GEMCO®

Series 958 Compact Housing LDT

Compact Housing Linear Displacement Transducer

Installation Manual

958A Compact Housing

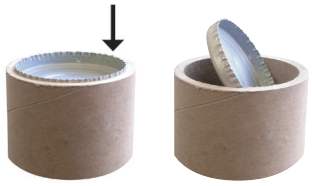
ABSOLUTE PROCESS CONTROL
KNOW WHERE YOU ARE... REGARDLESS

AMETEK®
FACTORY AUTOMATION

Contents

NOTE: Ametek has checked the accuracy of this manual at the time it was approved for printing. This manual may not provide all possible ways of installing and maintaining the LDT. Any errors or additional possibilities to the installation and maintenance of the LDT will be added in subsequent editions. Comments for the improvement of this manual are welcome.

Unpacking
Carefully remove the contents of the shipping carton and check each item on the packing slip before destroying the packing materials. Any damage must be reported to the shipping company. If you do not receive all of the parts, contact Ametek at 800-635-0289 (US and Canada) or 248-435-0700 (International).
Most probes are shipped in a Tube. To remove the metal end cap, use a large, flat blade screw driver or a metal rod and tap on the inner edge of the cap until it pivots. Grab the cap and pull it out. Use caution as the edge of the metal cap may be sharp.
If you have an RMA warranty claim, pack the probe in a shipping tube or with stiff reinforcement to prevent the probe from being bent in transit.



Chapter 1: 958A Compact Housing Overview

We know today's industrial challenges are extreme, so we designed and built a sensor to meet and exceed these demands, regardless of the application or environment. Innovation, proprietary technology and decades of experience were the key to the development of our 958A Compact Housing Linear Displacement Transducer.

The 958A Compact Housing was designed with the hydraulic cylinder market in mind. The 958A is a rugged, accurate, programmable zero and span, auto-tuning, non-contact linear displacement transducer in a Compact Housing rod-style package. The Compact Housing is less than 1.2" in depth, which allows the unit to be installed in applications where traditional Rod style transducers will not fit or in applications where customers are looking to ***simplify installation and serviceability*** of the sensor. The transducer is made entirely from Stainless Steel and utilizes our field-proven Magnetostrictive technology to give absolute analog position feedback, accurate to 0.04% of the programmable sensing distance.

This sensor is built to withstand the most severe environmental conditions and is completely absolute. This means that power loss will not cause the unit to lose position information or require re-zeroing. The non-contact design allows this device to be used in highly repetitive applications without mechanical wear.

The sensor can operate over a wide range of power (8 to 30VDC at 1.6 watts). A variety of different analog outputs with field programmable Zero & Span points are available to meet your needs. The Compact Housing LDT features our auto-tuning capability, which allows the unit to sense a magnet other than the standard ring magnet, and adjust its signal strength accordingly.

Units can be ordered in English or metric span lengths from 2" to 100" (50mm to 2540mm), and come standard with either integral cable assemblies or M12 style connectors.

The 958A units offer a unique diagnostic capability. When the magnet is present and within the programmed range, the unit will output a voltage or current within its selected range (depending on location of magnet). If the magnet moves .050" beyond the programmed Zero or Span points the output will indicate this with a voltage or current outside of the selected range. If the magnet signal is lost the unit will indicate this with a "Loss of Magnet" voltage or current. ***See chart below for details on Fault Conditions.*** All units come 100% calibrated from the factory and do not need to be re-programmed unless desired.

Voltage Output — **Specified at time of order (i.e. in Part Number)**

V0	Range	0 to +10VDC
	Resolution	16 bits (0.0015% of span)
	Fault Condition	Loss of Magnet 10.2V, below or above programmed range -0.1V or 10.1V

V1	Range	+10 to 0VDC
	Resolution	16 bits (0.0015% of span)
	Fault Condition	Loss of Magnet 10.2V, below or above programmed range 10.1V or -0.1V

V2	Range	0 to +5VDC
	Resolution	15 bits (0.0031% of span)
	Fault Condition	Loss of Magnet 5.2V, below or above programmed range -0.1V or 5.1V

V3	Range	+5 to 0VDC
	Resolution	15 bits (0.0031% of span)
	Fault Condition	Loss of Magnet 5.2V, below or above programmed range 5.1V or -0.1V

V4	Range	0.25 to +4.75VDC
	Resolution	~15 bits (0.0034% of span) (14.85 bits)
	Fault Condition	Loss of Magnet 5.2V, below or above programmed range -0.1V or 5.1V

V5	Range	+4.75 to 0.25VDC
	Resolution	~15 bits (0.0034% of span) (14.85 bits)
	Fault Condition	Loss of Magnet 5.2V, below or above programmed range 5.1V or -0.1V

