More Notes on LVDT's

1. Applications

① Cryogenic to 650°C

② Harsh environments: high vibration/shock, radiation, etc.

③ Examples: aircraft, satellites, nuclear reactors, automation, etc.

2. Advantages

① very simple construction

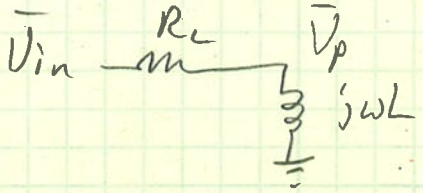
② little if any mechanical wear → lasts a long time ("no rubbing")

3. Drive Frequency

① "60 Hz common"

② "400 Hz common" in aircraft applications

③ phase delay issue worse at lower frequencies



4. Operational Range

- minimum: less than 1 μm
- maximum: ~ ±0.5 m

5. RVDT – Rotary Variable Differential Transformer

→ Similar concept to LVDT

→ measures angular displacement of a shaft

GHSA/GHSAR 750 Series

Spring-Loaded AC LVDT Position Sensors

Spring Loaded LVDTs > General Purpose LVDTs > GHSA/GHSAR 750 Series

Features

- Ranges of ±0.050" to ±2.00" [±1.25 mm to ±50.0 mm]
- Repeatability of 0.000025" [0.6 µm]
- Non-linearity of ±0.25% of FRO or better
- In-line connector (GHSA) or radial through-bore (GHSAR); mating plug for connector included
- Low pressure air-extend/spring-retract version available (GHSAR 750-A)
- Environmentally sealed to IEC IP-68

Applications

- Industrial gaging systems
- Electronic dial indicators
- Fabricated metal products gaging
- Materials testing apparatus
- Large shaft TIR measurements

GHSA and GHSAR 750 Series of 3/4 inch (19 mm) diameter AC LVDTs are designed for a wide range of position measurement applications. These rugged hermetically sealed sensors are constructed entirely of stainless steel, and are intended for general industrial use. The coil windings are sealed against hostile environments to IEC standard IP-68 and input/output connections are made through a sealed axial (GHSA) or radial (GHSAR) connector. The radial connector offers two important benefits. First, it results in a through-bore design, which allows for air purging of the sensor's bearings to remove potential contaminants. The second advantage is shorter installed length compared to units of the same range with axial connectors. The mating connector plug is supplied with the unit.

The sensor consists of a spring loaded shaft running in a precision sleeve bearing and connected to the core of an LVDT. The use of a precision sleeve bearing results in measurement repeatability of 0.000025 inches (0.6 µm) or better. The output from the LVDT can be connected to any standard LVDT signal conditioner and then passed to a gaging column display, digital readout, or computer based data acquisition system.

The probe shaft is fully extended by a spring exerting a nominal force of 6 to 20 ounces depending upon total range. The contact tip supplied is an AGD standard number 9 made from black oxide hardened tool steel. It is fully interchangeable with other 4-48-threaded AGD contact tips.

Macro Sensors also offers an air-extend/spring-retract version of the radial model. The GHSAR 750-A is designed for a wide range of cycled position measurement and automated dimensional gaging applications where it is necessary or desirable to move the probe out of the way between readings. The shaft is extended by introduction of a low-pressure (10-30 psi), clean, dry air supply, with a regulated flow, through a 1/4 inch barbed fitting on the end of the unit. With the release of pressure, an internal spring returns the probe to its normal position.

Available in ranges of ±0.050 inch (±1.25 mm) to ±2.00 inches (±50.0 mm), the maximum linearity error for a GHSA or GHSAR Series sensor is ±0.25% of full range output using a statistically best-fit straight line derived by the least squares method.

For simplified mounting the GHSA and GHSAR 750 Series have a 1/2-20 UNF-2A thread on the front of the housing, permitting the user to install the LVDT in a mating threaded part or by using the two hex nuts furnished with the sensor. This results in a ready-to-use package for position measurements and longer range gaging applications.

All GHSA/GHSAR Series LVDTs will operate properly with any conventional differential input LVDT signal conditioners, but operation with ratiometric LVDT signal conditioning is not recommended. Macro Sensors offers a full line of LVDT signal conditioners that will deliver optimum performance from any GHSA/GHSAR Series LVDT.

