

## Dimensional Gaging Measurements with Model 3B17

Linear Variable Displacement Transducers (LVDTs) are common in gaging systems. Two LVDTs can be used to measure the thickness or taper of an object. For a thickness measurement, the LVDTs are placed on either side of the object to be measured. The LVDTs are positioned such that there is a known maximum distance between them in the fully retracted position. When the object to be measured is placed between the two LVDTs, the displacement of both LVDTs are added together and then the computer or control system will subtract this total from the known distance between the LVDTs. Taper or slope measurements are done by positioning the two LVDTs at the same level at a known distance apart. If the object to be measured is on the same level as the LVDTs, both LVDTs would have the same reading. The difference between the displacements of the LVDTs divided by the known difference in position will yield the slope.

In a gaging application where many measurements are made, and thus many LVDTs are used, the cost for a signal conditioner for each transducer can be high. One Analog Devices' 3B17 LVDT signal conditioner can be configured to handle two inputs for both the differential and additive applications, thus cutting the signal conditioning costs in half. Figure 1 shows two LVDTs connected together with the input to the signal conditioning being the sum of both LVDTs. The LVDTs should have matched gains. Both LVDTs will receive the same excitation signal up to a maximum of 20 mA. The demodulation sync signal internal to the signal conditioner is two times the voltage at Pin 3 of the conditioner (labeled A) minus the voltage at Pin 2 (labeled A - B). This signal should not vary more than +50%. Numerically this indicates:

$$|V_{A1}| > |(A - B)_1 + (A - B)_2|$$

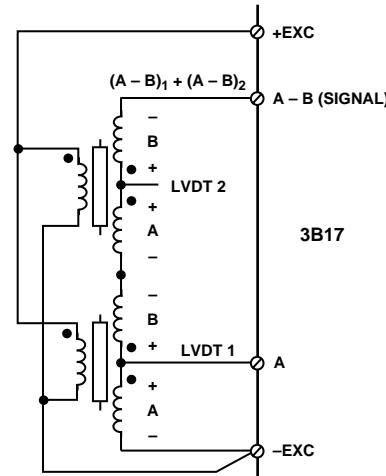


Figure 1. Additive LVDT Connections

### MODEL 3B17 LVDT INPUT SIGNAL CONDITIONING MODULE

The 3B17 is a nonisolated signal conditioning module for LVDT interfacing. It provides a programmable, very stable, low distortion ac excitation voltage for the transducer and accepts a 20 mV rms to 5 V rms input signal from the LVDT. All gain and span adjustments are accomplished with screwdriver attachments on the top of the module. The interpretation of the LVDT output voltage is done with a synchronous demodulator. This demodulator converts the ac output of the LVDT into a dc voltage. It automatically compensates for any phase error between primary and secondaries of the LVDT, and eliminates the need for a phase adjustment. It also rejects any residual quadrature or null voltage providing accurate, linear  $\pm 10$  volt and 4 mA–20 mA outputs.

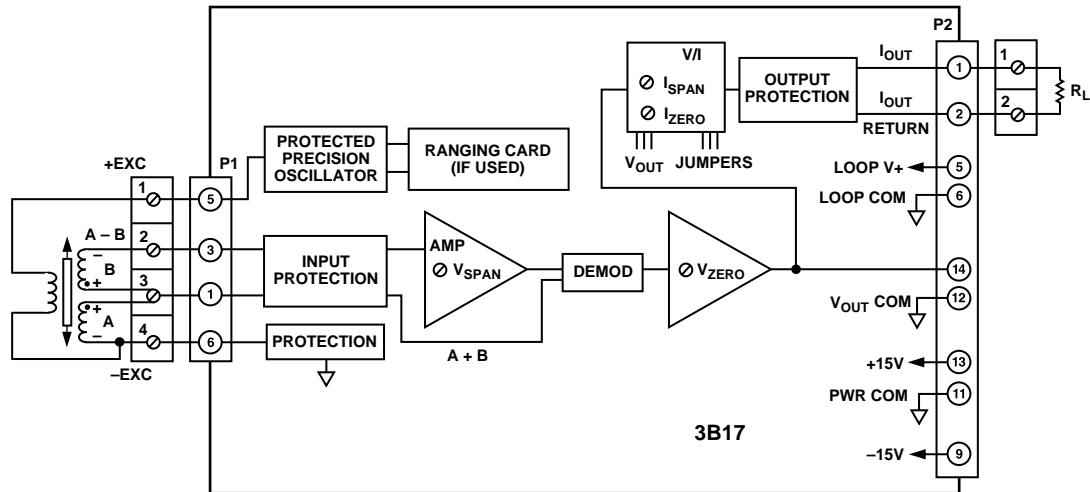


Figure 2. Block Diagram of Model 3B17

### INSIDE THE 3B17

The 3B17 accepts inputs from 4-wire, 5-wire and 6-wire LVDTs or RVDTs. A block diagram of Model 3B17 is shown in Figure 2.