V6	Range	0.5 to +4.5VDC
	Resolution	~15 bits (0.0034% of span) (14.68 bits)
	Fault Condition	Loss of Magnet 5.2V, below or above programmed range -0.1V or 5.1V

V7	Range	+4.5 to 0.5VDC
	Resolution	~15 bits (0.0034% of span) (14.68 bits)
	Fault Condition	Loss of Magnet 5.2V, below or above programmed range 5.1V or -0.1V

Curent Output — **Specified at time of order (i.e. in Part Number)**

C2	Range	20 to 4mA
	Resolution	15.7 bits, calibrated for 3.5-21mA (0 - 21mA, 16 bits)
	Fault Condition	Loss of Magnet 3.8mA, below or above programmed range 20.1mA or 3.9mA

C4	Range	4 to 20mA
	Resolution	15.7 bits, calibrated for 3.5-21mA (0 - 21mA, 16 bits)
	Fault Condition	Loss of Magnet 3.8mA, below or above programmed range 3.9mA or 20.1mA

All units can easily be changed in the field for reverse operation. See section 3.4 Setting Zero & Span Positions.

1.1: Dimension Drawing 958A Side Mount Connector Option

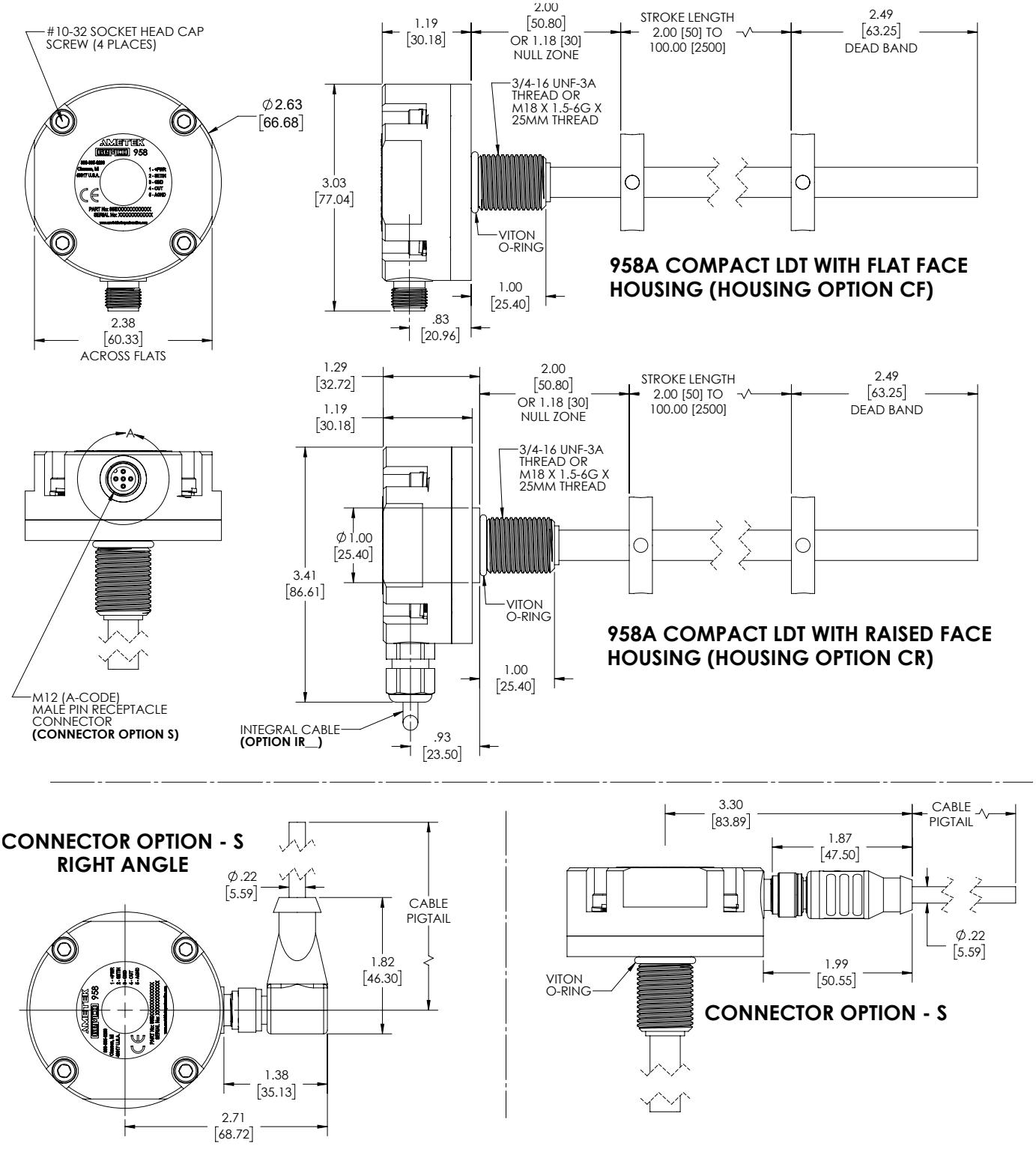


Figure 1-1: 958A Compact Housing – Side Mount Connector Option (PD-0126500)

