

# Series 310-320

## Long Stroke AC Gaging LVDTs

The Series 310-320 Long Stroke AC Gaging Transducers consist of a precision AC LVDT, a rugged stainless steel outer housing, and a spring actuated, stainless steel shaft. Consistent with the high performance normally found in Trans-Tek precision AC LVDTs, these transducers exhibit excellent non-linearity and extremely low temperature coefficients. Available in full stroke displacements of 0.5 to 20 inches, the transducers are ideal for use in single or multi-point gaging systems, thickness measurements, machine control, or any other applications requiring a precision, spring actuated linear displacement measurement.



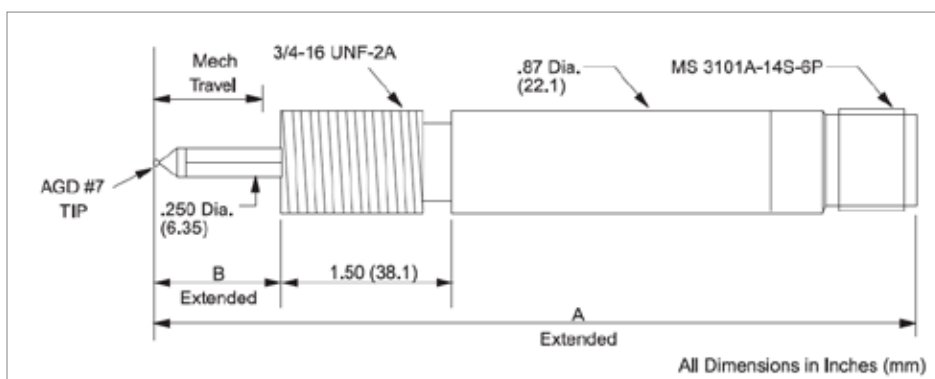
### KEY FEATURES

<b>Ranges from <math>\pm 0.25"</math> to <math>\pm 10.0"</math></b>	<b>Stainless Steel Construction</b>
<b>Non-linearity <math>\leq 0.25\%</math></b>	<b>Reversible Spring Option</b>

### SPECIFICATIONS

MODEL	LINEAR RANGE $\pm$ Inches (mm)	MAX USABLE RANGE $\pm$ Inches (mm)	MAX TIP FORCE Ounces	TOTAL LENGTH A Inches (mm)	SHAFT LENGTH B Inches (mm)	INPUT IMPEDANCE Ohms	DC INPUT RESISTANCE Ohms	OUTPUT IMPEDANCE Ohms	PHASE ANGLE Degrees
0315-0000	0.25 (6.35)	0.50 (12.7)	20	8.96 (228)	1.47 (37.3)	205	22	265	13
0316-0000	0.50 (12.7)	0.87 (22.1)	27	11.05 (281)	2.32 (58.9)	235	31	310	17
0317-0000	1.00 (25.4)	1.37 (34.8)	27	15.26 (388)	3.42 (86.9)	195	36	205	19
0318-0000	2.00 (50.8)	2.37 (60.2)	36	22.51 (572)	5.56 (141)	200	46	255	22
0319-0000	3.00 (76.2)	3.62 (91.9)	45	31.13 (791)	8.13 (207)	225	57	285	25
0320-0000	5.00 (127)	5.80 (147)	42	47.31 (1202)	12.85 (326)	360	89	460	31
0321-0000	7.50 (191)	8.25 (210)	41	68.23 (1733)	18.38 (467)	235	55	235	30
0322-0000	10.00 (254)	10.75 (273)	40	86.93 (2208)	23.88 (607)	330	72	285	31