GHSA/GHSAR 750 General Specifications

Input Voltage	**3.0 Vrms (nominal)**
Input Frequency	**2.5 to 3.0 kHz**
Linearity Error	**< ±0.25% of FRO**
Repeatability Error	**< 0.000025"**
	<0.6 µm
Operating Temperature	**-65 °F to +220 °F**
	-55 °C to +105 °C
Thermal Coefficient of Sensitivity	**-0.01%/°F (nominal)**
	-0.02%/°C (nominal)

http://www.macrosensors.com/GHSA_GHSAR_750.html

Rotary Variable Differential Transformer (RVDT)

TYPICAL APPLICATIONS

- Flight control actuation / navigation
- Fuel control / valves
- Cockpit controls
- Nose wheel steering systems
- Missile fin actuation

FEATURES

- Brushless, non-contacting technology
- Repeatable position sensing with infinite resolution
- Housed and frameless versions available
- Single cycle (+/- 80 deg.) or dual cycle (+/- 40 deg.)
- Standard size 8 (housed version) with servo clamp interface available
- Multiple channel (tandem) versions available
- Geared configurations available

BENEFITS

- Long life
- High reliability
- High accuracy
- Repeatable performance
- Robust, compact construction
- Custom electrical and mechanical designs available – contact factory with requirements

Note: If your application requires gearing or other complex mechanical configurations, please provide us with your requirements.

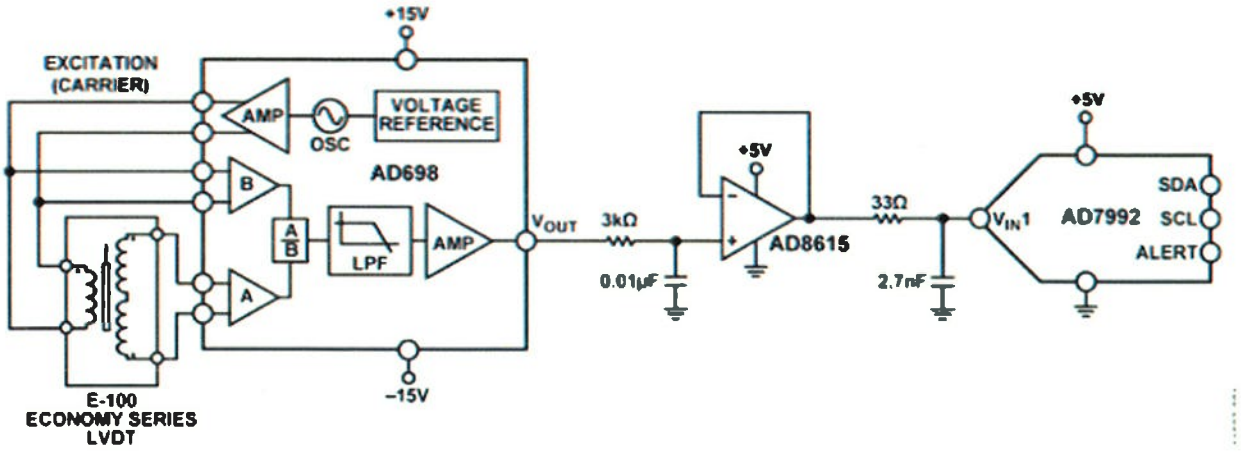
A Rotary Variable Differential Transformer (RVDT) is an electromechanical transducer that provides a variable alternating current (AC) output voltage that is linearly proportional to the angular displacement of its input shaft. When energized with a fixed AC source, the output signal is linear within a specified range over the angular displacement.