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Dimensions – Compact Housing – Front Top Mount Connector Option

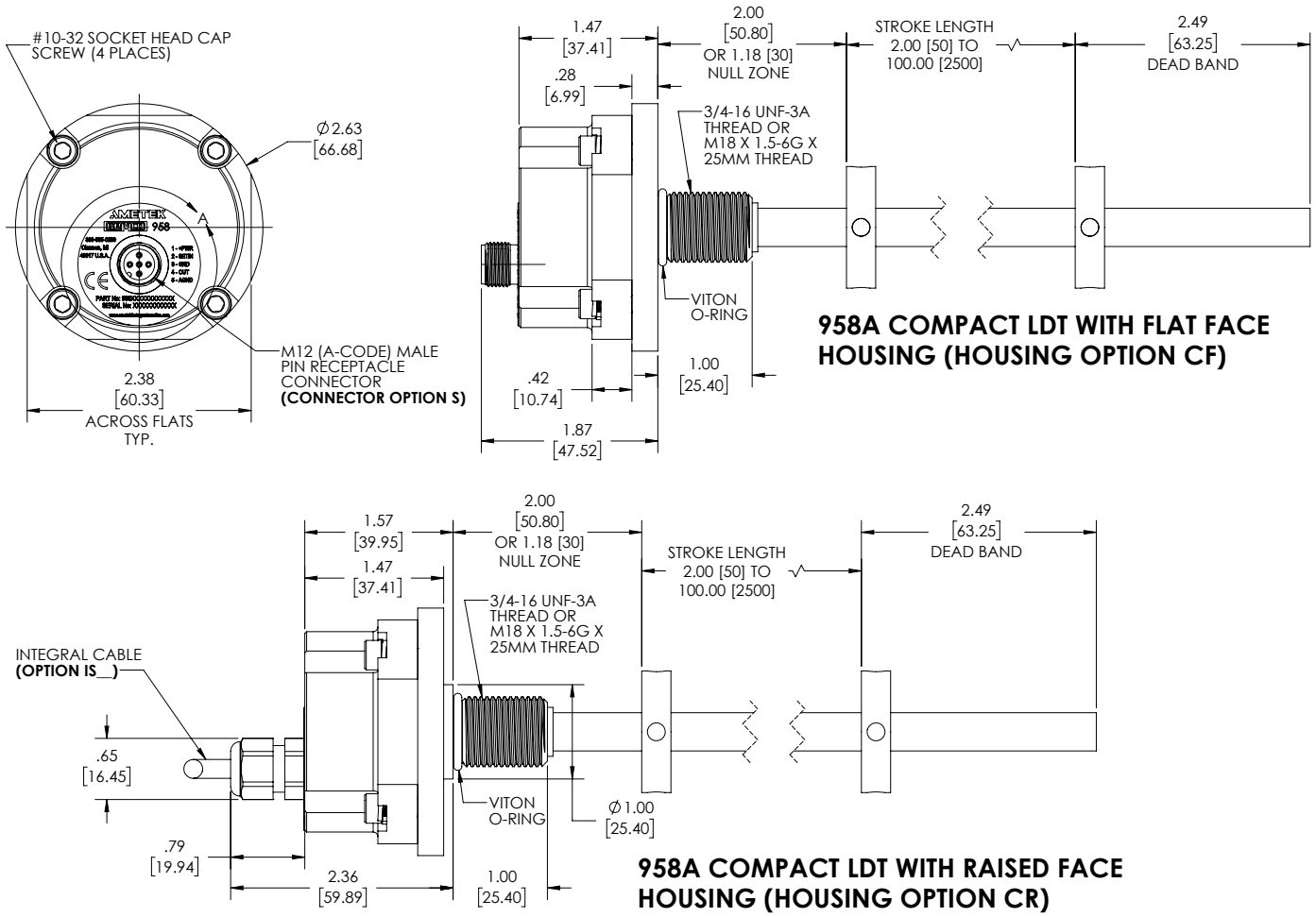

Figure 1-2: 958A Compact Housing – Front Top Mount Connector Option (PD-0126600)

Chapter 2: Installing the LDT

The 958A Compact Housing is designed for insertion into hydraulic cylinders and clevis style cylinders. The hydraulic cylinder must be prepped for a Rod Style Linear Transducer.

2.1: Installing the LDT in a Hydraulic Cylinder

Before installing an LDT in a hydraulic cylinder, note the following considerations. Items discussed in this section are found in Figures 2-1 and 2-2.