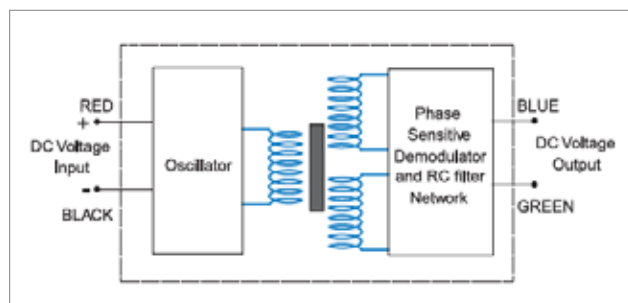
### DIMENSIONAL DIAGRAM



## TRANSDUCER SPECIFICATIONS

<b>NON-LINEARITY</b>	$\leq \pm 0.25\%$ FS (Best Fit Straight Line)
<b>REFERENCE FREQUENCY</b>	7.0 KHz
<b>SENSITIVITY</b>	0.50 V/V $\pm 10\%$ at FULL SCALE
<b>INPUT VOLTAGE</b>	20 VRMS, Max.
<b>NULL VOLTAGE</b>	< 1.0% Excitation Voltage
<b>TEMPERATURE COEFFICIENT</b>	< $\pm 0.001\%$ FS/°F Zero, < $\pm 0.01\%$ Reading/°F Span
<b>TEMPERATURE RANGE</b>	-67°F to +220°F (-55°C to +104°C) Operating -67°F to +275°F (-55°C to +135°C) Storage
<b>MATERIALS</b>	Stainless Steel Housing and Shaft; Aluminum

## SCHEMATIC



## ACCESSORIES

PART NUMBER	DESCRIPTION
C003-0057	Mating connector assembly consisting of: connector MS3106A-14S-6S (mates with MS3101A-14S-6P),
G000-0000	Replacement AGD #7 Gaging Tip
C000-0036	Cable Assembly: 15 Feet of 6 conductor, 24 AWG vinyl cable terminated with C003-0057. (Note: Operating temperature for cable is -22°F to +176°F); Color Code: A – Brown, B – White, C – Black
N001-0025	3/4 X 16 UNF-1B Hex Jam Nut
1000-0012	Oscillator/ Demodulator

## DC-DC OPERATION WITH OPTIONAL OSCILLATOR/DEMODULATOR

To facilitate prototyping, or in instances where the preference is a DC in - DC out system, any of the standard Series 310-320 can be used in conjunction with the Series 1000 Oscillator/ Demodulator. Designed to work together, the DC system gives the same level of performance as provided by the AC LVDT alone. The high level DC output voltage can be directly interfaced with analog

circuits as well as data acquisition cards, PLCs, or A/D converters. Provisions for customizing the Series 1000 to provide zero offsets and nonstandard gains allow a simple and cost effective method of tailoring a system to meet individual customer requirements. Detailed connection information can be found in the Accessories portion of this catalog.

## SYSTEM SPECIFICATIONS *(Combined Performance of LVDT and 1000-0012)*

<b>NON-LINEARITY</b>	$\leq \pm 0.25\%$ FS (Best Fit Straight Line)
<b>INPUT</b>	$\pm 14.5$ to $\pm 28.0$ VDC, $\pm 100$ mA Max; Internal regulation and input voltage reversal protection provided
<b>OUTPUT</b>	Adjustable to $\pm 5.0$ VDC at end of linear stroke, via SPAN adjustment
<b>FREQUENCY RESPONSE (-3dB)</b>	1000 Hz Min. (Electrical only, Mechanical response limited by spring)
<b>OUTPUT RIPPLE</b>	< 0.03 VRMS Max.
<b>TEMPERATURE COEFFICIENTS</b>	< $\pm 0.0035\%$ FS/°F Zero, < $\pm 0.02\%$ Reading/°F Span
<b>TEMPERATURE RANGE</b>	LVDT: -67°F to +220°F (-55°C to +104°C) Operating, -67°F to +275°F (-55°C to +135°C) Storage; Osc/Dem: +32°F to +158°F (0°C to +70°C) Operating, -67°F to +257°F (-55°C to +125°C) Storage

For more detailed information about these options, please contact the factory.

# Series 330

## 3/8 Inch AC Gaging LVDTs

The Series 330 3/8" AC Gaging LVDTs provide precise linear displacement sensing in a compact, spring loaded package. Advanced coil winding techniques are employed to minimize package length and optimize overall performance. Spring forces have been carefully selected to insure the proper balance of mechanical frequency response and tip force. Available in strokes ranging from  $\pm 0.005"$  to  $\pm 1.0"$ , these sensors are ideally suited to material thickness measurements, single or multi-point surface profiling, creep testing, or any other application requiring the use of a small, spring loaded LVDT. These transducers are also an excellent replacement for a standard dial indicator.



