	20k	red	blue	green	black	brown	yellow	shield
LBB315PA-040	49k9	20k	red	blue	green	black	brown	yellow	shield
025 MHR	39k + 3k3	10k + 6k81	red	blue	green	black	brown	yellow	body/ mass
AX/1/S (AF100)	12k	8k25 + 22k	yellow	green	white	yellow	blue	red	shield
LBB315PA-020	12k	24k9	red	blue	green	black	brown	yellow	shield

LVDT Calibration

1. Connect the new SD20 device with the new paired LVDT sensor and run the **SD20_ConfDiag** utility. Click **"Open configuration file"**. Select the supplied **SD20_<serial>.sd20** file that matches the serial number printed on the device label.
2. Click on **"Linearization curve / Noise Analysis"** button.
3. On the Linearization window click on **"Start communication"** > **"SD20 Conditioner (USB)"**. If more than one device is detected, a selection list will appear; otherwise the software will automatically connect to the only available SD20 unit.
4. To start create new calibration dataset click on menu **"Table"** > **"Remove all samples"**.
5. Properly position the LVDT at zero position and press **"F5"** (or menu **"Table"** > **"Insert current A/D readout"**) to add a new X value to the table. Type "0" as a new Y value (sensor readout). The zero position is an arbitrary position and could be when the plunger is fully extended, at center position (LVDT electrical zero position), fully contracted or any other place. Metrolog calibration standard refers as zero position when the plunger is fully contracted (A/D readout close to 2.5V) and measurement increases toward the fully extended position (A/D readout close to 0V).

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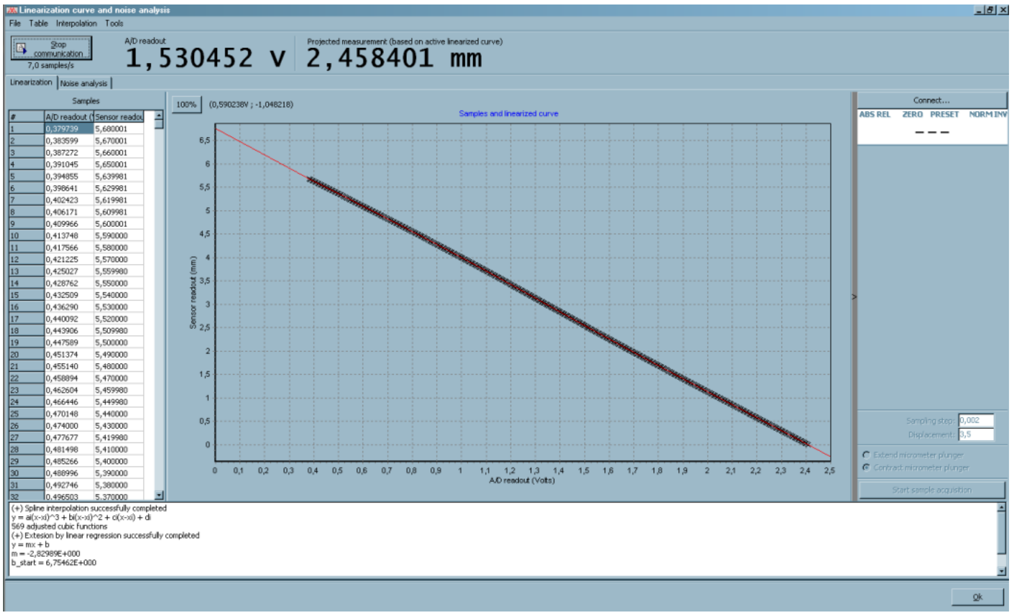

6. Apply a know displacement to the LVDT plunger, press "F5" to add a new point and type the displacament value at sensor readout column.
7. Repeat step 6 until the entire sensor range is scanned.
8. After all calibration points are entered and the interpolated curve is created (shown as a red curve in the graph area), click **"OK"** (or menu **"File"** > **"Confirm data and close window"**).
9. On the main window, click **"Edit general parameters"**. Update the transducer information, calibration date/time and notes. This step is optional but highly recommended. Click **"OK"** to close the general parameters window.
10. Save the updated configuration file (click on **"Save configuration file"**).
11. Finally, to transfer all new data, including the calibration data to the SD20 device, click on **"Transfer configuration file to SD20"**. Select the SD20 device from the list and click **"Next"**. Make sure both **"Transmit user data"** and **"Transmit interpolation table"** options are checked. Click **"Start"** to begin the data transfer. Full data transfer will take about 4 minutes to complete.
12. As a final verification step, run the **SD20 Datalogger** software and check sensor readouts against a reference master. It is recommended to scan the entire sensor range and verify final linearity and accuracy errors.

Notes about calibration:

- Minimum of 30 minutes warm up time is required before calibration or noise analysis.
- To archive the highest accuracy it is recommended to use displacement steps of 0.1% of full scale. For a +/-2.5mm LVDT, for example, 5um steps should be used.
- High accuracy dimensional displacement master should be used. Metrolog uses a Mitotoyo IChecker device for automatic data acquisition of high precision data calibration (interface options available within SD20 ConfDiag software).
- There are 3 interpolation method available within SD20 ConfDiag software: linear, cubic spline and cubic spline with linear extension. The later is recommended for most application (at least 3 data points are required).

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