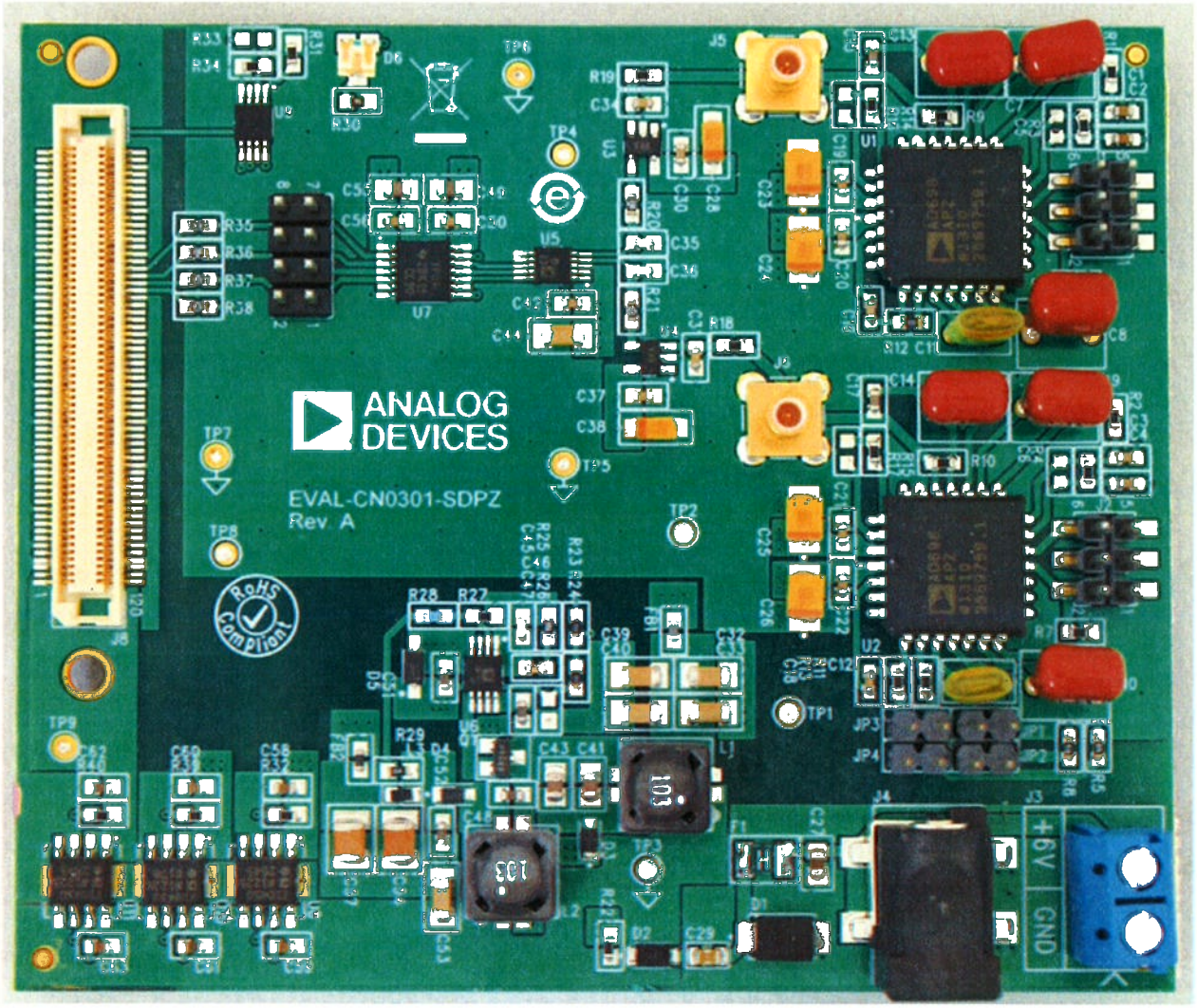
RVDT's utilize brushless, non-contacting technology to ensure long-life and reliable, repeatable position sensing with infinite resolution. Such reliable and repeatable performance assures accurate position sensing under the most extreme operating conditions.

Moog offers seven frequency optimized RVDT's in a basic size 8 configured housing. Each is designed to operate at a specific frequency. Frequency optimization provides the benefit of an increased operating range of angular displacement with a reduction in sensor size and weight.