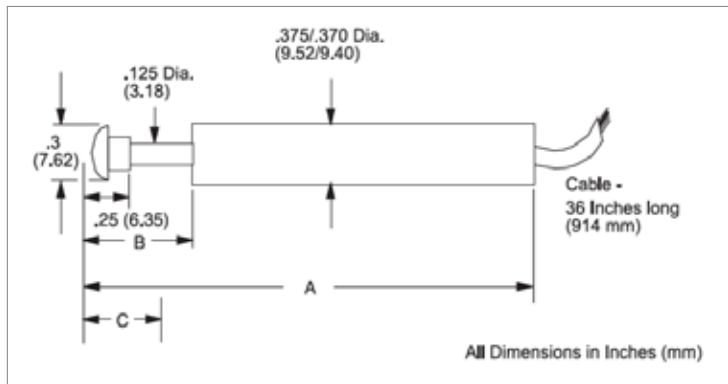
### KEY FEATURES

<b>Ranges from <math>\pm 0.005"</math> to <math>\pm 1.0"</math></b>	<b>Self-Lubricating Bearing</b>
<b>Non-linearity <math>\leq 0.20\%</math></b>	<b>20 MicroInch Repeatability</b>

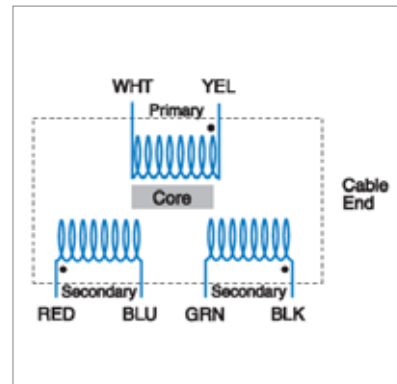
### SPECIFICATIONS

MODEL	UNITS	0330-0000	0331-0000	0332-0000	0333-0000	0334-0000	0335-0000	0336-0000	0337-0000
LINEAR RANGE	±Inches ±(mm)	0.005 (0.13)	0.01 (0.26)	0.025 (0.64)	0.05 (1.27)	0.1 (2.54)	0.25 (6.35)	0.5 (12.7)	1.0 (25.4)
NON LINEARITY		< ±0.25% Max.			< ±0.20% Max.				
OVERTRAVEL		OUTPUT MONOTONIC OVER ENTIRE MECHANICAL TRAVEL							
TEMPERATURE RANGE		-4°F to +176°F (-20°C to +80°C) (OPERATING) -65 °F to +176°F (-54°C to +80°C) (STORAGE)							
TEMP. COEFFICIENTS		ZERO: < ±0.001% Linear Range/°F    SENSITIVITY: < ±0.01% /°F							
SENSITIVITY	V/in./V ±10%	4	4	4	4	4	2	1	0.5
PHASE ANGLE	°	5	5	5	5	5	0	0	0
INPUT IMPEDANCE	Ohms	260	255	250	245	480	320	300	355
INPUT RESISTANCE	Ohms DC	36	36	36	36	60	22	30	40
OUTPUT RESISTANCE	Ohms DC	135	135	135	135	205	210	170	185
NULL VOLTAGE	% V Ex. Max.	0.2	0.25	0.3	0.4	0.8	1	1	1
MAXIMUM EXCITATION		15 VRMS							

## DIMENSIONAL DIAGRAM



## SCHEMATIC



## SPECIFICATIONS - MECHANICAL

MODEL	UNITS	0330-0000	0331-0000	0332-0000	0333-0000	0334-0000	0335-0000	0336-0000	0337-0000
<b>TOTAL LENGTH A</b>	Inches (mm)	2.45 (62.2)	2.45 (62.2)	2.45 (62.2)	2.45 (62.2)	2.93 (74.4)	5.35 (136)	6.86 (174)	10.45 (265)
<b>SHAFT EXTENSION B</b>	Inches (mm)	0.65 (16.5)	0.65 (16.5)	0.65 (16.5)	0.65 (16.5)	0.83 (21.1)	1.22 (30.9)	1.69 (42.9)	2.60 (66.0)
<b>NULL POSITION C</b>	Inches (mm)	0.1 (2.54)	0.1 (2.54)	0.1 (2.54)	0.1 (2.54)	0.15 (3.81)	0.35 (8.89)	0.57 (14.5)	1.15 (29.2)
<b>SPRING FORCE @ NULL</b>	Lbs.	0.73	0.73	0.73	0.73	1.07	0.74	0.57	0.70
<b>FREQ. RESPONSE</b>	Hz	250	180	110	75	45	18	6	4

## ACCESSORIES

PART NUMBER	DESCRIPTION
A002-0041	Adapter for alternate contact tips: 5-60 Thread to 4-48 UNF-2B Thread
G000-0000	Contact Tip, AGD #7
G000-0008	Contact Tip, .30" Spherical O.D.; 5-60 Internal Threads. (Included with transducer)

