HR-Z SERIES

Mild Radiation Resistance LVDT

SPECIFICATIONS

- **Mild Radiation Resistant**
- **High Reliability**
- **Large core-to-bore clearance**
- **Stroke ranges from ± 0.05 to ±10 inches**
- **AC operation from 400Hz to 5kHz**
- **Stainless steel housing**
- **Imperial or metric threaded core**

The **HR-Z** Series LVDTs are a variant of the popular HR Series. The HR-Z Series provide the optimum performance required for a majority of mild radiation applications. The large 1/16 inch [1.6mm] bore-to-core radial clearance provides for ample installation misalignments and therefore reduces the application costs. Featuring a high output voltage and a broad operating frequency range, these versatile and highly reliable LVDTs deliver worry-free and precise position measurements at temperatures up to 300°F [150°C].

Available in a variety of stroke ranges from ±0.05 to ±10 inches, the HR-Z Series can be configured with a metric threaded core as an option. With mild radiation resistance (10^{12} NVT total integrated flux; 10^{7} rads Gamma), the HR-Z Series is compatible with the full line of Measurement Specialties LVDT signal conditioners.

Like in most of our LVDTs, the HR-Z windings are vacuum impregnated with a specially formulated, high temperature, flexible resin, and the coil assembly is potted inside its housing with a two-component epoxy. This provides excellent protection against hostile environments such as high humidity, vibration and shock.

FEATURES

- Mild radiation resistance
- Large 1/16” core-to-bore clearance
- Shock and vibration tolerant
- Electromagnetic/electrostatic shielding
- Calibration certificate supplied with each unit

APPLICATIONS

- Mild radiations areas
- High temperature applications
- Process control
- Factory automation
- Applications with large misalignments

RADIATION RESISTANCE

Certain applications require resistance to a combination of gamma radiation, neutron radiation and high temperature. Before considering detailed specifications and suitability for a particular application, a review of the following working definitions and equivalents is appropriate.

Total integrated neutron flux

The total integrated neutron flux (also called neutron fluence) is the neutron flux integrated over time.

Neutron flux: the total distance travelled by all neutrons per unit time and volume
Formula for neutron flux: *number of neutrons/volume x distance/time = neutron density x velocity*
Neutron density: number of neutrons (n) per unit volume

Formula for total integrated neutron flux:

neutron density x velocity x time = neutron density x distance

Unit for total integrated neutron flux:

$n/m^3 \times m$ = $\mathbf{n/m^2}$ (n: number of neutrons; m: meter)
or
NVT (n/cm^2)
Conversion: $1\ NVT = 10^4\ n/m^2$

Gamma-ray total integrated dose (TID) radiation

The absorbed dose of ionizing radiation is the amount of energy deposited per unit of mass.

Units: *rad (radiation absorbed dose): radiation that will deposit 0.01 Joule of energy per kilogram of matter*

Gy (Gray): radiation that will deposit 1 joule of energy per kilogram (SI unit)
Conversion: *1 Gy = 100 rad*

All radiation produces some damage, therefore, the issue becomes how much radiation and what kind of radiation can an object sustain while maintaining its operation specification. At best, this can only be an estimate.

When radiant energy falls on an object, equal amounts of energy from different sources may result in greatly differing amounts of damage depending on the form of radiation, i.e. gamma rays, neutrons, etc. These different sources may also result in qualitatively different kinds of damage. One method to quantify these differences is to determine the rate of radiation that a unit can withstand without instantaneous and unacceptable damage. Another method is to determine the total integrated flux that can be absorbed before “wear-out” damage from radiation occurs. The distinction between rate of flux and total integrated flux must be kept clearly in mind.

There is no direct relationship between neutron fluence and gamma radiation. If we assume equal energy dissipation from differing sources, the energy absorbed by the unit will vary with its absorption cross section. If we try to equalize damage, there is even more uncertainty because of the qualitative differences of the damage caused by various forms of radiation.

PERFORMANCE SPECIFICATIONS

ELECTRICAL SPECIFICATIONS

Parameter	HR-Z 050	HR-Z 100	HR-Z 200	HR-Z 300	HR-Z 500	HR-Z 1000	HR-Z 2000	HR-Z 3000	HR-Z 4000	HR-Z 5000	HR-Z 7500	HR-Z 10000
Stroke range	±0.05 [±1.27]	±0.1 [±2.54]	±0.2 [±5.08]	±0.3 [±7.62]	±0.5 [±12.7]	±1 [±25.4]	±2 [±50.8]	±3 [±76.2]	±4 [±101.6]	±5 [±127]	±7.5 [±190.5]	±10 [±254]
Sensitivity V/V/inch [mV/V/mm]	5.8 [228]	4.2 [165]	2.5 [98.4]	1.3 [51.2]	0.7 [27.6]	0.39 [15.4]	0.23 [9.1]	0.25 [9.8]	0.20 [7.9]	0.14 [5.5]	0.13 [5.1]	0.07 [2.8]
Output at stroke ends, mV/V (*)	290	420	500	390	350	390	460	750	800	700	975	700
Phase shift	-1°	-5°	-4°	-11°	-1°	-3°	+5°	+11°	+1°	+3°	+1°	-5°
Input impedance (PRIMARY)	430Ω	1070Ω	1150Ω	1100Ω	460Ω	460Ω	330Ω	315Ω	275Ω	310Ω	260Ω	550Ω
Output impedance (SECONDARY)	4000Ω	5000Ω	4000Ω	2700Ω	375Ω	320Ω	300Ω	830Ω	400Ω	400Ω	905Ω	750Ω
Non-linearity	±% of FR											
@ 50% stroke	0.10	0.10	0.10	0.10	0.15	0.15	0.15	0.15	0.15	0.15	/	0.15
@100% stroke (maximum)	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**
@125% stroke	0.25	0.25	0.25	0.35	0.35	1.00	0 .50 *(**)*	0 .50 *(**)*	0 .50 *(**)*	1.00 *(**)*	/	1.00 *(**)*
@150% stroke	0.50	0.50	0.50	0.50	0.75	1.30 *(**)*	1.00 *(**)*	1.00 *(**)*	1.00 *(**)*	/	/	/
Input voltage	3 VRMS sine wave											
Input frequency	400Hz to 5kHz											
Test frequency	2.5kHz											
Null voltage	0.5% of FRO, maximum											

