GENERAL DYNAMICS
Ordnance and Tactical Systems

PANCAKE RESOLVERS | HANDBOOK

MAJOR CORPORATIONS AND ORGANIZATIONS RELY ON GENERAL DYNAMICS ORDNANCE AND TACTICAL SYSTEMS TO DESIGN, DEVELOP AND MANUFACTURE IMPORTANT, MISSION CRITICAL, INNOVATIVE MOTION CONTROL COMPONENTS AND ASSEMBLIES.

TABLE OF CONTENTS

PRODUCTS

Data by Ascending Outside Diameter (inches)

INTRODUCTION

General Dynamics Ordnance and Tactical Systems has designed, developed and produced a very large variety of high accuracy resolvers and synchros for military and special industrial customers for more than 30 years. These products are available either unhoused (frameless pancake type) or housed (self-contained, with bearings). Special designs, from segmented multi-speed units to brushless designs with rotary transformers are supplied for a wide range of demanding applications.

The changing market is demanding lower costs and shorter lead times; this has prompted us to develop the most complete product line of standardized, V-Line™, resolvers in the market today.

The following pages provide both a design guide to help you specify your resolver requirement and an entire library of highly tooled pancake designs ready for your selection with extremely short deliveries. These are all proven designs, based on in-stock laminations, created to meet military specifications, such as MIL-R-23417 and MIL-STD-202.

TRANSDUCER SELECTION

Resolvers are superior to many other kinds of absolute position sensors because of their ruggedness, and ability to provide a very high degree of angular accuracy under severe conditions. There are no optical paths to keep clear of smoke or oils that often disrupt the operation of optical encoders. Because they are a proportional device, they are also less subject to input signal anomalies; a voltage or frequency variance will change both the sine and cosine outputs equally.

Resolvers are a cost-effective answer to your control needs. They save you size and weight, being substantially smaller than other transducer approaches, and easily integrated into your system, component or motor design. Signal converters and balance circuitry can easily be incorporated into the resolver and/or output connector configuration. Ask our Sales Engineers about simplifying your design task with General Dynamics' integrated packages, including motion control components and related electronics.

V LINE PRODUCTS

Over the years General Dynamics Ordnance and Tactical Systems Engineering has developed many different pancake type resolvers for specific military and space programs, as well as for motion controls in robotics and machine tool applications. General Dynamics Ordnance and Tactical Systems now offers a line of standard frameless pancake resolvers, the V Line products, for the convenience of our customers, and in order to minimize nonrecurring cost and delivery times.

MECHANICAL CONFIGURATIONS

- "Bare Units" with stator and rotor lamination stacks, ground for concentric mounting directly into custom enclosures. These don't have sleeves and hubs.
- "Sleeves and Hubs" are added to provide rigidity and improve installation capabilities. Standard sleeves and hubs are made from stainless steel CRES 416.
- Lightweight sleeves and hubs can be made of Titanium as an option. They provide the ideal resolver enclosures, because of their light weight and the coefficient of thermal expansion matching that of resolver magnetic cores.
- Sleeves and hubs with flanges can be provided as a special option. Flanges may further increase structural stability for resolvers having thin cross sections, or very large diameters, and ultimately increase accuracy. They may also be used as an alternative type of mounting. (see page 16 for details.
- Lead Break-out: Standard resolvers usually have flexible leads of 28 or 32 AWG Teflon® coated 7 strand color coded lead wires per MIL-W-16878/6, 18 inches long. They provide a convenient means for the customer to connect the unit to their system.
- Resolvers can be provided with connectors as a special option. Units may also incorporate a "trim board" to provide improved accuracy with the use of external trim resistors. (see page 15, Special Options). Terminals may also be provided for special application. Consult General Dynamics Ordnance and Tactical Systems for leadwire specification on different unit types.

ACCURACY

Electrical errors range from 15' (arc minutes) for low accuracy units to 5" (arc seconds) for high accuracy units. Available accuracies are listed in the data tables for every unit type.

Resolver schematics and phase equations are listed on page 73 at the end of the data pages for reference.

An explanation of the easy to use V Line numbering system is given on page 20 at the end of this section. If you wish to specify a resolver exactly as it is specified in the tables, you need only to enter the part number. If you wish to modify the part, General Dynamics Ordnance and Tactical Systems Engineers will be happy to assist you in defining the modified part number to order.

LOW COST APPLICATIONS

Resolvers are more stable than potentiometers in varying environmental conditions, and are not sensitive to voltage or frequency fluctuations. Resolvers can be placed on the driven device or easily integrated directly into the motor, providing both accurate positioning information and feedback to commutate a brushless motor.

HIGH PRECISION APPLICATIONS

Resolvers can be made more compact than optical encoders and exhibit much higher signal-to-noise ratios than inductosyns. Combined with R-to-D converters, their resolution and accuracy is as good or better than available optical discs.

There is an optimum speed for the highest accuracy, depending on size and other design parameters. Winding distribution and other factors act opposite to the averaging effect of the higher multispeed designs.

A resolver is an "absolute position transducer." Comparison with "absolute encoders" favors the resolvers in price, size, installation convenience, and stability.

BEFORE YOU START

Selecting a rotary position transducer to meet your application looks straightforward at first. You know the accuracy and rotational speed you want and the rest involves size and installation. Then you start to think about your system needs: temperature, shock and vibration, signal processing, effects of load impedances, servo bandwidth and operating environment. Is this resolver really for me?

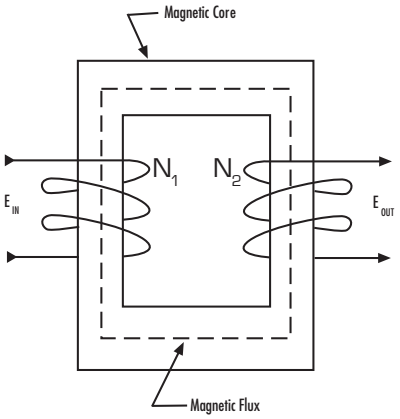
General Dynamics Ordnance and Tactical Systems' Engineers are prepared to help you through the selection process, assuring the most cost-effective product for your requirement. If you are not familiar with specifying resolvers we invite you to read through the following tutorial before you tackle the specification sheets.

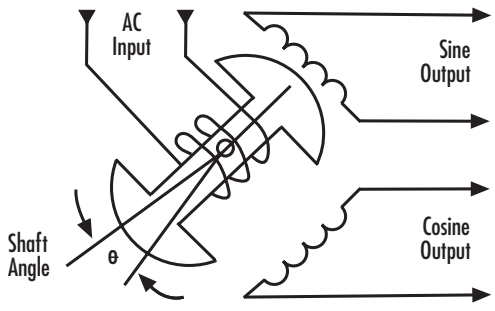
HOW A RESOLVER WORKS

STATIONARY TRANSFORMERS

Fundamental transformer theory is the basis of resolver design. An AC voltage is applied to the primary winding (E_{IN}) and a proportional output is developed on the secondary winding (E_{OUT}). The proportional is based on the ratio of turns on the secondary N_2 to the primary N_1, known as the transformation ratio.

$$\text{Transformer } E_{OUT} = E_{IN} \left(\frac{N_2}{N_1}\right)$$





When precise positioning is required there are many ways to address the problem, but only a resolver can provide ruggedness of construction and high positioning accuracy in extremely hostile environments.

APPLICATIONS

MILITARY/AEROSPACE

Radar fire controls
Night vision pods
Gyro navigation systems
Air traffic control radar
Missile guidance systems
Seeker heads
Telescopes
Periscopes
Stabilized platforms

INDUSTRIAL

Ballscrew positioning
Machine vision systems
Remote video controls
Motor commutation
X-Y tables
Pick and place machines
Robotics positioning
Component insertion
Wave guides

INSTRUMENTATION

Coordinate Measuring
Optical measurement
Oil exploration
Robotics
Antenna positioning
Proximity measurement

MEDICAL

C-T scanners
MRI patient positioning
Laser positioning

ROTATING TRANSFORMERS (RESOLVERS)

In a resolver the iron core for the primary and secondary are two multitoothed lamination stacks, one being stationary (stator and one which rotates (rotor). The output voltage is affected by change in the position of the secondary winding relative to the primary winding.

As the rotor turns, the amplitude of the secondary voltage changes, modulating the input carrier. Secondary windings are always placed with their axes at right angles. This establishes two separate outputs having a sine/cosine relationship.

POSITION SENSING

The primary winding, excited by the carrier voltage, E_{IN}, induces variable voltages E_1 and E_2 into two secondaries, depending on the shaft angle θ

$$E_1 = KE_{IN}\sin\ \theta$$
$$E_2 = KE_{IN}\cos\ \theta$$

Where:

"K" is the transformation ratio

The ratio of the output signals accurately expresses the shaft angle information. By taking the ratio of E_1/E_2 you get

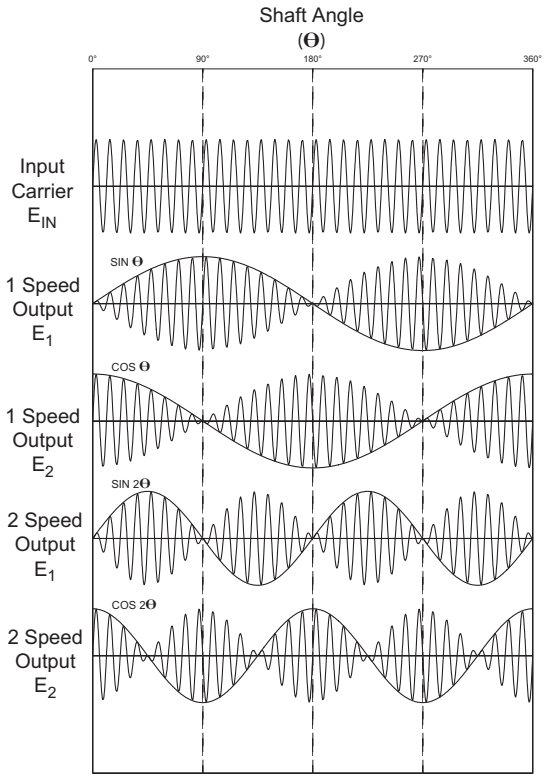
tan θ and can then find θ by taking the arctangent:

$$\theta_{out} = \arctan\left(\frac{E_1}{E_2}\right)$$

The relations above are shown for "single speed" resolvers. "Speed" is the number of resolvers pole pairs (P). For multi-speed resolvers output voltage can be expressed as:

$$E_1 = KE_{IN}\sin(P\theta)$$
$$E_2 = KE_{IN}\cos(P\theta)$$

The number of sine and cosine output voltage cycles is equal to "P". (Example is shown for a 2 speed resolver)



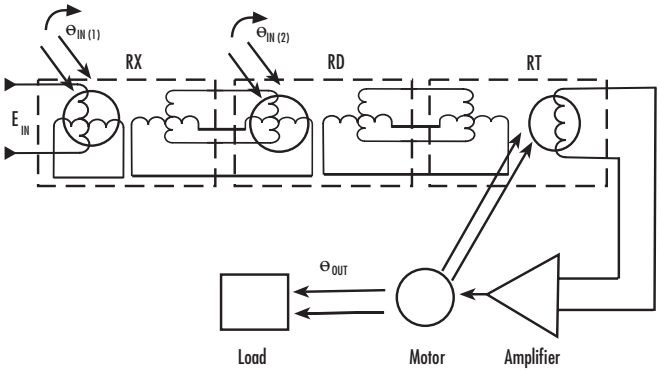
RESOLVER FUNCTIONS

A resolver is an electromagnetic transducer that can perform three basic functions: transmitting information, receiving information and correcting information. The three types of devices can be used as individual machines or as a system with the units directly interfacing with each other. They are usually defined as follows:

"Resolver Transmitter" (RX): Converts mechanical position into an electrical signal.

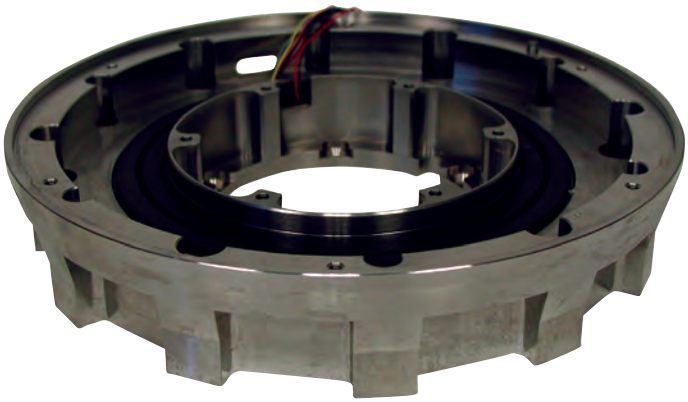
"Resolver Receiver or Transformer" (RT): Translates electrical signals into angular position in conjunction with a servo amplifier and electromechanical or hydraulic drive.

"Resolver Differential" (RD): Provides a system correction by acting as a variable



$$\theta_{out} = \theta_{IN(1)} \pm \theta_{IN(2)} + \Delta$$

Where Δ is the system error



electrical coupling between a RT and RX, adding a second angular vector to the input signal.

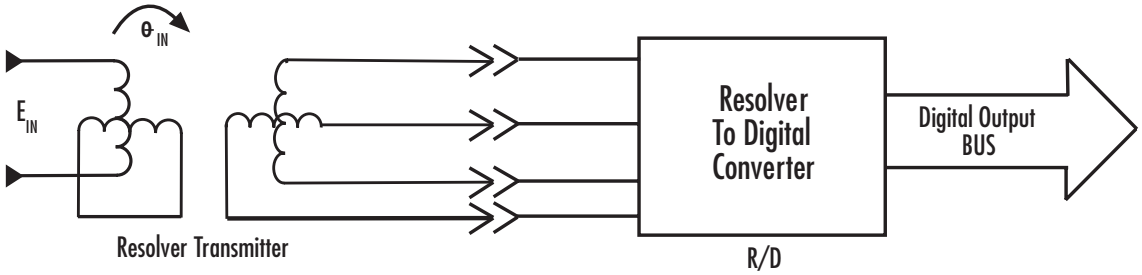
Resolver transmitters, receivers and differentials were widely used before the computer age to serve as computation devices, to resolve a vector representing voltage into its orthogonal components, to convert coordinates, rectangular to polar and vice versa, and to transmit angular positions without using complex electronics, such as converters, or computers, which were nonexistent, or large and very expensive at the time. Some of these applications are still in use today.

With an advance in electronics and computer technology, resolvers in modern systems are more often used as highly accurate and reliable position sensors. In this capacity they are connected to electronic circuits, including computers, directly or through "Resolver-to-Digital Converters" for digital output.

Most applications require the conversion of angular position into electrical signals. That is why most of the unit types in this catalog are Resolver Transmitters (RX). General Dynamics Ordnance and Tactical Systems will provide both resolvers receivers (RT) and also Differential Resolvers (RD), if necessary, as a special option.

There is a big advantage in using resolvers as position sensor; accuracy is not affected by TR, phase shift, voltage or small frequency changes.

DIGITAL DATA TRANMISSION SYSTEM



R TO D CONVERTERS

Resolvers with an input AC reference volt-age (E_{IN}) will have output voltages of: $KE_{IN}\sin\theta$ and $KE_{IN}\cos\theta$. The Resolver-to-Digital (R-to-D) converter transforms these signals into easy to use digital representation of the angular position (θ). When combined with such converters, resolvers can provide digital outputs with up to 22 bit resolutions and system accuracies to 18 bit are achievable.

PANCAKE RESOLVERS

Resolvers are considered pancake types when their diameter is greater than their length. They may be self-contained, having their own bearings, brushes, etc. or they may be frameless with separate rotor and stator parts designed to integrate directly into a gimbal or other type of supporting structure. Frameless pancake resolvers offer many advantages to the designer of motion control systems.

Mounting frameless units direct to the system eliminates the error inherent with couplings and binding due to misalignment. Direct placement of rotor onto the system shaft eliminates windup or backlash.

The large inside diameter of pancake resolvers provides a convenient path for both electrical and mechanical linkages such as wave guides, optics, electrical conductors and coolant lines. Units of this type can be "wrapped around" the system for the sake of simplicity, compactness and weight reduction.

RESOLVER WINDINGS

A resolver functioning as a transmitter, having one primary winding requires at least two secondary windings (sine & cosine) with axes in space "quadrature" (90 degrees apart). Primary and secondary windings can be located on either a stator or rotor. In a resolver transmitter with one primary winding it is usually located on a rotor, in order to have only two leads on the rotating part. One and two speed resolvers need to have a second "quadrature" primary winding which is usually shorted internally in order to equalize secondary short circuit impedances, regardless of the positional angle, improving accuracy. Low impedance of the input voltage source essentially acts as a short on the main primary winding. In some cases the leads of the quadrature winding can be brought out to be used for angular correction.

MULTI-SPEED RESOLVERS

Modern requirements for high resolution and extremely accurate angular sensing and data transmission have driven our development of a large variety of standard multi-speed resolvers. The number of pole pairs is referred to as the resolver "speed," so a 1 speed (1X) has P = 1 pole pair (2 poles), an 8 speed (8X) has P = 8 pole pairs (16 poles), etc. The 'V Line' of standard pancake resolvers establish speed ranges of 2^n pole pairs (2, 4, 8, 16, 32), which are all readily adaptable to digital systems. The increased number of pole pairs effectively increases system resolution by proportionately reducing the number of rotational degrees represented by one complete electrical cycle:

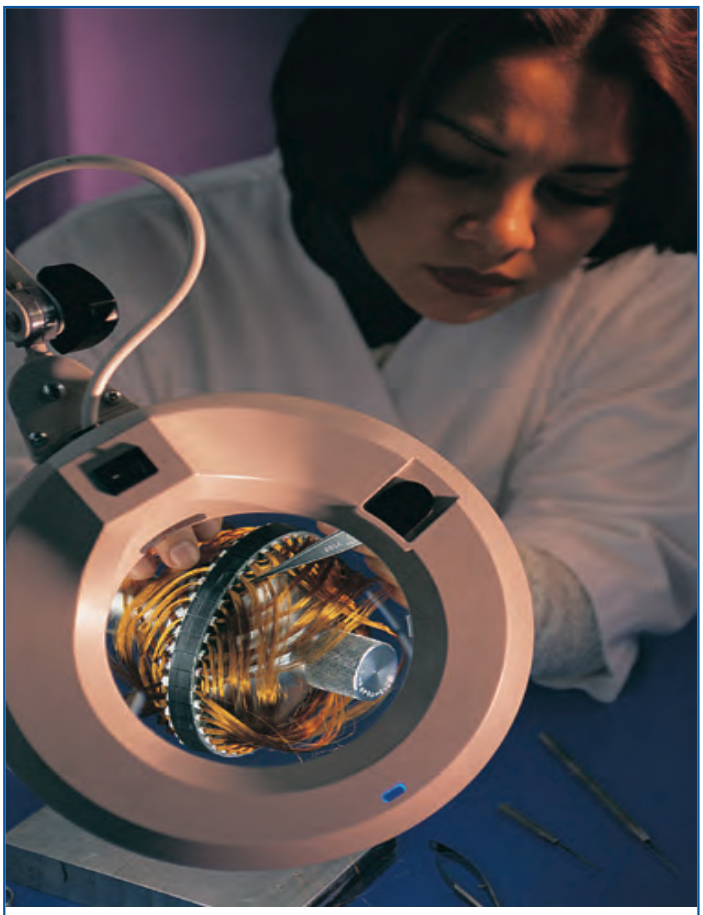
$$\frac{360°}{\#\text{ pole pairs}} = \text{period in degrees}$$

Multi-speed resolvers can greatly enhance system performance, repeatability and reliability. The primary advantage relates to the averaging effect of multi-pole designs; any local mechanical or winding perturbation is averaged in the distributed flux of the air gap.

Another advantages relates to effects from combined system errors which are diminished by the number of pole pairs. For example:

If the 1X Resolver Transmitter with 60" max error is used with R/D converter having 80" max error, then maximum system error will be:

60" (resolver) + 80" (converter) = 140"



There is an optimum speed for the highest accuracy, depending on size and other design parameters. Winding distribution and other factors act opposite to the averaging effect of the higher multispeed designs.

If the 8X resolver with 15" max error is used with the same accuracy converter, then the resulting maximum error will be:

$$\text{15" (resolver)} + \frac{\text{80"(converted)}}{\text{8 (pole pairs)}} = \text{25"}$$

This is not the complete story of resolver accuracy, however, as there is an optimum speed for the highest accuracy depending on size and other design factors. Winding distribution and other factors act opposite to the averaging effect of the higher multi-speed designs.

Mulitspeed windings alone can be used only for the angular range less than 360˚ divided by the number of pole pairs. To avoid ambiguity when using a larger angular range, General Dynamics Ordnance and Tactical Systems includes a 1 speed or 2 speed winding to provide the cyclical reference. These "coarse" windings are located on the same magnetic core as the multi-speed "fine" windings. General Dynamics Ordnance and Tactical Systems employs proprietary techniques to minimize interaction of the different speed windings and assure accurate signal interpolation on each channel.

Mulitspeed resolvers do not require a primary "quadrature" winding, since their secondary short circuit impedances are very close to the secondary open circuit impedences, and do not change significantly with change of positional angle. General Dynamics Ordnance and Tactical Systems Resolvers are designed to optimize stator/rotor slot combination in order to reduce common space harmonics and improve angular accuracy. Every dimension and tolerance is carefully chosen, and windings are specially designed in order to make a near-perfect sinusoidal magnetic flux distribution, and reduce the errors resulting from manufacturing limitations.

For super-high accuracy units, in order to compensate for any remaining imperfections in the manufacturing process, General Dynamics Ordnance and Tactical Systems has developed a special mechanical and electrical trimming technique.

SPECIFYING A RESOLVER

Once the basic function of the resolver has been established it becomes important to define the various inputs and outputs to insure consistent performance across the operating range. Our Application Engineers will help you to avoid any surprises by asking about your particular installation.

The mounting and/or coupling of the device may be critical to the accuracy of a resolver. General Dynamics Ordnance and Tactical Systems Engineers are ready to assist you with each of these details, assuring you of the best solution for your application, however, it is still best to understand these factors and just how they can affect your requirements. The next few pages provide you with all the knowledge you need to effectively specify and select a resolver from the Data Pages that follow.

RESOLVER PARAMETERS

INPUT VOLTAGE AND FREQUENCY

Preferable voltage ranges for pancake resolvers are from 1 to 26 volts and frequency ranges from 400 Hz to 5000 Hz. Developing special windings for every individual application is not always necessary, however, as a resolver can be operated at voltages and frequencies other than those specified, when certain conditions are met. For this reason, General Dynamics Ordnance and Tactical Systems has developed a family of resolvers designed to meet the more commonly used 400 Hz and 2000 Hz excitation frequencies at a standard 26 volts. In order to take advantage of the standardized 'V Line' designs, the designer should keep in mind the following points:

- Input voltage can usually be decreased for Resolver Transmitters (RX), with out noticeable change of other parameters. Since the transformation ratio stays the same, there will be some decrease in sensitivity, but it will not affect resolver performance. In some cases a reduction to .5 or 1.0 volt can be beneficial, for instance, when the resolver is energized through an R-to-D converter.

- Input voltage decreases to a Resolver Receiver (RT) may result in slightly increased error, since the resolver's magnetic core will operate in the nonlinear portion of its magnetic curve.

- Large voltage increases or frequency decreases can cause saturation of a resolver's magnetic structure, resulting in increased error and null voltage as well as changing some other parameters.

- Higher frequencies may result in increased magnetic flux leakage as well as changes in capacitance coupling. This, in turn, will degrade accuracy and increase null voltage.

VOLTAGE SENSITIVITY

Voltage sensitivity is the output voltage per one degree of shaft angle. This parameter (also referred to as voltage gradient) is not usually specified, but can be easily calculated.

$$VS = E_{IN} K \sin(P\alpha)\ 1000 \quad \frac{mV}{degree}$$

Where:

E_{IN} is input voltage (RMS)
K is the transformation ratio
α = 1° of shaft angle
P = number of speeds

A 1 speed example:

$$VS = E_{IN} K(17.45) \quad \frac{mV}{degree}$$

IMPEDANCES, CURRENT AND POWER

Resolvers are like most other active AC components, the ratio of resolver output impedance to that of the load must be kept low to reduce effects on performance. General Dynamics Ordnance and Tactical Systems has designed these components to provide the lowest possible output impedance; for one speed units they are usually 100 ohms or lower, for multispeed units, they seldom reach 1000 ohms. When used with R-to-D converters, which have input impedances larger than 250,000 ohms, the loading effect is negligible.

Impedances are usually specified in rectangular form as R +jX where R is the "active component" and X is the "reactive component." Active component value is the sum of DC and AC resistive components; the DC resistive component depending on wire gauge and number of turns is temperature sensitive, the AC component depending on core losses resulting from the eddy currents and hysteresis of the magnetic core is frequency sensitive.

For the standard resolver magnetic cores General Dynamics Ordnance and Tactical Systems uses high permeability nickel alloy. This material assures the best resolver characteristics and low core loss.

General Dynamics Ordnance and Tactical Systems specifies the impedances based on the definition of primary and secondary windings. If the primary windings are on a rotor side, then impedances are specified as follows:

Z_{RO} - Primary (rotor) open circuit
Z_{SS} - Secondary (stator) short circuit

(For stator primary it will be Z_{SO} and Z_{RS} respectively)

Primary Impedance (Z_{RO}) defines the input current (I_{IN}) and power (P_{IN}) as follows:

$$I_{IN} = \frac{E_{IN}}{Z_{RO}}$$

$$P_{IN} = I_{IN}^2 R$$

Where:

E_{IN} is the primary voltage
R is the resistive component of primary impedance

Pancake resolvers in general have a relatively high ratio of R/X in their impedance values (in relation to regular size resolvers), since they have a smaller length. One speed pancake resolvers also have a relatively high share of R_{AC} in the resistive component (R), especially in high frequency units and in large diameter units.

In multispeed resolvers, ratio R/X is even larger than in one speed units but the share of R_{AC} in "R" component is much smaller. These features are mentioned here for better understanding of the changes in characteristics with temperature change.

TRANSFORMATION RATIO

Transformation Ratio (TR) is the ratio of output voltage to input voltage when output is at maximum coupling. TR is a constant for each design and is determined primarily by winding design, approximately proportional to the ratio of effective turns, secondary (N_2) to primary (N_1).

$$\text{Transformation Ratio} = K \frac{N_2}{N_1}$$

A higher TR presents no problems to one speed resolvers. In multispeed resolvers, however, the increased R/X and increased flux leakage makes it more difficult to achieve a higher TR. Compensating by increasing the number of secondary turns becomes difficult with the high speed resolvers

as very fine magnet wire must be used, complicating the manufacturing process.

General Dynamics Ordnance and Tactical Systems specifies Transformation Ratios for one speed resolvers at 1.0 or at 0.454, and at 0.454 or at 0.200 for most of the multi-speed resolvers.

PHASE SHIFT

When a resolver is excited with an AC voltage, the magnitude of its output voltage will be proportional to the TR and will be a trigonometric function of the shaft position. In addition the output carrier AC voltage will be "time delayed" from the input, since a resolver is an inductive instrument. The phase shift, expressed in degrees, is the difference between the time phase of the primary and secondary voltage, when the output is at maximum coupling. Phase shift ∅ can be approximated as follows:

$$\varnothing = \arctan \frac{R_{DC}}{X_L}$$

Where:

R_{DC} is the primary winding DC resistance X_L is the primary inductive component

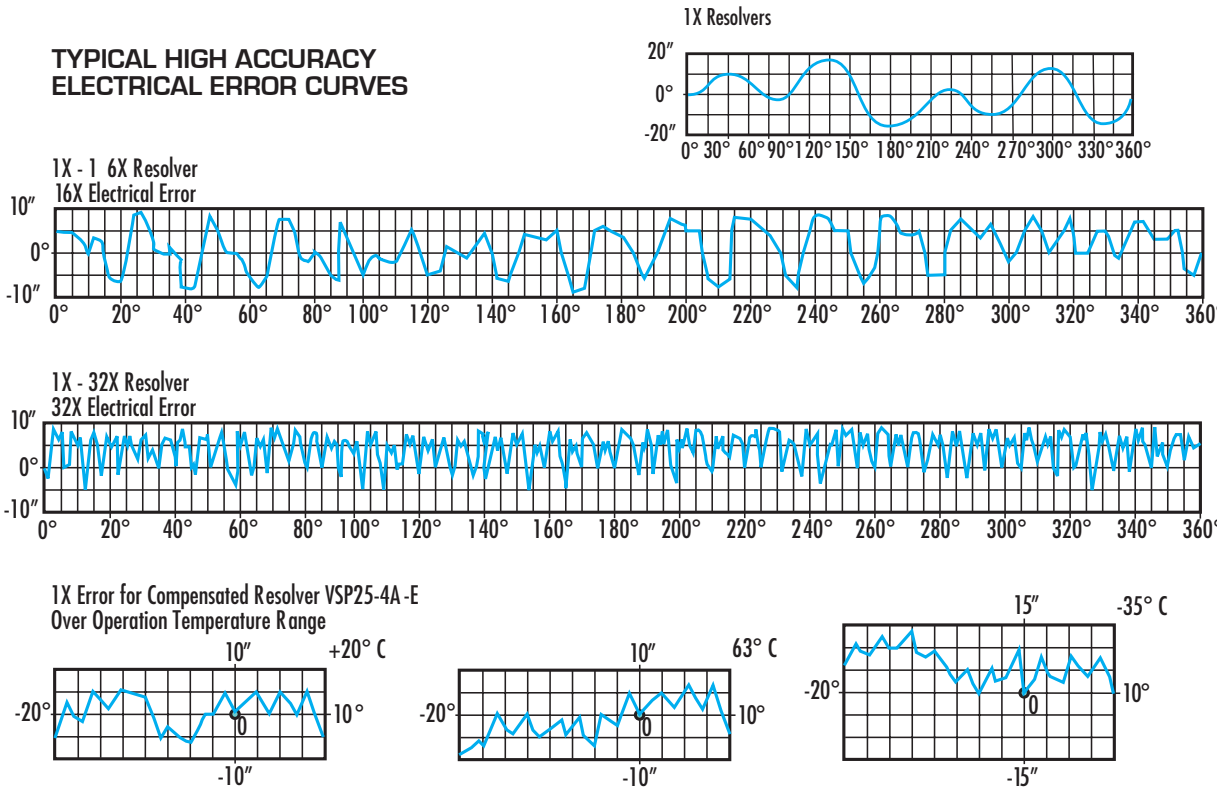
Generally, one speed resolvers have a relatively small leading phase shift, between 0° and 20°. Multispeed resolvers have a larger leading phase shift due to a larger R/X ratio and larger share of R_{DC} in the resistive impedance component "R". Its value is between 30° and 60° , and in some 16 or 32 speed windings it may reach 65° to 70° (@400Hz). It decreases with the increase of frequency.