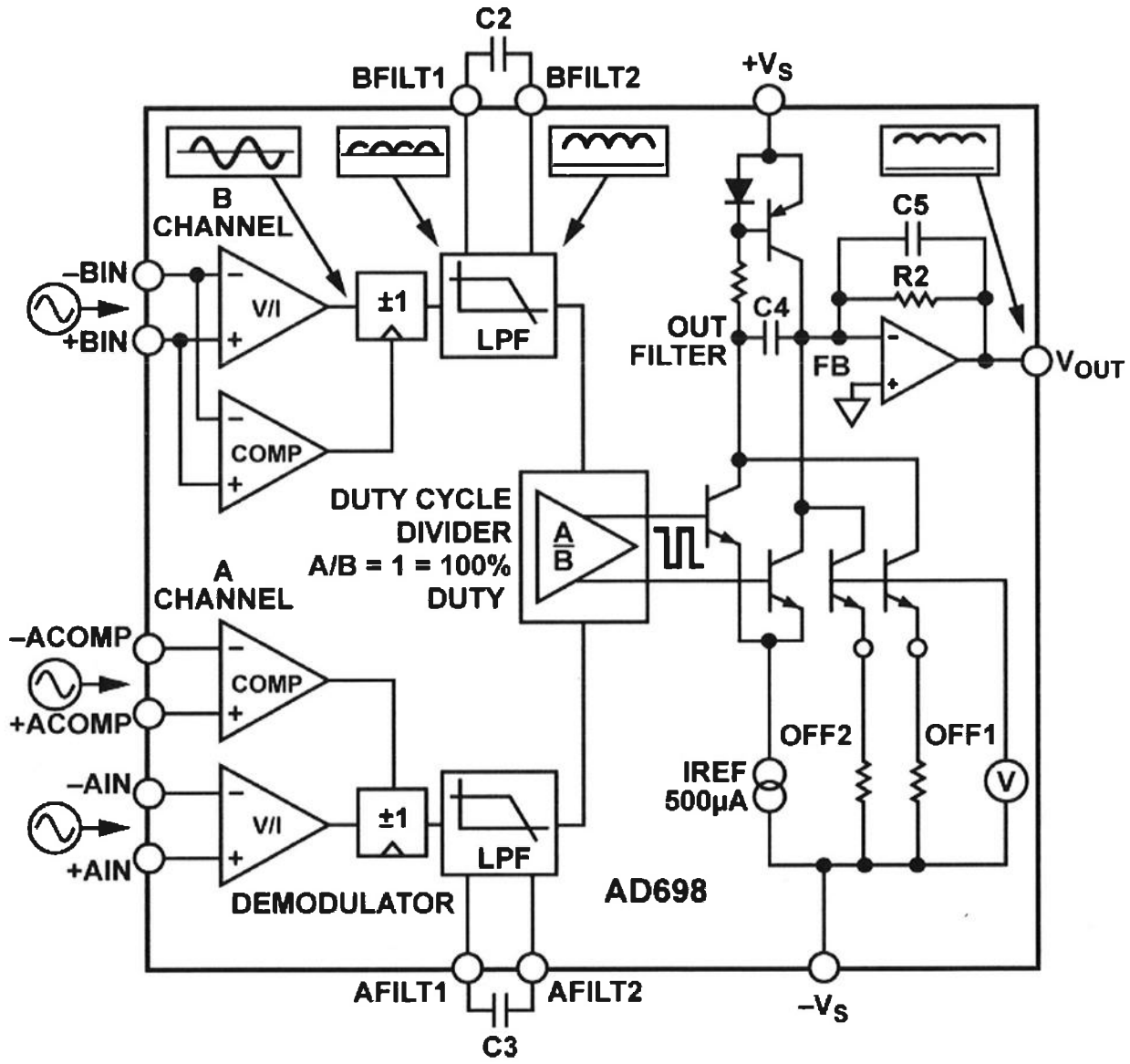
Please contact our application engineers for more information and to discuss your specific needs.