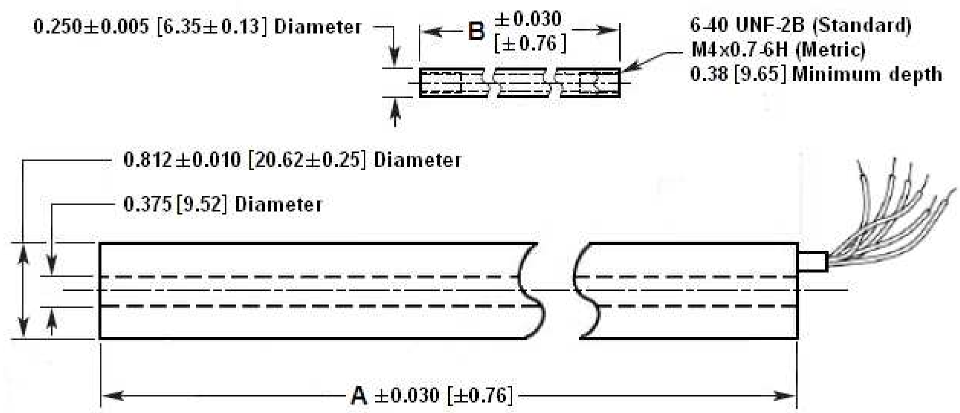
ENVIRONMENTAL SPECIFICATIONS & MATERIALS

Operating temperature	-65°F to +300°F [-55°C to 150°C]
Shock survival	1,000 g (11ms half-sine)
Vibration tolerance	20 g up to 2KHz
Housing material	AISI 400 Series stainless steel
Electrical connection	Six lead-wires, 28 AWG stranded plated Copper, Polyalkene insulated, PVDF jacket, 3 foot [1 meter] long
IEC 60529 rating	IP61

Notes:
Dimensions are in inch [mm]
All values are nominal unless otherwise noted
Electrical specifications are for the test frequency indicated in the table
FR: Full Range is the stroke range, end to end; FR=2xS for ±S stroke range
FRO (Full Range Output): Algebraic difference in outputs measured at the ends of the range
(*) Unit for output at stroke ends is millivolt per volt of excitation (input voltage)
(**) Requires special reduced core length

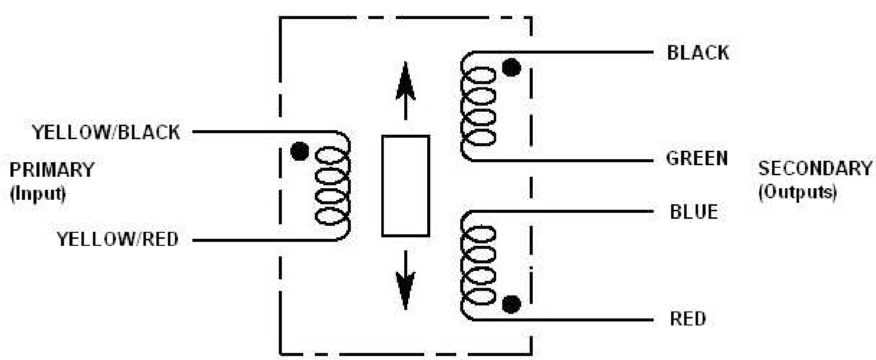
MECHANICAL SPECIFICATIONS

Parameters	HR-Z 050	HR-Z 100	HR-Z 200	HR-Z 300	HR-Z 500	HR-Z 1000	HR-Z 2000	HR-Z 3000	HR-Z 4000	HR-Z 5000	HR-Z 7500	HR-Z 10000
Body length "A"	1.13 [28.7]	1.81 [46.0]	2.50 [63.5]	3.22 [81.8]	5.50 [139.7]	6.63 [168.4]	10.00 [254]	12.82 [325.6]	15.64 [397.3]	17.88 [454.2]	24.09 [611.9]	30.85 [783.6]
Core length "B"	0.80 [20.3]	1.3 [33.0]	1.65 [41.9]	1.95 [49.5]	3.45 [87.6]	4.00 [101.6]	5.30 [134.6]	5.60 [142.2]	7.00 [177.8]	7.00 [177.8]	7.00 [177.8]	8.50 [215.9]
Body weight, oz [g]	1.13 [32]	1.69 [48]	2.12 [60]	2.72 [77]	3.85 [109]	4.45 [126]	5.93 [168]	7.94 [225]	10.41 [295]	11.99 [340]	16.16 [458]	20.46 [580]
Core weight, oz [g]	0.14 [4]	0.21 [6]	0.28 [8]	0.35 [10]	0.64 [18]	0.74 [21]	0.95 [27]	0.99 [28]	1.27 [36]	1.27 [36]	1.27 [36]	1.52 [43]



Dimensions are in inch [mm]

WIRING INFORMATION



Connect blue (BLU) to green (GRN) for differential output