- There are 3 different magnet styles offered (see accessories page). When the magnet is installed in a ferrous material it is necessary to add a non-ferrous spacer between the magnet and piston. Non-ferrous materials, such as brass, copper, aluminum, non-magnetic stainless steel, or plastics, can be in direct contact with the magnet assembly and rod end without producing any adverse results. The magnet should not be closer than 1.18" (30mm) from the base of the LDT's hex head when the piston rod is fully retracted. In instances where space restraints exist, it may be required to countersink the magnet into the piston rod. Three magnets are available for mounting to the piston: the standard 1.29" in diameter (P/N SD0400800) four-hole magnet, the 1.0" cylinder magnet (P/N SD0410300) and our 17.4mm (04-588105) magnet. The SD0410300 and 04-588105 magnets are designed exclusively for countersunk mounting applications. These magnets must be secured with a snap ring.

- An O-ring is provided at the base of the LDT's mounting hex for pressure sealing. The O-ring seal was designed to meet Mil-Std-MS33656. Refer to SAE J514 or SAE J1926/1 for machining of mating surfaces.

- A chamfered rod bushing in front of the magnet may be required. It is recommended that a chamfered rod bushing be used with LDTs having a rod 60.0" or longer. This bushing will help prevent wear on the magnet assembly (wear occurs as the piston retracts from extended lengths). This rod bushing should be manufactured from a high wear polymer, such as Teflon®.

- It is recommended the bore for the cylinder piston rod have an inside diameter of at least 0.50". The LDT rod has an outside diameter of 0.405". Use standard practices for machining and mounting these components. Consult the cylinder manufacturer for details on applicable SAE or military specifications.

It may be necessary to perform machining and mounting operations on the hydraulic cylinder before installing the LDT. Consult the information and specifications provided by the cylinder manufacturer before beginning the following steps:

1. Unscrew the LDT's jam nut from the threads protruding from the head assembly.

2. Position the non-ferrous spacer against the piston face, followed by the magnet, and then the chamfered rod bushing if the LDT's rod is 60.0" or longer in length.

3. Insert non-ferrous screws through the chamfered rod bushing (if used), magnet, and non-ferrous spacer. Secure items by tightening screws.

4. If the leading edge of the magnet will come closer than 1.18" (30mm) from the base of the LDT's hex head when the piston rod is fully retracted, it will be necessary to counterbore the magnet assembly into the piston rod. Refer to LDT part number to determine if the 1.18" (30mm) or 2.0" (50.4mm) Null Band was ordered.

5. Insert the LDT's rod into the hole of the hydraulic cylinder's mounting bracket. The protective Plug may need to be removed from the hydraulic cylinder before inserting the LDT. The end cap should contain a 3/4-16 UNF-2B threaded hole (M18 x 1.5 for metric units). Screw the LDT into this hole using the 2.38" flats across the LDT's back cover.

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6. Once inserted into the hydraulic cylinder, the LDT's cover can be rotated +/- 180° to align where the connector exists the sensor.

   a. To rotate the connector / cover you will need a 5/32" Allen hex wrench. Remove the four 10-32 socket head cap screws from the back cover. Gently rotate the cover up to +/-180° to the desired position. *Damage can occur to the internal wiring if the cover is rotated greater than 180°*

   b. Replace the four 10-32 socket head cap screws, torque to 33.1 in-lbs.

   See Figure 2-1 and 2-2.

Figure 2-1: 958A Compact Housing Hydraulic Cylinder Installation Drawing

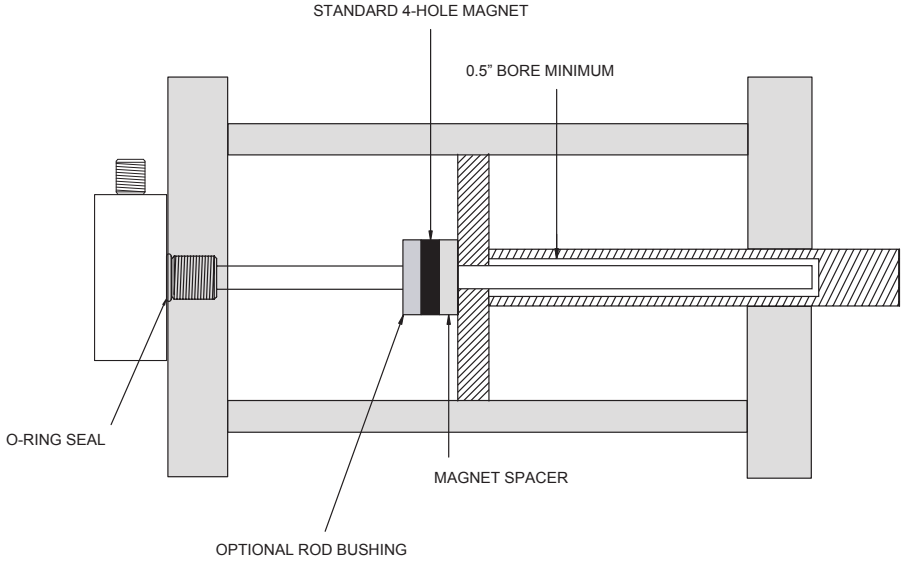


Figure 2-2: Port Details (SAE J1926/1)