Analog Devices CN0301 Universal LVDT Signal Conditioning Circuit





AD698 LDVT Signal Conditioning Subsystem

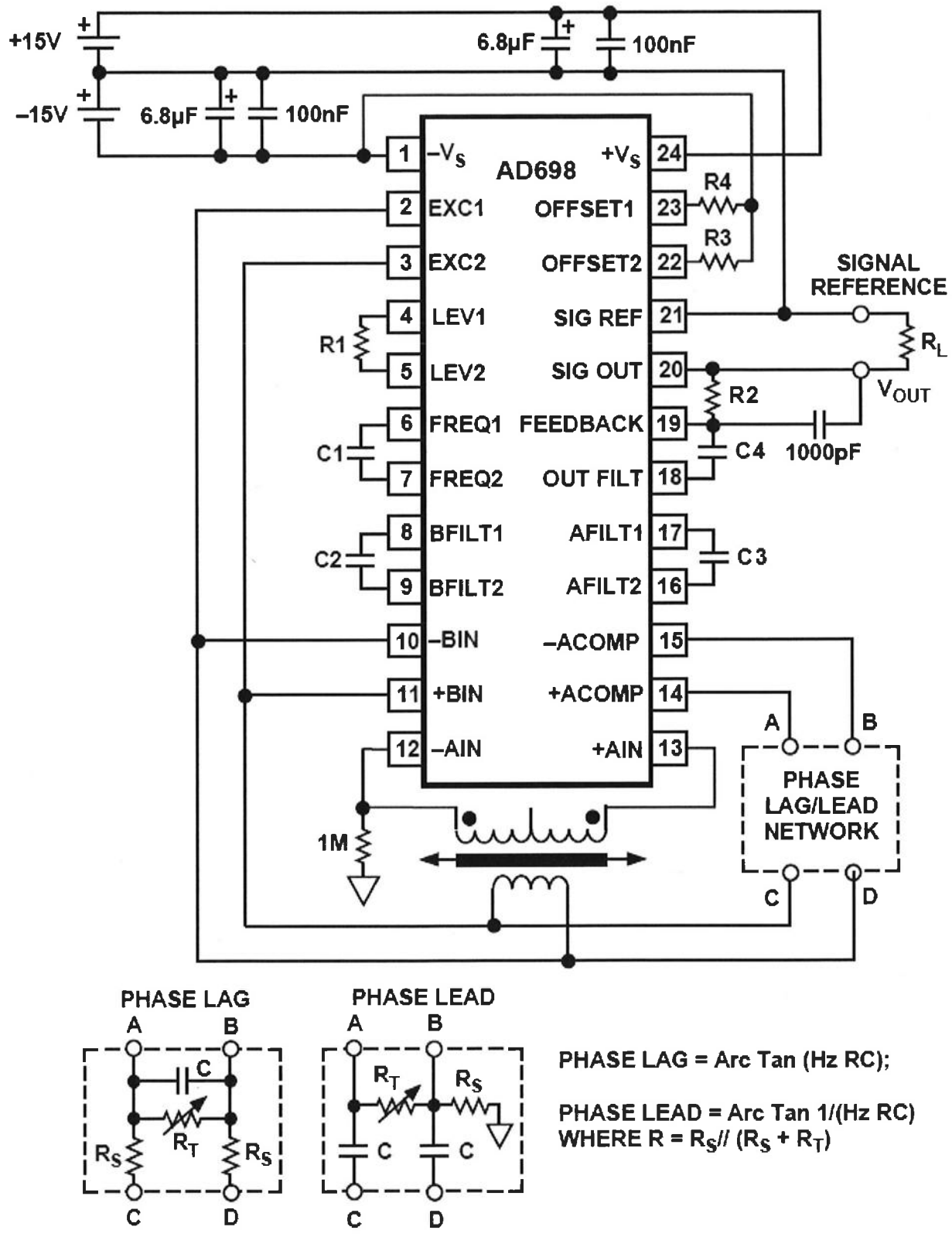


Sinewave Oscillator: 20Hz to 20KHz (capacitor selection), $2V_{rms}$ to $24V_{rms}$

+-BIN is the drive signal across the primary coil. It is synchronously demodulated with itself, producing a full wave rectified output that is then lowpass filtered

-ACOMP and +ACOMP is the voltage across the secondary coils. It is demodulated with a "phase delayed" version of BIN, +-AIN

A duty cycle divider calculates A/B in PWM that gets lowpass filtered to get V_{out}


+15V
–15V
6.8µF
100nF
6.8µF
100nF
AD698
1 –VS
2 EXC1
3 EXC2
4 LEV1
5 LEV2
6 FREQ1
7 FREQ2
8 BFILT1
9 BFILT2
10 –BIN
11 +BIN
12 –AIN
24 +VS
23 OFFSET1
22 OFFSET2
21 SIG REF
20 SIG OUT
19 FEEDBACK
18 OUT FILT
17 AFILT1
16 AFILT2
15 –ACOMP
14 +ACOMP
13 +AIN
R1
R2
R3
R4
C1
C2
C3
C4
1000pF
1M
SIGNAL REFERENCE
RL
VOUT
A
B
C
D
PHASE LAG/LEAD NETWORK
PHASE LAG
PHASE LEAD
RS
RT
C
PHASE LAG = Arc Tan (Hz RC);
PHASE LEAD = Arc Tan 1/(Hz RC)
WHERE R = RS// (RS + RT)