A large phase shift usually does not cause any problems in resolver performance. If the resolver is used with an R-to-D converter, then phase shift is recommended to be smaller than 45° by most converter manufacturers. Phase shift can be reduced, if necessary, by using a resolver designed for higher frequency, or by introducing a compensation circuit.

NULL VOLTAGE

"Null Voltage" is the residual voltage at the point of minimum magnetic coupling between the primary and secondary windings. It is measured when the "in-phase" secondary voltage is zero. Theoretically, this occurs when the axis of the secondary and primary windings are orthogonal, the point of minimum coupling. Mechanical imperfections, winding errors, and both electrical and magnetic short circuits can cause some voltage to be induced, however, even though the principal magnetic axis are perpendicular to each other.

TYPICAL HIGH ACCURACY ELECTRICAL ERROR CURVES



The "Total Null Voltage" has three components: in phase fundamental, quadrature fundamental, and harmonics.

- In-phase Fundamental can be offset by re-nulling the rotor. So it is not considered to be a "Null Voltage," but becomes one of the error components.

- Quadrature Fundamental component is 90° out of time phase with the in-phase component, and has the same frequency as the input voltage. It is called "Fundamental Null Voltage."

- Harmonics add mostly third order time harmonics into a null voltage. The combined fundamental and harmonics create "Total Null Voltage."

Null voltages in pancake resolvers are relatively low and do not cause any problems. They depend on size, input voltage, frequency and resolver speed. Usually total null voltage, of one speed resolvers, is approximately 1 to 3 millivolts per volt of maximum output voltage; in multispeed resolvers it drops to 0.2 to 0.5 millivolts per volt of maximum output volt. Null voltage is specified in resolver drawings as a "max" value.

In all General Dynamics Ordnance and Tactical Systems Pancake Resolvers total null voltage is very close to fundamental null voltage. Operating at 400 Hz and 2000 Hz, the 'V Line' Resolvers are designed for low flux density eliminating concerns over saturation that adversely effect 60 HZ and nonpancake type devices.

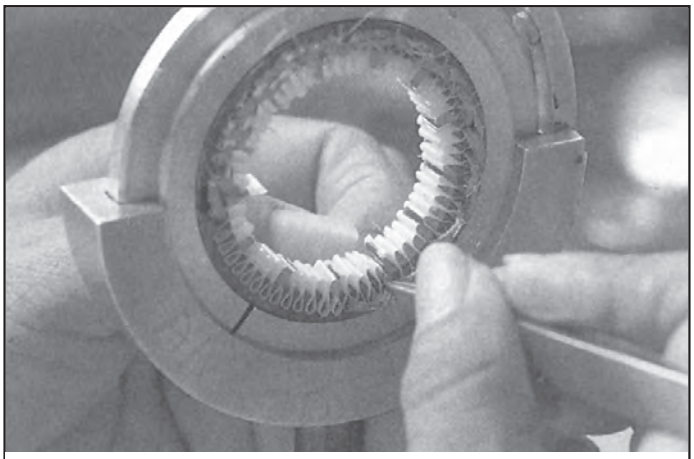
ACCURACY

ZERO ALIGNMENT

For dual speed resolvers when both coarse (single speed) and fine (multispeed) windings are located on the same lamination stack there are interactions that must be considered in design and installation of your resolver. There can exist a difference between the mechanical angle of the Electrical Zeros (EZ) of the coarse and fine windings. This specification must be taken into consideration by the system designer.

ELECTRICAL ERROR

Electrical error in the representation of the exact mechanical position of the rotor with respect to the stator is the most important resolver parameter. For Resolver Transmitters accuracy is the error in conversion of rotor position into electrical signals. For Resolver Receivers accuracy is the error in conversion of electrical signals into rotor position. It is defined as the difference between the position of the rotor calculated from electrical signals and the actual rotor position in mechanical degrees.



General Dynamics Ordnance and Tactical Systems manufactures exceptionally reliable, multispeed and segmented positioning sensors which can be absolute position sensors providing a high degree of angular accuracy and extremely high resolution.

$$\text{Error } \triangle_i = \left(\frac{1}{P}\right)\arctan\left(\frac{E_{sin,i}}{E_{cos,i}}\right) - \alpha_i$$

Where:

P is the resolver speed
α_i is the actual rotor position, in mechanical degrees
$E_{sin,i}$ is a secondary "sine" voltage for position "i"
$E_{cos,i}$ is a secondary "cosine" voltage for position "i"

Accuracy is specified as a maximum value of error over the entire operating angular range of the resolver. It is specified in "arc minutes" or "arc seconds" in the Data Pages.

General Dynamics Ordnance and Tactical Systems design and manufacturing procedures minimize the possibility of irregularities in winding distribution and other assembly factors that contribute to inaccuracies. For very high accuracy resolvers developed a special trimming technique, to trim certain error components down either mechanically or

by use of external trim resistors. Examples of actual error curves are shown on page 12. Maximum errors can be very low (5 to 10 seconds of arc). Compensating certain error curve harmonics using electronics can reduce them even further.

VELOCITY ERROR

A resolver has many of the electromagnetic characteristics of a motor when operating at high speeds and electrical errors can occur as the rotational speed approaches the synchronous velocity. Fortunately most pancake resolvers are operated in the near static conditions at very slow speeds, and "velocity errors" are nonexistent. In special applications like high speed motor controls, these errors should

be considered. As a rule-of-thumb, speeds above one-forth of the synchronous speed should be avoided. An easy way to calculate synchronous speed is as follows:

Synchronous Rotational Velocity (RPM)

$$S_c = \frac{60 \text{ x frequency (Hz)}}{\text{\# of pole pairs}}$$

For example, a 16 speed resolver at 400 Hz has synchronous velocity of:

$$S_c = 60 \left(\frac{400}{16}\right) = 1500 \text{ RPM}$$

Therefore, rotational speed should be held below

$$\frac{1500}{4} = 375 \text{ RPM}$$

LOADING EFFECTS

Loading presents almost no problem for most installations of General Dynamics Ordnance and Tactical Systems Resolvers because they are designed for the lowest possible output impedance. The rule-of-thumb is that the electrical loading should be at least ten times greater than the output short circuit impedance, and the standardized multispeed units are seldom above 1000 ohms. Single speed units are usually less than 100 ohms. If the output load impedance happens to be very small however, output voltage will decrease, input current and null voltage will increase, and the accuracy will degrade.

Resolvers are available with transmitter, differential or receiver functions. Specifically design to withstand high-impact (shock) and environments containing dirt, grease, oil or other contaminants. Available housed or unhoused, in a variety of configurations.

When used with R-to-D converters, whose input impedances exceed 250,000 ohms, the loading effect is negligible. If loads of 10,000 to 20,000 ohms or less are used, the most important thing to watch is the load imbalance. If the ratio of load resistance to output resolver impedance (R_L/Z_{SS}) is low, the load imbalance can cause additional resolver error.

For one speed resolvers, an approximate relation between (R_L/Z_{SS}) and additional error is as follows

$$\text{for } \frac{R_L}{Z_{ss}} = 10$$

0.5% load imbalance will result in about 50" error
0.1% load imbalance will result in about 10" error

$$\text{for } \frac{R_L}{Z_{ss}} = 20$$

0.5% load imbalance will result in about 20" error
0.1% load imbalance will result in about 4" error.

For multispeed resolvers the error values should be divided by the number of speeds, again making the multispeed unit a more attractive selection.

INSULATION

Both dielectric withstanding voltage and insulation resistance tests check the quality of insulation between different windings, and between windings and the magnetic core.

Dielectric withstanding voltage test (which is also called a High Potential or "Hi-Pot" test) also proves a resolver's ability to withstand momentary voltage surges while operating at its normal specified levels of usually 26 volts. Insulation resistance tests check for any breakdown in the insulation of the windings when an over-voltage condition is applied.

Hi-Pot tests are performed per military specifications at 250 volts RMS and 60 Hz; leakage current is to be less than 1 milliamp. Insulation resistance tests are run at 100 volts DC; resistance is to remain above 50 megohms.

General Dynamics Ordnance and Tactical Systems uses the highest quality insulation materials and impregnation varnishes, closely controlling manufacturing processes and incoming inspection of vendor materials. Insulation quality is guaranteed, even under the most hostile environments. Special materials may be specified for operation in high radiation environments as well as for high temperature (up to 200˚C) and space or vacuum applications requiring low out-gassing.

TEMPERATURE EFFECT

Theoretically, the electrical error of a given unit should not change with the change of temperature, since errors are a result of design limitations and manufacturing inaccuracies. However, mounting and temperature stresses may cause error variations. Usually, these variations do not cause change in the shape of the error curve, but change the position of the electrical zero. It is referred to as "EZ Shift."

General Dynamics Ordnance and Tactical Systems Pancake Resolvers are always designed and manufactured to minimize any possible stress that could result in EZ shift. If sleeve and hub are used, their coefficient of thermal expansion matches the one of the lamination material. However, EZ shift also depends on customer mounting, and customer choice of materials. If mounting recommendations are followed, then EZ shift is minimal.

One speed resolvers are more sensitive to temperature variations than multi-speed resolvers. For properly mounted pancake resolvers, approximate level of EZ shift versus temperature can be as follows:

- For one speed units, approximately 1 to 2 arc seconds/°C (dependent on size and rigidity)
- For multispeed units (8X or 16X), approximately 0.1 to 0.3 arc seconds/°C

Changes in phase shift and Transformation Ratio (TR) versus temperature are a primary result of resistance changes in the copper magnet wire of the resolver primary winding. Increased temperatures result in higher resistance, increasing the phase shift and decreasing the TR. One speed units in this case are much less sensitive to temperature variations than multispeed units, since the share of DC resistance in the total primary impedance value in multispeed resolvers is much greater than in one speed resolvers.

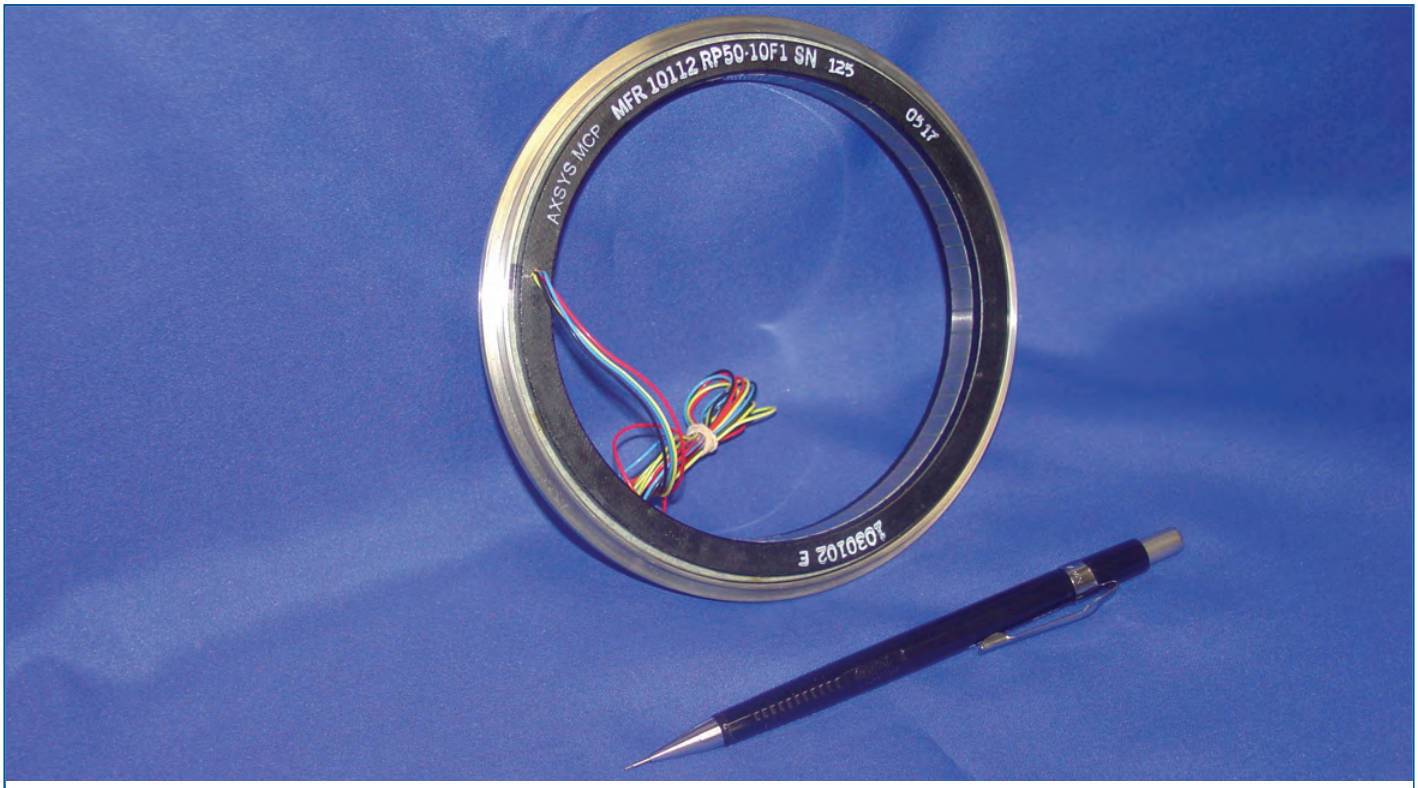
Fortunately these changes do not result in accuracy degradation. This is a big advantage in using resolvers as angular position sensors; the accuracy of angular conversion does not depend on TR, phase shift, primary voltage or frequency changes. These changes affect the output voltages on sine and cosine secondary windings the same way, and their ratio, which determines the converted output remains constant.

$$\theta_{OUT} = \arctan \frac{E_{sin}}{E_{cos}}$$

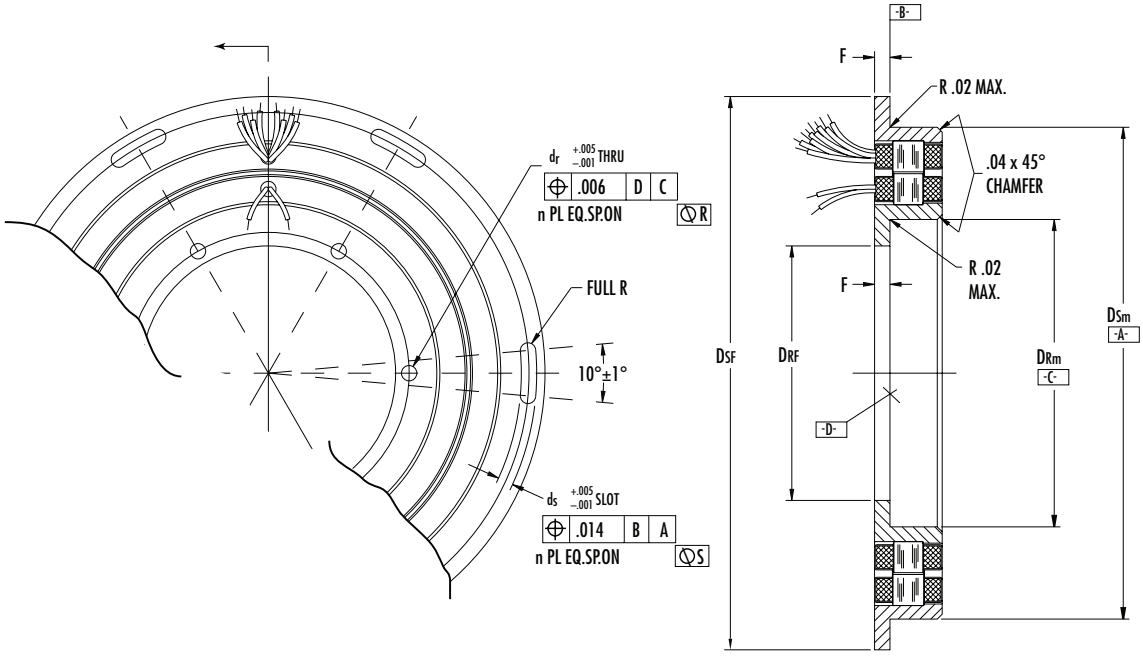
SPECIAL OPTIONS

CONNECTORS AND TRIM BOARDS

General Dynamics Ordnance and Tactical Systems will provide connectors, if necessary. They can be attached to every unit type if the customer specifies this feature. In order to keep rotor and stator leads separate, one can use two connectors. If customer wants, General Dynamics Ordnance and Tactical Systems can tie rotor and stator leads together, and attach only one connector. A trim board can also be attached if the resolver requires electrical trimming to increase accuracy.



General Dynamics Ordnance and Tactical Systems has consistently provided the most innovative military and industrial resolvers, designed to meet severe environmental conditions while providing the highest degree of angular accuracy.



Resolvers with Flanged Sleeves & Hubs

A typical flanged resolver is shown here, and standard dimensions for different "V Line" size resolvers are shown in the table below. The customer may specify flanges on either sleeve or hub. For advantages of flanged resolvers see mechanical configurations, page 4.

DIMENSIONS FOR STANDARD RESOLVERS WITH FLANGES

Size	Mounting Diameters				Flanged Dia.		Flange Width F	Slots ds & dr	Bolt Circle		No. of Slots	Rec. Size for Mtg. Screw
	Stator		Rotor		Stator	Rotor			Stator	Rotor		
	D_{SM}	TOL	D_{RM}	TOL	D_{SF}	D_{RF}			∅S	∅R		
015	1.6500	+.0000 -.0003	.5500	+.0002 -.0000	1.960*	.240*	.094	.092	1.800	.400	3	2-56UNC
019	1.9998	+.0000 -.0003	.6245	+.0003 -.0000	2.430*	.200*	.125	.092	2.210	.415	3	2-56UNC
022	2.3749	+.0000 -.0003	1.100	+.0003 -.0000	2.800*	.675*	.125	.125	2.585	.890	3	4-40UNC
028	2.9500	+.0000 -.0005	1.5500	+.0003 -.0000	3.460	1.120*	.125	.125	3.200	1.340	3	4-40UNC
034	3.5700	+.0000 -.0005	2.0800	+.0005 -.0000	4.080	1.650*	.125	.125	3.820	1.870	6	4-40UNC
038	4.0000	+.0000 -.0005	2.5000	+.0005 -.0000	4.500	2.070*	.125	.125	4.240	2.290	6	4-40UNC
050	5.2000	+.0000 -.0010	3.2400	+.0010 -.0000	5.700	2.810*	.125	.125	5.440	3.030	6	4-40UNC
065	6.6875	+.0000 -.0010	4.7720	+.0010 -.0000	7.190	4.270	.125	.125	6.930	4.530	6	4-40UNC
094	9.6063	+.0000 -.0010	8.0709	+.0010 -.0000	10.220	7.440	.156	.146	9.900	7.760	6	6-32UNC
115	11.6250	+.0000 -.0020	8.9500	+.0020 -.0000	12.250	8.320	.156	.146	11.930	8.640	8	6-32UNC

* Designed for reduced diameter washer.

MOUNTING RECOMMENDATIONS

Resolvers are easy to install. They are more rigid and reliable than optical encoders or inductosyns. They also withstand more severe environmental conditions. Frameless pancake resolvers are supplied with rotor and stator, to be separately installed in the enclosure, axially aligned and concentric to each other and the axis of rotation. They only need, typically. to be put at electrical zero by slight adjustment of stator angular position, relative to the rotor. One speed resolvers are affected by eccentricity or by mechanical and temperature stress much more than multispeed resolvers. Improper mounting of a one speed resolver can cause change of the electrical error within several angular minutes. The number of pole pairs in a multispeed unit divides this same error. However, multispeed resolvers are usually specified more accurate than one speeds units, and the effect can be just as critical.

When resolvers (one speed or multispeed) are used over a small angular range they experience less influence from improper mounting conditions than those with full rotation.

Pancake resolvers constitute a relatively thin set of rings designed to take up as little room as possible and to reduce weight. Sleeves and hubs add rigidity for high accuracy applications. General Dynamics Ordnance and Tactical Systems provides precisely ground mounting surfaces for stator OD and rotor ID as well as square shoulders which allow the customer to mount the unit concentrically in the system. In some very large diameter resolvers, however, General Dynamics Ordnance and Tactical Systems recommends some different mounting techniques.

INSTALLATION

Here are some helpful hints when developing procedures for resolver installations.

- Do not apply excessive force when mounting the resolver components. This may cause distortion that will affect its electrical performance. When inserting the stator or rotor into the system enclosure try to push it straight, applying even pressure around the surface of the unit. When properly installed, it should be able to be turned, but there should not be any radial movement possible.

- Concentricity requirements are specified on the outline drawings for each unit. Usually a rotor and stator should be mounted concentric to the axis of rotation starting from .0003 to .0005 inch for high accuracy, relatively small units to .001 to .002 inch for the more rigid or larger units having bigger air gaps. The rule-of-thumb is that concentricity will not affect performance if it is within 10% of the rotor/stator air gap clearance dimension.

- Axial alignment tolerance on V Line Pancake Resolvers should be maintained at ±.005 inches.

- The stator and rotor positions depend not only on the concentricity of mounting surfaces, but also on the gap between mounting and resolver surfaces. This fit should not be too loose, causing concentricity errors, nor too tight, causing distortion of the resolver. It can be from .0002 to .0003 inch for small units to 0.001 inch for large units.

- In order to minimize the effects of temperature change, the coefficient of thermal expansion should match that of the resolver as closely as possible. General Dynamics Ordnance and Tactical Systems' Standard Pancake Resolvers have coefficient of expansion equal to $10x10^{-6}$ per degree C.

- Do not use excessive force in clamping the resolver in place. Bare resolvers, without sleeves or hubs are especially sensitive to distortion. If you are cementing the unit in place, be sure to use a material that remains somewhat flexible under different temperature conditions; in order to minimize temperature-related stress.

- For the very large units General Dynamics Ordnance and Tactical Systems incorporates some optional features, which ease their mounting. In the size 083 General Dynamics Ordnance and Tactical Systems some models could be provided with axial holes through the stator and rotor lamination stacks (12 or 16 in each). The unit is mounted concentric, using accurate OD and ID cylindrical surfaces and is attached to the enclosure by screws, going through the axial holes. This feature eliminates the need to have special clamps that would increase the diameter of the mounting enclosure.

GLOSSARY

ACCURACY (ELECTRICAL ERROR):
The deviation of the mechanical or rotor position angle from the electrical angle, as indicated by the output voltage.

A/D CONVERTER:
An electronic circuit designed to convert analog signals to digital for computer interfacing.

COMPENSATION WINDING:
An added winding in the stator used to sense magnetic field changes. This "information" is fed back to the associated amplifier to correct for errors primarily due to temperature changes.

COARSE WINDING:
The lowest speed winding (usually 1 or 2 speed) on a dual speed resolver having also a multispeed "fine winding."

DUAL SPEED:
A resolver with both coarse and fine windings on the same lamination stack.

ELECTRICAL ZERO (EZ):
The mechanical angle at which the sine output voltage is at an in-phase null.

EXCITATION VOLTAGE:
AC voltage which excites the primary windings.

EZ SHIFT:
Variation between the electrical zero positions due to mechanical stresses caused by mounting or temperature.

FINE WINDINGS:
The higher speed winding of a dual speed resolver having also a 1 or 2 speed "coarse winding."

INPUT CURRENT:
Current in the primary winding at rated RMS voltage and frequency.

INPUT IMPEDANCE:
The (algebraic) sum of the DC and AC resistances with the inductive reactance of the input winding, when output windings are open.

INPUT POWER:
Power, in watts, consumed by the primary winding at rated RMS voltage and frequency.

INPUT WINDING:
Winding which receives the excitation voltage.

INTERAXIS ERROR:
Deviation from 90° between two windings that are wound in quadrature. Measured in mechanical minutes of shaft rotation.

MECHANICAL ZERO:
The marked point of alignment between rotor and stator, indicating electrical zero.

MULTISPEED:
A resolver that produces multiple sine and cosine cycles on the output windings for each complete mechanical rotation.

NULL VOLTAGE:
Residual voltage measure when excitation and output windings are at minimum coupling.

NULL SPACING ERROR:
Deviation from 180° between nulls of an output winding with respect to an excited input winding.

OUTPUT IMPEDANCE:
The (algebraic) sum of the DC and AC resistances with the inductive reactance of the output winding, when main and quadrature input windings are shorted.

OUTPUT VOLTAGE:
The no load voltage of the secondary windings at maximum coupling with rated voltage and frequency applied to the primary winding.

PHASE SHIFT:
The time phase difference between the primary and secondary voltages when the output is at maximum coupling.

PRIMARY WINDING:
The winding which receives the excitation voltage.

R-TO-D CONVERTER:
A circuit used to convert the analog output of a resolver into a digital representation of angular position.

ROTOR AND STATOR:
By convention the inner resolver member is called the rotor and the outer member is called the stator. Either may rotate in the actual application.

SECONDARY WINDING:
The output winding, inductively coupled to the primary winding.

SENSITIVITY:
Output voltage representative of one mechanical degree.

TRANSFORMATION RATIO:
The ratio of output voltage to input voltage when the two windings are at maximum coupling.