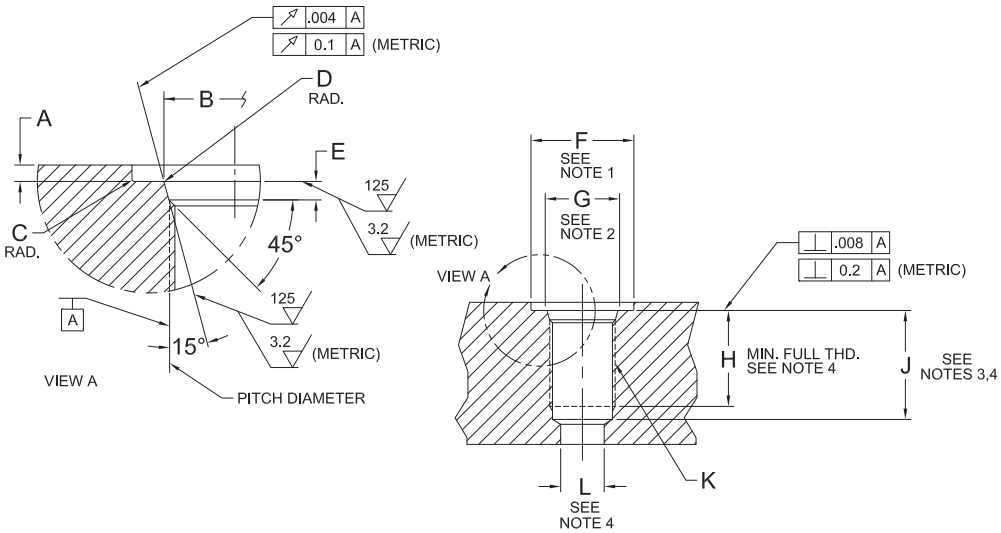
NOTES:

1. IF FACE OF PORT IS ON A MACHINED SURFACE, DIMENSIONS "A" AND "F" NEED NOT APPLY, PROVIDED RADIUS "D" IS MAINTAINED TO PREVENT DAMAGE TO O-RING DURING ASSEMBLY.

2. MEASURE PERPENDICULARITY TO DATUM "A" AT THIS DIAMETER.

3. THIS DIMENSION APPLIES WHEN TAP DRILL CANNOT PASS THROUGH ENTIRE BOSS.

4. THIS DIMENSION DOES NOT CONFORM TO SAE J1926-1 OR ISO 6149-1.



THREAD "K"	A (MAX.)	φB	C (MAX.)	D	E	φF (MIN.)	φG (MIN.)	H	J	φL
3/4-16 UNF-2B	.094	.813 ± .002	.015	.006 ± .002	.106 ± .008	1.18	.866	1.100	1.250	.500
M18 X 1.5	2MM	19.9/19.8MM	0.4MM	0.2/0.1MM	2.8/2.4MM	26MM	24.5MM	14.5MM	17MM	12.7MM

PORT DETAIL (SAE J1926-1)

Chapter 3: Connections and Wiring

Once the LDT has been installed, wiring connections can be made. Units are available with Integral cable assemblies or a 5 pin M12 (A-Code) connector. Refer to part numbering on unit in question for proper wiring. See Appendix A for part numbering grid. See Figure 3-2 for connection options.

Once the LDT has been installed, wiring connections can be made. On units with the M12 connector option it is recommended to use an industry standard 5 pin 12mm Euro style cordset with a shield tied to the coupling nut. On units with our Integral Cable option the shield is tied directly to the LDT's housing. To reduce electrical noise the shield must be properly used. Connect the cable's shield to the controller system Ground. Always observe proper grounding techniques and isolate high voltage (i.e. 120/240VAC) from low voltage (i.e. 24 VDC cables).

WARNING: Do not route the LDT cable near high voltage sources.

Warning: Do not use molded cordsets with LEDs!

It is preferable that the cable between the LDT and the interface device be one continuous run. If you are using a junction box, it is recommended that the splice junction box be free of AC and/or DC transient-producing lines. The shield should be carried through the splice and terminated at the interface device end.