## DC-DC OPERATION WITH OPTIONAL OSCILLATOR/DEMODULATOR

To facilitate prototyping, or in instances where the preference is a DC in - DC out system, any of the standard or High Temperature Series 330 can be used in conjunction with the Model 1000- 0014 Oscillator/Demodulator. Designed to work together, the DC system gives the same level of performance as provided by the AC LVDT alone. The high level DC output voltage can be directly

interfaced with analog circuits as well as data acquisition cards, PLCs, or A/D converters. Provisions for customizing the Model 1000-0014 to provide zero offsets and nonstandard gains allow a simple and cost effective method of tailoring a system to meet individual customer requirements.

## SYSTEM SPECIFICATIONS *(Combined Performance of LVDT and 1000-0014)*

MODEL	UNITS	0330-0000	0331-0000	0332-0000	0333-0000	0334-0000	0335-0000	0336-0000	0337-0000
<b>SIGNAL OUTPUT</b>	±VDC	0.2	0.4	1.0	2.0	4.0	5.0	5.0	5.0
<b>OUTPUT CURRENT</b>		±3 mA without distortion							
<b>OUTPUT RIPPLE</b>	VRMS	0.004	0.008	0.02	0.03	0.03	0.03	0.03	0.03
<b>POWER INPUT</b>		±14.5 to ±28 VDC @ ±100 mA Max., Input polarity protected							
<b>TEMPERATURE RANGE</b>	1000-0014	+32°F to +158°F (0°C to +70°C) (Operating) -65°F to +257°F (-54°C to +125°C) (Storage)							
<b>TEMP. COEFFICIENTS</b>	1000-0014	Zero < ±0.00035 VDC/°F Sensitivity < ±0.02%/°F							

## HIGH TEMPERATURE VERSION: $-65^{\circ}\text{F}$ to $+400^{\circ}\text{F}$ ( $-55^{\circ}\text{C}$ to $+204^{\circ}\text{C}$ )

The High Temperature version of the Series 330 is identical to the standard version except for the following:

1. Operating Temperature is  $-67^{\circ}\text{F}$  to  $+400^{\circ}\text{F}$  ( $-55^{\circ}\text{C}$  to  $+204^{\circ}\text{C}$ );
2. Units terminate in six #30 AWG Teflon insulated leads (3 ft. long);
3. Some materials such as the epoxy, solder, and magnet wire have been replaced by their high temperature equivalents;
4. Electrical characteristics of certain units have been changed as described in the accompanying table.

MODEL #	STROKE ±Inches (mm)	PHASE ANGLE Degrees	INPUT IMPEDANCE Ohms	INPUT RESISTANCE Ohms	OUTPUT RESISTANCE Ohms
0330-0001	0.005 (0.13)	No Change	No Change	No Change	No Change
0331-0001	0.010 (0.26)	No Change	No Change	No Change	No Change
0332-0001	0.025 (0.64)	No Change	No Change	No Change	No Change
0333-0001	0.05 (1.27)	No Change	No Change	No Change	No Change
0334-0001	0.10 (2.54)	No Change	No Change	No Change	No Change
0335-0001	0.25 (6.35)	6	315	17	285
0336-0001	0.50 (12.7)	6	325	22	230
0337-0001	1.00 (25.4)	7	450	45	275

*Note: all electrical and physical specifications are the same as the standard Series 330 LVDTs.*

# Series 350

## General Purpose DC Gaging LVDTs

The Series 350 DC Gaging Transducers are an integrated package consisting of a spring loaded spindle, precision linear variable differential transformer, a solid state oscillator, and a phase-sensitive demodulator. The transducer is designed for excellent linearity, infinite resolution, and high sensitivity. Input and output circuits are electrically isolated from each other and from the coil assembly housing, making them usable directly in floating or ground return systems. DC indicators, recorders, and control systems can usually be driven directly by the large DC output. The spindle, when displaced axially within the coil assembly, produces a voltage change in the output directly proportional to the displacement.