PART NUMBER EXPLANATION

RP029-161STBA-EOV

R - Resolver

P - Pancake

Lamination Size (Stator O.D. Rounded to the next highest 1/10 of an inch)

Number of "Speed" (Pole Pairs)
"01" for 1 Speed Units

Coarse Speed for Multispeed Units
Usually "1" or "2"
"0" if no coarse speed, and for 1X units

Mechanical Configuration
B - Bare (No Sleeve, No Hub)
S - Simple Sleeve and Hub
F - With Flanged Sleeve and Hub

Sleeve/Hub Material
M - Magnetic Cres 416
N - Nonmagnetic Cres 303
T - Titanium
A - Aluminum
B - Bare Units

Rotor 'Leads' Termination
F - Flexible Leads
B - Brushless, (with Rotary Transformer)
C - Unit with Connector

Electrical Variation (Next Available Letter for Given Speed)

Accuracy (Max. Error in Shaft Angle)

A	B	C	D	E	F	G	H	K	L	M	N	P	R
5″	10″	15″	20″	30″	40″	1′	2′	3′	6′	10′	15′	20′	30′

Angular Range (In Degrees)

0	1	2	3	4	5	6	7
360	±90	±45	±30	±20	±15	±10	±5

V Line Product

Special Features (Number or Letter)

Selection Guide							
Part Number:	O.D. (in.)	I.D. (in.)	Height (in.)	Speed	Accuracy	Frequency (Hz)	Page No.
RP007-010BBFA-H6V	.7100	.1250	0.320	1	2’	2000	29
RP007-010BBFA-K6V	.7100	.1250	0.320	1	3’	2000	
RP007-010BBFA-L0V1	.7100	.1250	0.320	1	6’	2000	
RP007-010BBFA-L2V	.7100	.1250	0.320	1	6’	2000	29
RP007-010BBFA-M0V	.7100	.1250	0.320	1	10’	2000	
RP007-010BBFB-K6V	.7100	.1250	0.320	1	3’	5000	
RP007-010BBFB-M0V	.7100	.1250	0.320	1	10’	5000	
RP007-010BBFC-K6V	.7100	.1250	0.320	1	3’	5000	30
RP007-010BBFC-M0V	.7100	.1250	0.320	1	10’	5000	
RP007-010BBFD-L0V	.7100	.1250	0.320	1	6’	800	
RP012-010BBFA-M1V	1.1875	.5625	0.300	1	10’	1000	31
RP012-010BBFA-N0V	1.1875	.5625	0.300	1	15’	1000	
RP012-010BBFB-K1V	1.1875	.5625	0.300	1	3’	1000	
RP012-010BBFB-L0V	1.1875	.5625	0.300	1	6’	1000	31
RP012-010BBFC-M1V	1.1875	.5625	0.300	1	10’	2000	
RP012-010BBFC-N0V	1.1875	.5625	0.300	1	15’	2000	
RP012-010BBFD-H2V	1.1875	.5625	0.300	1	2’	2000	
RP012-010BBFD-K1V	1.1875	.5625	0.300	1	3’	2000	
RP012-010BBFD-K1V1	1.1875	.5625	0.300	1	3’	5000	32
RP012-010BBFD-K2V	1.1875	.5625	0.300	1	3’	2000	
RP012-010BBFD-L0V	1.1875	.5625	0.300	1	6’	2000	
RP012-010BBFD-L3V	1.1875	.5625	0.300	1	6’	2000	
RP012-010BBFE-M1V	1.1875	.5625	0.300	1	10’	2000	
RP012-010BBFE-N0V	1.1875	.5625	0.300	1	15’	2000	
RP012-010BBFF-K1V	1.1875	.5625	0.300	1	3’	2000	33
RP012-010BBFF-L0V	1.1875	.5625	0.300	1	6’	2000	
RP012-010SMFG-K2V	1.3125	.4500	0.500	1	3’	400	
RP012-010SMFG-L0V	1.3125	.4500	0.500	1	6’	400	
RP012-030BBFA-L6V	1.1875	.5625	0.250	3	6’	2000	34
RP012-030BBFA-N2V	1.1875	.5625	0.250	3	15’	2000	

Selection Guide							
Part Number:	O.D. (in.)	I.D. (in.)	Height (in.)	Speed	Accuracy	Frequency (Hz)	Page No.
RP015-010BBFA-K2V	1.5000	.7000	0.370	1	3’	400	35
RP015-010BBFA-LOV	1.5000	.7000	0.370	1	6’	400	
RP015-010BBFB-K0V	1.5000	.7000	0.370	1	3’	2000	
RP015-010SMFA-K2V	1.6500	.5500	0.400	1	3’	400	35
RP015-010SMFA-LOV	1.6500	.5500	0.400	1	6’	400	
RP015-030BBFA-F2V	1.5000	.7000	0.370	3	40”	2000	
RP015-030BBFA-GOV	1.5000	.7000	0.370	3	1’	2000	
RP015-030FMFA-F2V1	1.6500	.5500	0.400	3	40”	2000	
RP015-030SMFA-F2V	1.6500	.5500	0.400	3	40”	2000	36
RP015-030SMFA-K2V	1.6500	.5500	0.400	3	3’	2000	
RP015-030SMFC-K2V	1.6500	.5500	0.400	3	3’	400	
RP015-040BBFA-G1V	1.5000	.7000	0.370	4	1’	2000	
RP015-080BBFA-C6V	1.5000	.7000	0.370	8	15”	1000	
RP015-080BBFA-D4V	1.5000	.7000	0.370	8	20”	2000	
RP015-080BBFA-E0V	1.5000	.7000	0.370	8	30”	2000	37
RP015-080SMFA-B6V	1.6500	.5500	0.400	8	10”	2000	
RP015-080SMFA-D0V	1.6500	.5500	0.400	8	20”	2000	
RP015-080SMFA-D3V	1.6500	.5500	0.400	8	20”	2000	
RP015-081BBFA-GOV	1.5000	.7000	0.370	1/8	15’/1’	5000	
RP015-160BBFA-C7V	1.5000	.7000	0.370	16	15”	5000	38
RP015-161BBFB-C7V	1.5000	.7000	0.370	1/16	15’/15”	5000	
RP015-161BBFB-EOV	1.5000	.7000	0.370	1/16	15’/30”	5000	
RP019-010BBFA-H2V	1.8380	.8380	0.460	1	2’	400	39
RP019-010BBFA-K0V	1.8380	.8380	0.460	1	3’	400	
RP019-010BBFA-L0V	1.8380	.8380	0.460	1	6’	400	
RP019-010SMFA-L0V	1.9998	.6245	0.650	1	6’	400	39
RP019-010SMFB-B7V	1.9998	.6245	0.650	1	10”	400	
RP019-010SMFB-K0V	1.9998	.6245	0.650	1	3’	400	
RP019-040BBFA-H2V	1.8380	.8380	0.460	4	2’	400	40

Selection Guide							
Part Number:	O.D. (in.)	I.D. (in.)	Height (in.)	Speed	Accuracy	Frequency (Hz)	Page No.
RP019-040BBFA-K0V	1.8380	.8380	0.464	4	3’	400	40
RP019-040FMFA-G2V	1.9998	.6245	0.650	4	1’	400	40
RP019-040SMFA-H2V	1.9998	.6245	0.650	4	2’	400	
RP019-080BBFA-C4V	1.8380	.8380	0.600	8	15”	400	
RP019-080BBFA-D0V	1.8380	.8380	0.600	8	20”	400	
RP019-080FMFA-B4V	1.9998	.6245	0.650	8	10”	400	41
RP019-080FMFA-G4V	1.9998	.6245	0.650	8	1’	400	
RP019-080SMFA-B4V	1.9998	.6245	0.650	8	10”	400	
RP019-080SMFA-C0V	1.9998	.6245	0.650	8	15”	400	
RP019-081FMFA-D1V	1.9998	.6245	0.650	1/8	30’/20”	2000	
RP019-160SMFC-C6V	1.9998	.6245	0.650	16	15”	2000	
RP019-161BBFA-C7V	1.8380	.8380	0.600	1/16	15’/15”	400	42
RP019-161BBFA-E0V	1.8380	.8380	0.600	1/16	15’/30”	400	
RP019-161FMFA-D1V	1.9998	.6245	0.650	1/16	15’/20”	400	
RP019-161SMFA-C7V	1.9998	.6245	0.650	1/16	15’/15”	400	
RP019-161SMFA-D0V	1.9998	.6245	0.650	1/16	15’/20”	400	
RP019-161SMFA-E0V	1.9998	.6245	0.650	1/16	15’/30”	400	
RP019-161SMFB-C6V	1.9998	.6245	0.650	1/16	15’/15”	2000	43
RP019-161SMFB-D0V	1.9998	.6245	0.650	1/16	15’/20”	2000	
RP019-162SMFD-C7V	1.9998	.6245	0.650	2/16	15’/15”	400	
RP019-162SMFD-E2V	1.9998	.6245	0.650	2/16	15’/30”	400	
RP022-010BBFA-K2V	2.2000	1.3100	0.500	1	3’	400	44
RP022-010BBFA-L0V	2.2000	1.3100	0.500	1	6’	400	44
RP022-010BBFB-L0V	2.2000	1.3100	0.500	1	6’	800	
RP022-010SMFA-H2V	2.3749	1.1000	0.530	1	2’	400	
RP022-010SMFA-L0V	2.3749	1.1000	0.530	1	6’	400	
RP022-020BBFA-H1V	2.2000	1.3100	0.500	2	2’	400	
RP022-020BBFA-K0V	2.2000	1.3100	0.500	2	3’	400	45
RP022-020BBFC-H1V1	2.2000	1.3100	0.500	2	2’	400	

Selection Guide							
Part Number:	O.D. (in.)	I.D. (in.)	Height (in.)	Speed	Accuracy	Frequency (Hz)	Page No.
RP022-020BBFD-H7V1	2.2000	1.3100	0.500	2	2’	400	45
RP022-020SMFA-G1V	2.3749	1.1000	0.530	2	1’	400	45
RP022-020SMFA-H0V	2.3749	1.1000	0.530	2	2’	400	
RP022-020SMFB-F1V	2.3749	1.1000	0.530	2	40”	2000	
RP022-080BBFA-D4V	2.2000	1.3100	0.530	8	20”	400	46
RP022-080BBFB-D5V1	2.2000	1.3100	0.500	8	20”	400	
RP022-080SMFA-C4V	2.3749	1.1000	0.530	8	15”	400	
RP022-081BBFA-D2V1	2.2000	1.3100	0.500	1/8	15’/20”	400	
RP022-160BBFA-D5V	2.2000	1.3100	0.530	16	20”	400	
RP022-160SMFA-C7V	2.3749	1.1000	0.530	16	15”	400	
RP022-160SMFA-D5V	2.3749	1.1000	0.530	16	20”	400	47
RP022-161SMFA-D0V	2.3749	1.1000	0.530	1/16	15’/20”	2000	
RP028-010BBFA-G0V	2.7500	1.5000	0.600	1	1’	400	48
RP028-010BBFA-G0V1	2.7500	1.5000	0.600	1	90”	400	48
RP028-010BBFA-L0V	2.7500	1.7450	0.600	1	6’	400	
RP028-010BBFA-L0V1	2.7500	1.7450	0.600	1	6’	400	
RP028-010BBFD-L0V	2.7500	1.7450	0.600	1	6’	400	
RP028-010SMFA-K0V	3.0000	1.5000	0.690	1	3’	400	
RP028-010SMFA-L0V	3.0000	1.5000	0.690	1	6’	400	49
RP028-010SMFB-G0V1	3.0000	1.5000	0.690	1	1’	400	
RP028-020BBFA-H1V	2.7500	1.7450	0.600	2	2’	400	
RP028-020BBFA-K0V	2.7500	1.7450	0.600	2	3’	400	
RP028-020SMFA-G1V	3.0000	1.5000	0.690	2	1’	400	
RP028-020SMFA-H1V	3.0000	1.5000	0.690	2	2’	400	
RP028-020SMFA-K0V	3.0000	1.5000	0.690	2	3’	400	50
RP028-080BBFA-C4V	2.7500	1.7450	0.680	8	15”	2000	
RP028-080BBFA-D0V	2.7500	1.7450	0.680	8	20”	2000	
RP028-080SMFA-B4V	3.0000	1.5000	0.690	8	10”	2000	
RP028-080SMFA-C0V	3.0000	1.5000	0.690	8	15”	2000	

Selection Guide							
Part Number:	O.D. (in.)	I.D. (in.)	Height (in.)	Speed	Accuracy	Frequency (Hz)	Page No.
RP028-080SNFA-B4V	3.0000	1.5000	0.690	8	10”	2000	50
RP028-160SMFC-C7V	3.0000	1.5000	0.690	16	15”	5000	51
RP028-161BBFA-D7V	2.7500	1.7450	0.680	1/16	15’/20”	400	
RP028-161BBFA-E0V	2.7500	1.7450	0.680	1/16	15’/30”	400	
RP028-161BBFB-D6V	2.7500	1.7450	0.680	1/16	15’/20”	2000	
RP028-161BBFB-E0V	2.7500	1.7450	0.680	1/16	15’/30”	2000	
RP028-161SMFB-C7V	3.0000	1.5000	0.690	1/16	15’/15”	2000	
RP028-161SMFB-D0V	3.0000	1.5000	0.690	1/16	15’/20”	2000	52
RP028-361SMFA-D0V	3.0000	1.5000	0.690	1/36	15’/20”	2000	
RP034-010BBFA-H0V1	3.3740	2.2503	0.520	1	2’	400	53
RP034-010BBFA-K0V	3.3740	2.2503	0.520	1	3’	400	53
RP034-010BBFA-L0V	3.3740	2.2503	0.520	1	6’	400	
RP034-010BBFA-L0V1	3.3740	2.2503	0.520	1	6’	400	
RP034-010BBFB-L0V	3.3740	2.2503	0.520	1	6’	800	
RP034-010BBFB-L0V1	3.3740	2.2503	0.520	1	6’	2000	
RP034-010BBFC-K0V1	3.3740	2.2503	0.520	1	3’	1000	54
RP034-010FMFA-H0V1	3.5700	2.0800	0.520	1	2’	400	
RP034-080BBFA-C4V	3.3740	2.2503	0.600	8	15”	400	
RP034-080BBFA-D0V	3.3740	2.2503	0.600	8	20”	400	
RP034-080SMFA-B4V	3.5700	2.0800	0.600	8	10”	400	
RP034-080SMFA-C0V	3.5700	2.0800	0.600	8	15”	400	
RP034-160BBFD-C4V	3.3740	2.2503	0.600	16	15”	400	55
RP034-160BBFD-C4V1	3.3740	2.2503	0.600	16	15”	400	
RP034-160BBFD-D4V1	3.3740	2.2503	0.600	16	20”	2000	
RP034-160SMFC-C7V	3.5700	2.0800	0.600	16	15”	2000	
RP034-161BBFA-D7V	3.3740	2.2503	0.600	1/16	15’/20”	400	
RP034-161BBFA-E0V	3.3740	2.2503	0.600	1/16	15’/30”	400	
RP034-161BBFB-D7V	3.3740	2.2503	0.600	1/16	15’/20”	2000	56
RP034-161BBFB-E0V	3.3740	2.2503	0.600	1/16	15’/30”	2000	
RP034-161BBFB-E0V1	3.3740	2.2503	0.600	1/16	15’/30”	2000	

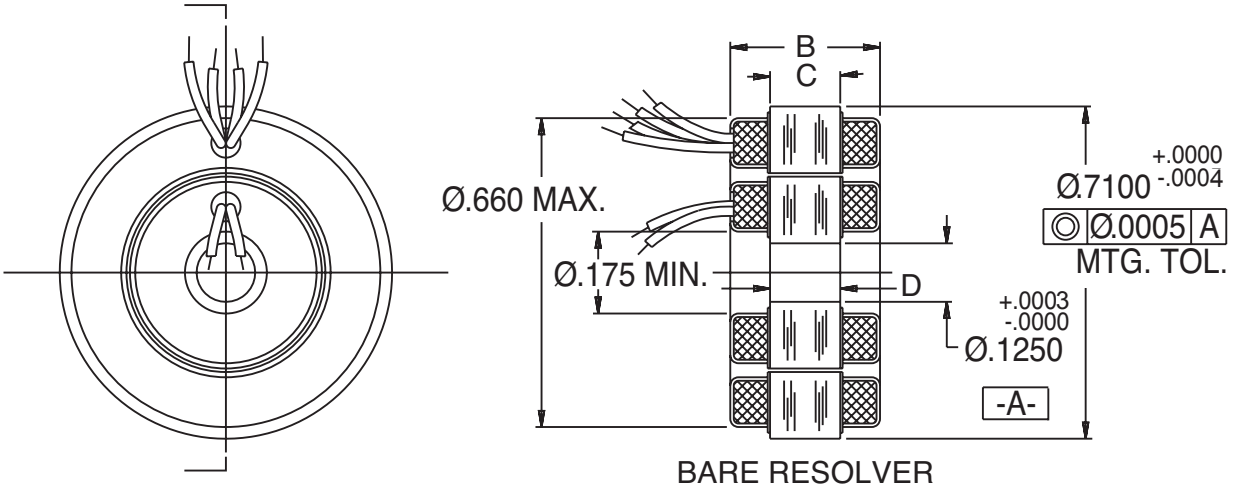
Selection Guide							
Part Number:	O.D. (in.)	I.D. (in.)	Height (in.)	Speed	Accuracy	Frequency (Hz)	Page No.
RP034-161SMFB-C7V	3.5700	2.0800	0.600	1/16	15'/15"	2000	56
RP034-161SMFB-D0V	3.5700	2.0800	0.600	1/16	15'/20"	2000	
RP038-010SMFA-L0V	4.0000	2.5000	0.560	1	6'	400	57
RP038-010BBFA-K0V	3.7800	2.7400	0.560	1	3'	400	57
RP038-010BBFA-K0V1	3.7800	2.7400	0.560	1	3'	1000	
RP038-010SMFA-H0V	4.0000	2.5000	0.560	1	2'	400	
RP038-010SMFC-H0V	4.0000	2.5000	0.560	1	2'	2000	
RP038-040BBFA-G0V	3.7800	2.7400	0.560	4	1'	400	
RP038-040FMFB-F0V1	4.0000	2.5000	0.560	4	40"	2000	58
RP038-040SMFA-D4V	4.0000	2.5000	0.560	4	20"	400	
RP038-040SMFA-F0V	4.0000	2.5000	0.560	4	40"	400	
RP038-080SMFB-D2V	4.0000	2.5000	0.560	8	20"	2000	
RP038-081SMFA-E0V	4.0000	2.5000	0.560	1/8	15'/30"	2000	
RP038-081SMFA-M0V	4.0000	2.5000	0.560	1/8	15'/10'	2000	
RP038-081SMFD-E0V	4.0000	2.5000	0.560	1/8	15'/30"	2000	59
RP038-161SMFA-E0V	4.0000	2.5000	0.560	1/16	15'/30"	2000	
RP038-161SMFB-D1V	4.0000	2.5000	0.560	1/16	15'/20"	400	
RP050-010BBFA-K0V	4.9946	3.4553	0.750	1	3'	400	60
RP050-010BBFA-K5V	4.9946	3.4553	0.750	1	3'	400	60
RP050-010BBFA-L0V	4.9946	3.4553	0.750	1	6'	400	
RP050-010FMFB-H0V1	5.200	3.240	0.750	1	2'	4500	
RP050-160BBFC-B4V	4.9946	3.4553	0.750	16	10"	400	61
RP050-160BBFC-B4V1	4.9946	3.4553	0.750	16	10"	400	
RP050-160BBFC-C0V	4.9946	3.4553	0.750	16	15"	400	
RP050-161BBFA-C0V	4.9946	3.4553	0.750	1/16	10'/15"	400	
RP050-161BBFA-E0V	4.9946	3.4553	0.750	1/16	10'/30"	400	
RP050-161BBFB-E0V	4.9946	3.4553	0.750	1/16	10'/30"	2000	
RP050-161BBFE-E0V	4.9946	3.4553	0.750	1/16	10'/30"	2000	62
RP050-161FNFE-E0V	5.200	3.220	.760	1/16	10'/30"	2000	
RP050-161SMFA-C0V1	5.240	3.240	.760	1/16	10'/15"	400	
RP050-161SMFD-D0V	5.240	3.220	.760	1/16	10'/20"	400	

Selection Guide							
Part Number:	O.D. (in.)	I.D. (in.)	Height (in.)	Speed	Accuracy	Frequency (Hz)	Page No.
RP050-321BBFA-B6V	4.9946	3.4553	0.750	1/32	10’/10”	400	62
RP050-321BBFA-C0V	4.9946	3.4553	0.750	1/32	10’/15”	400	
RP050-321BBFA-D0V	4.9946	3.4553	0.750	1/32	10’/20”	400	63
RP050-321SMFA-B6V	5.240	3.220	0.760	1/32	10’/10”	400	
RP050-321SMFA-C0V	5.240	3.220	0.760	1/32	10’/15”	400	
RP065-010BBFA-K0V	6.485	4.975	0.650	1	3’	400	64
RP065-010BBFB-K0V	6.485	4.975	0.650	1	3’	2000	64
RP065-010BBFD-K0V1	6.485	4.975	0.650	1	3’	400	
RP065-010SMFA-H0V	6.750	4.712	0.650	1	2’	400	
RP065-010SMFB-H0V1	6.750	4.712	0.650	1	2’	2000	65
RP065-010SMFB-K0V	6.750	4.712	0.650	1	3’	2000	
RP065-010SMFB-K0V1	6.750	4.712	0.650	1	3’	2000	
RP065-010SMFC-G0V1	6.750	4.712	0.650	1	1’	2000	
RP065-161BBFA-E0V	6.485	4.975	0.650	1/16	15’/30”	2000	
RP065-161BBFA-G0V	6.485	4.975	0.650	1/16	15’/1’	2000	66
RP065-161SMFA-C0V	6.750	4.712	0.650	1/16	15’/15”	2000	
RP065-161SMFA-C0V1	6.750	4.712	0.650	1/16	15’/15”	1450	
RP065-161SMFA-C0V2	6.750	4.712	0.650	1/16	15’/15”	2000	
RP065-321BBFB-B0V1	6.750	4.712	0.650	1/32	15’/10”	1200	
RP065-321FMFB-B0V	6.6875	4.7720	0.650	1/32	15’/10’’	2000	67
RP065-321SMFA-A2V	6.750	4.712	0.650	1/32	15’/5”	2000	
RP065-321SMFA-B0V	6.750	4.712	0.650	1/32	15’/10’’	2000	
RP065-321FMFA-B0V	6.6875	4.7720	0.650	1/32	15’/10’’	2000	
RP065-321FMFA-A2V	6.6875	4.7720	0.650	1/32	15’/5”	2000	
RP083-010BBFA-K0V1	8.2500	6.2300	0.850	1	3’	1500	68
RP083-010BBFA-L0V	8.2500	6.2300	0.850	1	6’	400	68
RP083-081BBFA-E2V	8.2500	6.2300	0.850	1/8	15’/30’’	400	
RP083-081BBFA-E0V	8.2500	6.2300	0.850	1/8	15’/30’’	400	
RP083-161BBFA-C6V	8.2500	6.2300	0.850	1/16	15’/15’’	400	
RP083-161BBFA-D0V	8.2500	6.2300	0.850	1/16	15’/20’’	400	69
RP083-161BBFB-B6V	8.2500	6.2300	0.850	1/16	15’/10’’	400	

Selection Guide							
Part Number:	O.D. (in.)	I.D. (in.)	Height (in.)	Speed	Accuracy	Frequency (Hz)	Page No.
RP083-161BBFB-C0V	8.2500	6.2300	0.850	1/16	15'/15"	400	69
RP083-321BBFA-A6V	8.2500	6.2300	0.850	1/32	15'/5"	400	
RP083-321BBFA-B0V	8.2500	6.2300	0.850	1/32	15'/10"	400	
RP083-321BBFB-D0V	8.2500	6.2300	0.850	1/32	15'/20"	400	
RP094-010SMFA-M0V	9.6063	8.0709	1.024	1	10'	400	70
RP094-161SMFA-D5V	9.6063	8.0709	1.024	1/16	15'/20"	400	70
RP094-161SMFA-E0V	9.6063	8.0709	1.024	1/16	15'/30"	400	
RP115-010BBFA-L0V	11.360	9.192	1.000	1	6'	400	71
RP115-010SMFA-L0V	11.675	8.880	1.000	1	6'	400	71
RP115-161BBFA-B6V	11.360	9.192	1.000	1/16	15'/10"	400	
RP115-161BBFA-D0V	11.360	9.192	1.000	1/16	15'/20"	400	
RP115-161SMFA-A6V	11.675	8.880	1.000	1/16	15'/5"	400	
RP115-161SMFA-C0V	11.675	8.880	1.000	1/16	15'/15"	400	
RP115-320SMFA-B0V	11.675	8.880	1.000	32	10"	400	72
RP115-321SMFA-C0V	11.675	8.880	1.000	1/32	15'/15"	400	
RP115-321SMFD-B0V	11.675	8.880	1.000	1/32	15'/10"	1200	

Other sizes available. Contact General Dynamics Ordnance and Tactical Systems for your specific application.

RP007
PANCAKE RESOLVERS



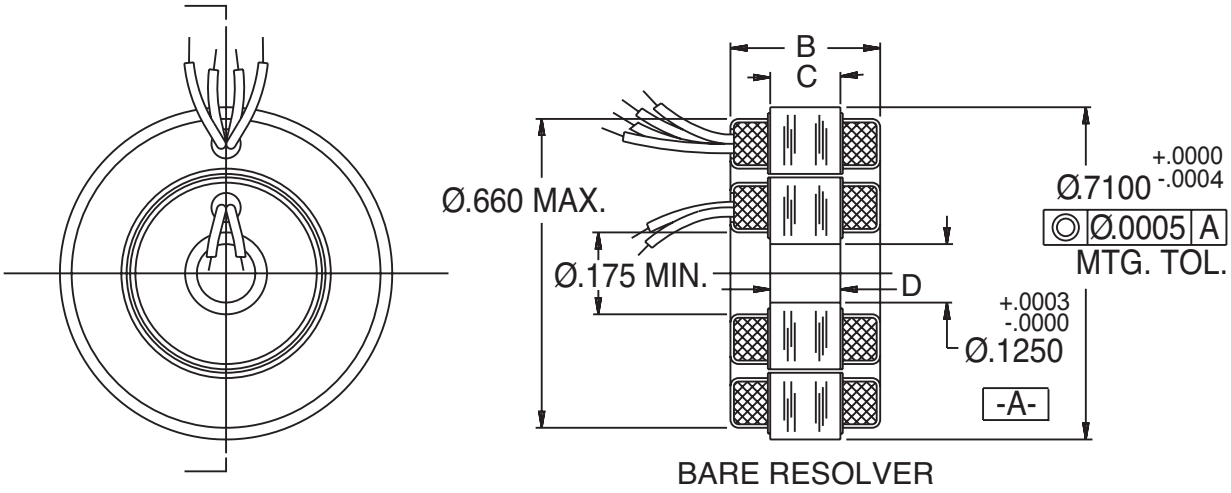
BARE RESOLVER

RP007-	010BBFA-H6V	010BBFA-K6V	010BBFA-L0V1	010BBFA-L2V	010BBFA-M0V	010BBFB-K6V
Bare	✔	✔	✔	✔	✔	✔
Sleeve and Hub						
B (overall height) (in.)	0.320	0.320	0.320	0.320	0.320	0.320
C (stator) (in.)	0.150	0.150	0.150	0.150	0.150	0.150
D (rotor) (in.)	0.150	0.150	0.150	0.150	0.150	0.150
Mntg. Concen. (in.)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1	1	1	1	1	1
Function	RX	RX	RX	RX	RX	RT
Primary Winding	R	R	R	R	R	S
Input (VRMS)	5	5	5	5	5	5
Frequency (Hz)	2000	2000	2000	2000	2000	5000
Input Current (ma) Max.	50	50	50	50	50	10
Input Power (watts) Max.	0.13	0.13	0.13	0.13	0.13	0.02
Phase Shift (deg.) nom.	21	21	21	21	21	5
Transformation Ratio	0.454	0.454	1	0.454	0.454	0.454
Accuracy	2'	3'	6'	6'	10'	3'
Optional Accuracy Avail.	-	-	-	3'[B]	6'[B]	2'[B]
Angular Range (deg.)	±10	±10	360	±45	360	±10
Weight (oz.)	0.3	0.3	0.3	0.3	0.3	0.3
Inertia ($x10^{-6}$ oz-in-sec^2)	4.6	4.6	4.6	4.6	4.6	4.6
Schematic No.	1	1	1	1	1	2
Notes:		A		A,B	A,B	A,B

Characteristics at 25°C [A]Sleeve and hub available on special order. [B]Accuracy available when supplied with trim resistors.

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP007
PANCAKE RESOLVERS

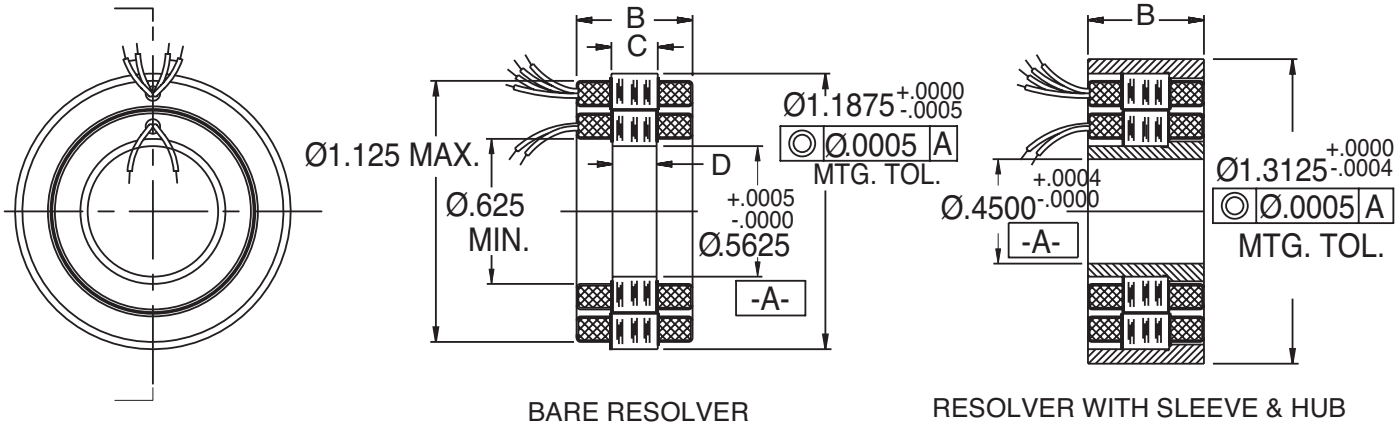


BARE RESOLVER

RP007-	010BBFB-MOV	010BBFC-K6V	010BBFC-MOV	010BBFD-L0V
Bare	✔	✔	✔	✔
Sleeve and Hub				
B (overall height) (in.)	0.320	0.320	0.320	0.320
C (stator) (in.)	0.150	0.150	0.150	0.150
D (rotor) (in.)	0.150	0.150	0.150	0.150
Mntg. Concen. (in.)	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1	1	1	1
Function	RT	RX	RX	RX
Primary Winding	S	R	R	S
Input (VRMS)	5	5	5	5
Frequency (Hz)	5000	5000	5000	800
Input Current (ma) Max.	10	25	25	75
Input Power (watts) Max.	0.02	0.05	0.05	0.05
Phase Shift (deg.) nom.	5	10	10	36
Transformation Ratio	0.454	0.480	0.480	1.00
Accuracy	10'	3'	10'	6'
Optional Accuracy Avail.	6'[B]	2'[B]	6'[B]	3'[B]
Angular Range (deg.)	360	±10	360	360
Weight (oz.)	0.3	0.3	0.3	0.3
Inertia ($x10^{-6}$ oz-in-sec^2)	4.6	4.6	4.6	4.6
Schematic No.	2	1	1	1
Notes:	A,B	A,B	A,B	A,B
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]Accuracy available when supplied with trim resistors.				

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP012
PANCAKE RESOLVERS



BARE RESOLVER

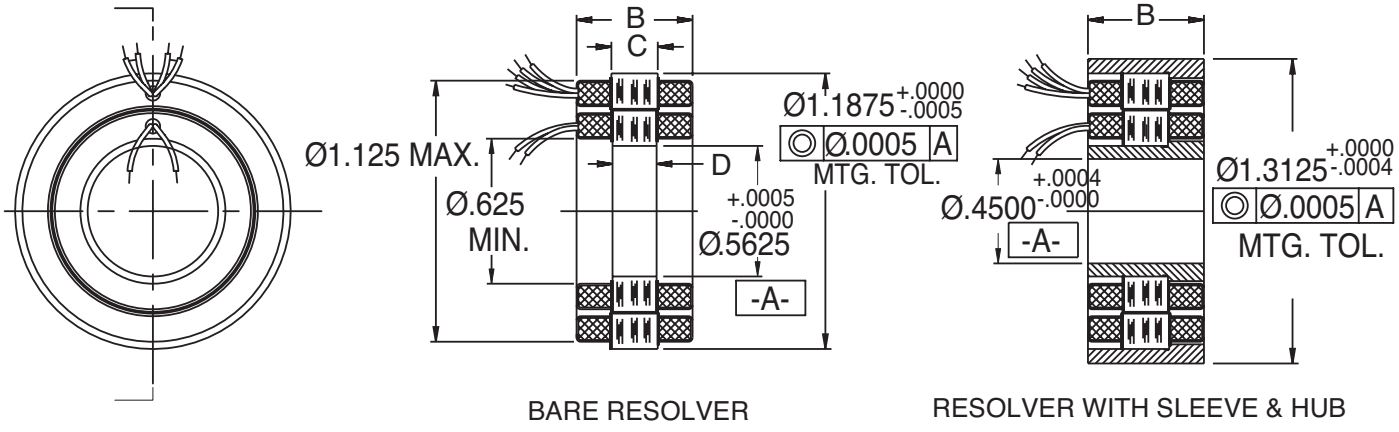
RESOLVER WITH SLEEVE & HUB

RP012-	010BBFA-M1V	010BBFA-N0V	010BBFB-K1V	010BBFB-L0V	010BBFC-M1V	010BBFC-N0V
Bare	✔	✔	✔	✔	✔	✔
Sleeve and Hub						
B (overall height) (in.)	0.300	0.300	0.300	0.300	0.300	0.300
C (stator) (in.)	0.150	0.150	0.150	0.150	0.150	0.150
D (rotor) (in.)	0.140	0.140	0.140	0.140	0.140	0.140
Mounting Concentricity (in)	.0005	.0005	.0005	.0005	.0005	.0005
Speed (no. of pole pairs)	1	1	1	1	1	1
Function	RX	RX	RX	RX	RX	RX
Primary Winding	S	S	S	S	S	S
Input (VRMS)	5	5	5	5	5	5
Frequency (Hz)	1000	1000	1000	1000	2000	2000
Input Current (ma) Max.	45	45	55	55	50	50
Input Power (watts) Max.	0.16	0.16	0.21	0.21	0.13	0.13
Phase Shift (deg.) nom.	30	30	38	38	18	18
Transformation Ratio	1.00	1.00	0.90	0.90	1.00	1.00
Accuracy	10’	15’	3’	6’	10’	15’
Optional Accuracy Avail.	-	-	-	-	-	-
Angular Range (deg.)	±90	360	±90	360	±90	360
Weight (oz.)	0.7	.0.7	0.7	0.7	.0.7	0.7
Inertia ($x10^{-4}$ oz-in-sec^2)	1.0	1.0	1.0	1.0	1.0	1.0
Schematic No.	3	3	3	3	3	3
Notes:	A	A	A	A	A	A

Characteristics at 25°C [A]Sleeve and hub available on special order.