NOTE: When grounding the LDT, a single earth ground should be connected to the Power Supply Common (circuit ground). The LDT Power Supply Common should be connected to the Power Supply Common (-) terminal. The LDT power supply (+VDC) should be connected to the power supply positive terminal (+). The LDT cable shield should be tied to earth ground at the power supply. The LDT analog common should not be connected to earth ground and should be used for connection to interface devices only.

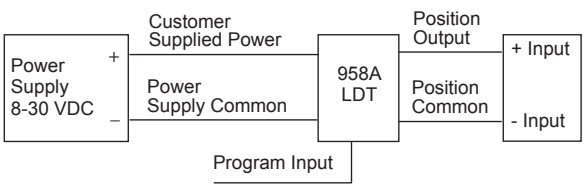
The 958A offers up to 16-Bits of resolution, and is fully programmable over the entire active stroke length. Keep in mind that there is a 1.18" (30mm) or a 2.0" (50.8mm) Null Zone at the connector end of the LDT and a 2.49" Dead Band at the other end of the LDT that the magnet must stay out of at all times. The units come fully programmed from the factory and do not require re-programming unless desired. Refer to part number on label for Null dimensions.

The analog output is referenced to the analog common terminal and should not be referenced to any of the other common terminals. For wiring, see Figure 3-1. For programming Zero and Span, See Section 3.4.

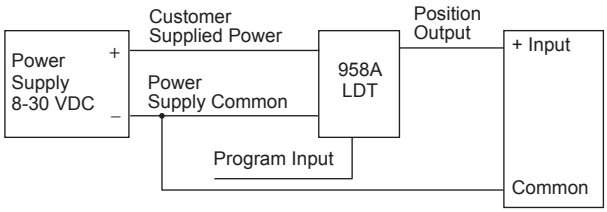
3.1: Wiring

Figure 3-1 shows two common methods for wiring the 958A to a customer supplied interface device, such as a PLC or motion controller. The two different methods are commonly referred to as Single Ended Input and Differential Input. Differential Input is the preferred wiring method.

With the Differential Input, the Analog Common wire is connected to the customer supplied input device and the Power Supply Common is wired separately to the customers supplied power source. When wired using the Differential method, the electrical noise and voltage offset errors produced by the currents running through the Power Supply Common are eliminated. The Power Supply Common and Analog Common are internally connected inside of the 958A LDT.



Differential Input
(Preferred Method)



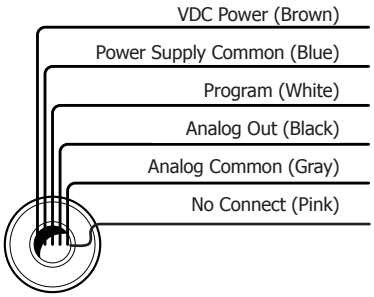
Single Ended Input

Figure 3-1: Wiring – Single Ended vs. Differential

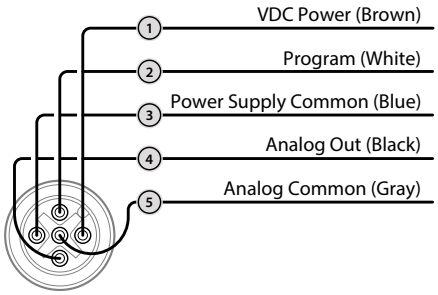
The 958A-C is current sourcing, which allows the current to flow from the LDT into the user's equipment.

3.2: Pinouts and Wiring

There are two different connection options. Refer to part numbers on unit in question for proper wiring.



(C✻) Integral Cable



M12 – 5 Pin (A Code)

Figure 3-2: Pinouts and Wiring

Cable Specifications				
Cable Type	**Gauge**	**Jacket**	**Temp**	**Bend Radius**
Multi-conductor Shielded	26	PUR	-40° to 90°C	Fixed Applications 1.05" Moving Applications 3.15"

3.3: Features

Automatic Gain Control

The Automatic Gain Control feature will automatically search and find the magnet on power up and adjust the signal strength to the optimum setting. If power is applied without a magnet on the LDT, the LDT will go into a fault condition and transmit a voltage or current outside of the programmed range. See Chapter 1: 958A Overview, for list of fault conditions and outputs. To correct this, turn power off and place magnet within the active stroke area, re-apply power.

3.4: Setting Zero & Span Positions

As an option the 958A can be ordered with Programmable Zero & Span positions. See page 11, part numbering to see if this option field was selected. Note: If option “P” or “B” was not selected in part number configuration, the unit is non-programmable.

All units come fully programmed from the factory and do not require re-programming unless desired. The units are 100% absolute and will not lose programmed parameters on power loss. The Zero and Span points can be programmed in any order and anywhere within the LDT’s active sensor area.

NOTE 1: Zero or Span can be adjusted individually without setting the other.

