Newtons4th Ltd
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APPLICATION NOTE - 003
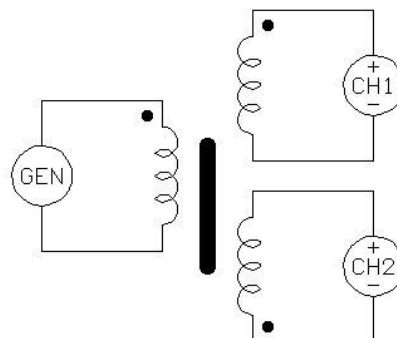## Using the PSM Range with LVDT's

Introduction

LVDTs (Linear Variable Differential Transformer) consist of a transformer with one primary winding, two secondary windings and a moveable armature. With the primary energised at a suitable frequency, the magnitude and relative phase of the secondaries change as the armature is moved.

There are two main ways of detecting the displacement – ratiometric and differential:

Ratiometric measurement:

With ratiometric measurement, the fundamental magnitudes of the two secondaries are measured.

Energise the primary from the PSM generator, and connect one secondary to CH1 input, the other to CH2 input as shown below:

Select 'Vector Voltmeter' mode and using the SETUP menu select 'LVDT ratio' as the parameter. Enter the electrical stroke of the LVDT in meters as the scale factor (if required). The magnitudes of the two inputs are computed by DFT analysis at the fundamental frequency. The displacement is computed as:

ratio = (V1 – V2) / (V1 + V2)
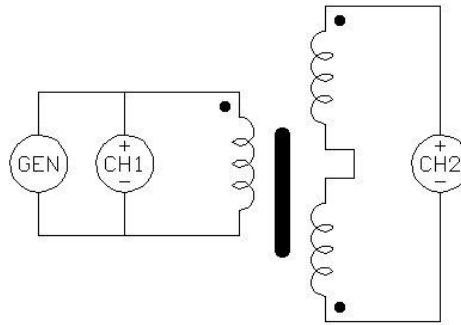displacement = scale factor * ratio

where V1, V2 are the magnitudes of CH1 and CH2.

When the armature is in the middle, V1 is equal to V2, and the ratio therefore is zero. As the armature moves, one secondary voltage increases, while the other decreases. If V1 becomes greater than V2 then V1 - V2 is positive and a positive displacement is computed; if V2 becomes greater than V1 increases then V1 – V2 is negative and a negative displacement is computed (V1 + V2 is always positive as V1 and V2 are the magnitude measurements).

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Differential measurement:

With differential measurement, the two secondaries are connected in series with opposite polarity so that their magnitudes subtract (or 'buck'). The in-phase component of the resulting secondary voltage is measured relative to the primary excitation.

Energise the primary from the PSM generator, connect the primary to CH1 input, and connect the two secondaries in series to CH2 input, as shown below.

Select 'Vector Voltmeter' mode, and using the SETUP menu select 'LVDT diff' as the parameter. Enter the electrical stroke of the LVDT in meters as the scale factor (if required). The in-phase component of the secondary is computed by DFT analysis at the fundamental frequency. The displacement is computed as:

> ratio = A2 / A1
> displacement = scale factor * ratio

where A1, A2 are the in-phase components of CH1 and CH2.

When the armature is in the middle, the voltage across secondary 1 is equal and opposite to secondary 2 so A2 is zero, and the ratio therefore is zero. As the armature moves, one secondary voltage increases, while the other decreases, resulting in a net positive voltage for A2, or a net negative voltage.

Other options:

The default display shows the A & B values, the LVDT ratio, the frequency and phase difference. If a stroke value has been entered then the displacement in metres is also displayed. Pressing DISP on the PSM2200 changes the PSM display to a NULL meter. On the PSM1700 and PSM1735 units, the NULL meter display is visible on normal display mode.

Note that when an external generator can be used instead of the PSM generator – the frequency will be measured from CH1 input. Also laboratory amplifiers are available as accessories to boost the output drive capability of the PSM if required.