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP012
PANCAKE RESOLVERS



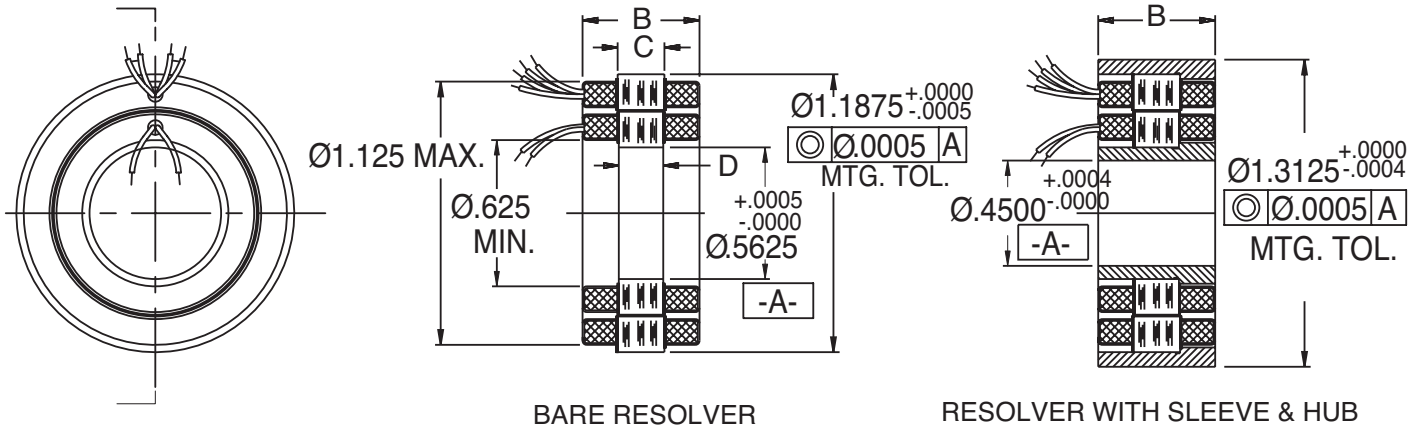
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP012-	010BBFD-H2V	010BBFD-K1V	010BBFD-K1V1	010BBFD-K2V	010BBFD-L0V	010BBFD-L3V
Bare	✔	✔	✔	✔	✔	✔
Sleeve and Hub						
B (overall height) (in.)	0.300	0.300	0.300	0.300	0.300	0.300
C (stator) (in.)	0.150	0.150	0.150	0.150	0.150	0.150
D (rotor) (in.)	0.140	0.140	0.140	0.140	0.140	0.140
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1	1	1	1	1	1
Function	RX	RX	RX	RX	RX	RX
Primary Winding	S	S	S	S	S	S
Input (VRMS)	5	5	2	5	5	5
Frequency (Hz)	2000	2000	5000	2000	2000	2000
Input Current (ma) Max.	70	70	20	70	70	70
Input Power (watts) Max.	0.22	0.22	0.04	0.22	0.22	0.22
Phase Shift (deg.) nom.	25	25	15	25	25	25
Transformation Ratio	0.90	0.90	1.00	0.90	0.90	0.90
Accuracy	2’	3’	3’	3’	6’	6’
Optional Accuracy Avail.	-	-	-	-	-	-
Angular Range (deg.)	±45	±90	±90	±45	360	±30
Weight (oz.)	0.7	0.7	0.7	0.7	0.7	0.7
Inertia (x10^{-4} oz-in-sec^2)	1.0	1.0	1.0	1.0	1.0	1.0
Schematic No.	3	3	3	3	3	3
Notes:	A	A	A	A	A	A
Characteristics at 25°C [A]Sleeve and hub available on special order.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP012
PANCAKE RESOLVERS



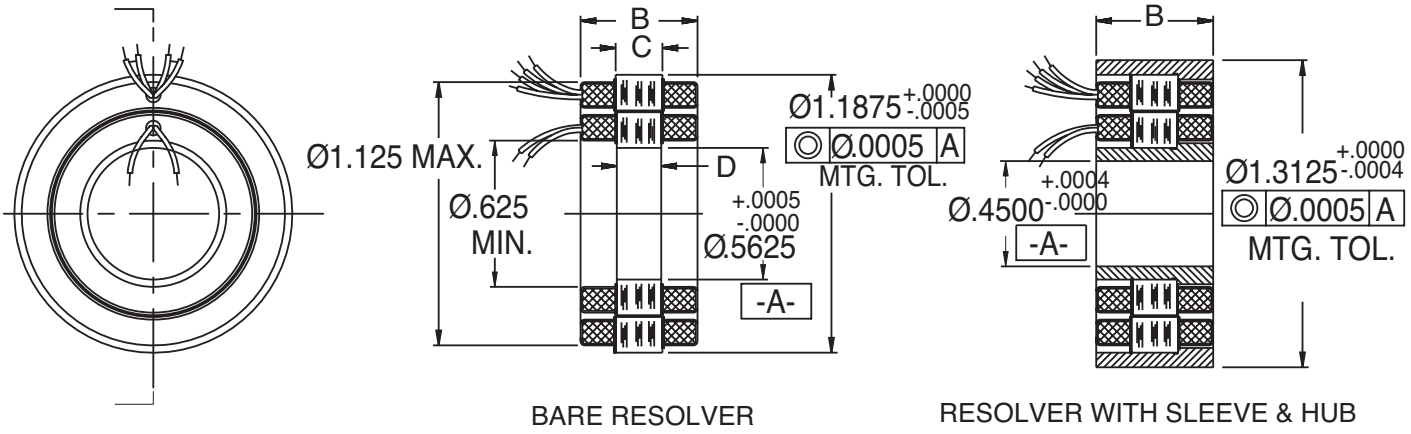
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP012-	010BBFE-M1V	010BBFE-N0V	010BBFF-K1V	010BBFF-L0V	010SMFG-K2V
Bare	✔	✔	✔	✔	
Sleeve and Hub					✔
B (overall height) (in.)	0.300	0.300	0.300	0.300	0.500
C (stator) (in.)	0.150	0.150	0.150	0.150	-
D (rotor) (in.)	0.140	0.140	0.140	0.140	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1	1	1	1	1
Function	RT	RT	RT	RT	RX
Primary Winding	S	S	S	S	R
Input (VRMS)	5	5	5	5	5
Frequency (Hz)	2000	2000	2000	2000	400
Input Current (ma) Max.	10	10	12	12	30
Input Power (watts) Max.	0.04	0.04	0.05	0.05	0.11
Phase Shift (deg.) nom.	17	17	23	23	35
Transformation Ratio	1.00	1.00	.90	.90	1.00
Accuracy	10’	15’	3’	6’	3’
Optional Accuracy Avail.	-	-	-	-	2’
Angular Range (deg.)	±90	360	±90	360	±45
Weight (oz.)	0.7	0.7	0.7	0.7	1.7
Inertia ($x10^{-4}$ oz-in-sec^2)	1.0	1.0	1.0	1.0	1.5
Schematic No.	2	2	2	2	1
Notes:	A	A	A	A	
Characteristics at 25°C [A]Sleeve and hub available on special order.					

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP012
PANCAKE RESOLVERS



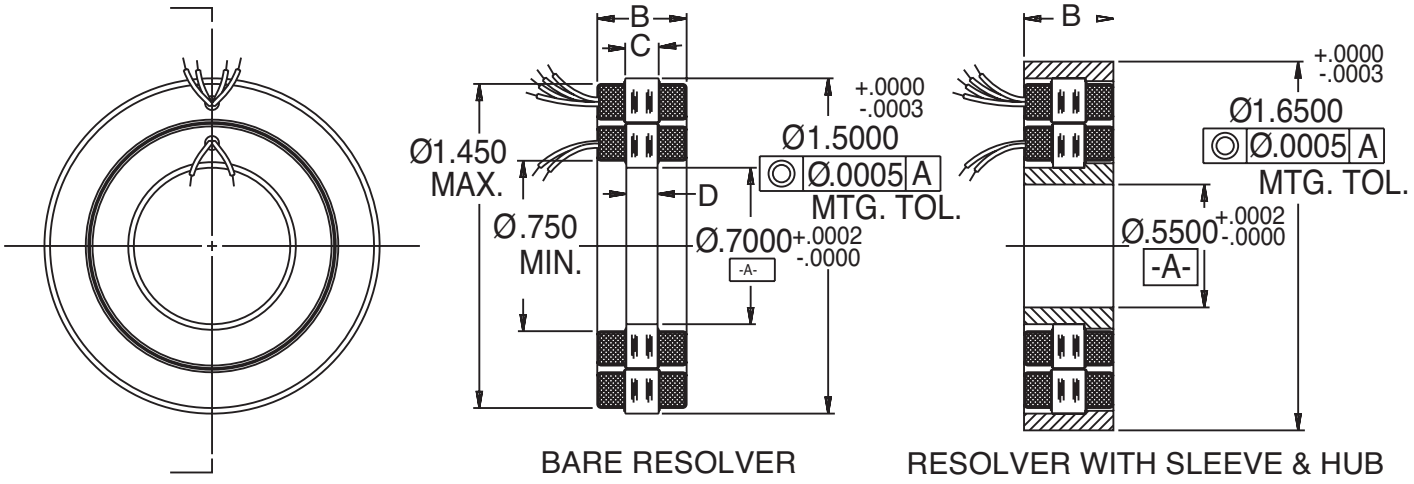
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP012-	010SMFG-L0V	030BBFA-L6V	030BBFA-N2V
Bare		✔	✔
Sleeve and Hub	✔		
B (overall height) (in.)	0.500	0.250	0.250
C (stator) (in.)	-	0.098	0.098
D (rotor) (in.)	-	0.084	0.084
Mounting Concentricity (in)	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1	3	3
Function	RX	RX	RX
Primary Winding	R	S	S
Input (VRMS)	5	5	5
Frequency (Hz)	400	2000	2000
Input Current (ma) Max.	30	30	30
Input Power (watts) Max.	0.11	0.10	0.10
Phase Shift (deg.) nom.	35	30	30
Transformation Ratio	1.00	0.500	0.500
Accuracy	6’	6’	15’
Optional Accuracy Avail.	3’	3’	6’
Angular Range (deg.)	360	±10	±45
Weight (oz.)	1.7	0.5	0.5
Inertia ($x10^{-4}$ oz-in-sec^2)	1.5	0.6	0.6
Schematic No.	1	8	8
Notes:		A	A

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP015
PANCAKE RESOLVERS



BARE RESOLVER

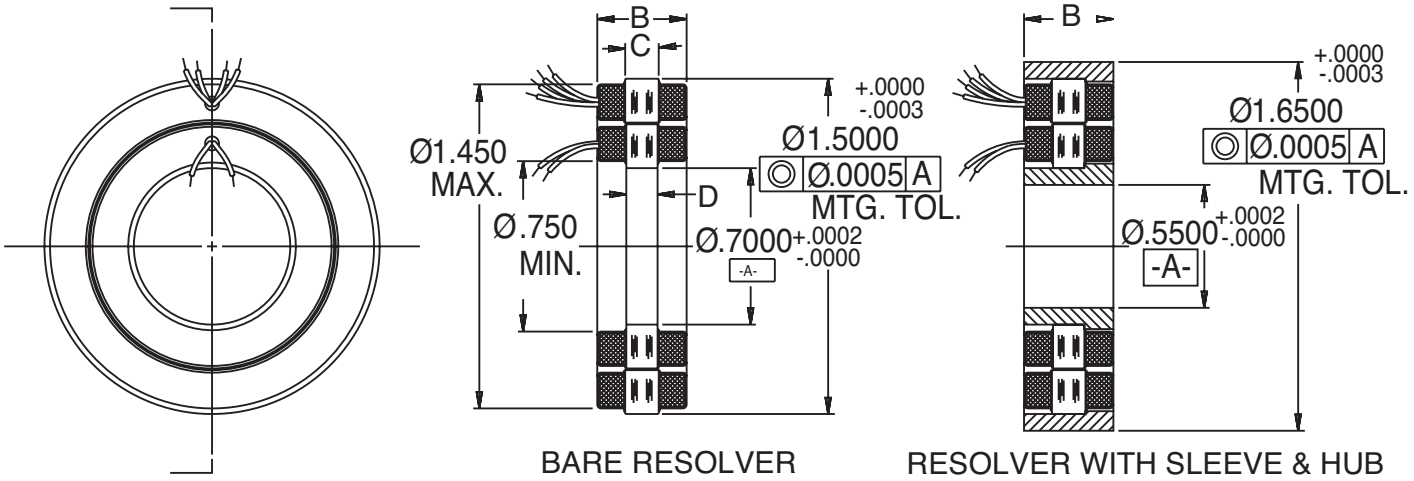
RESOLVER WITH SLEEVE & HUB

RP015-	010BBFA-K2V	010BBFA-L0V	010BBFB-K0V	010SMFA-K2V	010SMFA-L0V	030BBFA-F2V
Bare	✔	✔	✔			✔
Sleeve and Hub				✔	✔	
B (overall height) (in.)	0.370	0.370	0.370	.400	0.400	.370
C (stator) (in.)	0.150	0.150	0.150	-	-	0.150
D (rotor) (in.)	0.140	0.140	0.140	-	-	0.140
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0003	0.0003	0.0005
Speed (no. of pole pairs)	1	1	1	1	1	3
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	S	R	R	S
Input (VRMS)	5	5	2	5	5	5
Frequency (Hz)	400	400	2000	400	400	2000
Input Current (ma) Max.	26	26	5	26	26	27
Input Power (watts) Max.	0.10	0.10	0.01	0.10	0.10	0.06
Phase Shift (deg.) nom.	24	24	8	24	24	15
Transformation Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Accuracy	3’	6’	3’	3’	6’	40”
Optional Accuracy Avail.				2’	3’	
Angular Range (deg.)	±45	360	360	±45	360	±45
Weight (oz.)	1.1	1.1	1.1	2.0	2.0	1.0
Inertia ($x10^{-3}$ oz-in-sec^2)	0.25	0.25	0.25	0.32	0.32	0.25
Schematic No.	1	1	3	1	1	8
Notes:	A,D	A,D	A	A,D	A,D	A,C,D

Characteristics at 25°C [A]Sleeve and hub available on special order. [B]Low outgasing. [C]Lead exit opposite flange end. [D]26V 2000 Hz available.

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP015
PANCAKE RESOLVERS



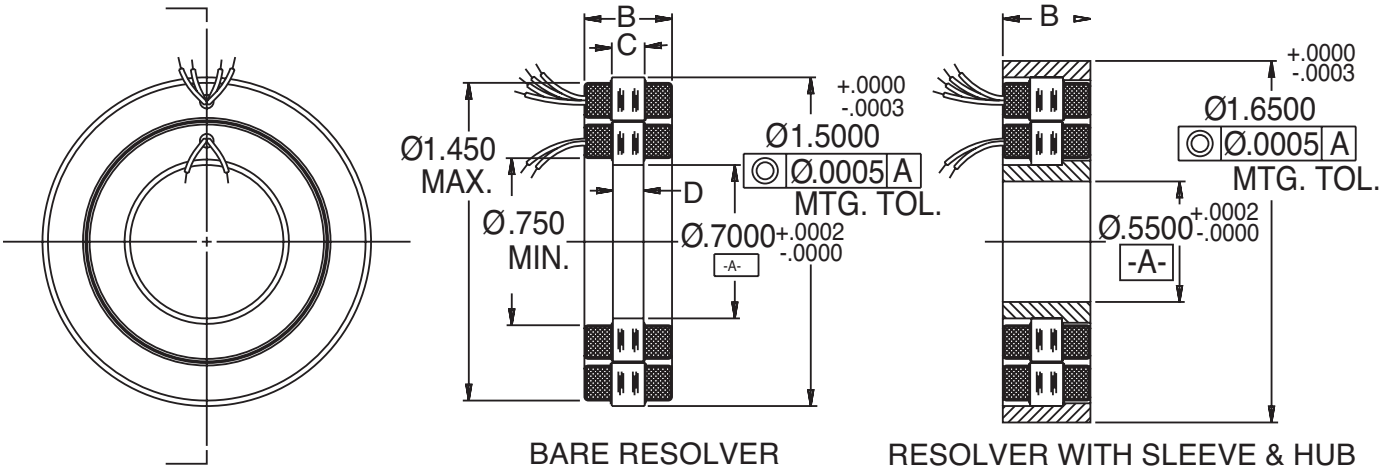
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP015-	030BBFA-G0V	030FMFA-F2V1	030SMFA-F2V	030SMFA-K2V	030SMFC-K2V
Bare	✔				
Sleeve and Hub		✔	✔	✔	✔
B (overall height) (in.)	0.370	0.400	0.400	0.400	0.400
C (stator) (in.)	0.150	-	-	-	-
D (rotor) (in.)	0.140	-	-	-	-
Mounting Concentricity (in)	0.0005	0.0003	0.0003	0.0003	0.0003
Speed (no. of pole pairs)	3	3	3	3	3
Function	RX	RX	RX	RX	RX
Primary Winding	S	S	S	S	S
Input (VRMS)	5	5	5	5	2.67
Frequency (Hz)	2000	2000	2000	2000	400
Input Current (ma) Max.	27	27	27	27	50
Input Power (watts) Max.	0.06	0.06	0.06	0.06	0.1
Phase Shift (deg.) nom.	15	15	15	15	43
Transformation Ratio	1.00	1.00	1.00	1.00	0.75
Accuracy	1’	40”	40”	3’	3’
Optional Accuracy Avail.					
Angular Range (deg.)	360	±45	±45	±45	±45
Weight (oz.)	1.0	2.5	2.0	2.0	2.0
Inertia ($x10^{-3}$ oz-in-sec^2)	0.25	0.33	0.31	0.31	0.32
Schematic No.	8	8	8	8	8
Notes:	A	C			D
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]Low outgasing. [C]Lead exit opposite flange end. [D]26V 2000 Hz available.					

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP015
PANCAKE RESOLVERS



BARE RESOLVER

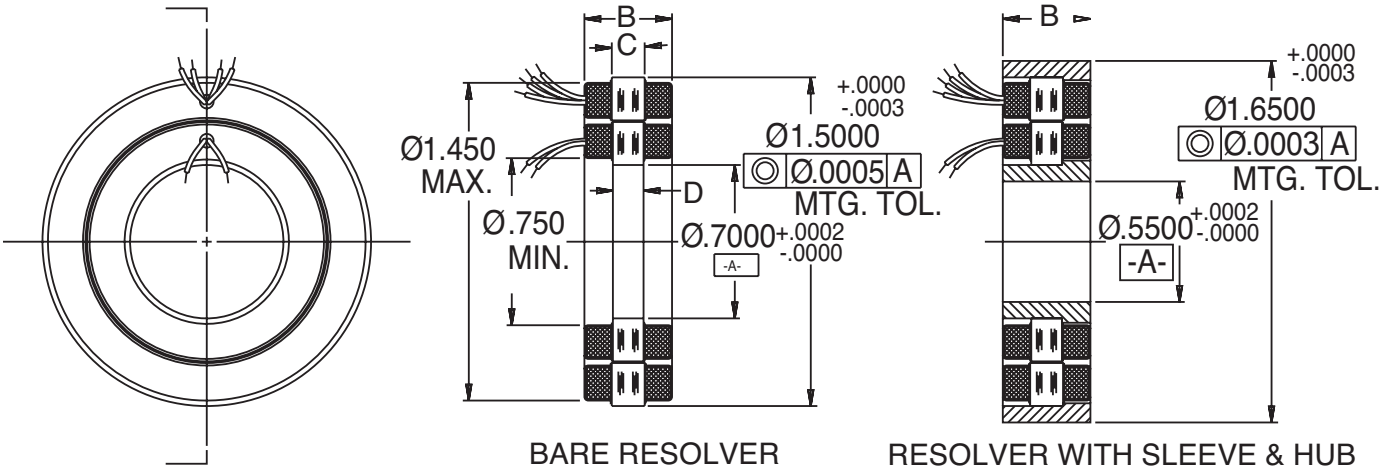
RESOLVER WITH SLEEVE & HUB

RP015-	040BBFA-G1V	080BBFA-C6V	080BBFA-D4V	080BBFA-E0V	080SMFA-B6V	080SMFA-D0V
Bare	✔	✔	✔	✔		
Sleeve and Hub					✔	✔
B (overall height) (in.)	0.370	0.370	0.370	0.370	0.400	0.400
C (stator) (in.)	0.150	0.150	0.150	0.150	-	-
D (rotor) (in.)	0.140	0.140	0.140	0.140	-	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0003	0.0003
Speed (no. of pole pairs)	4	8	8	8	8	8
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	5	1	1	1	1	1
Frequency (Hz)	2000	2000	2000	2000	2000	2000
Input Current (ma) Max.	17	6	6	6	6	6
Input Power (watts) Max.	0.03	0.005	0.005	0.005	0.005	0.005
Phase Shift (deg.) nom.	23	38	38	38	38	38
Transformation Ratio	0.500	0.500	0.500	0.500	0.500	0.500
Accuracy	1’	15”	20”	30”	10”	20”
Optional Accuracy Avail.						
Angular Range (deg.)	±90	±10	±20	360	±10	360
Weight (oz.)	1.0	0.9	0.9	0.9	1.8	1.8
Inertia (x10^{-3} oz-in-sec^2)	0.22	0.20	0.20	0.20	0.27	0.27
Schematic No.	4	4	4	4	4	4
Notes:	A	A	A	A	A	

Characteristics at 25°C [A]Sleeve and hub available on special order.

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP015
PANCAKE RESOLVERS



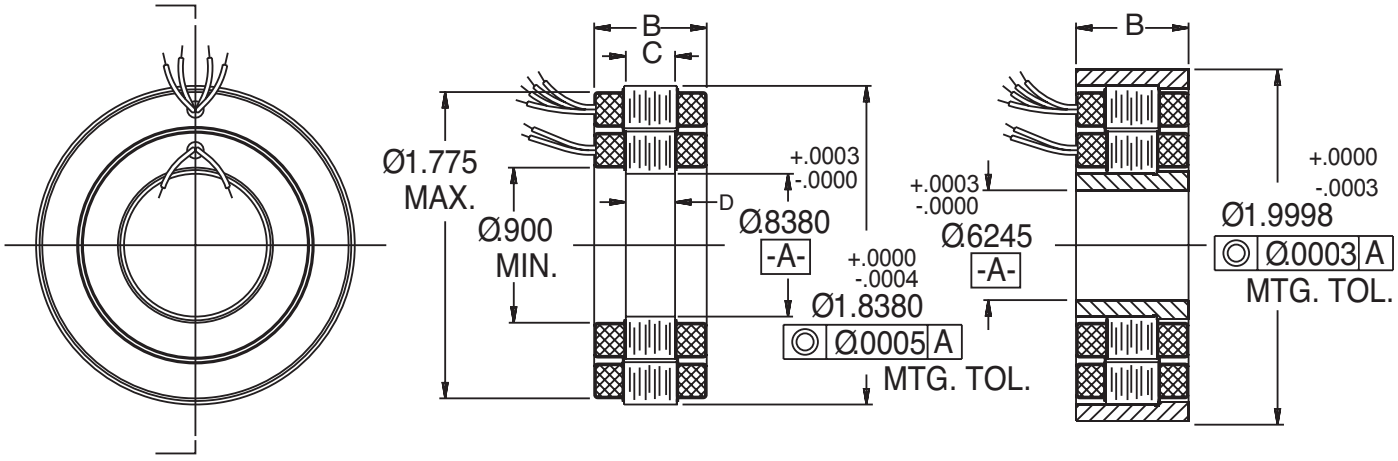
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP015-	080SMFA-D3V	081BBFA-G0V	160BBFA-C7V	161BBFB-C7V	161BBFB-E0V
Bare		✔	✔	✔	✔
Sleeve and Hub	✔				
B (overall height) (in.)	0.400	0.370	0.370	0.370	0.370
C (stator) (in.)	-	0.150	0.150	0.150	0.150
D (rotor) (in.)	-	0.140	0.140	0.140	0.140
Mounting Concentricity (in)	0.0003	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	8	1/8	16	1/16	1/16
Function	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R
Input (VRMS)	1	5	5	5	5
Frequency (Hz)	2000	5000	5000	5000	5000
Input Current (ma) Max.	6	50	50	50	50
Input Power (watts) Max.	0.005	0.30	0.25	0.30	0.30
Phase Shift (deg.) nom.	38	5/24	34	5/28	5/28
Transformation Ratio	.500	.200/.200	.200	.200/.200	.200/.200
Accuracy	20”	15’/60”	15”	15’/15”	15’/30”
Optional Accuracy Avail.					
Angular Range (deg.)	±30	360	±5	±5	360
Weight (oz.)	1.8	1.0	0.95	1.0	1.0
Inertia ($x10^{-3}$ oz-in-sec^2)	0.27	0.25	0.20	0.25	0.25
Schematic No.	4	5	4	5	5
Notes:		A	A	A	A
Characteristics at 25°C [A]Sleeve and hub available on special order.					