NOTE 2: Zero = 0V on 0-10 VDC, 0V on 0-5 VDC, .25 on .25-4.75 VDC, .5 on .5-4.5 VDC units and 4mA on 4-20mA units.

There is a timing sequence that is used to unlock the probe for programming. This is to ensure that the Zero or Span positions cannot be accidentally re-programmed by someone in the field.

Manual Setting of Zero & Span

To set the Zero and Span position, follow these steps:

1. Apply power to the LDT.
2. Place magnet assembly where Zero is to be located, but within the active region of the probe.
3. Short the Program Input pin to the Power Supply Common for 4 seconds. Remove the short for 1 second. Within 5 seconds, short the Programming Input pin to the Power Supply Common. This completes the Zero programming process.
4. Place magnet assembly where Span is to be located, but within the active region of the probe.
5. Short the Program Input pin to the Power Supply Common for 4 seconds. Remove the short for 1 second. Within 5 seconds, short the Programming Input pin to the Power Supply +VDC.

This completes the programming process.

NOTE: The LDT must be unlocked to program the Zero and unlocked again to program the Span. Once either the Zero or Span is programmed the LDT will go back into the locked mode.

WARNING: During normal operation, electrically insulate the Program wire to prevent accidental setting of Span.

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Appendix A: Part Numbering

The 958A Compact Housing LDT is available with a number of analog outputs and connector options. The numbering scheme below will break down all available options. The “Unit of Measure” field will allow you to select either inch or millimeter threads as well as stroke lengths.

958A — V0 — 0120 — E — CR — S — X

Output	
V0	Voltage Output 0 - 10
V1	Voltage Output 10 - 0
V2	Voltage Output 0 - 5
V3	Voltage Output 5 - 0
V4	Voltage Output .25 - 4.75
V5	Voltage Output 4.75 - .25
V6	Voltage Output .5 - 4.5
V7	Voltage Output 4.5 - .5
C2	Current Output 20 - 4mA
C4	Current Output 4 - 20mA

Stroke
Strokes from 2" to 100" in .1" or 5 mm increments Entered as a 4 digit number ie. 0120E is 12" stroke ie 0100M is 100mm stroke

Unit of Measure	
E	English (inches)
M	Metric (millimeters)

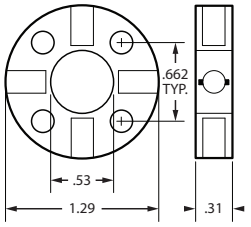
Housing Type	
CR	67 mm Housing - 10 mm Rod mounting threads match unit of measure – Raised Face
CF	67 mm Housing - 10 mm Rod mounting threads match unit of measure – Flat Face

Connector	
S	M12 – 5 Pin Side Mount Connector
F	M12 – 5 Pin Face Mount Connector
IS_	Integral Cable – Straight exit Insert length in meters Available in 2, 5 and 10 meter lengths
IR_	Integral Cable Assembly – Right angle exit Insert length in meters Available in 2, 5 and 10 meter lengths

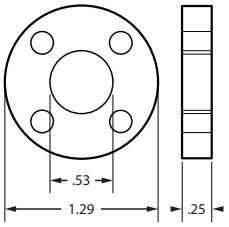
Options	
X	No options – 1.18" (30mm) Null
A	No options – 2.0" Null
P	Programmable & Zero Span – 1.18" Null
B	Programmable & Zero Span – 2.0" Null

Accessories – Magnets and Cables

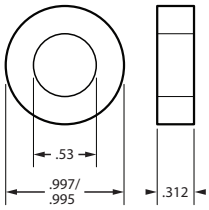
There are 3 magnet choices available for the 958 Series. Magnets and magnet spacers must be ordered as separate line items.



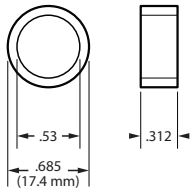
Standard 4 Hole Magnet
P/N: SD0400800



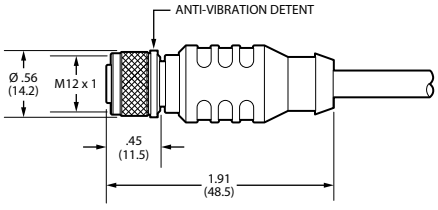
Non-Ferrous Spacer for
4 Hole Magnet
P/N: M0822400



1" Cylinder Magnet
P/N: SD0410300



17.4 mm Cylinder Magnet
P/N: 04588105



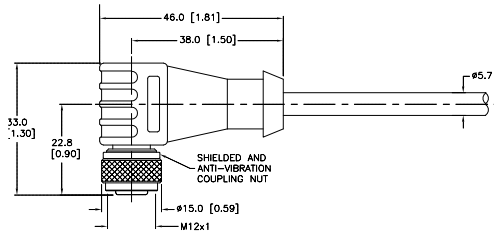
Straight Connector

Cable M12-A Straight to flying leads – Shielded

2 meter: 949045L2M

5 meter: 949045L5M

10 meter: 949045L10M



Right Angle Connector

Cable M12-A Right Angle to flying leads – Shielded

2 meter: 949046L2M

5 meter: 949046L5M

10 meter: 949046L10M

Appendix B: Specifications

General Specifications	
Displacement	2" to 100" (50mm to 2540mm) in .1" or 5mm increments

