R-Series Models RP and RH Sensors - Analog Output
Position, Speed, Speed with Direction
Single or Dual-Magnet Positions

- **Rugged industrial sensor**
- **Linear, absolute measurement**
- **LEDs for sensor diagnostics**
- **Non-contact sensing technology**
- **Non-linearity less than 0.01%**
- **Repeatability within 0.001%**
- **Direct Analog output, displacement + speed**
- **Dual magnet position measurement**
- **100% field adjustable Null and Span setpoints**

Parameters	Specifications
Measured variables:	Displacement, speed (magnitude), or velocity (with direction) for single or dual magnets
Resolution:	Position measurement: 16 bit; 0.0015% (minimum 1 µm) Speed measurement: 0.1 mm/s
Non-linearity:	< ± 0.01% full stroke (minimum ± 50 µm)
Repeatability:	< ± 0.001% full stroke (minimum ± 2.5 µm) Hysteresis: < 4 µm
Outputs:	Voltage: 0 to 10, 10 to 0, -10 to +10, +10 to -10 Vdc (minimum controller load >5k ohms) Current: 4(0) to 20 mA, 20 to 4(0) mA, (min./max. load 0/500 ohms)
Stroke length:	Profile style: 50 mm (2 in.) to 5080 mm (200 in.)
(Position Measurement	Rod style: 50 mm (2 in.) to 7620 mm (300 in.)
Range)	Update time: 0.5 ms up to 1200 mm, 1.0 ms up to 2400 mm, 2.0 ms up to 4800 mm, 5.0 ms up to 7620 mm stroke length.
Speed measurement:	Range: 0.025 - 10 m/s (1.0 - 400.0 in./s) Deviation: <0.5% Resolution: 0.1 mm/s (0.004 in./s) Update time: See position measuring range
Operating voltage:	+24 Vdc nominal: -15 or +20% Polarity protection: up to -30 Vdc Overvoltage protection: up to 36 Vdc Current drain: 100 mA typical Dielectric withstand voltage: 500 Vdc (DC ground to machine ground)

Parameters	Specifications (continued)
Operating conditions:	- 40 °C (-40 °F) to 75 °C (167 °F) Relative humidity: 90% no condensation Temperature coefficient: < 30 ppm / °C Setpoint adjustment, (Null/Span): 100% of electrical stroke length. Min. 25 mm (0.98 in.) distance between setpoints. For dual magnet outputs: Min 76 mm (3 in.) distance between magnets.
EMC test:	Emissions IEC/EN 50081-1, Immunity IEC/EN 50082-2, IEC/EN 61000-4-2/3/4/6, level 3/4 criterium A, CE qualified
Shock rating:	100 g (single hit)/IEC standard 68-2-27 (survivability)
Vibration rating:	15 g (30 g with HVR option)/ 10-2000 Hz/IEC standard 68-2-6
Connection type:	6-pin male D60 connector or integral cable
PROFILE STYLE (MODEL RP) SENSOR	
Electronic head:	Aluminum housing Diagnostic display (LED's located beside connector/cable exit)
Sealing:	IP 65
Sensor extrusion:	Aluminum
Mounting:	Adjustable mounting feet or T-slot nut (M5 threads) in base channel
Magnet type:	Captive-sliding magnet or open-ring magnet
ROD STYLE (MODEL RH) SENSOR	
Electronic head:	Aluminum housing Diagnostic display (LED's located beside connector/cable exit)
Sealing:	IP 67 or IP 68 for integral cable model
Sensor rod:	304L Stainless steel
Operating pressure:	350 bar static, 690 bar peak (5000 psi static, 10,000 psi peak)
Mounting:	Any orientation, threaded flange M18 x 1.5 or 3/4-16 UNF-3A
Typical mounting torque:	45 N-m (33 ft. - lbs.)
Magnet type:	Ring magnet, open-ring magnet or magnet float

CE ISO 9001 CERTIFIED

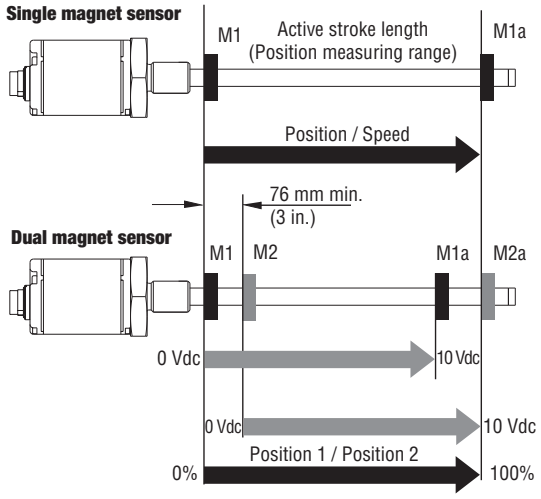
R-SERIES ANALOG SENSOR OUTPUT OPTIONS

Outputs

R-Series Models RP and RH analog sensors provide single or dual magnet sensor options along with one or two channel outputs.

