LVDT Sensor with Nucleo

LVDT signal conditioning using only STM32G474 and external audio amplifier

20.05.2024

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Problem and Theory

Linear Variable Differential Transformer (LVDT)

- Non-contact position sensing device
- Based on electromagnetic induction
- One primary coil and two secondary coils
- Ferrite core movement affects mutual inductance
- **Output**: Voltages from secondary coils proportional to core position
- $x_{\text{core position}} = k \cdot \frac{U_{\text{SEC1}} - U_{\text{SEC2}}}{U_{\text{SEC1}} + U_{\text{SEC2}}}$

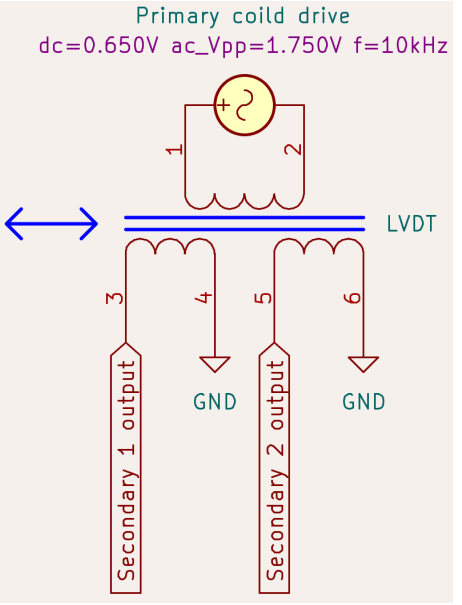

Figure 1: LVDT Operating Principle

Solution Design

System Components:

- **STM32G474** Nucleo board for signal generation and processing
- **LM4889** External audio amplifier
  - Powers primary coil **10kHz** AC
- ADC **120kSa/s** sampling of secondary coil outputs
- Digital signal processing for displacement calculation
  - **Goertzel algorithm**

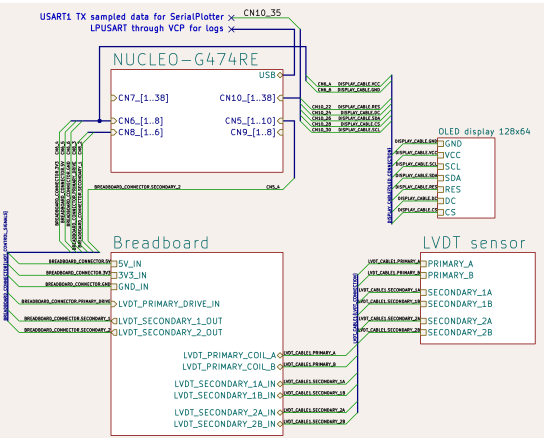

Figure 2: System Block Diagram

Implementation

Hardware Implementation:

- Nucleo board connections:
  - DAC output to audio amplifier
  - ADC inputs from secondary coils
- Signal conditioning circuit for secondary outputs
  - Resistor divider
  - Protection diodes

Figure 3: Homemade LVDT Sensor

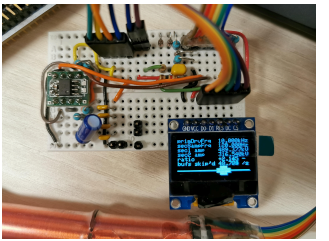

Figure 4: Complete Circuit Setup

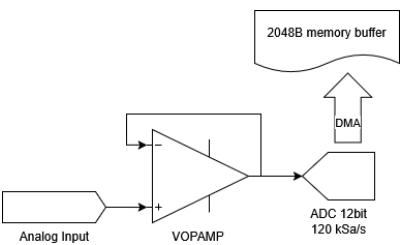

Figure 5: Sampling

Results and Performance

Measurement Results:

- Linear range: ±27.5 mm

Signal processing approach:

- Goertzel algorithm for FT at 10 kHz
- Adjustable sample averaging

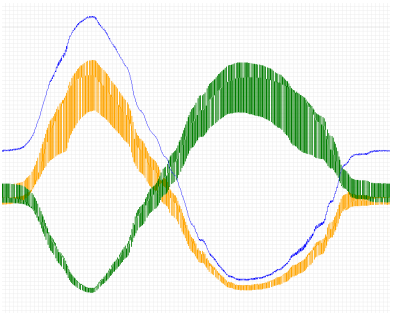

Figure 6: Processed Signals

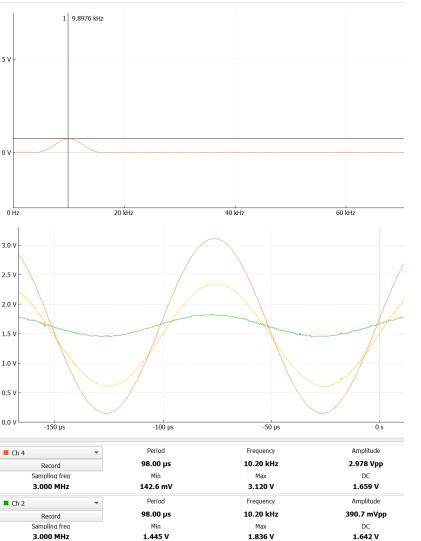

Figure 7: Raw Signals