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP019
PANCAKE RESOLVERS



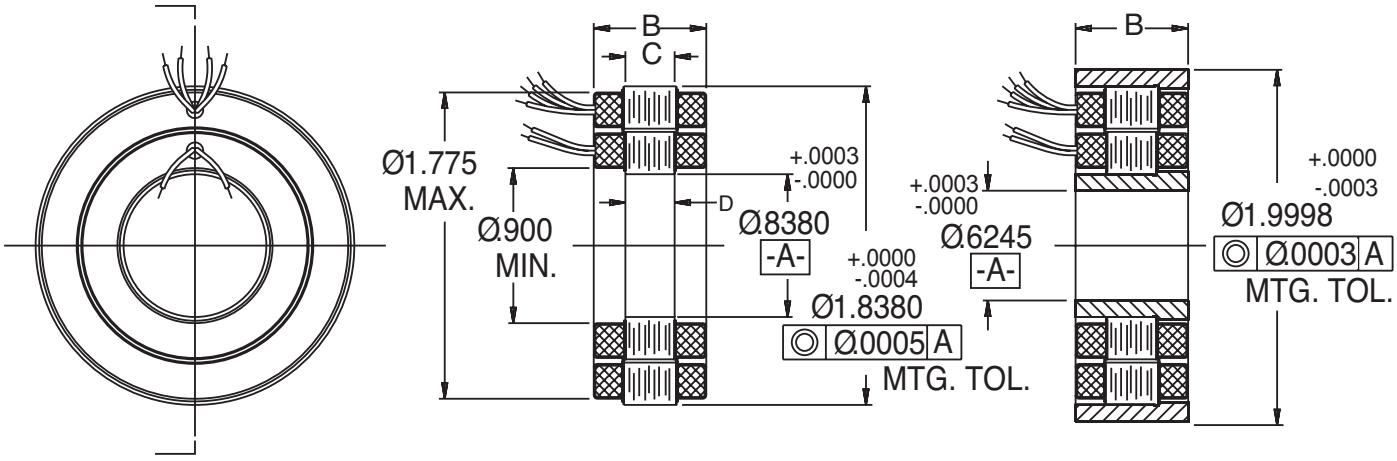
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP019-	010BBFA-H2V	010BBFA-K0V	010BBFA-L0V	010SMFA-L0V	010SMFB-B7V	010SMFB-K0V
Bare	✔	✔	✔			
Sleeve and Hub				✔	✔	✔
B (overall height) (in.)	0.460	0.460	0.460	0.650	0.650	0.650
C (stator) (in.)	0.150	0.150	0.150	-	-	-
D (rotor) (in.)	0.140	0.140	0.140	-	-	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0003	0.0003	0.0003
Speed (no. of pole pairs)	1	1	1	1	1	1
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	400	400	400	400	400	400
Input Current (ma) Max.	22	22	22	22	65	65
Input Power (watts) Max.	0.3	0.3	0.3	0.3	0.7	0.7
Phase Shift (deg.) nom.	16	16	16	16	12	12
Transformation Ratio	0.454	0.454	0.454	0.454	0.454	0.454
Accuracy	2’	3’	6’	6’	10”	3’
Optional Accuracy Avail.						
Angular Range (deg.)	±45	360	360	360	±5	360
Weight (oz.)	1.9	1.9	1.9	5.2	5.2	5.2
Inertia ($x10^{-3}$ oz-in-sec^2)	0.53	0.53	0.53	0.8	1.2	1.2
Schematic No.	1	1	1	1	1	1
Notes:	A,B	A,B	A,B	B	B	B
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]26V 2000 Hz available.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP019
PANCAKE RESOLVERS

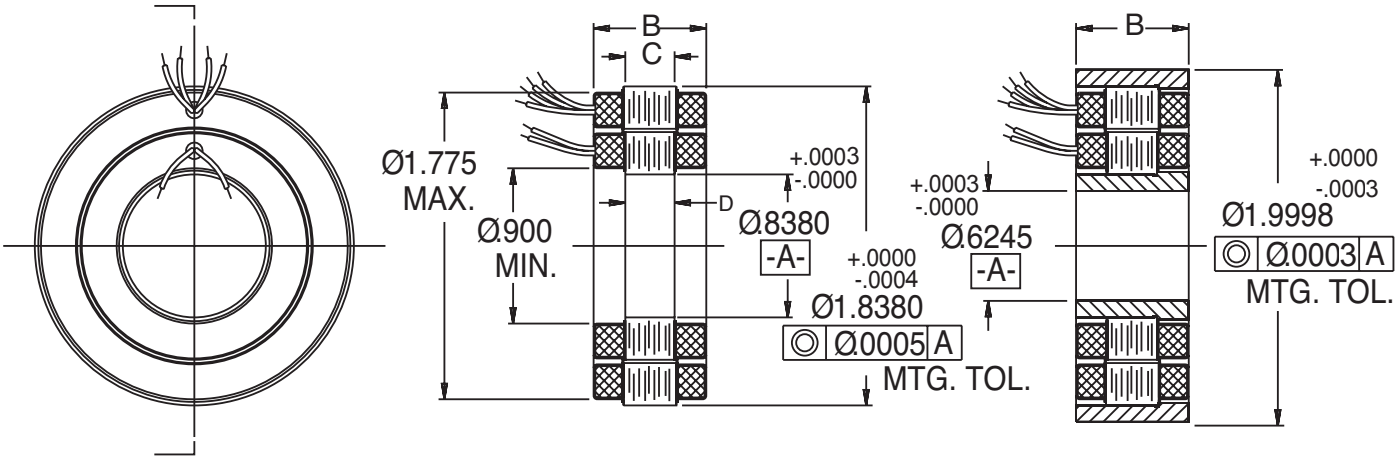


BARE RESOLVER RESOLVER WITH SLEEVE & HUB

RP019-	040BBFA-H2V	040BBFA-K0V	040FMFA-G2V	040SMFA-H2V	080BBFA-C4V	080BBFA-D0V
Bare	✔	✔			✔	✔
Sleeve and Hub			✔	✔		
B (overall height) (in.)	0.460	0.460	0.650	0.650	0.600	0.600
C (stator) (in.)	0.150	0.150	-	-	0.290	0.290
D (rotor) (in.)	0.140	0.140	-	-	0.270	0.270
Mounting Concentricity (in)	0.0005	0.0005	0.0003	0.0003	0.0005	0.0005
Speed (no. of pole pairs)	4	4	4	4	8	8
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	400	400	400	400	400	400
Input Current (ma) Max.	80	80	120	120	70	70
Input Power (watts) Max.	1.2	1.2	1.4	1.4	1.5	1.5
Phase Shift (deg.) nom.	33	33	23	20	52	52
Transformation Ratio	0.454	0.454	0.454	0.454	0.454	0.454
Accuracy	2’	3’	1’	2’	15”	20”
Optional Accuracy Avail.						
Angular Range (deg.)	±45	360	±45	±45	±20	360
Weight (oz.)	1.9	1.9	5.9	5.2	2.9	2.9
Inertia ($x10^{-3}$ oz-in-sec^2)	0.53	0.53	1.0	1.0	0.67	0.67
Schematic No.	4	4	4	4	4	4
Notes:	A,B	A,B	B	B	A,B	A,B
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]26V 2000 Hz available.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP019
PANCAKE RESOLVERS



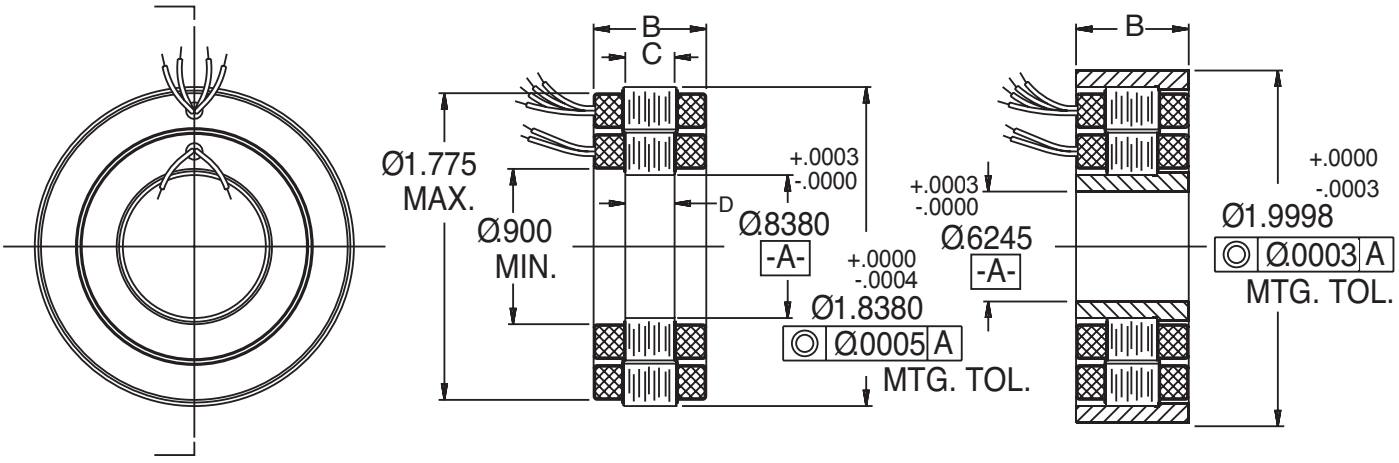
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP019-	080FMFA-B4V	080FMFA-G4V	080SMFA-B4V	080SMFA-C0V	081FMFA-D1V	160SMFC-C6V
Bare						
Sleeve and Hub	✔	✔	✔	✔	✔	✔
B (overall height) (in.)	0.650	0.650	0.650	0.650	0.650	0.650
C (stator) (in.)	-	-	-	-	-	-
D (rotor) (in.)	-	-	-	-	-	-
Mounting Concentricity (in)	0.0003	0.0003	0.0003	0.0003	0.0005	0.0003
Speed (no. of pole pairs)	8	8	8	8	1/8	16
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	10	26
Frequency (Hz)	400	400	400	400	2000	2000
Input Current (ma) Max.	70	70	70	70	60	70
Input Power (watts) Max.	1.5	1.5	1.5	1.5	0.350	0.50
Phase Shift (deg.) nom.	52	52	52	52	8/21	25
Transformation Ratio	0.454	0.454	0.454	0.454	.200/.200	.200
Accuracy	10"	1'	10"	15"	30'/20"	15"
Optional Accuracy Avail.						
Angular Range (deg.)	±20	±20	±20	360	±90	±10
Weight (oz.)	6.2	6.2	5.1	5.1	6.3	5
Inertia ($x10^{-3}$ oz-in-sec^2)	1.0	1.0	0.96	.96	1.0	0.95
Schematic No.	4	4	4	4	5	4
Notes:	B	B	B	B		
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]26V 2000 Hz available.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP019
PANCAKE RESOLVERS



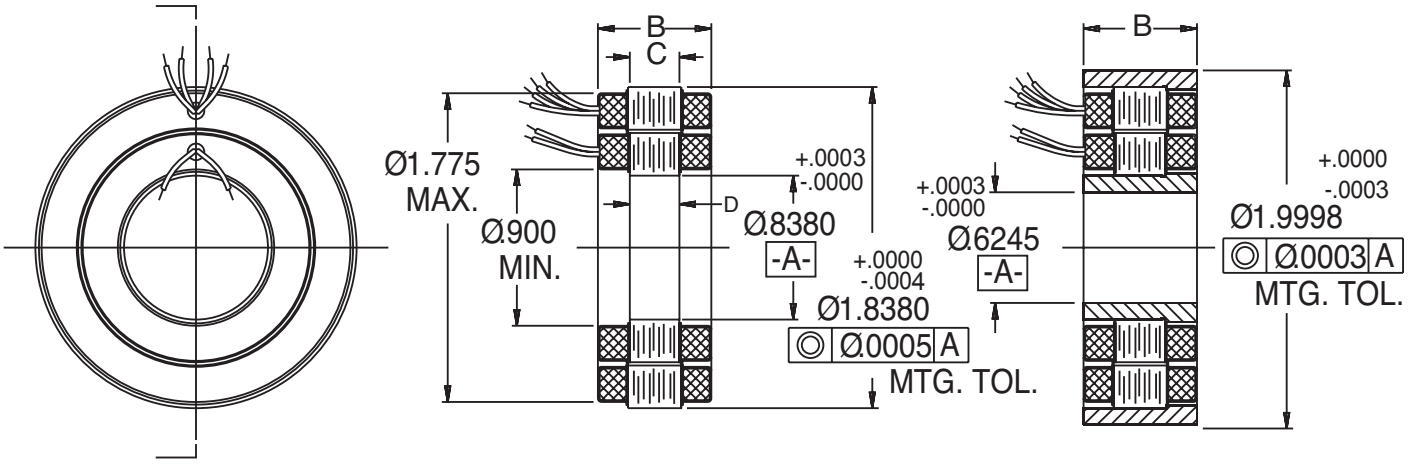
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP019-	161BBFA-C7V	161BBFA-E0V	161FMFA-D1V	161SMFA-C7V	161SMFA-D0V	161SMFA-E0V
Bare	✔	✔				
Sleeve and Hub			✔	✔	✔	✔
B (overall height) (in.)	0.600	0.600	0.650	0.650	0.650	0.650
C (stator) (in.)	0.290	0.290	-	-	-	-
D (rotor) (in.)	0.270	0.270	-	-	-	-
Mounting Concentricity (in)	0.0005	0.0005	0.0003	0.0003	0.0003	0.0003
Speed (no. of pole pairs)	1/16	1/16	1/16	1/16	1/16	1/16
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	400	400	400	400	400	400
Input Current (ma) Max.	120	120	120	120	120	120
Input Power (watts) Max.	3.0	3.0	3.0	3.0	3.0	3.0
Phase Shift (deg.) nom.	24/64	24/64	24/64	24/64	24/64	24/64
Transformation Ratio	.250/.200	.250/.200	.250/.200	.250/.200	.250/.200	.250/.200
Accuracy	15'/15"	15'/30"	15'/20"	15'/15"	15'/20"	15'/30"
Optional Accuracy Avail.						15'/25"
Angular Range (deg.)	±5	360	±90	±5	360	360
Weight (oz.)	3.1	3.1	6.5	5.4	5.4	5.4
Inertia ($x10^{-3}$ oz-in-sec^2)	0.77	0.77	1.15	1.05	1.05	1.05
Schematic No.	5	5	5	5	5	5
Notes:	A,B	A,B	B	B	B	B
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]26V 2000 Hz available.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP019
PANCAKE RESOLVERS



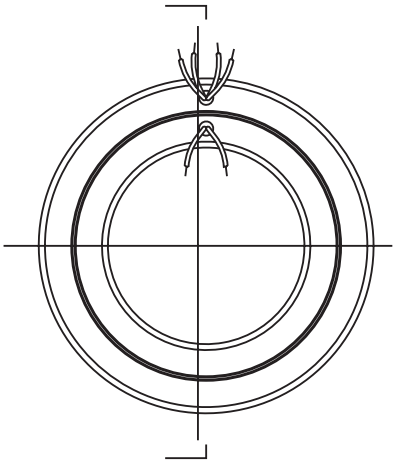
BARE RESOLVER RESOLVER WITH SLEEVE & HUB

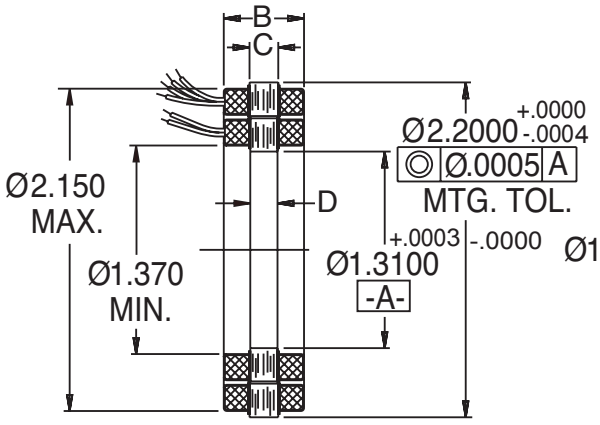
RP019-	161SMFB-C6V	161SMFB-D0V	162SMFD-C7V	162SMFD-E2V
Bare				
Sleeve and Hub	✔	✔	✔	✔
B (overall height) (in.)	0.650	0.650	0.650	0.650
C (stator) (in.)	-	-	-	-
D (rotor) (in.)	-	-	-	-
Mounting Concentricity (in)	0.0003	0.0003	0.0003	0.0003
Speed (no. of pole pairs)	1/16	1/16	2/16	2/16
Function	RX	RX	RX	RX
Primary Winding	R	R	R	R
Input (VRMS)	8.5	8.5	26	26
Frequency (Hz)	2000	2000	400	400
Input Current (ma) Max.	80	80	150	150
Input Power (watts) Max.	0.4	0.4	4.0	4.0
Phase Shift (deg.) nom.	4/30	4/30	30/70	30/70
Transformation Ratio	.200/.200	.200/.200	.250/.200	.250/.200
Accuracy	15'/15"	15'/20"	10'/15"	15'/30"
Optional Accuracy Avail.				
Angular Range (deg.)	±10	360	±5	±45
Weight (oz.)	5.4	5.4	5.1	5.1
Inertia ($x10^{-3}$ oz-in-sec^2)	1.0	1.0	.96	.96
Schematic No.	5	5	5[c]	5[c]
Notes:			B,D	B,D

Characteristics at 25°C [A]Sleeve and hub available on special order. [B]26V 2000 Hz available.
[D]Refer to drawing for proper 2X-16X schematic & equations.

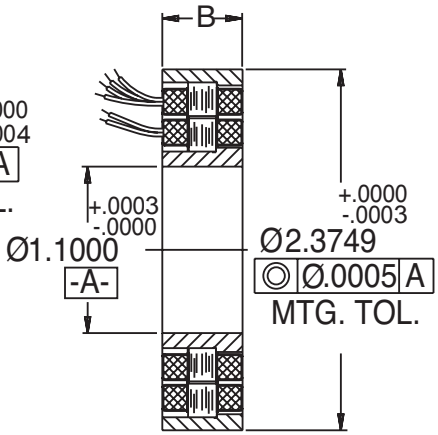
Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP022
PANCAKE RESOLVERS





BARE RESOLVER

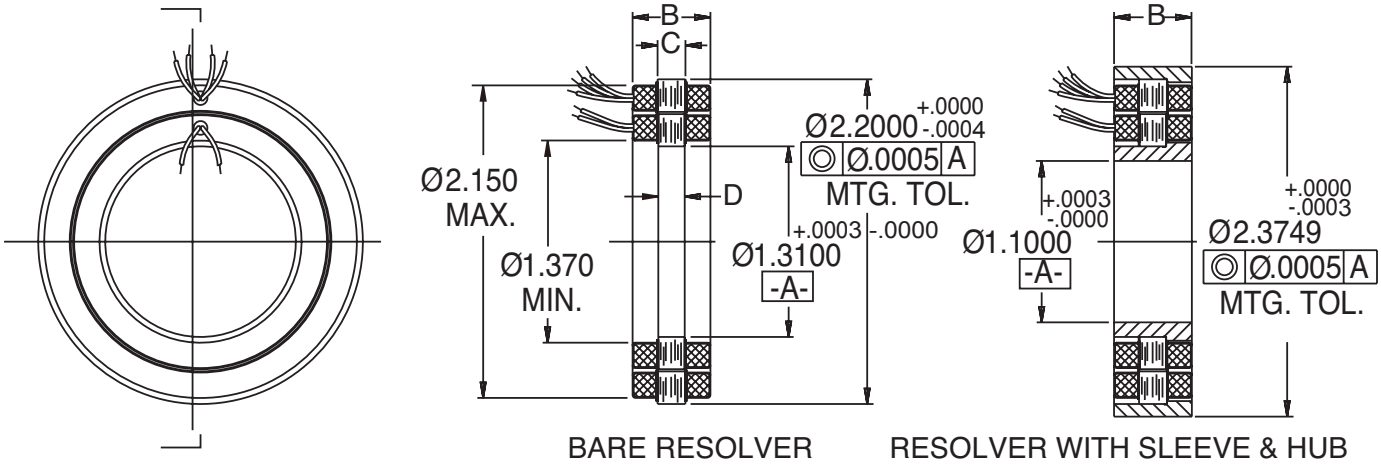


RESOLVER WITH SLEEVE & HUB

RP022-	010BBFA-K2V	010BBFA-L0V	010BBFB-LOV	010SMFA-H2V	010SMFA-LOV	020BBFA-H1V
Bare	✔	✔	✔			✔
Sleeve and Hub				✔	✔	
B (overall height) (in.)	0.500	0.500	0.500	0.530	0.530	0.500
C (stator) (in.)	0.190	0.190	0.190	-	-	0.190
D (rotor) (in.)	0.180	0.180	0.180	-	-	0.180
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1	1	1	1	1	2
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	2	26	26	26
Frequency (Hz)	400	400	800	400	400	400
Input Current (ma) Max.	25	25	25	25	25	60
Input Power (watts) Max.	0.25	0.25	0.012	0.25	0.25	0.65
Phase Shift (deg.) nom.	20	20	8	20	20	22
Transformation Ratio	.454	.454	1.00	.454	.454	.454
Accuracy	3’	6’	6’	2’	6’	2’
Optional Accuracy Avail.						
Angular Range (deg.)	±45	360	360	±45	360	±90
Weight (oz.)	2.8	2.8	2.8	5.2	5.2	2.8
Inertia ($x10^{-3}$ oz-in-sec^2)	3.00	3.00	3.00	4.00	4.00	3.00
Schematic No.	1	1	1	1	1	4
Notes:	A	A	A			A
Characteristics at 25°C [A]Sleeve and hub available on special order.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP022
PANCAKE RESOLVERS



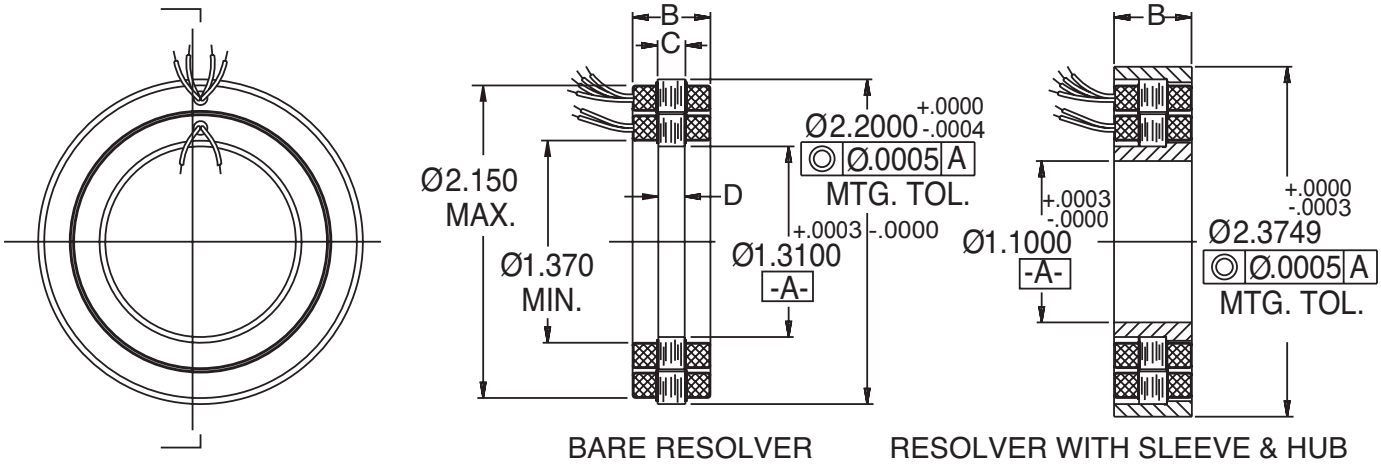
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP022-	020BBFA-K0V	020BBFC-H1V1	020BBFD-H7V1	020SMFA-G1V	020SMFA-H0V	020SMFB-F1V
Bare	✔	✔	✔			
Sleeve and Hub				✔	✔	✔
B (overall height) (in.)	0.500	0.500	0.500	0.530	0.530	0.530
C (stator) (in.)	0.190	0.190	0.190	-	-	-
D (rotor) (in.)	0.180	0.180	0.180	-	-	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	2	2	2	2	2	2
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	S	R	R	R	R
Input (VRMS)	26	7	7	26	26	1
Frequency (Hz)	400	400	400	400	400	2000
Input Current (ma) Max.	60	30	35	60	60	10
Input Power (watts) Max.	0.65	0.20	0.15	0.65	0.65	0.004
Phase Shift (deg.) nom.	22	35	26	22	22	2
Transformation Ratio	.454	1.00	1.00	0.454	0.454	0.500
Accuracy	3’	2’	2’	1’	2’	40”
Optional Accuracy Avail.						
Angular Range (deg.)	±360	-95/+75	±5	±90	360	±90
Weight (oz.)	2.8	2.8	2.8	5.2	5.2	5.2
Inertia ($x10^{-3}$ oz-in-sec^2)	3.00	3.00	3.00	4.00	4.00	4.00
Schematic No.	4	8	4	4	4	4
Notes:	A		A			
Characteristics at 25°C [A]Sleeve and hub available on special order.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP022
PANCAKE RESOLVERS



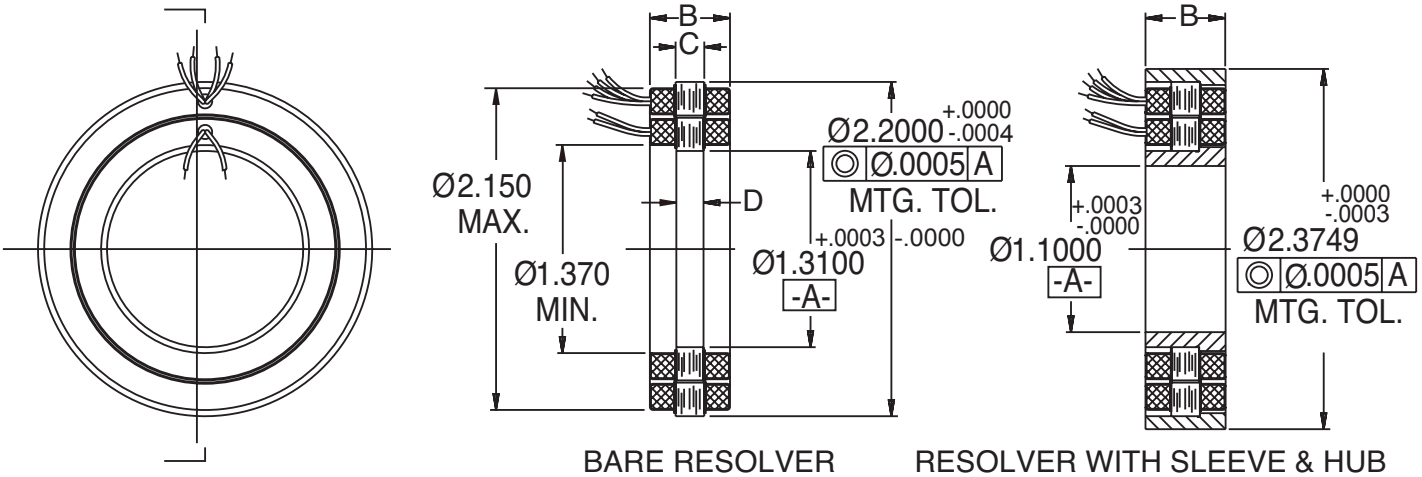
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP022-	080BBFA-D4V	080BBFB-D5V1	080SMFA-C4V	081BBFA-D2V1	160BBFA-D5V	160SMFA-C7V
Bare	✔	✔		✔	✔	
Sleeve and Hub			✔			✔
B (overall height) (in.)	0.530	0.530	0.530	0.530	0.500	0.530
C (stator) (in.)	0.218	0.218	-	0.218	0.190	-
D (rotor) (in.)	0.204	0.204	-	0.204	0.180	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	8	8	8	1/8	16	16
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	7.07	26	7.07	26	26
Frequency (Hz)	400	400	400	400	400	400
Input Current (ma) Max.	50	55	50	85	70	70
Input Power (watts) Max.	0.63	0.30	0.63	0.50	1.5	1.5
Phase Shift (deg.) nom.	33	33	33	30/45	54	54
Transformation Ratio	0.454	1.00	0.454	1.00/1.00	0.454	0.454
Accuracy	20”	20”	15”	15’/20”	20”	15”
Optional Accuracy Avail.						
Angular Range (deg.)	±20	±15	±20	-15/+50	±15	±5
Weight (oz.)	2.8	2.8	5.2	2.8	2.8	5.2
Inertia ($x10^{-3}$ oz-in-sec^2)	3.00	3.00	4.00	3.00	3.00	4.00
Schematic No.	4	4	4	5	4	4
Notes:	A	A		A	A	
Characteristics at 25°C [A]Sleeve and hub available on special order.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP022
PANCAKE RESOLVERS



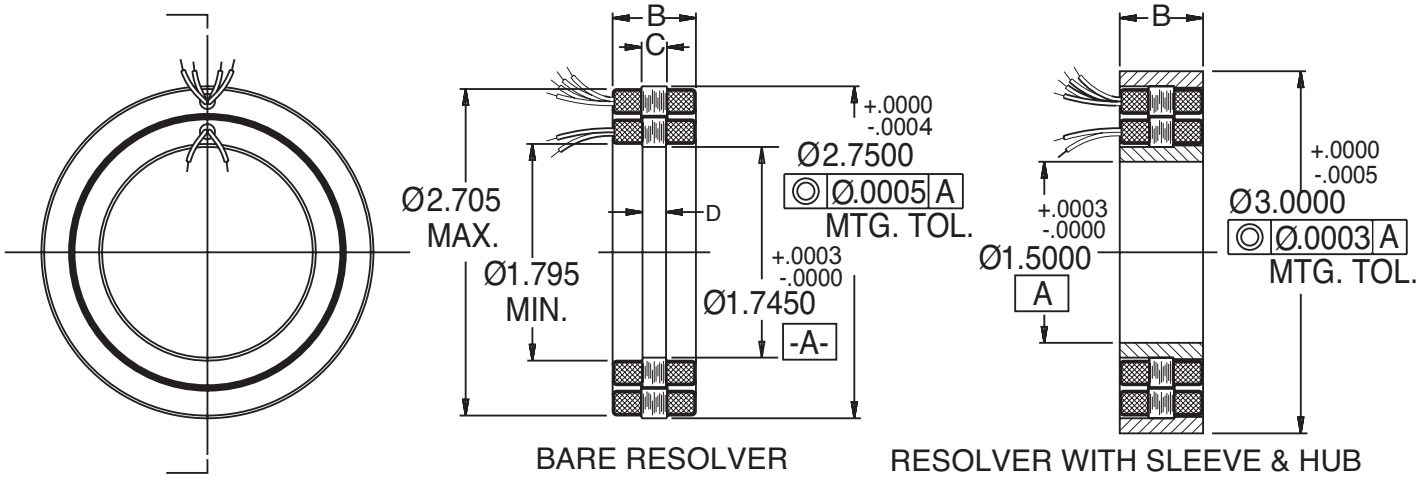
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP022-	160SMFA-D5V	161SMFA-D0V
Bare		
Sleeve and Hub	✔	✔
B (overall height) (in.)	0.530	0.530
C (stator) (in.)	-	-
D (rotor) (in.)	-	-
Mounting Concentricity (in)	0.0005	0.005
Speed (no. of pole pairs)	16	1/16
Function	RX	RX
Primary Winding	R	R
Input (VRMS)	26	26
Frequency (Hz)	400	2000
Input Current (ma) Max.	70	50
Input Power (watts) Max.	1.5	0.65
Phase Shift (deg.) nom.	54	4/22
Transformation Ratio	0.454	.200/.200
Accuracy	20”	15’/20”
Optional Accuracy Avail.		
Angular Range (deg.)	±15	360
Weight (oz.)	5.2	5.2
Inertia ($x10^{-3}$ oz-in-sec^2)	4.0	4.0
Schematic No.	4	5
Notes:		
Characteristics at 25°C		

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

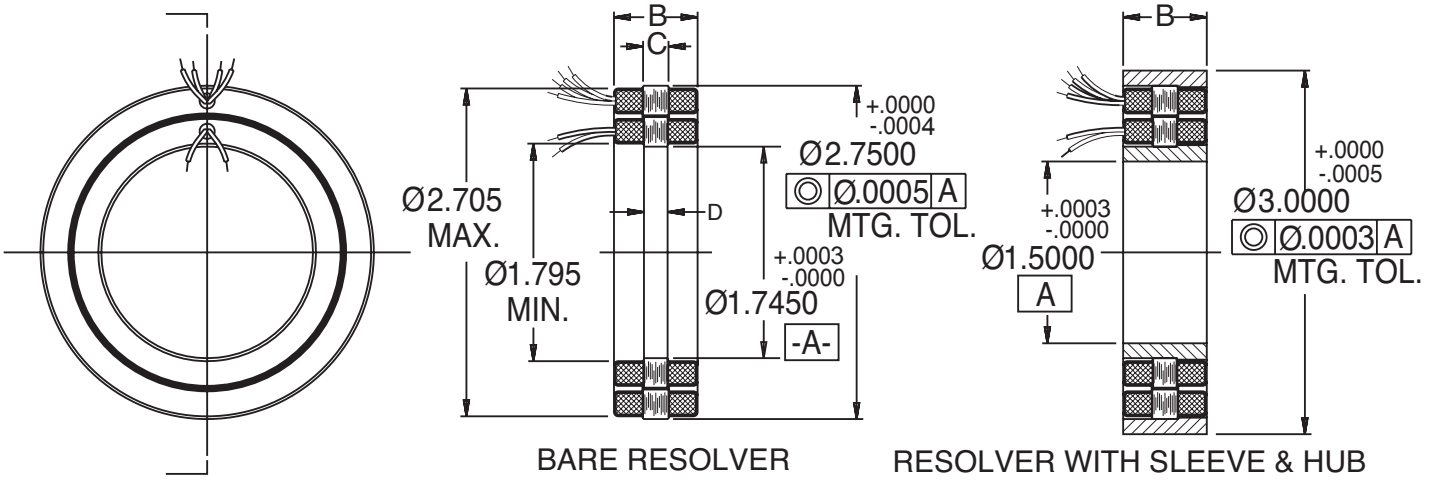
RP028
PANCAKE RESOLVERS



RP028-	010BBFA-G0V	010BBFA-G0V1	010BBFA-L0V	010BBFA-L0V1	010BBFD-L0V	010SMFA-K0V
Bare	✔	✔	✔	✔	✔	
Sleeve and Hub						✔
B (overall height) (in.)	0.600	0.600	0.600	0.600	0.600	0.690
C (stator) (in.)	0.210	0.210	0.210	0.210	0.210	-
D (rotor) (in.)	0.195	0.195	0.195	0.195	0.195	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0003
Speed (no. of pole pairs)	1	1	1	1	1	1
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	1	26	26	26	26
Frequency (Hz)	400	400	400	400	400	400
Input Current (ma) Max.	20	0.5	20	20	20	20
Input Power (watts) Max.	0.30	0.040	0.30	0.30	0.30	0.30
Phase Shift (deg.) nom.	13	10	13	13	13	13
Transformation Ratio	0.454	1.00	0.454	0.454	1.00	0.454
Accuracy	1’	90”	6’	6’	6’	3’
Optional Accuracy Avail.			3’	3’	3’	
Angular Range (deg.)	360	360	360	360	360	360
Weight (oz.)	4.3	4.3	4.3	4.3	4.3	11.2
Inertia ($x10^{-3}$ oz-in-sec^2)	8.5	8.5	8.5	8.5	8.5	16
Schematic No.	1	1	1	1	1	1
Notes:	A	A	A	A,B	A	
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]Rotor & Stator lead wires exit opposite sides.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