The 3B17 provides an ac excitation of 1 V rms to 5 V rms at frequencies ranging from 1 kHz to 10 kHz on input screw terminals 1 and 4. The ac excitation is limited to a 20 mA rms load; this sets a lower circuit primary impedance of 50  $\Omega$  for a 1 V excitation and 250  $\Omega$  for a 5 V excitation. If the primary impedance of the LVDT/RVDT is below 50  $\Omega$ , the impedance of the LVDT/RVDT can be increased by increasing the excitation frequency. Input protection of up to 130 V rms is provided for the excitation and input circuitry. The signal is amplified to provide the high level voltage output.

The 3B17 is designed to compensate for error terms typically found in LVDT or RVDT applications, such as quadrature voltages (voltages that are 90° out-of-phase to the output signal) and null voltages. Quadrature and null voltages can appear at the differential output of the LVDT/RVDT; they can be caused by interwinding capacitance and winding asymmetries or a fixed-phase shift from the primary to the secondary of the LVDT/RVDT. The two secondary windings are identified as A and B, with the normal output being A - B. (Refer to Figure 1). The 3B17 generates the function A + B (a voltage that is in phase with the secondaries and nearly invariant with the core replacement) by manipulating the A and A - B outputs. Since A + B is much larger than the quadrature voltage, A + B can drive the demodulator, eliminating the need to manually trim the phase of the demodulator. In addition, the 3B17 automatically rejects any residual quadrature voltages.

You can adjust the voltage output over  $\pm 5$  V from the center setting of the LVDT/RVDT. After you adjust the voltage output, you can independently adjust the 130 V ac protected current output over a  $\pm 5\%$  span range for zero and span.

### OTHER LVDT CONNECTIONS

A 6-wire LVDT is shown connected to the 3B17 in Figure 2. 4-wire and 5-wire connections are shown in Figures 3a, 3b, 4a and 4b.

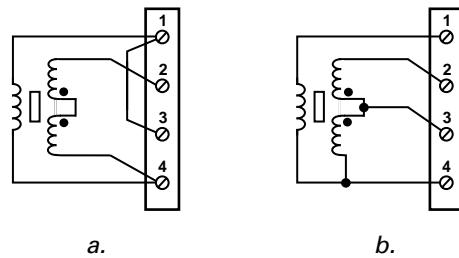


Figure 3. Four-Wire LVDT Connections

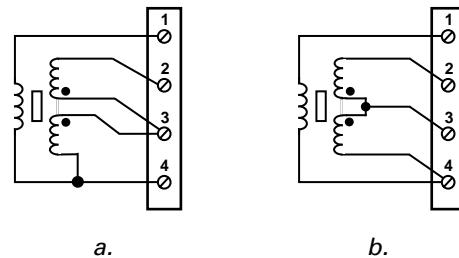
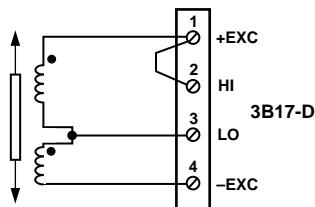


Figure 4. Five-Wire LVDT Connections

## USING THE 3B17 FOR DIFFERENTIAL COIL CONDITIONING

The 3B17-D version of the 3B17 module can be used for differential coil applications as shown in Figure 5. The 3B17-D is intolerant of a capacitive load across the excitation terminals that is greater than 100 pF. Any capacitor that is across the entire differential coil must be removed.



*Figure 5. Differential Coil Connection*

## USING NONSPECIFIED EXCITATION VOLTAGE AND FREQUENCY

Whenever possible, the voltage and frequency of the excitation provided by the 3B17 module should match the voltage and frequency of the LVDT/RVDT specification. If this results in an excitation current of more than 20 mA rms load on the excitation pins of the 3B17, the following procedure is recommended;

- Decrease the excitation voltage to 1 V rms. The 3B17 operates at gains of up to 230 ( $V_{DC\ OUT}/V_{RMS\ IN}$ ), and can support the increased gain demand;
- Increase the frequency to 10 kHz; this increases the primary impedance. Keep in mind that the primary to secondary phase shift changes, however, the internal synchronization automatically compensates for any change in phase shift. In addition, the linearity of the LVDT/RVDT may change when operated at a different frequency than specified. Consult the LVDT/RVDT data sheet or manufacturer for more information.