### KEY FEATURES

Ranges from  $\pm 0.05"$  to  $\pm 3.0"$

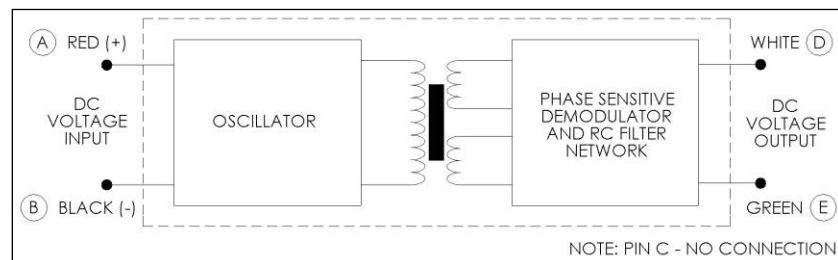
Non-linearity < 0.5%

High Sensitivity

6 to 28 VDC Excitation

### SPECIFICATIONS - ELECTRICAL

MODEL NUMBER	0350-0000	0350-0010	0351-0000	0351-0006	0352-0000	0353-0000	0354-0000	0355-0000	0356-0000
WORKING RANGE, ±INCHES (MM)	0.050 (1.27)	0.050 (1.27)	0.10 (2.54)	0.10 (2.54)	0.25 (6.35)	0.50 (12.7)	1.00 (25.4)	2.00 (50.8)	3.00 (76.2)
MECH. TRAVEL, INCHES (MM)	0.16 (4.06)	0.14 (3.56)	0.31 (7.87)	0.31 (7.87)	0.75 (19.1)	1.25 (31.8)	2.25 (57.2)	4.25 (108)	6.25 (159)
INPUT, VDC	6.0 Min. to 28 Max.								
NOMINAL F.S. OUTPUT ± VDC (tested with load impedance simulating open circuit)									
@ 6V INPUT	1.2	1.2	2.1	2.0	1.6	3.0	4.3	4.0	3.1
@ 15V INPUT	3.0	3.0	5.4	5.8	4.2	7.5	10.8	10.0	7.8
@ 24V INPUT	5.0	5.0	9.0	9.4	7.0	12.5	18.0	16.0	13.0
@ 28V INPUT	5.6	5.8	10.1	10.4	7.9	14.0	20.3	18.7	14.6
INPUT CURRENT	6.3mA @ 6V Input to 48mA @ 28V Input								
LINEARITY % FULL SCALE OVER TOTAL WORKING RANGE	±0.50								
INTERNAL CARRIER FREQUENCY Hz NOM. GREATER THAN:	13000	13000	12000	14000	3600	3400	3200	1500	1400
% RIPPLE (RMS) NOM.	0.7	0.7	0.7	0.7	0.8	0.8	0.8	1.0	1.0
OUTPUT IMPEDANCE, Ohms	2500	2500	3500	3500	5200	5500	5600	5500	5600
TEMPERATURE RANGE	-65°F to +200°F (-54°C to +93°C)								
RESOLUTION	Infinite								



#### NOTES:

1. Polarity of excitation must be observed for proper function. Reversal will not damage the unit.
2. Load impedance of 50 KOhms minimum required for proper operation.
3. Output polarity will be positive on one side of null, negative on the other side of null.
4. Transducers are calibrated at 24 VDC.
5. White lead is more positive with respect to the Green lead when the core is moved toward the lead end.

## SPECIFICATIONS – MECHANICAL

MODEL NUMBER	UNITS	0350-0000	0350-0010	0351-0000	0351-0006	0352-0000	0353-0000	0354-0000	0355-0000	0356-0000
FIGURE #		1	3	1	3	2	2	2	2	2
TOTAL LENGTH, A	INCHES (MM)	3.01 (76.5)	2.63 (66.8)	3.52 (89.4)	3.74 (95.0)	9.89 (251)	10.89 (277)	15.31 (389)	25.43 (646)	35.02 (890)
SHAFT EXTENSION, B	INCHES (MM)	0.41 (10.4)	0.39 (9.91)	0.56 (14.2)	0.56 (14.2)	1.42 (36.1)	1.42 (36.1)	2.42 (61.5)	4.75 (121)	6.75 (172)
TIP FORCE, MAX	GRAMS	57	57	170	85	312	425	482	1276	1361
WEIGHT	GRAMS	200	104	207	125	239	275	372	625	845