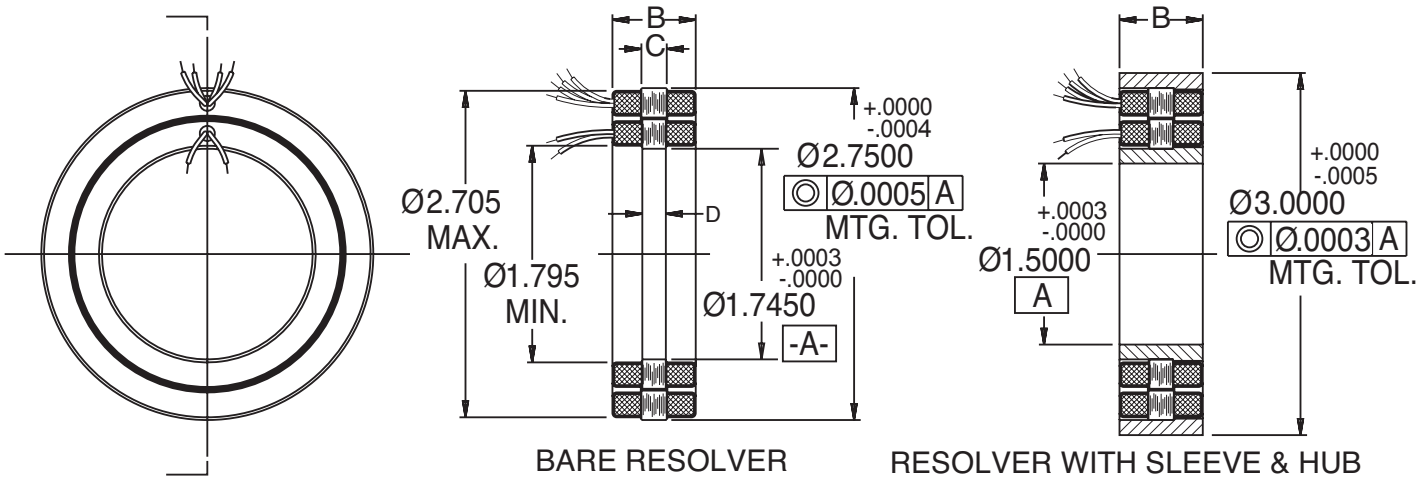
RP028
PANCAKE RESOLVERS



RP028-	010SMFA-L0V	010SMFB-GOV1	020BBFA-H1V	020BBFA-K0V	020SMFA-G1V	020SMFA-H1V
Bare			✔	✔		
Sleeve and Hub	✔	✔			✔	✔
B (overall height) (in.)	0.690	0.690	0.600	0.600	0.690	0.690
C (stator) (in.)	-	-	0.210	0.210	-	-
D (rotor) (in.)	-	-	0.195	0.195	-	-
Mounting Concentricity (in)	0.0003	0.0003	0.0005	0.0005	0.0003	0.0003
Speed (no. of pole pairs)	1	1	2	2	2	2
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	S	R	R	R	R
Input (VRMS)	26	7	26	26	26	26
Frequency (Hz)	400	400	400	400	400	400
Input Current (ma) Max.	20	10	15	15	15	15
Input Power (watts) Max.	0.30	0.110	0.20	0.20	0.20	0.20
Phase Shift (deg.) nom.	13	15	18	18	18	18
Transformation Ratio	0.454	1.00	0.454	0.454	0.454	0.454
Accuracy	6’	1’	2’	3’	1’	2’
Optional Accuracy Avail.						
Angular Range (deg.)	360	±142	±90	360	±90	±90
Weight (oz.)	11.2	11.2	4.3	4.3	11.2	11.2
Inertia ($x10^{-3}$ oz-in-sec^2)	16	16	8.5	8.5	16	16
Schematic No.	1	3	4	4	4	4
Notes:			A	A		
Characteristics at 25°C [A]Sleeve and hub available on special order.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

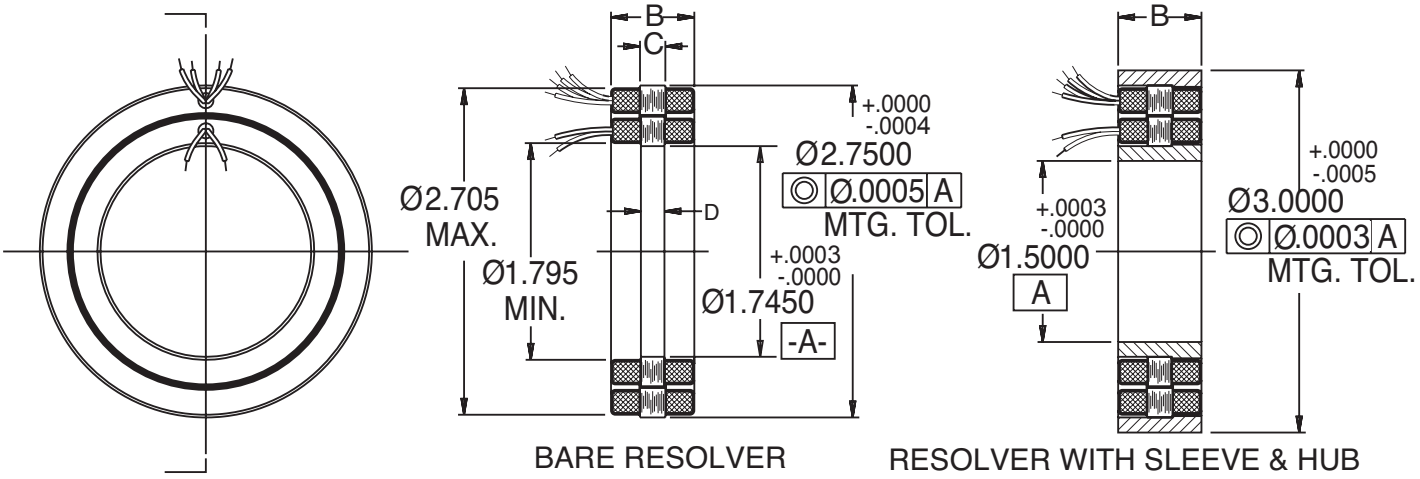
RP028
PANCAKE RESOLVERS



RP028-	020SMFA-K0V	080BBFA-C4V	080BBFA-D0V	080SMFA-B4V	080SMFA-COV	080SNFA-B4V
Bare		✔	✔			
Sleeve and Hub	✔			✔	✔	✔
B (overall height) (in.)	0.690	0.680	0.680	0.690	0.690	0.690
C (stator) (in.)	-	0.260	0.260	-	-	-
D (rotor) (in.)	-	0.250	0.250	-	-	-
Mounting Concentricity (in)	0.0003	0.0005	0.0005	0.0003	0.0003	0.0003
Speed (no. of pole pairs)	2	8	8	8	8	8
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	400	2000	2000	2000	2000	2000
Input Current (ma) Max.	15	70	70	70	70	70
Input Power (watts) Max.	0.20	0.50	0.50	0.50	0.50	0.50
Phase Shift (deg.) nom.	18	11	11	10	10	10
Transformation Ratio	0.454	0.454	0.454	0.454	0.454	0.454
Accuracy	3’	15”	20”	10”	15”	10”
Optional Accuracy Avail.						
Angular Range (deg.)	360	±20	360	±20	360	±20
Weight (oz.)	11.2	4.3	4.3	11.2	11.2	11.2
Inertia ($x10^{-3}$ oz-in-sec^2)	16	8.5	8.5	16	16	16
Schematic No.	4	4	4	4	4	4
Notes:		A	A			
Characteristics at 25°C [A]Sleeve and hub available on special order.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

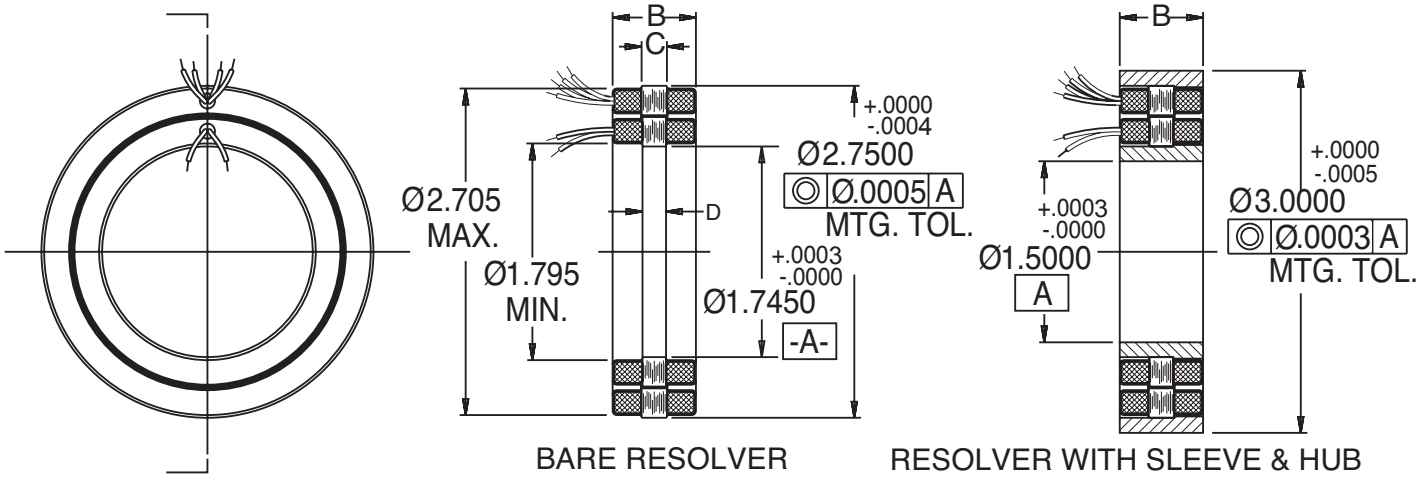
RP028
PANCAKE RESOLVERS



RP028-	160SMFC-C7V	161BBFA-D7V	161BBFA-E0V	161BBFB-D6V	161BBFB-E0V	161SMFB-C7V
Bare		✔	✔	✔	✔	
Sleeve and Hub	✔					✔
B (overall height) (in.)	0.690	0.680	0.680	0.680	0.680	0.690
C (stator) (in.)	-	0.260	0.260	0.260	0.260	-
D (rotor) (in.)	-	0.250	0.250	0.250	0.250	-
Mounting Concentricity (in)	0.0003	0.0005	0.0005	0.0005	0.0005	0.0003
Speed (no. of pole pairs)	61	1/16	1/16	1/16	1/16	61
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	5000	400	400	2000	2000	2000
Input Current (ma) Max.	85	130	130	50	50	50
Input Power (watts) Max.	0.50	3.5	3.5	.65	.65	.65
Phase Shift (deg.) nom.	7	17/60	17/60	2/20	2/20	2/20
Transformation Ratio	1.00	.200/.200	.200/.200	.200/.200	.200/.200	.200/.200
Accuracy	15”	15’/20”	15’/30”	15’/20”	15’/30”	15’/15”
Optional Accuracy Avail.						
Angular Range (deg.)	±5	±5	360	±10	360	±5
Weight (oz.)	11.2	4.3	4.3	4.3	4.3	11.2
Inertia ($x10^{-3}$ oz-in-sec^2)	16	8.5	8.5	8.5	8.5	16
Schematic No.	4	5	5	5	5	5
Notes:		A	A	A	A	
Characteristics at 25°C [A]Sleeve and hub available on special order.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

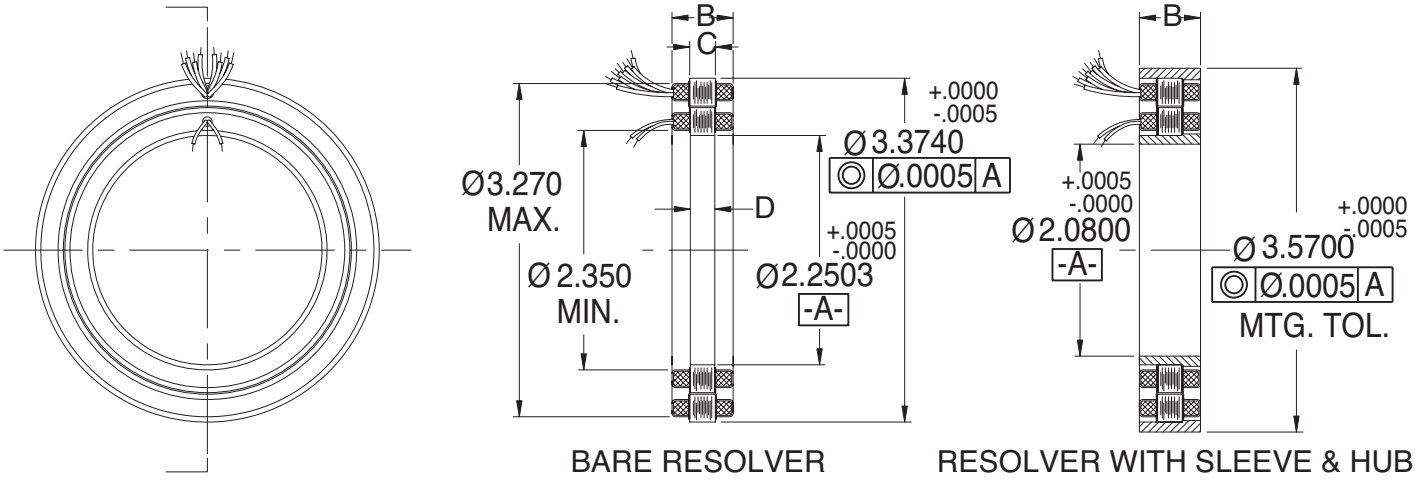
RP028
PANCAKE RESOLVERS



RP028-	161SMFB-D0V	361SMFA-D0V
Bare		
Sleeve and Hub	✔	✔
B (overall height) (in.)	0.690	0.690
C (stator) (in.)	-	-
D (rotor) (in.)	-	-
Mounting Concentricity (in)	0.0003	0.0003
Speed (no. of pole pairs)	1/16	1/36
Function	RX	RX
Primary Winding	R	R
Input (VRMS)	26	26
Frequency (Hz)	2000	2000
Input Current (ma) Max.	50	50
Input Power (watts) Max.	0.65	0.70
Phase Shift (deg.) nom.	2/20	2/20
Transformation Ratio	.200/.200	.200/.200
Accuracy	15'/20"	15'/20"
Optional Accuracy Avail.		
Angular Range (deg.)	360	360
Weight (oz.)	11.2	11.2
Inertia ($x10^{-3}$ oz-in-sec2)	16	16
Schematic No.	5	5
Notes:		
Characteristics at 25°C [A]Sleeve and hub available on special order.		

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP034
PANCAKE RESOLVERS



BARE RESOLVER

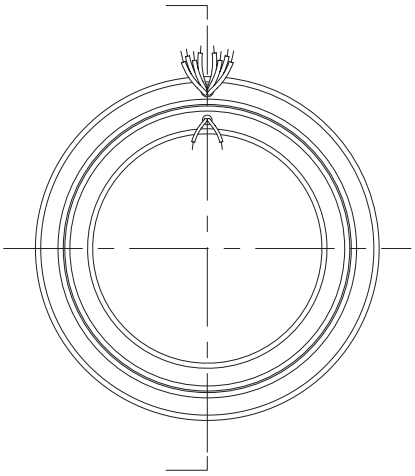
RESOLVER WITH SLEEVE & HUB

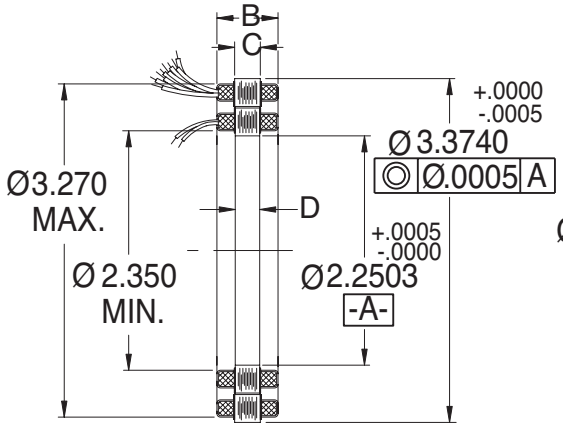
RP034-	010BBFA-H0V1	010BBFA-K0V	010BBFA-L0V	010BBFA-L0V1	010BBFB-L0V	010BBFB-L0V1
Bare	✔	✔	✔	✔	✔	✔
Sleeve and Hub						
B (overall height) (in.)	0.520	0.520	0.520	0.520	0.520	0.520
C (stator) (in.)	0.250	0.250	0.250	0.250	0.250	0.250
D (rotor) (in.)	0.265	0.265	0.265	0.265	0.265	0.265
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1	1	1	1	1	1
Function	RX	RX	RX	RX	RX	RX
Primary Winding	S	S	S	S	R	R
Input (VRMS)	26	26	26	26	2	2
Frequency (Hz)	400	400	400	400	800	2000
Input Current (ma) Max.	20	20	20	20	25	15
Input Power (watts) Max.	0.35	0.35	0.35	0.35	0.022	0.014
Phase Shift (deg.) nom.	16	16	16	16	8	1.3
Transformation Ratio	0.98	0.98	0.98	0.98	1.00	1.03
Accuracy	2’	3’	6’	6’	6’	6’
Optional Accuracy Avail.						
Angular Range (deg.)	360	360	360	360	360	360
Weight (oz.)	5.4	5.4	5.4	5.4	5.4	5.4
Inertia ($x10^{-3}$ oz-in-sec2)	8	8	8	8	8	8
Schematic No.	3	3	3	3	1	1
Notes:	A,B	A	A	A,B	A	A,C

Characteristics at 25°C [A]Sleeve and hub available on special order. [B]Leads exit opposite ends.
[C]RP034-010BBFA-LOV except tested at 2V, 2000 Hz.

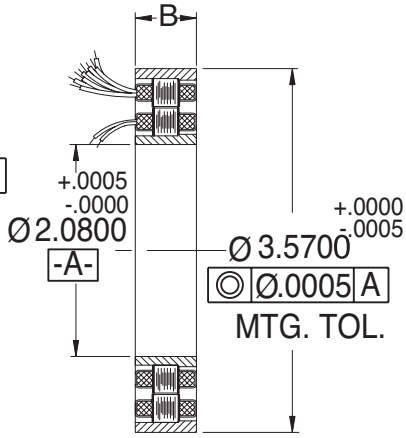
Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP034
PANCAKE RESOLVERS





BARE RESOLVER



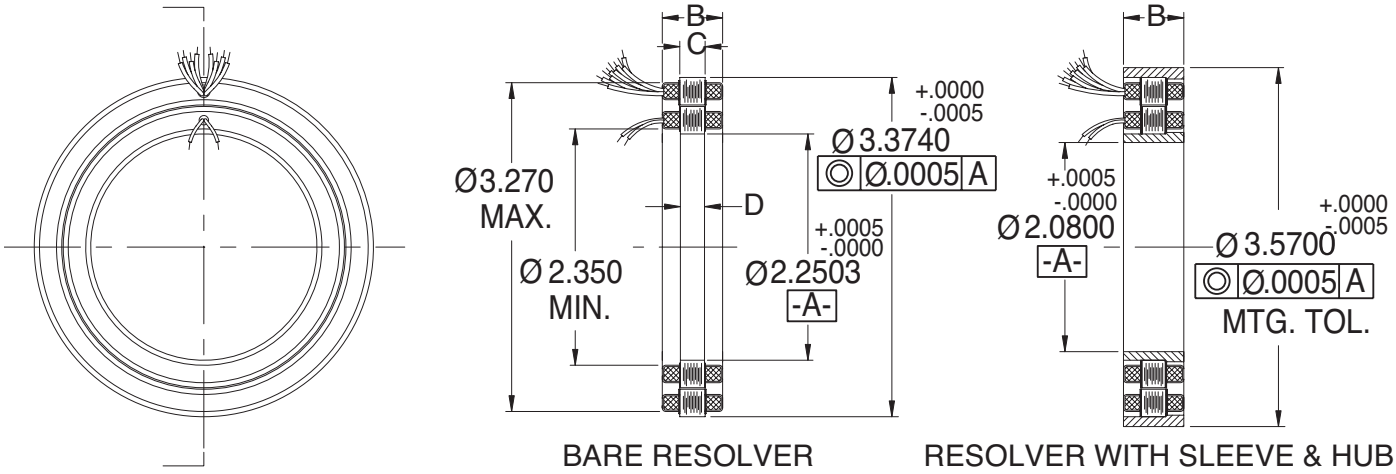
RESOLVER WITH SLEEVE & HUB

RP034-	010BBFC-K0V1	010FMFA-H0V1	080BBFA-C4V	080BBFA-D0V	080SMFA-B4V	080SMFA-C0V
Bare	✔		✔	✔		
Sleeve and Hub		✔			✔	✔
B (overall height) (in.)	0.520	0.520	0.600	0.600	0.600	0.600
C (stator) (in.)	0.250	-	0.242	0.242	-	-
D (rotor) (in.)	0.265	-	0.230	0.230	-	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1	1	8	8	8	8
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	S	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	1000	400	400	400	400	400
Input Current (ma) Max.	25	20	80	80	80	80
Input Power (watts) Max.	0.49	0.35	1.0	1.0	1.0	1.0
Phase Shift (deg.) nom.	5	16	22	22	25	25
Transformation Ratio	0.454	0.98	.454	.454	0.454	0.454
Accuracy	3’	2’	15”	20”	10”	15”
Optional Accuracy Avail.						
Angular Range (deg.)	360	360	±20	360	±20	360
Weight (oz.)	5.4	12.6	5.4	5.4	10	10
Inertia (x10^{-3} oz-in-sec2)	8	14	8	8	12.5	12.5
Schematic No.	1	3	4	4	4	4
Notes:	B	C	A	A		

Characteristics at 25°C [A]Sleeve and hub available on special order. [B]Leads exit opposite ends.
[C]See drawing for flange dimensions.

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP034
PANCAKE RESOLVERS

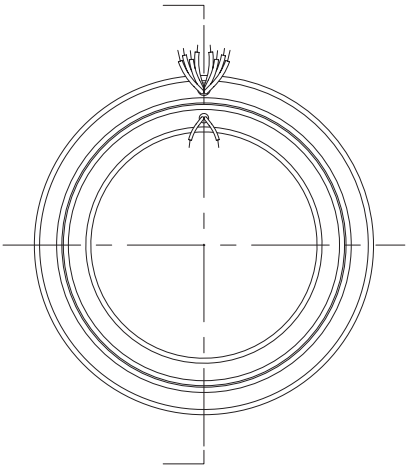


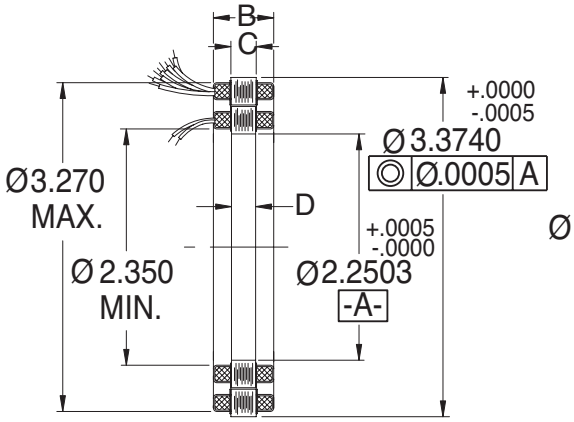
RP034-	160BBFD-C4V	160BBFD-C4V1	160BBFD-D4V1	160SMFC-C7V	161BBFA-D7V	161BBFA-E0V
Bare	✔	✔	✔		✔	✔
Sleeve and Hub				✔		
B (overall height) (in.)	0.600	0.600	0.600	0.600	0.600	0.600
C (stator) (in.)	0.242	0.242	0.242	-	0.242	0.242
D (rotor) (in.)	0.230	0.230	0.230	-	0.230	0.230
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	16	16	16	16	1/16	1/16
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	4.4	4.4	26	26	26
Frequency (Hz)	400	400	2000	2000	400	400
Input Current (ma) Max.	75	75	5	250	75	75
Input Power (watts) Max.	1.3	1.3	0.05	1.5	1.3	1.3
Phase Shift (deg.) nom.	37	37	7.5	12	12/44	12/44
Transformation Ratio	.454	.454	0.570	0.454	.200/.200	.200/.200
Accuracy	15”	15”	20”	15”	15’/20”	15’/30”
Optional Accuracy Avail.						
Angular Range (deg.)	±20	±20	±20	±5	±5	360
Weight (oz.)	6.6	6.6	6.6	10	6.6	6.6
Inertia ($x10^{-3}$ oz-in-sec2)	8	8	8	12.5	8	8
Schematic No.	4	4	4	4	5	5
Notes:	A,B	A,B	A,B		A,B	A,B

Characteristics at 25°C [A]Sleeve and hub available on special order.
[B]Mechanical tolerance applies to average dia. Free state roundness is 0.0015 max.

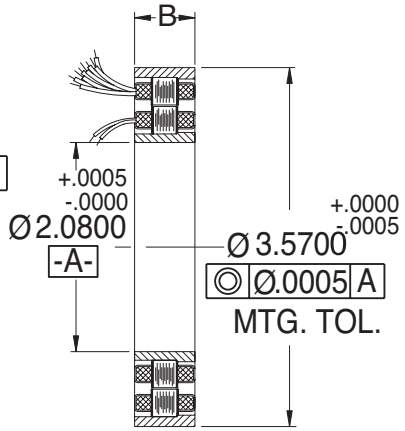
Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP034
PANCAKE RESOLVERS





BARE RESOLVER



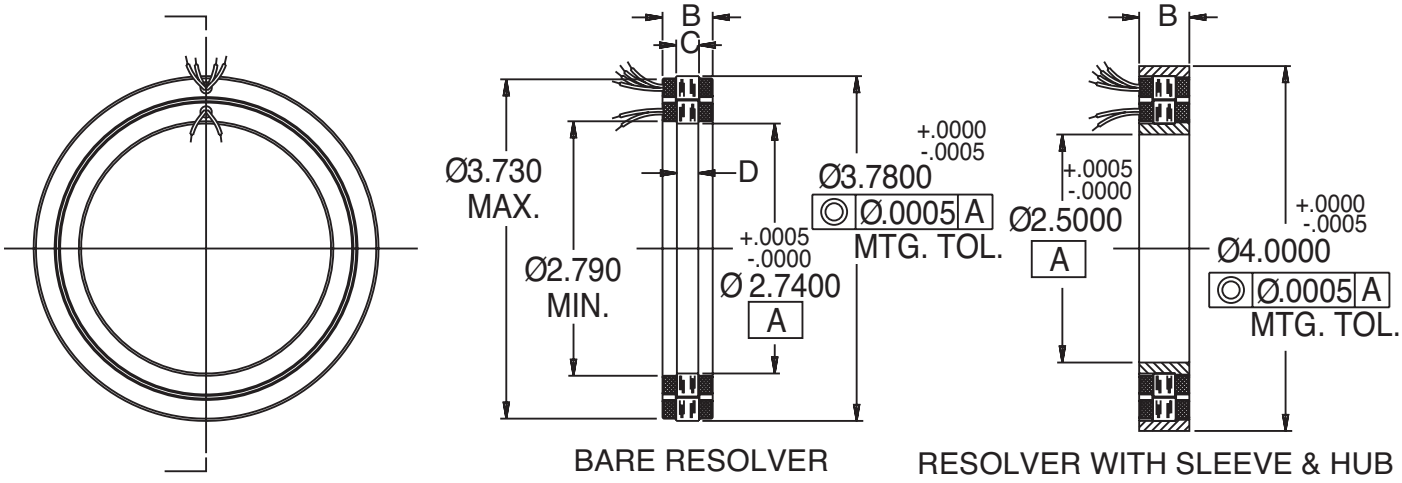
RESOLVER WITH SLEEVE & HUB

RP034-	161BBFB-D7V	161BBFB-E0V	161BBFB-E0V1	161SMFB-C7V	161SMFB-D0V
Bare	✔	✔	✔		
Sleeve and Hub				✔	✔
B (overall height) (in.)	0.600	0.600	0.600	0.600	0.600
C (stator) (in.)	0.242	0.242	0.242	-	-
D (rotor) (in.)	0.230	0.230	0.230	-	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1/16	1/16	1/16	1/16	1/16
Function	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R
Input (VRMS)	26	26	26	26	26
Frequency (Hz)	2000	2000	2000	2000	2000
Input Current (ma) Max.	150	150	150	150	150
Input Power (watts) Max.	1.20	1.20	1.20	1.20	1.20
Phase Shift (deg.) nom.	1/14	1/14	1/14	1/14	1/14
Transformation Ratio	.454/.454	.454/.454	.454/.454	.454/.454	.454/.454
Accuracy	15'/20"	15'/30"	15'/30"	15'/15"	15'/20"
Optional Accuracy Avail.					
Angular Range (deg.)	±5	360	360	±5	360
Weight (oz.)	6.6	6.6	6.6	10	10
Inertia ($x10^{-3}$ oz-in-sec2)	8	8	8	12.5	12.5
Schematic No.	5	5	5	5	5
Notes:	A,B	A,B	A,B,C		

Characteristics at 25°C [A]Sleeve and hub available on special order.
[B]Mechanical tolerance applies to average dia. Free state roundness is 0.0015 max. [C]Uses low outgassing materials.

