

Woodward has been designing customized aerospace motion-control systems for over 50 years. This experience gives us the unique expertise to provide packaging and performance solutions for any RVDT or Synchro/Resolver application. Our engineers draw from qualified, field-proven designs to offer our customers any combination of multi-channel redundancy, environmental resistance, custom mounting, extended operating range, and other special options. The following pages present some of the most popular custom features.



Tandem Multi-Channel Redundancy

Woodward employs a proprietary coupling scheme to join Synchro/Resolver or RVDT channels end-to-end for applications requiring multiple-channel redundancy. Woodward has produced and qualified two-, three-, and four - channel tandem configurations. Our proprietary coupling method virtually eliminates channel-to-channel crosstalk. Tracking and electrical zero alignment are 100% tested and guaranteed to meet customer specifications. The tandem configuration can be designed with any other custom options found within this section. *Pictured to the right are dual-channel, triplex, and quad-redundant tandem designs.*



Cluster Multi-Channel Redundancy

Woodward offers clustered multi-channel designs for redundant applications where installation constraints prohibit the use of tandems. AGMA Class 12 antbacklash gearing on each RVDT or Synchro/Resolver channel is coupled with a centrally located common input shaft. Woodward has produced and qualified cluster designs from two to eight channels. *Pictured to the right are triple- and quad-redundant cluster designs.*



Extended Range - Up to 3,000 Revolutions

Woodard has been manufacturing the highest quality precision gearing on our sensors, motors, and actuators for over four decades. This gearing expertise allows Woodward to offer single, tandem, and cluster RVDTs and Synchro/Resolvers with integral high-accuracy spur gearing, which extends the operating range to up to 3,000+ revolutions. Our capability guarantees a 100%-tested geared sensor composite accuracy, which encompasses all transmission, hysteresis and sensor errors. Use of an integrally geared design eliminates the need for gear reduction between the measurand and an ungeared sensor—thereby reducing cost and complexity, as well as eliminating geartrain accuracy uncertainty.

Pictured to the right are single- and dual-tandem designs with integral high-accuracy gearhead modules.



For RVDT applications requiring between 80° to 160° of operating range, Woodward offers ungeared one-cycle designs. The one-cycle RVDT, an electromechanical variant of our standard two-cycle design, doubles the maximum operating range at a reduced accuracy ($\pm 1^\circ$ for full 160° range). The accuracy reduction is usually acceptable when traded-off with reduced sensor size and the elimination of gearing expense.

Environmentally Sealed

Externally housed configurations are available for all redundancy and extended-range configurations for both RVDT and Synchro/Resolver –based position sensors. This packaging is designed to pass the most rigorous environmental testing requirements of MIL-STD-810 and DO-160. Environmental sealing is accomplished using dynamic shaft seals, o-rings and hard-mounted connectors to prevent foreign object and fluid ingress.

Pictured to the right are environmentally sealed single-channel, quad-redundant cluster, and dual tandem packages.



Frameless Sensors

Woodward offers both RVDTs and Synchro/Resolvers in frameless configurations, wherein the sensor utilizes the existing bearing system on the assembly, and the separable rotor and stator is directly assembled into the end item. Standard and custom frame sizes are available. *Pictured to the right is a frameless synchro/resolver and a frameless RVDT (far right).*



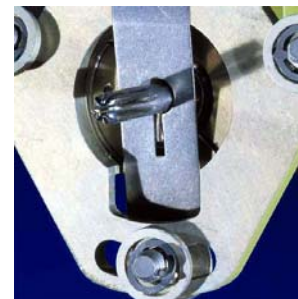
DC RVDT

Woodward has packaged hybridized high-reliability, HIRF/Lightning-tolerant circuitry within the sensor's environmentally sealed housing to internally perform the DC-to-AC excitation conversion and AC-to-DC signal conditioning. The DC input circuit can be configured to accept any unipolar (such as +28 or +10 VDC) or bipolar (± 15 , ± 10 , or other) input voltages. The signal conditioning circuitry utilizes temperature coefficient-cancelling ratiometric logic, and can be configured to up to ± 10 VDC full-scale output. Offset and reduced full-scale voltages can be easily configured for existing equipment replacement applications. *The reader is referred to a single-channel DC-DC RVDT, to the right.*



Pre-Rigged Shaft Lock

For applications requiring pre-installation rigging control, several styles of auto-release or manually removed shaft locks are available. These shaft locks prevent the sensor shaft from rotating during shipment and pre-installation handling. They are factory-preset at any customer-specified critical shaft position. Pre-rigged non-geared units are typically equipped with auto-release type shaft locks, wherein the shaft is released upon tightening of a position sensor attachment bolt. Extended range geared units are typically equipped with a manually-removed disposable cap. *Shown are: engaged shaft lock (to the right) and shaft lock release bolt (far right).*



Custom Winding Designs

Woodward can custom-engineer RVDT or Synchro/Resolver windings to meet or match any combination of electrical requirements. Special scale factor, input/output impedance, and ratiometric gain/half-coil voltage requirements are routinely met by manipulating various winding characteristics. Winding variants and specialized calibration can create other useful performance features.

Flex-Spline and Flex-Spline Adapter

Woodward's flex-spline option provides the user with a resilient, backlash-free RVDT shaft interface for blind installations. The design is based on a standard 8-tooth, 48/96-pitch external spline per ANSI B92.1a (1976). The flex-spline tooth profile is manufactured to positively interfere with the standard sized internal mate. The antibacklash action is achieved by separating each tooth from its neighbor, which provides radial compliance upon installation. The flex-spline also allows the RVDT to tolerate up to .005" misalignment between the measurand and RVDT mounting pilot without overloading the sensor bearings.



The mating interface for use with the flex-spline is a standard 8-tooth internal spline manufactured per the above referenced ANSI specification. Woodward can provide flex-spline adapter inserts which can be press-fit or bolted onto the measurand. Press-fit inserts can accommodate more precise tooth location control, when compared to broaching the measurand itself. For applications requiring rigging adjustment at the measurand, Woodward can supply a bolt-mounted internal spline plate with slotted attachment bolt holes. The slotted bolt holes allow rotation of the mating internal spline during rigging rather than rotating the sensor body. This type of rigging scheme is valuable for installations where sensor body rotation is difficult or impossible. *Pictured are RVDT channel with flex-spline (left), and press-fit flex-spline adapter (right).*

Pressure Sealed and Submersible Sensors

Woodward has been a pioneer in the development of pressure-sealed and submersible RVDT and Synchro/Resolvers for use in hydraulic fluid, fuel and other various pressurized fluid-exposed systems. Sealed-bore designs allow system fluid to enter into the bore of the sensor and engulf the rotor and bearings. Since the bore is lined with a seamless metallic barrier, the sensor acts a pressure sealed cork to the external environment. An o-ring gland is provided at the mounting surface to facilitate the necessary static seal. Submersible designs are used in applications which require the sensor windings to operate in system fluid. Woodward has designed and qualified single-channel, tandem and cluster multi-channel, as well as geared pressure-sealed designs for systems operating at up to 3,000+ psi. *Pictured are single-channel, triple-cluster, and dual-tandem pressure-sealed sensors (top photo). Submersible commutation resolver designed for use in electro hydrostatic actuator (lower left); high-pressure, high-gear ratio, environmentally housed, dual tandem design (lower right).*