FIGURE 1

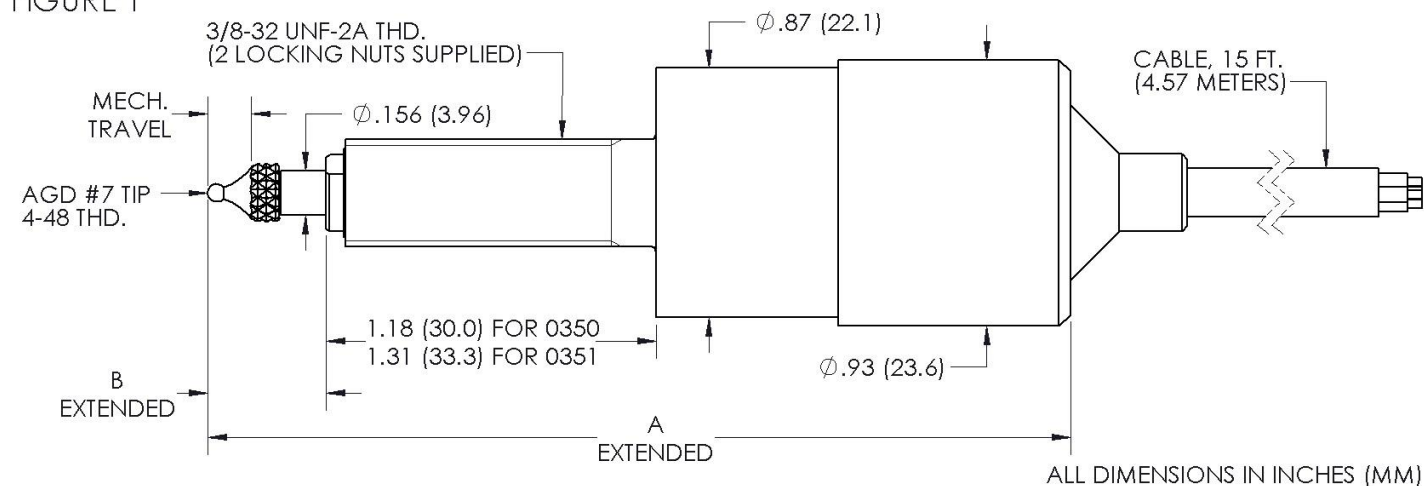


FIGURE 2

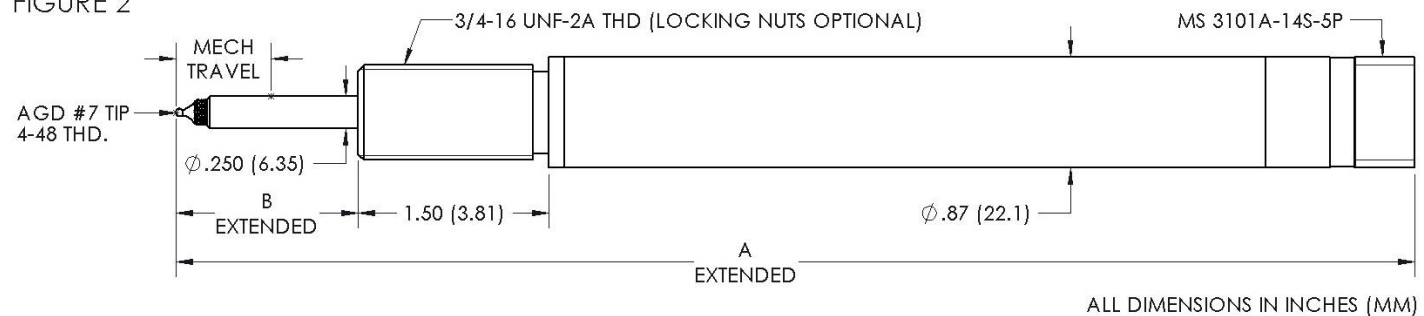
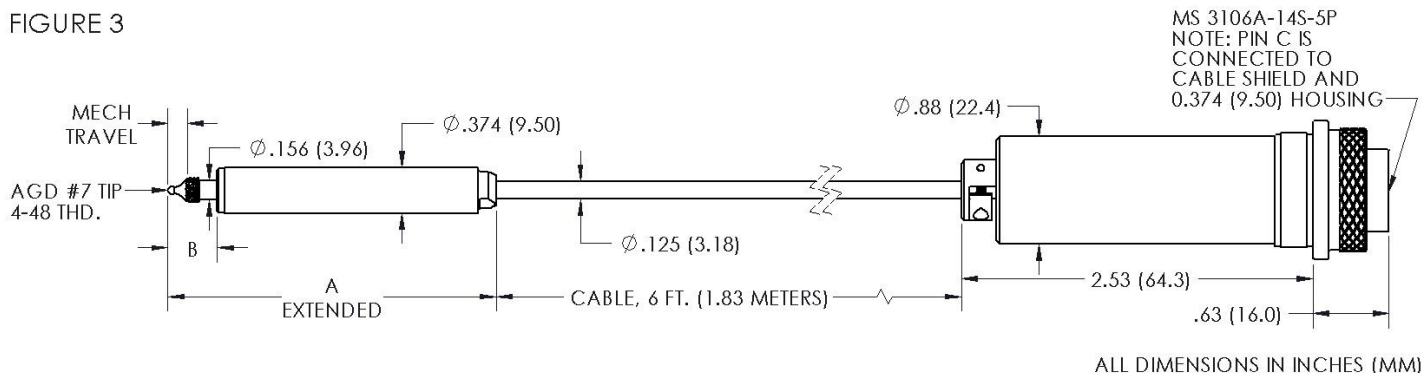
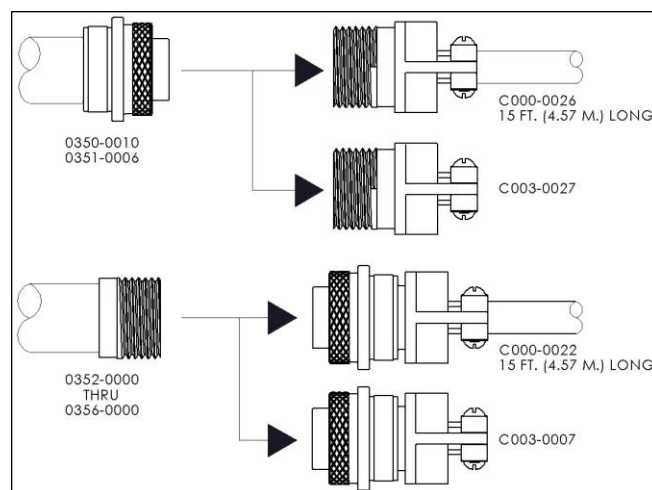