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems

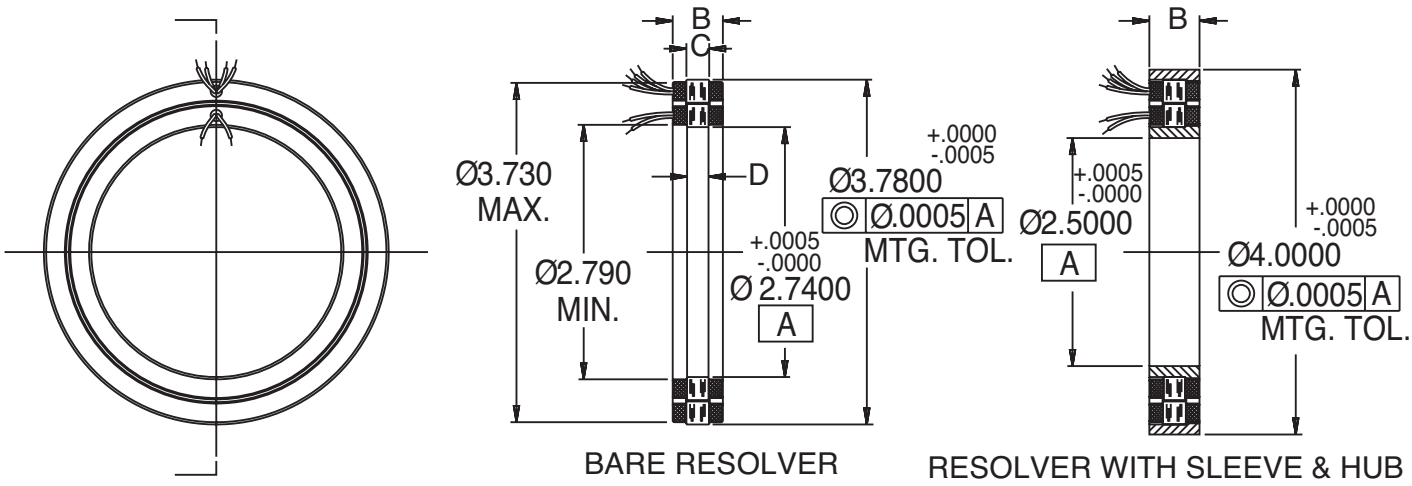
RP038
PANCAKE RESOLVERS



RP038-	010BBFA-K0V	010BBFA-K0V1	010SMFA-H0V	010SMFA-L0V	010SMFC-H0V	040BBFA-G0V
Bare	✔	✔				✔
Sleeve and Hub			✔	✔	✔	
B (overall height) (in.)	0.560	0.560	0.560	0.560	0.560	0.560
C (stator) (in.)	0.250	0.250	-	-	-	0.250
D (rotor) (in.)	0.235	0.235	-	-	-	0.235
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1	1	1	1	1	4
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	400	1000	400	400	2000	400
Input Current (ma) Max.	36	20	36	36	32	75
Input Power (watts) Max.	0.65	0.50	0.65	0.65	0.65	0.75
Phase Shift (deg.) nom.	15	5	15	15	1	17
Transformation Ratio	.454	0.500	.454	0.454	0.454	0.454
Accuracy	3’	3’	2’	6’	2’	1’
Optional Accuracy Avail.						
Angular Range (deg.)	360	360	360	360	360	360
Weight (oz.)	6	6	11.5	11.5	11.5	6
Inertia ($x10^{-3}$ oz-in-sec2)	15.5	15.5	26.5	26.5	26.5	15.5
Schematic No.	1	1	1	1	1	4
Notes:		A,B				
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]Rotor and stator leads on opposite sides.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

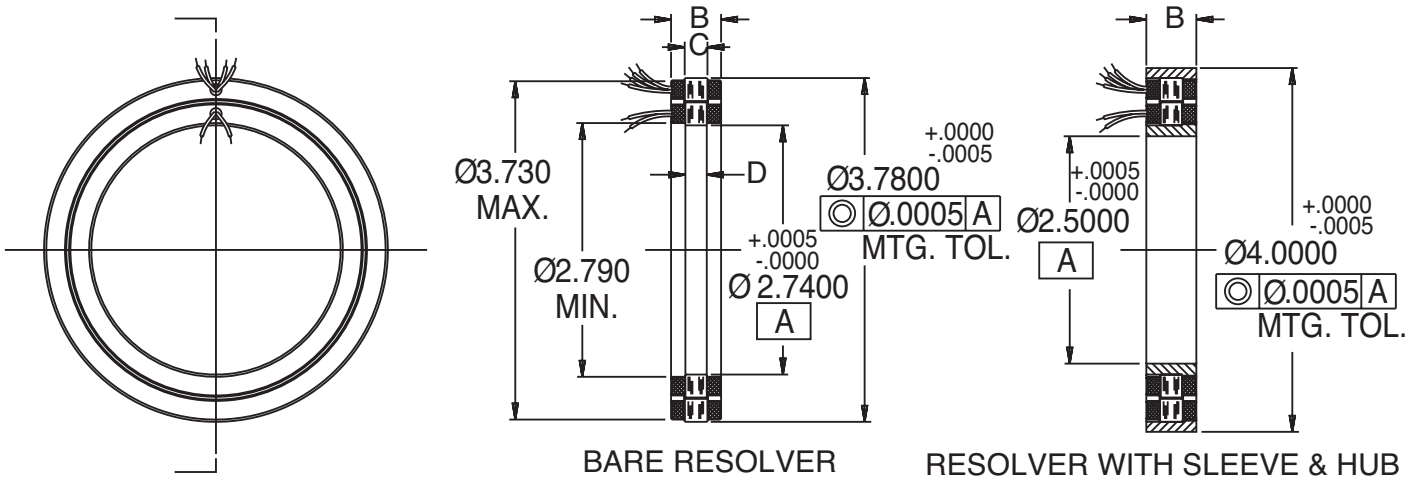
RP038
PANCAKE RESOLVERS



RP038-	040FMFB-F0V1	040SMFA-F0V	040SMFA-D4V	080SMFB-D2V	081SMFA-M0V	081SMFA-E0V
Bare						
Sleeve and Hub	✔	✔	✔	✔	✔	✔
B (overall height) (in.)	0.560	0.560	0.560	0.560	0.560	0.560
C (stator) (in.)	-	-	-	-	-	-
D (rotor) (in.)	-	-	-	-	-	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	4	4	4	8	1/8	1/8
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	2000	400	400	2000	2000	2000
Input Current (ma) Max.	32	75	75	70	130	130
Input Power (watts) Max.	0.65	0.75	0.75	0.35	1.50	1.50
Phase Shift (deg.) nom.	3.3	17	17	7	3/8	3/8
Transformation Ratio	0.454	0.454	0.454	0.454	0.454/0.454	0.454/0.454
Accuracy	40”	40”	20”	20”	15’/10’	15’/30”
Optional Accuracy Avail.						
Angular Range (deg.)	360	360	±20	±45	360	360
Weight (oz.)	14.5	11.5	11.5	11.5	11.5	11.5
Inertia (x10^{-3} oz-in-sec2)	30	26.5	26.5	26.5	26.5	26.5
Schematic No.	4	4	4	4	4	4
Notes:					A	
Characteristics at 25°C [A]Low accuracy for motor commutation.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

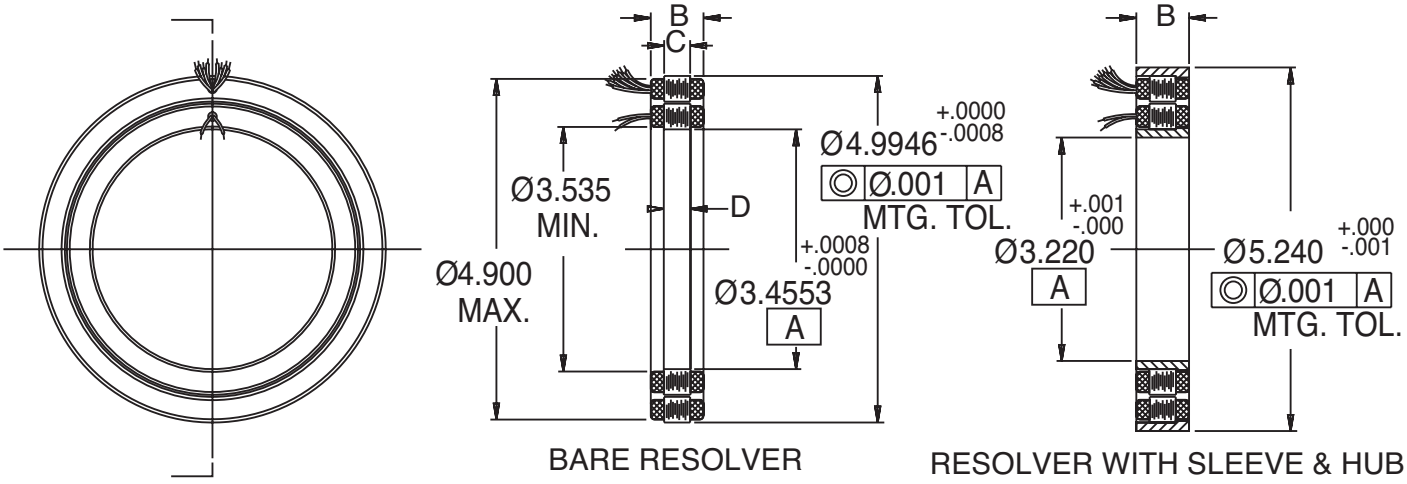
RP038
PANCAKE RESOLVERS



RP038-	011SMFD-E0V	161SMFA-E0V	161SMFB-D1V
Bare			
Sleeve and Hub	✔	✔	✔
B (overall height) (in.)	0.560	0.560	0.560
C (stator) (in.)	-	-	-
D (rotor) (in.)	-	-	-
Mounting Concentricity (in)	0.0005	0.0005	0.0005
Speed (no. of pole pairs)	1/8	1/16	1/16
Function	RX	RX	RX
Primary Winding	R	R	S
Input (VRMS)	26	26	7
Frequency (Hz)	2000	2000	400
Input Current (ma) Max.	130	70	113
Input Power (watts) Max.	1.50	0.80	0.53
Phase Shift (deg.) nom.	3/8	2.5/21	26/41
Transformation Ratio	1.0/1.0	.200/.200	1.00/1.00
Accuracy	15'/30"	15'/30"	15'/20"
Optional Accuracy Avail.			
Angular Range (deg.)	360	360	±90
Weight (oz.)	11.5	11.5	11.5
Inertia ($x10^{-3}$ oz-in-sec2)	26.5	26.5	26.5
Schematic No.	5	5	6
Notes:			
Characteristics at 25°C			

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

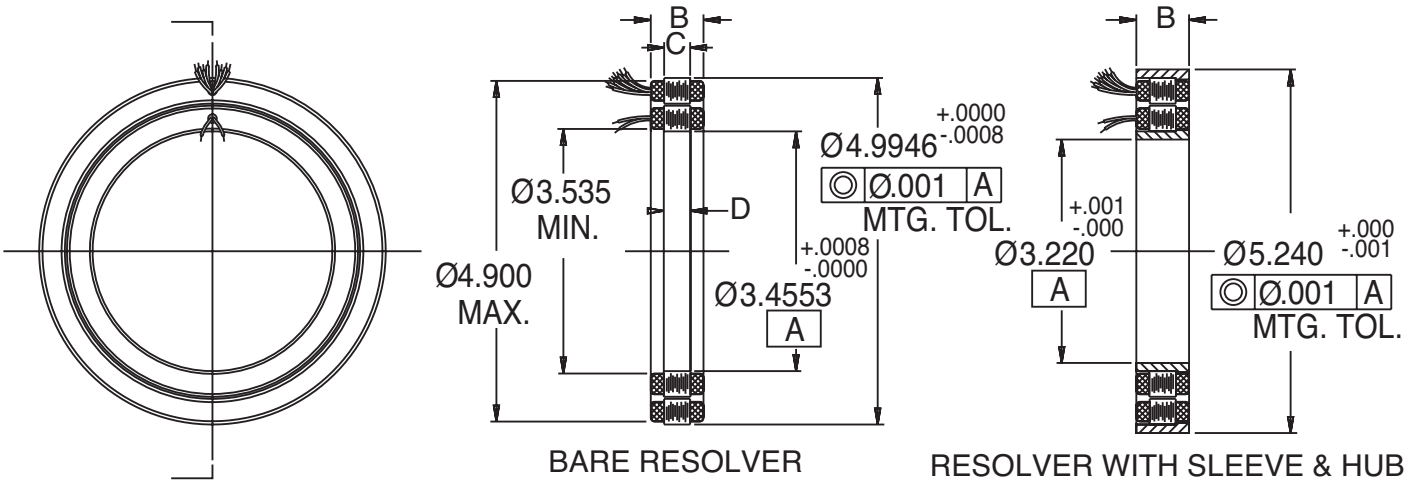
RP050
PANCAKE RESOLVERS



RP050-	010BBFA-K0V	010BBFA-K5V	010BBFA-L0V	010FMFB-H0V1
Bare	✔	✔	✔	
Sleeve and Hub				✔
B (overall height) (in.)	0.750	0.750	0.750	0.750
C (stator) (in.)	0.375	0.375	0.375	-
D (rotor) (in.)	0.385	0.385	0.385	-
Mounting Concentricity (in)	0.002	0.002	0.002	0.002
Speed (no. of pole pairs)	1	1	1	1
Function	RX	RX	RX	RX
Primary Winding	R	R	R	R
Input (VRMS)	26	26	26	26
Frequency (Hz)	400	400	400	4500
Input Current (ma) Max.	75	75	75	100
Input Power (watts) Max.	1.0	1.0	1.0	2.0
Phase Shift (deg.) nom.	5	5	5	10
Transformation Ratio	0.454	0.454	0.454	0.50
Accuracy	3’	3’	6’	2’
Optional Accuracy Avail.				
Angular Range (deg.)	360	±15	360	360
Weight (oz.)	17	17	17	32
Inertia ($x10^{-3}$ oz-in-sec2)	51	51	51	87
Schematic No.	1	1	1	1
Notes:	A	A	A	B
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]See drawing for flange details.				

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

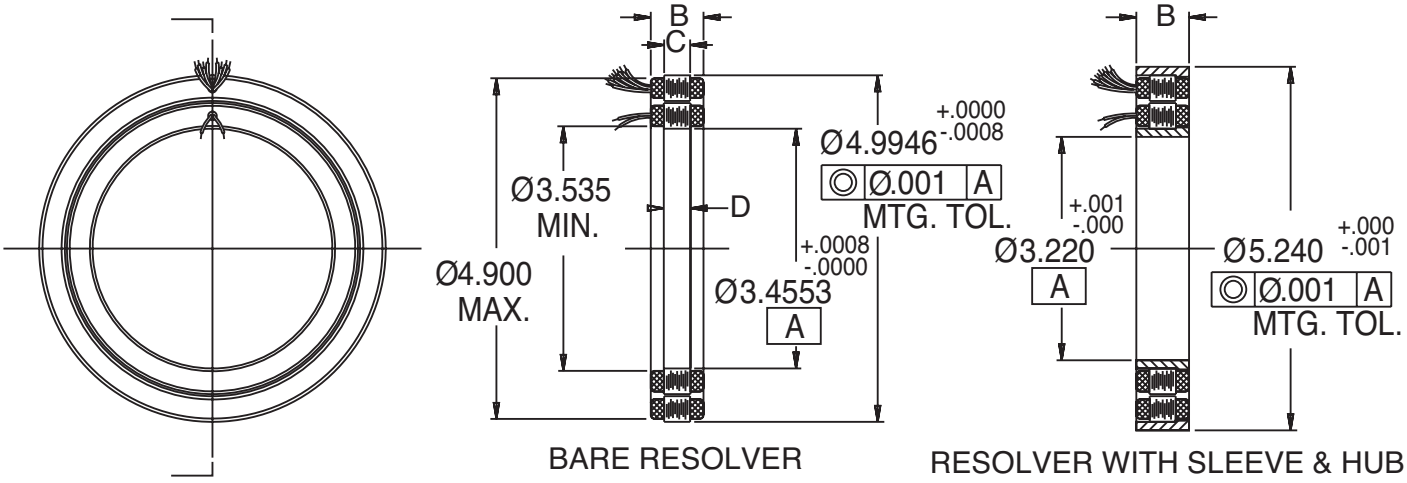
RP050
PANCAKE RESOLVERS



RP050-	160BBFC-B4V	160BBFC-B4V1	160BBFC-C0V	161BBFA-C0V	161BBFA-E0V	161BBFB-E0V
Bare	✔	✔	✔	✔	✔	✔
Sleeve and Hub						
B (overall height) (in.)	0.750	0.750	0.750	0.750	0.750	0.750
C (stator) (in.)	0.375	0.375	0.375	0.375	0.375	0.375
D (rotor) (in.)	0.385	0.385	0.385	0.385	0.385	0.385
Mounting Concentricity (in)	0.001	0.001	0.001	0.001	0.001	0.001
Speed (no. of pole pairs)	16	16	16	1/16	1/16	1/16
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	400	400	400	400	400	2000
Input Current (ma) Max.	75	75	75	90	90	25
Input Power (watts) Max.	1.3	1.3	1.3	1.7	1.7	0.20
Phase Shift (deg.) nom.	30	30	30	14/32	14/32	2/7
Transformation Ratio	0.454	0.454	0.454	.250/.260	.250/.260	.260/.310
Accuracy	10”	10”	15”	10’/15”	10’/30”	10’/30”
Optional Accuracy Avail.						
Angular Range (deg.)	±20	±20	360	360	360	360
Weight (oz.)	17	17	17	17	17	17
Inertia ($x10^{-3}$ oz-in-sec2)	51	51	51	51	51	51
Schematic No.	4	4	4	5	5	5
Notes:	A	A,B	A	A	A	A
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]Rotor & stator exit opposite sides.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

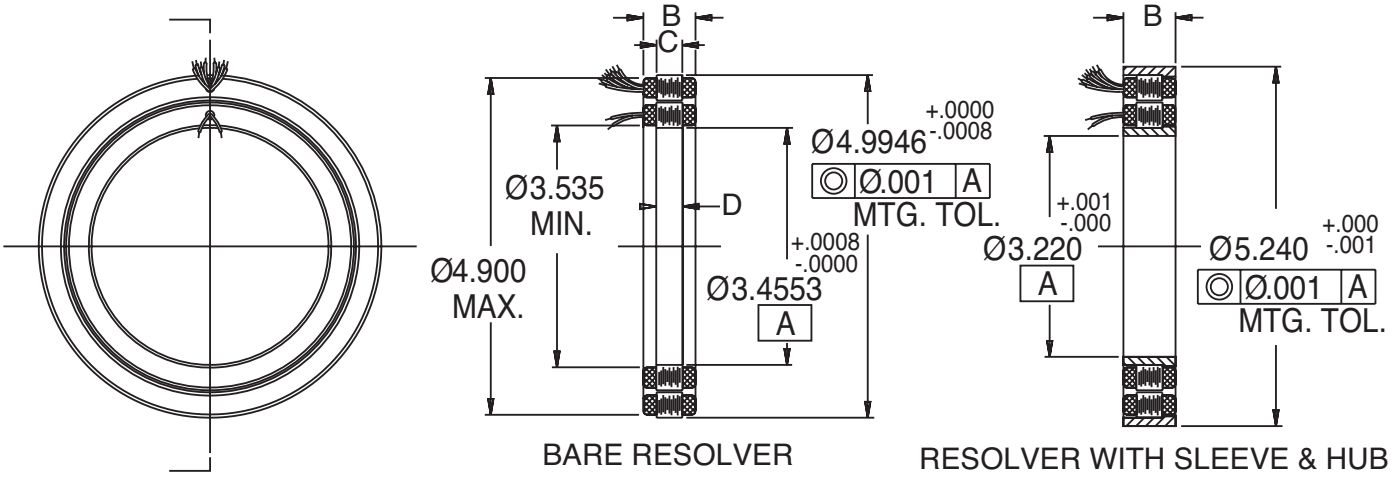
RP050
PANCAKE RESOLVERS



RP050-	161BBFE-E0V	161FNFE-E0V	161SMFA-C0V1	161SMFD-D0V	321BBFA-B6V	321BBFA-C0V
Bare	✔				✔	✔
Sleeve and Hub		✔	✔	✔		
B (overall height) (in.)	0.750	0.750	0.760	0.760	0.750	0.750
C (stator) (in.)	0.375	-	-	-	0.375	0.375
D (rotor) (in.)	0.385	-	-	-	0.385	0.385
Mounting Concentricity (in)	0.001	0.002	0.002	0.002	0.001	0.001
Speed (no. of pole pairs)	1/16	1/16	1/16	1/16	1/32	1/32
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	S	R	S	R	R
Input (VRMS)	26	4.4	26	7	26	26
Frequency (Hz)	2000	2000	400	400	400	400
Input Current (ma) Max.	25	24	90	70	100	100
Input Power (watts) Max.	0.20	0.02	1.7	0.24	1.5	1.5
Phase Shift (deg.) nom.	2/7	5/5	14/32	9/31	7/32	7/32
Transformation Ratio	.260/.310	.454/.454	.250/.260	1.00/1.00	.454/.454	.454/.454
Accuracy	10’/30”	10’/30”	10’/15”	10’/20”	10’/10”	10’/15”
Optional Accuracy Avail.						
Angular Range (deg.)	360	360	360	360	±10	360
Weight (oz.)	17	32	28	28	17	17
Inertia ($x10^{-3}$ oz-in-sec2)	51	87	80	80	51	51
Schematic No.	5	6	5	6	5	5
Notes:		B			A	A
Characteristics at 25°C [A]Sleeve and hub available on special order. [B]See drawing for flange details.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

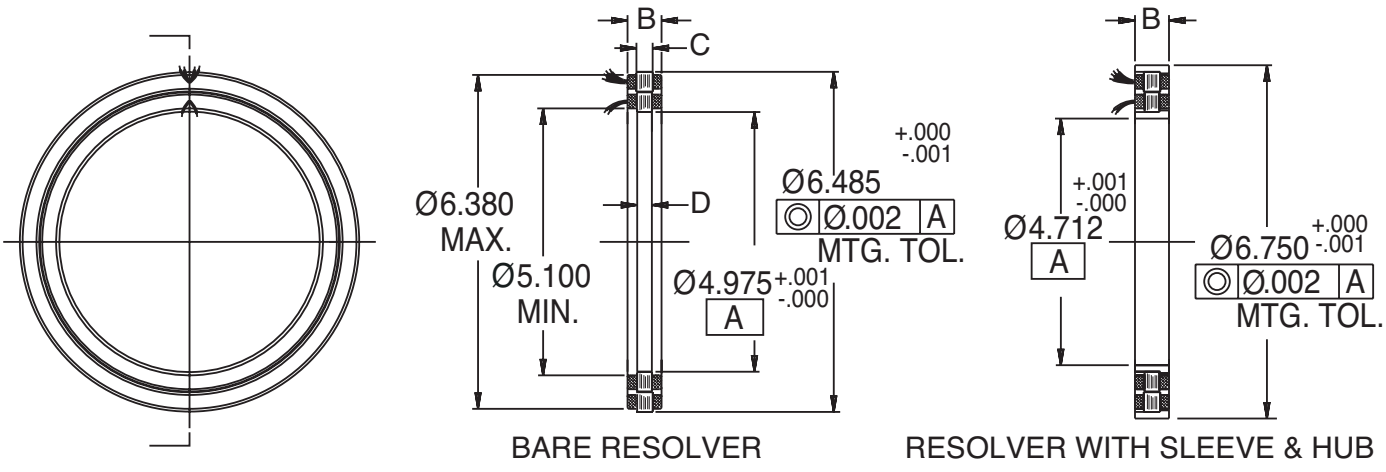
RP050
PANCAKE RESOLVERS



RP050-	321BBFA-D0V	321SMFA-B6V	321SMFA-C0V
Bare	✔		
Sleeve and Hub		✔	✔
B (overall height) (in.)	0.750	0.760	0.760
C (stator) (in.)	0.375	-	-
D (rotor) (in.)	0.385	-	-
Mounting Concentricity (in)	0.001	0.002	0.002
Speed (no. of pole pairs)	1/32	1/32	1/32
Function	RX	RX	RX
Primary Winding	R	R	R
Input (VRMS)	26	26	26
Frequency (Hz)	400	400	400
Input Current (ma) Max.	100	100	100
Input Power (watts) Max.	1.5	1.5	1.5
Phase Shift (deg.) nom.	7/32	7/32	7/32
Transformation Ratio	.454/.454	.454/.454	.454/.454
Accuracy	10'/20"	10'/10"	10'/15"
Optional Accuracy Avail.			
Angular Range (deg.)	360	±10	360
Weight (oz.)	17	28	28
Inertia ($x10^{-3}$ oz-in-sec2)	51	80	80
Schematic No.	5	5	5
Notes:	A		
Characteristics at 25°C [A]Sleeve and hub available on special order.			

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

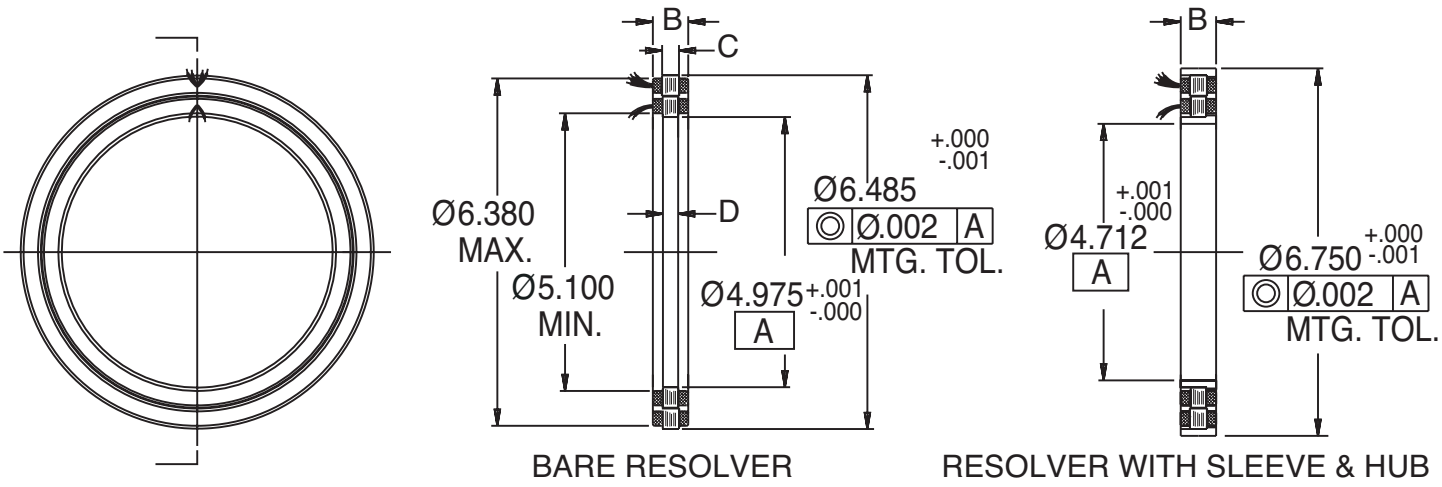
RP065
PANCAKE RESOLVERS



RP065-	010BBFA-K0V	010BBFB-K0V	010BBFD-K0V1	010SMFA-H0V
Bare	✔	✔	✔	
Sleeve and Hub				✔
B (overall height) (in.)	0.650	0.650	0.650	0.650
C (stator) (in.)	0.310	0.310	0.310	-
D (rotor) (in.)	0.280	0.280	0.280	-
Mounting Concentricity (in)	0.002	0.002	0.002	0.002
Speed (no. of pole pairs)	1	1	1	1
Function	RX	RX	RX	RX
Primary Winding	R	R	R	R
Input (VRMS)	26	26	26	26
Frequency (Hz)	400	2000	400	400
Input Current (ma) Max.	68	25	65	68
Input Power (watts) Max.	1.1	0.63	1.2	1.1
Phase Shift (deg.) nom.	11	1	13	11
Transformation Ratio	0.454	0.465	0.97	0.454
Accuracy	3’	3’	3’	2’
Optional Accuracy Avail.				
Angular Range (deg.)	360	360	360	360
Weight (oz.)	16.7	16.7	16.7	34.3
Inertia ($x10^{-3}$ oz-in-sec2)	110	110	110	195
Schematic No.	1	1	1	1
Notes:	A	A	A	
Characteristics at 25°C [A]Also available with sleeve and hub.				