Performance Specifications - Measurement	
Linearity	+/-0.04% of Span or +/-0.008", whichever is greater
Hysteresis	0.001" maximum
Repeatability	Equal to Resolution of output signal, +/-0.01% of Span or 0.001", whichever is greater
Update Time	0.5 ms minimum, proportional to length of LDT - not to exceed 4ms

Null & Dead Bands	
Null	1.18" (30mm) or 2.0" (50.8mm) – Part number dependent
Dead	2.49" (63.25mm) from end of rod

Mechanical Specifications - Housing	
Material - Housing	Stainless Steel 1.4404 / AISI 316
Diameter	2.63" (66.8mm)
Length (width)	1.19" (30.18mm) or 1.47" (37.41mm) Housing dependent
Guide Tube Material	Stainless Steel 1.4404 / AISI 316/316L
Diameter - Guide Tube	10mm (10.29mm actual)
Guide Tube Pressure	
Continuous	5,076 PSI (350 bar)
Spike	10,000 PSI (689 bar)

Temperature	
Head - Electronics	-40°C to + 85°C
Guide Tube	-40°C to + 105°C
Storage	-40°C to + 105°C

Shock & Vibration	
Shock	1,000G, single hit (per IEC 60068-2-27)
Vibration	30G, 10Hz - 2kHz (per IEC 60068-2-6)

Ingress Protection	
Protection level	IP68 (per EN 60529)

Electrical Specifications	
Power Consumption	1.6 Watt maximum (50mA @ 24VDC typical)
Input Voltage	8 to 30VDC

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Protection	
Polarity	Reverse polarity protected
Overvoltage	Transient overvoltage protection to +33VDC

Output Resolution	
0 to 10VDC	16 bits (0.0015% of span)
0 to 5VDC	15 bits (0.0031% of span)
0.25 to +4.75VDC	~15 bits (0.0034% of span) (14.85 bits)
0.5 to +4.5VDC	~15 bits (0.0034% of span) (14.85 bits)
4 to 20mA	15.7 bits, calibrated for 3.5-21mA (0 - 21mA, 16 bits)

Output Loading	
Voltage	2kΩ minimum
Current	500Ω maximum

Connection Options	
Integral Cable	Multi-conductor, 26 AWG, shielded, PUR jacket (-40ºC to +90ºC)
5 Pin - M12	5 pin -A-Code

Isolation	
Housing to any signal	500V

Approvals	
CE (Electromagnetic Compatibility)	2014/30/EU - When installed in grounded metal housing
RoHS 2	2011/65/EU
Electromagnetic compatibility - Part 6-4: Generic standards – Emission standards for industrial environments	EN61000-6-4
Electromagnetic compatibility (EMC) - Part 6-2: Generic standards – Immunity for industrial environments	EN61000-6-2
Agricultural and forestry machinery	ISO 14982:1998
Road vehicles - electrical disturbances from narrowband radiated electromagnetic energy — Part 5: Stripline	ISO 11452-5
Road vehicles - Electrical disturbances from conduction and coupling	ISO 7637-1/2/3
Earthmoving Machinery	ISO 13766
Industrial Trucks	EN 12895
Railway Applications	EN 50121-3-2

953 VMAX LDT

- Shock resistant to 1000Gs
- Vibration resistant to 30Gs
- Analog outputs, 0-10 VDC, +/-10 VDC, 0-5 VDC, +/-5 VDC, 4-20mA
- Digital output Start/Stop, Control Pulse, and Variable Pulse (PWM)
- SSI (Synchronous Serial Interface) 24, 25, or 26 Bit, Binary or Gray Code, Synchronous or Asynchronous Mode
- Removable cartridge
- IP68 rating
- Stroke length to 300"
- Input power range is 7 to 30 VDC
- Programmable zero and span
- Diagnostic Tri-Color LED

958A Embedded LDT

- Embedded Style LDT
- Shock resistant to 1,000 Gs
- Vibration resistant to 30 Gs
- Strokes from 2” to 100”
- Analog Outputs, 0 to 10VDC, 0.25 to 4.75VDC, 0.5 to 4.5VDC or 4-20mA
- 16-bit resolution
- Multiple connector options– M12 – 5 pin, Integral cables, bare leads
- IP68
- Programmable Zero & Span
- Diagnostics

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