FIGURE 3



## ACCESSORIES

PART NUMBER	DESCRIPTION
C003-0007	Mating connector assembly: Connector MS3106A-14S-5S (Mates with MS3101A-14S-5P). Cable clamp and strain relief.
C000-0022	Cable assembly: 15 FT of 4 conductor, 22 AWG vinyl cable terminated with C003-0007. (NOTE: Operating temperature for cable is -22°F TO +176°F); COLOR CODE: A – RED, B – BLACK, D – WHITE, E – GREEN
C003-0027	Mating connector assembly: connector MS3101A-14S-5S (Mates with MS3106A-14S-5P). Cable clamp and strain relief.
C000-0026	Cable assembly: 15 FT of 4 conductor, 22 AWG vinyl cable terminated with C003-0007. (NOTE: Operating temperature for cable is -22°F TO +176°F); COLOR CODE: A – RED, B – BLACK, D – WHITE, E – GREEN
G000-0000	Replacement AGD #7 gaging tip (Included with transducer).
N001-0025	¾ X 16 UNF-1B Hex jam nut



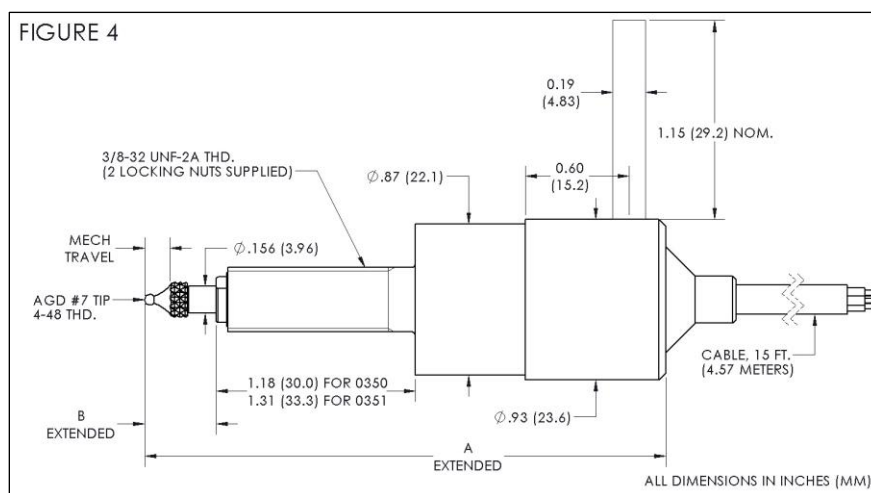
## SALES OPTIONS

Option #	DESCRIPTION
X0027	Reverse spring; spring will be in retracted position. Applies to Models 0350-0000, 0350-0010, 0351-0000 and 0351-0006.
X0031	Special length interconnecting cable (10 FT. Max.). Applies to Models 0350-0010 and 0351-0006.
X0038	Alternate spring selection (not available for Models 0355-0000 and 0356-0000). See following page for spring model numbers and corresponding tip force.
<b>The following options apply only to Models 0352-0000 through 0356-0000</b>	
X0013	Vented housing and LVDT for high pressure applications.
X0014	Terminate in 7" leads instead of connector.
X0028	Reverse spring; spring will be in retracted position.
X0029	Air Purge port for maintaining positive air pressure in the unit.
X0030	Non-rotating shaft.

## AIR-ACTUATED VERSIONS

In certain gaging applications, such as part inspection systems, it is desirable to have the shaft fully retracted and actuated by the application of positive air pressure.

There are two models available with this option, Models 0350-0012 and 0351-0012. These units are physically identical to the standard -0000 versions, except the spring is reversed to keep the shaft retracted, and a 3/16" stainless steel air inlet is added at the cable end. Filtered shop air can be used to actuate the shaft at user defined intervals.



MODEL	UNITS	0350-0012	0351-0012
STROKE	±INCHES (MM)	0.05 (1.27)	0.10 (2.54)