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

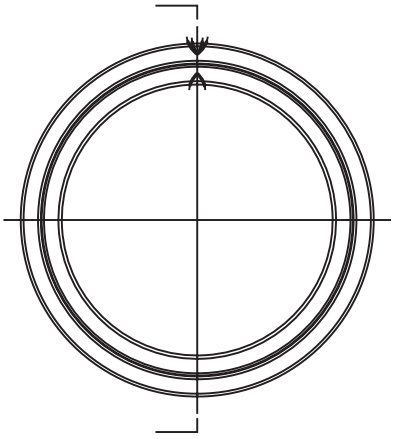
RP065
PANCAKE RESOLVERS

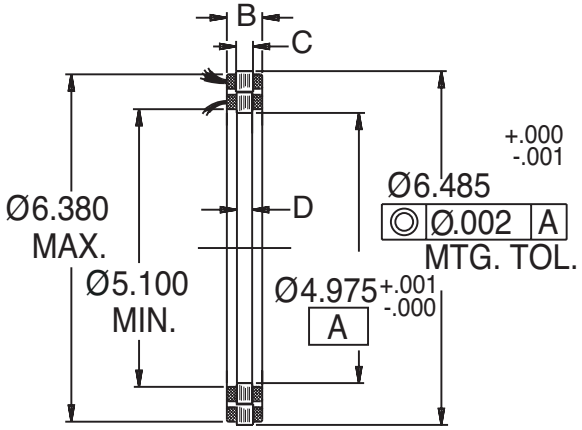


RP065-	010SMFB-H0V1	010SMFB-K0V	010SMFB-K0V1	010SMFC-G0V1	161BBFA-E0V
Bare					✔
Sleeve and Hub	✔	✔	✔	✔	
B (overall height) (in.)	0.650	0.650	0.650	0.650	0.650
C (stator) (in.)	-	-	-	-	0.310
D (rotor) (in.)	-	-	-	-	0.280
Mounting Concentricity (in)	0.002	0.002	0.002	0.002	0.002
Speed (no. of pole pairs)	1	1	1	1	1/16
Function	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R
Input (VRMS)	26	26	26	1	26
Frequency (Hz)	2000	2000	2000	2000	2000
Input Current (ma) Max.	25	25	25	1.5	135
Input Power (watts) Max.	0.63	0.63	0.63	0.002	0.65
Phase Shift (deg.) nom.	0.5	0.5	0.5	-1	2/6
Transformation Ratio	0.465	0.465	0.465	0.50	.454/.454
Accuracy	2'	3'	3'	1'	15'/30"
Optional Accuracy Avail.					
Angular Range (deg.)	±360	±360	360	360	360
Weight (oz.)	34.3	34.3	34.3	34.3	16.7
Inertia ($x10^{-3}$ oz-in-sec2)	195	195	195	195	110
Schematic No.	1	1	1	1	5
Notes:			B	C	A
Characteristics at 25°C [A]Also available with sleeve and hub. [B]Special lead wire. [C]Special lead wire and lead breakout.					

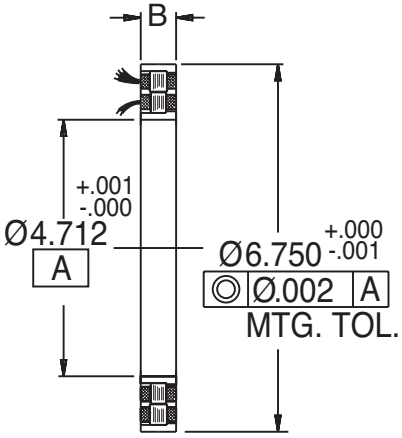
Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP065
PANCAKE RESOLVERS





BARE RESOLVER

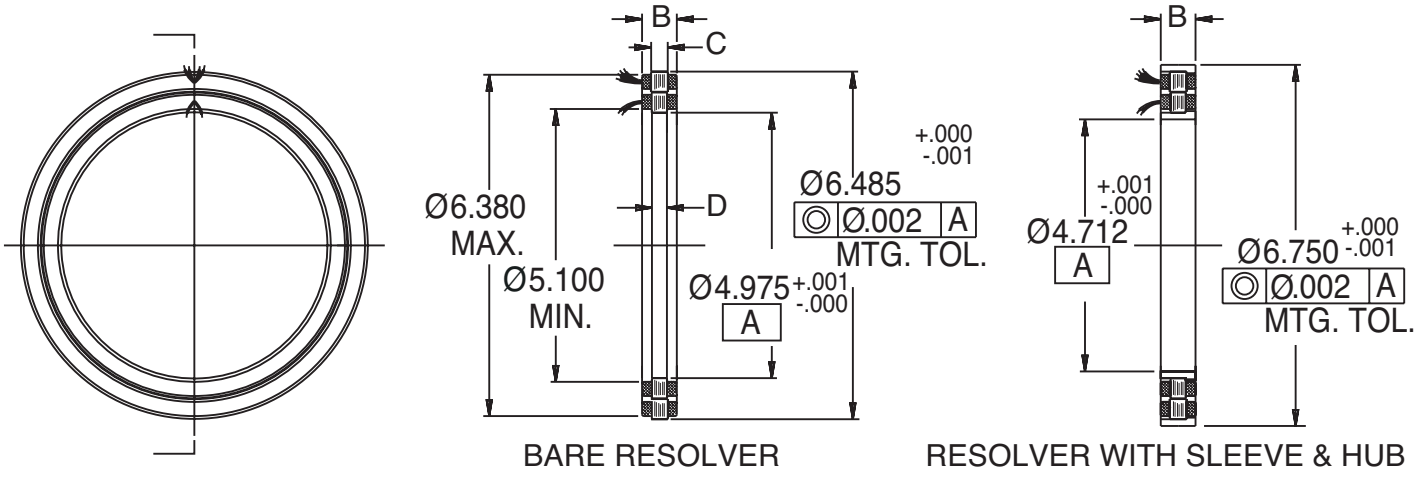


RESOLVER WITH SLEEVE & HUB

RP065-	161BBFA-G0V	161SMFA-C0V	161SMFA-C0V1	161SMFA-C0V2	321BBFB-B0V1
Bare	✔				✔
Sleeve and Hub		✔	✔	✔	
B (overall height) (in.)	0.650	0.650	0.650	0.650	0.650
C (stator) (in.)	0.310	-	-	-	0.310
D (rotor) (in.)	0.280	-	-	-	0.280
Mounting Concentricity (in)	0.002	0.001	0.001	0.001	0.002
Speed (no. of pole pairs)	1/16	1/16	1/16	1/16	1/32
Function	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R
Input (VRMS)	26	26	26	4.4	26
Frequency (Hz)	2000	2000	1450	2000	1200
Input Current (ma) Max.	135	135	170	25	500
Input Power (watts) Max.	0.65	0.65	1.4	0.03	7.5
Phase Shift (deg.) nom.	2/6	2/6	4/10	2/6	40/15
Transformation Ratio	.454/.454	.454/.454	.454/.454	.454/.454	.44/.41
Accuracy	15'/60"	15'/15"	15'/15"	15'/15"	15'/10"
Optional Accuracy Avail.					
Angular Range (deg.)	360	360	360	360	360
Weight (oz.)	16.7	30	30	30	16.7
Inertia ($x10^{-3}$ oz-in-sec2)	110	195	195	195	110
Schematic No.	5	5	5	5	5
Notes:					A,B
Characteristics at 25°C [A]Also available with sleeve and hub. [B]Also tested at 10V 400 Hz (accuracy = 20" max).					

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

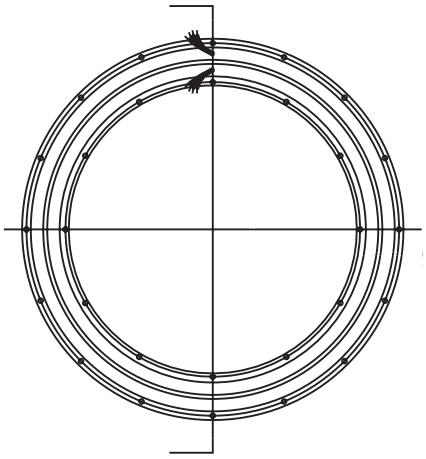
RP065
PANCAKE RESOLVERS

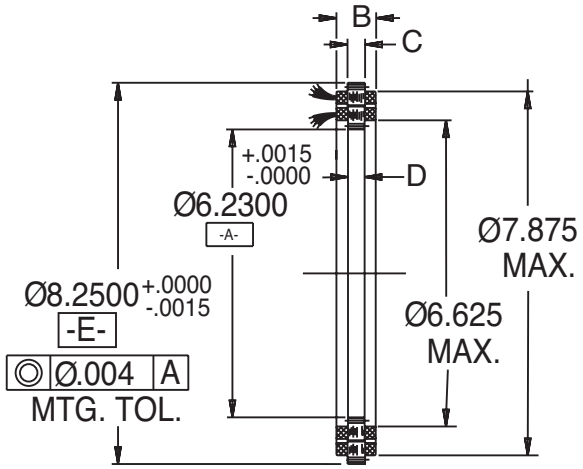


RP065-	321FMFB-B0V	321SMFA-A2V	321SMFA-B0V	321FMFA-BOV	321FMFA-A2V
Bare					
Sleeve and Hub	✔	✔	✔	✔	✔
B (overall height) (in.)	0.650	0.650	0.650	0.650	0.650
C (stator) (in.)	-	-	-	-	-
D (rotor) (in.)	-	-	-	-	-
Mounting Concentricity (in)	0.001	0.001	0.001	0.001	0.001
Speed (no. of pole pairs)	1/32	1/32	1/32	1/32	1/32
Function	RX	RX	RX	RX	RX
Primary Winding	R	S	S	S	S
Input (VRMS)	26	26	26	26	26
Frequency (Hz)	2000	2000	2000	2000	2000
Input Current (ma) Max.	300	300	300	300	300
Input Power (watts) Max.	2.8	2.8	2.8	2.8	2.8
Phase Shift (deg.) nom.	6/19	6/18	6/18	6/18	6/18
Transformation Ratio	.454/.454	.454/.454	.454/.454	.454/.454	.454/.454
Accuracy	15'/10"	15'/5"	15'/10"	15'/10"	15'/5"
Optional Accuracy Avail.					
Angular Range (deg.)	360	±45	360	360	±45
Weight (oz.)	40	34.3	34.3	40	40
Inertia ($x10^{-3}$ oz-in-sec2)	195	195	195	222	222
Schematic No.	5	6	6	6	6
Notes:	A			A	A
Characteristics at 25°C [A]See drawing for sleeve and hub dimension details.					

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP083
PANCAKE RESOLVERS



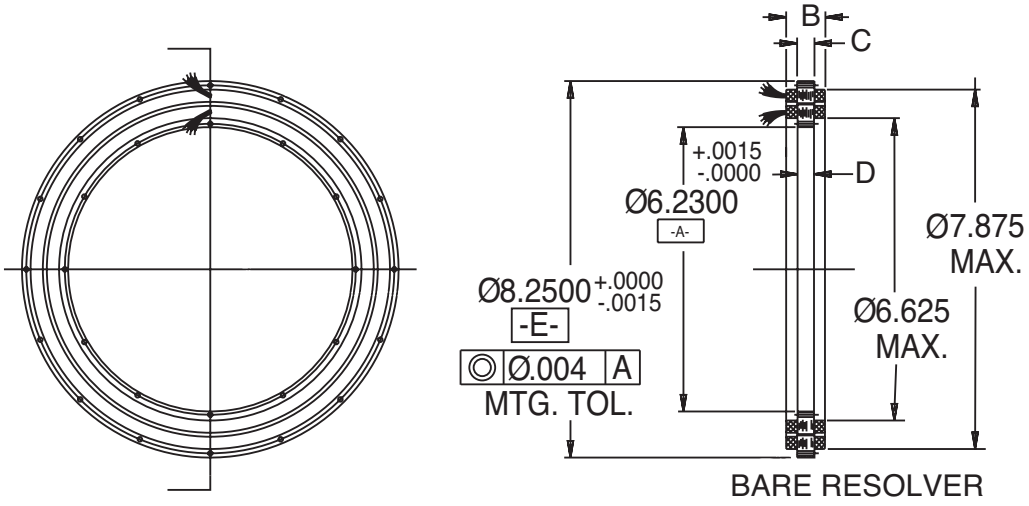


BARE RESOLVER

RP083-	010BBFA-K0V1	010BBFA-LOV	081BBFA-E2V	081BBFA-E0V	161BBFA-C6V
Bare	✔	✔	✔	✔	✔
Sleeve and Hub					
B (overall height) (in.)	0.850	0.850	0.850	0.850	0.850
C (stator) (in.)	0.38	0.38	0.38	0.38	0.38
D (rotor) (in.)	0.36	0.36	0.36	0.36	0.36
Mounting Concentricity (in)	0.004	0.004	0.004	0.004	0.004
Speed (no. of pole pairs)	1	1	1/8	1/8	1/16
Function	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R
Input (VRMS)	26	26	26	26	26
Frequency (Hz)	1500	400	400	400	400
Input Current (ma) Max.	60	90	200	200	200
Input Power (watts) Max.	0.6	1.2	2	2	3
Phase Shift (deg.) nom.	2	9	22/22	22/22	22/35
Transformation Ratio	0.450	0.454	..454/.454	.454/.454	.454/.454
Accuracy	3’	6’	15’/30”	15’/30”	15’/15”
Optional Accuracy Avail.		3’			
Angular Range (deg.)	360	±360	±45	360	±10
Weight (oz.)	37.7	37.7	37.7	37.7	37.7
Inertia ($x10^{-3}$ oz-in-sec2)	320	320	320	320	320
Schematic No.	1	1	5	5	5
Notes:	A	A	A	A	A
Characteristics at 25°C [A]Mechancial tolerance applies to average dia. Free state roundness is 0.0025 max.					

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP083
PANCAKE RESOLVERS

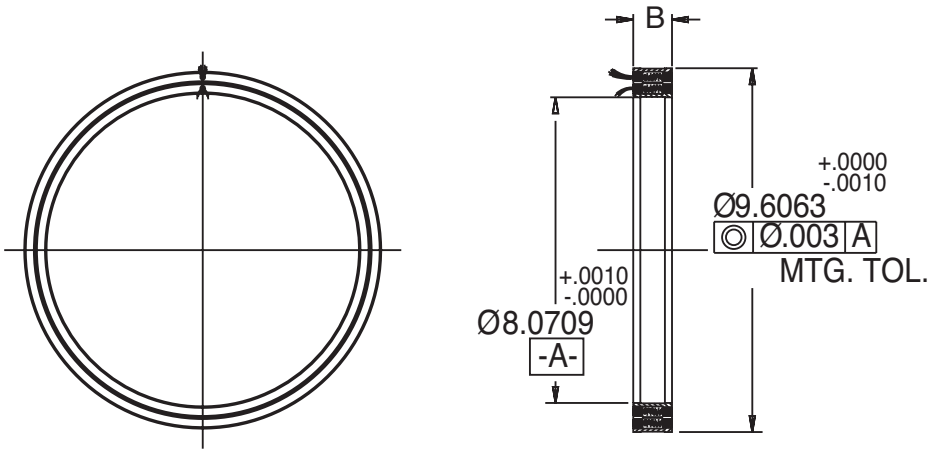


BARE RESOLVER

RP083-	161BBFA-D0V	161BBFB-B6V	161BBFB-C0V	321BBFA-A6V	321BBFA-B0V	321BBFB-D0V
Bare	✔	✔	✔	✔	✔	✔
Sleeve and Hub						
B (overall height) (in.)	0.850	0.850	0.850	0.850	0.850	0.850
C (stator) (in.)	0.39	0.39	0.39	0.39	0.39	0.39
D (rotor) (in.)	0.36	0.36	0.36	0.36	0.36	0.36
Mounting Concentricity (in)	0.004	0.004	0.004	0.004	0.004	0.004
Speed (no. of pole pairs)	1/16	1/16	1/16	1/32	1/32	1/32
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	400	400	400	400	400	400
Input Current (ma) Max.	200	200	200	200	200	200
Input Power (watts) Max.	3	2	2	2	2	2
Phase Shift (deg.) nom.	22/35	9/22	9/22	10/24	10/24	8/24
Transformation Ratio	.454/.454	.200/.200	.200/.200	.200/.200	.200/.200	.454/.454
Accuracy	15'/20"	15'/10"	15'/15"	15'/5"	15'/10"	20'/20"
Optional Accuracy Avail.						
Angular Range (deg.)	360	±10	360	±10	360	±360
Weight (oz.)	37.7	37.7	37.7	37.7	37.7	37.7
Inertia ($x10^{-3}$ oz-in-sec2)	320	320	320	320	320	320
Schematic No.	5	5	5	5	5	5
Notes:	A	A	A	A	A	A
Characteristics at 25°C [A]Mechancial tolerance applies to average dia. Free state roundness is 0.0025 max.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP094
PANCAKE RESOLVERS

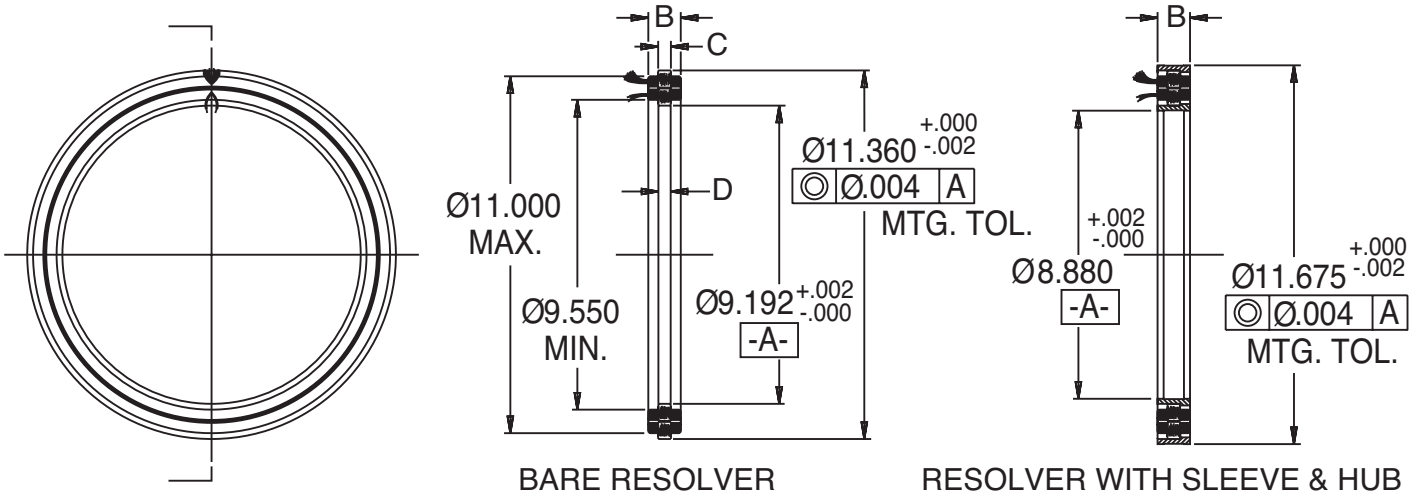


RESOLVER WITH SLEEVE & HUB

RP094-	010SMFA-M0V	161SMFA-D5V	161SMFA-E0V
Bare			
Sleeve and Hub	✔	✔	✔
B (overall height) (in.)	1.024	1.024	1.024
C (stator) (in.)	-	-	-
D (rotor) (in.)	-	-	-
Mounting Concentricity (in)	0.003	0.003	0.003
Speed (no. of pole pairs)	1	1/16	1/16
Function	RX	RX	RX
Primary Winding	R	R	R
Input (VRMS)	26	26	26
Frequency (Hz)	400	400	400
Input Current (ma) Max.	20	70	70
Input Power (watts) Max.	0.35	1	1
Phase Shift (deg.) nom.	12	20/16	20/16
Transformation Ratio	0.454	.454/.454	.454/.454
Accuracy	10’	15’/20”	15’/30”
Optional Accuracy Avail.			
Angular Range (deg.)	360	±15	360
Weight (oz.)	56.5	56.5	56.5
Inertia (x10^{-3} oz-in-sec2)	527	527	527
Schematic No.	1	5	5
Notes:	A,B,C	A,B,C	A,B,C
Characteristics at 25°C [A]Mechancial tolerance applies to average dia. Free state roundness is 0.003 max. [B]2000 Hz units are available. [C]Not available as a “bare” unit.			

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP115
PANCAKE RESOLVERS



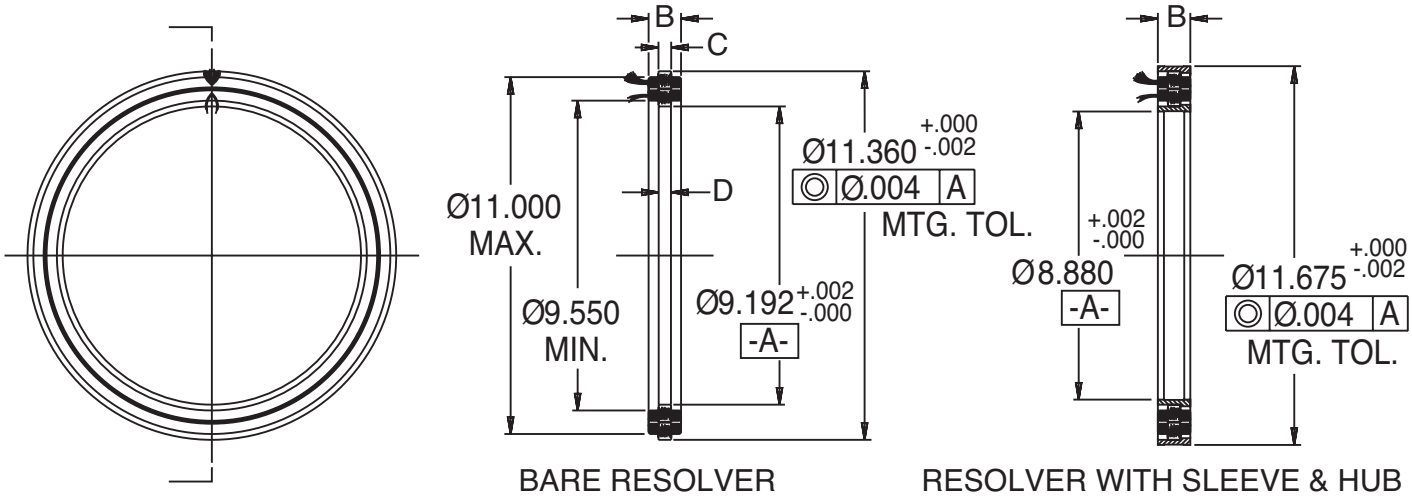
BARE RESOLVER

RESOLVER WITH SLEEVE & HUB

RP115-	010BBFA-L0V	010SMFA-L0V	161BBFA-B6V	161BBFA-D0V	161SMFA-A6V	161SMFA-C0V
Bare	✔		✔	✔		
Sleeve and Hub		✔			✔	✔
B (overall height) (in.)	1.000	1.000	1.000	1.000	1.000	1.000
C (stator) (in.)	0.392	-	0.392	0.392	-	-
D (rotor) (in.)	0.378	-	0.378	0.378	-	-
Mounting Concentricity (in)	0.004	0.004	0.004	0.004	0.004	0.004
Speed (no. of pole pairs)	1	1	1/16	1/16	1/16	1/16
Function	RX	RX	RX	RX	RX	RX
Primary Winding	R	R	R	R	R	R
Input (VRMS)	26	26	26	26	26	26
Frequency (Hz)	400	400	400	400	400	400
Input Current (ma) Max.	25	25	140	140	140	140
Input Power (watts) Max.	0.45	0.45	1.0	1.0	1.0	1.0
Phase Shift (deg.) nom.	5	5	12/14	12/14	12/14	12/14
Transformation Ratio	0.454	0.454	.454/.454	.454/.454	.454/.454	.454/.454
Accuracy	6’	6’	15’/10”	15’/20”	15’/5”	15’ 15”
Optional Accuracy Avail.						
Angular Range (deg.)	360	360	±10	360	±10	360
Weight (oz.)	58	105	58	58	105	105
Inertia ($x10^{-3}$ oz-in-sec2)	1490	1950	1490	1490	1950	1950
Schematic No.	1	1	5	5	5	5
Notes:	A		A	A		
Characteristics at 25°C [A]Mechancial tolerance applies to average dia. Free state roundness is 0.003 max.						

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

RP115
PANCAKE RESOLVERS



BARE RESOLVER

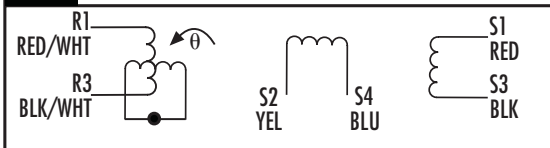
RESOLVER WITH SLEEVE & HUB

RP115-	320SMFA-B0V	321SMFA-C0V	321SMFD-B0V
Bare			
Sleeve and Hub	✔	✔	✔
B (overall height) (in.)	1.000	1.000	1.000
C (stator) (in.)	-	-	-
D (rotor) (in.)	-	-	-
Mounting Concentricity (in)	0.004	0.004	0.004
Speed (no. of pole pairs)	32	1/32	1/32
Function	RX	RX	RX
Primary Winding	R	R	R
Input (VRMS)	26	26	12
Frequency (Hz)	400	400	1200
Input Current (ma) Max.	150	95	50
Input Power (watts) Max.	2.25	2.5	0.25
Phase Shift (deg.) nom.	25	19/31	3/15
Transformation Ratio	0.454	.454/.454	.454/.454
Accuracy	10”	15’/15”	15’/10”
Optional Accuracy Avail.			
Angular Range (deg.)	360	360	360
Weight (oz.)	105	105	105
Inertia ($x10^{-3}$ oz-in-sec2)	1950	1950	1950
Schematic No.	4	5	5
Notes:			
Characteristics at 25°C			

Should you require a different design or modifications, please contact General Dynamics Ordnance and Tactical Systems.

SCHEMATICS AND PHASE EQUATIONS

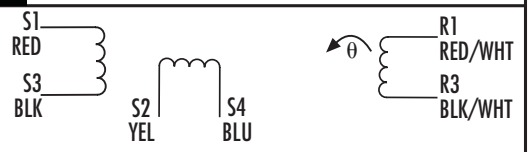
1 1 Speed Resolver Transmitter (RX) (Rotor Primary)



$E_{S1-S3} = K E_{R1-R3} \cos\theta$ $E_{S2-S4} = K E_{R1-R3} \sin\theta$

θ is positive for CCW Rotation of the rotor as viewed from lead exit side.

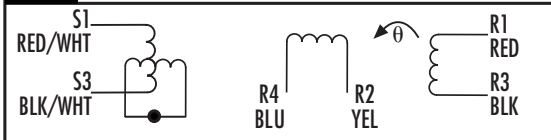
2 1 Speed Resolver Transformer (RT) (Stator Primary)



$E_{R1-R3} = K(E_{S1-S3} \cos\theta + E_{S2-S4} \sin\theta)$

θ is positive for CCW Rotation of the rotor as viewed from lead exit side.

3 1 Speed Resolver Transmitter (RX) (Stator Primary)



$E_{R1-R3} = K E_{S1-S3} \cos\theta$ $E_{R2-R4} = K E_{S1-S3} \sin\theta$

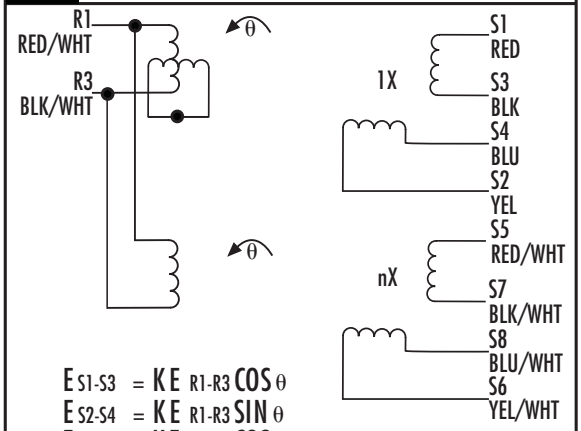
θ is positive for CCW Rotation of the rotor as viewed from lead exit side.

4 "n" Speed Resolver Transmitter (RX) (Rotor Primary)

$E_{S1-S3} = K E_{R1-R3} \cos n\theta$ $E_{S2-S4} = K E_{R1-R3} \sin n\theta$

θ is positive for CCW Rotation of the rotor as viewed from lead exit side.

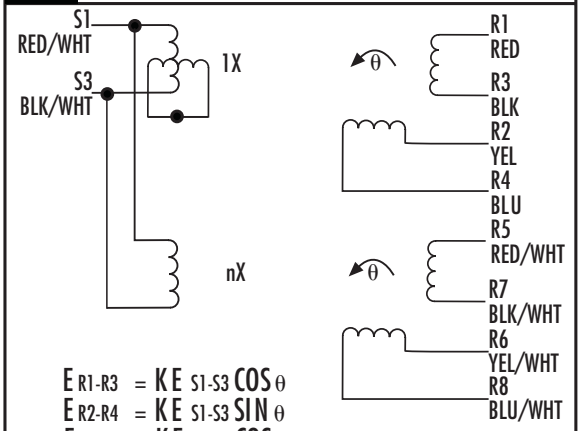
5 1X - nX Resolver Transmitter (RX) (Rotor Primary)



$E_{S1-S3} = K E_{R1-R3} \cos\theta$
$E_{S2-S4} = K E_{R1-R3} \sin\theta$
$E_{S5-S7} = K E_{R1-R3} \cos n\theta$
$E_{S6-S8} = K E_{R1-R3} \sin n\theta$

θ is positive for CCW Rotation of the rotor as viewed from lead exit side.

6 1X - nX Resolver Transmitter (RX) (Stator Primary)



$E_{R1-R3} = K E_{S1-S3} \cos\theta$
$E_{R2-R4} = K E_{S1-S3} \sin\theta$
$E_{R5-R7} = K E_{S1-S3} \cos n\theta$
$E_{R6-R8} = K E_{S1-S3} \sin n\theta$

θ is positive for CCW Rotation of the rotor as viewed from lead exit side.

7 1X Resolver Transmitter (RX) (Quad. Winding Leads R2 & R4 Provided)

$E_{(S1-S3)} = K E_{(R1-R3)} \cos\theta - K E_{(R1-R3)} \sin\theta$
$E_{(S2-S4)} = K E_{(R1-R3)} \sin\theta + K E_{(R2-R4)} \cos\theta$

θ is positive for CCW Rotation of the rotor as viewed from lead exit side.

8 "n" Speed Resolver Transmitter (RX) (Stator Primary)

$E_{R1-R3} = K E_{S1-S3} \cos n\theta$ $E_{R2-R4} = K E_{S1-S3} \sin n\theta$

θ is positive for CCW Rotation of the rotor as viewed from lead exit side.