TOTAL LENGTH, A	±INCHES (MM)	3.01 (76.5)	3.52 (89.4)
SHAFT EXTENSION, B	±INCHES (MM)	0.41 (10.4)	0.56 (14.2)
MIN. AIR PRESSURE FOR COMPLETE ACTUATION	P.S.I.	10	20



## ALTERNATE SPRINGS TO BE USED IN OPTION X0038

The standard springs are designated by an asterisk\*. The tip force is given for operation within the linear region of the transducer at full extension (TF-), full compression (TF+), and the null position (TF<sub>0</sub>). The tip forces were determined while the transducer was in the vertical position, pointing down. To determine the tip force when the unit is in a horizontal position, simply subtract the shaft assembly weight from the tip force. To determine the tip force when the unit is vertical, and pointing up, subtract twice the shaft assembly weight. The weight of the shaft assembly includes both the weight of the shaft and the return spring(s). Both the tip forces and the weight of the shaft assembly are given in grams. To convert this value to ounces, divide by 28.38.

MODEL	SHAFT RETURN SPRING		TIP FORCE VERSUS POSITION (gm)			SHAFT ASSEMBLY (gm)
	SPRING	QTY.	TF-	TF <sub>0</sub>	TF+	
0350-0000	S006-0001	1	8.5	9.9	11.5	3
	S006-0000*		33	41	53	3
	S006-0023		57.5	79	96.5	3.1
	S006-0022		130	204	287	3.2
	S006-0021		350	462	616	3.1
0350-0010	S006-0001	1	7.5	9.2	11	2.2
	S006-0000*		35	42.5	54	2.2
	S006-0023		64	82.5	101	2.3
	S006-0022		133	220	300	2.4
	S006-0021		378	510	658	2.3
0351-0000	S006-0001	1	9.5	11.5	13.5	3.8
	S006-0000*		37.5	45	57	3.8
	S006-0023		63.1	87	109	3.8
	S006-0022		161	240	332	4
	S006-0021		406	532	714	3.9
0351-0006	S006-0001	1	9	11.5	13.5	3.8
	S006-0000*		31	45	53	3.9
	S006-0023		50	70	89	3.9
	S006-0022		131	193	275	4.1
	S006-0021		339	440	500	4
0352-0000	S006-0020	1	61.5	96.7	114.3	25.8
	S006-0012		114.3	161	205.1	26
	S006-0004*		205	310	408.5	26
	S006-0008		448	588	728	26
0353-0000	S006-0020	1	96.7	169.9	222.7	26.5
	S006-0012		143.6	210.9	392.6	26.5
	S006-0004*		190.5	427.8	596.5	26.5
	S006-0008		495.2	764.7	1060.7	26.5
0354-0000	S006-0020	2	51.5	108.6	157.1	42.5
	S006-0012		93.5	140	224.5	42.5
	S006-0004*		112.5	182	448.6	42.5
	S006-0008		235.2	562.8	974.4	4.26
0355-0000	S006-0008*	3	357.5	714.9	1265.8	72.7
0356-0000	S006-0008*	5	427.8	688.5	1295.1	115.4

NOTE: \*Standard Spring