The R-Series analog sensor can be ordered for a single-position magnet providing one displacement output, and/or one velocity output over the active stroke length.

The sensor can also be ordered for dual-position magnets providing two displacement outputs, or two velocity outputs, or one of each.

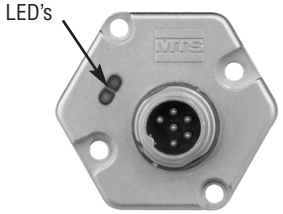


When using dual magnets, the minimum allowed distance between the magnets is 3.0 in. (76 mm) to maintain proper sensor output.

Enhanced monitoring and diagnostics

Sensor status and diagnostic display

Integrated LEDs (green/red) provide basic visual feedback for normal sensor operation and troubleshooting.



Green	Red	Description
ON	OFF	Normal function (operation mode)
ON	Flashing	Magnet out of setup range
ON	ON	Magnet not detected or wrong quantity of magnets
Flashing	ON	Programming mode

ADVANCED COMMUNICATION AND PROGRAMMABILITY

Sensor field programming

R-Series Model RP and RH Analog sensors are preconfigured at the factory by model number designation. For many applications, no adjustments are required for normal sensor installation and operation. If, however, sensor parameter changes are needed while in the field, the R-Series Analog sensor is easily programmed externally. There is no need to open the sensor's electronic housing.

R-Series Analog PC Programming kit, part no. 253309
For single or dual magnet sensors

This programming kit includes a wall adapter style power supply, serial converter box, two connection cables (wired for the LIN protocol), and the software CD-ROM. The serial converter box and one of the cables are required to communicate between a Windows PC and the sensor. When running the R-Series Analog PC Setup software many customized settings are possible for:

- Setpoint 1 (Null) and Setpoint 2 (Span) for single or dual magnets. (See the description for setpoints under the section, "R-Series Analog Handheld Programmer".)
- Output range settings for speed, or for speed with direction.
- Assign position or velocity output functions for the single or dual magnets, and for the one or two output channels. (Output function assignments are limited to the manufacturing build type of the sensor, see below.)
- Error output values when the magnet moves beyond the programmed setpoints.

Field programming is available to adjust the output values for any setting needed, within the selected output range. Each sensor's output range is selected from the available options when ordering a particular sensor model number, (see pages 7 and 8).

There are 6 different manufacturing build types used to provide for the various output ranges. These are:

Single Channel Output for either position or speed
1) Voltage output between 0 and +10 volts
2) Voltage output between -10 and +10 volts
3) Current output between 0 (or 4) and 20 mA

Two Channel Outputs for position and/or speed
4) Voltage outputs between 0 and +10 volts
5) Voltage outputs between -10 and +10 volts
6) Current outputs between 0 (or 4) and 20 mA

Note:
Field programming allows for numerous custom sensor configurations, however, please note that field programming can not be used to change the R-Series Analog sensor from one manufacturing build type to another.

ADVANCED COMMUNICATION AND PROGRAMMABILITY

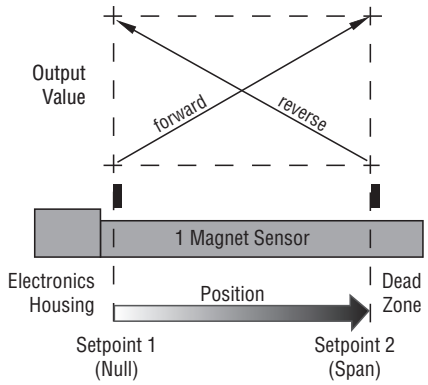
Sensor field programming

R-Series Analog handheld programmer (for single magnet sensors)

The R-Series Analog handheld programmer (part number 253124) can be used to program the magnet positions for the start of output, (0% = 0 Vdc, -10 Vdc, 4 mA, or 0 mA), and the end of output, (100% = 10 Vdc or 20 mA), for the single magnet version of the R-Series Analog sensor.

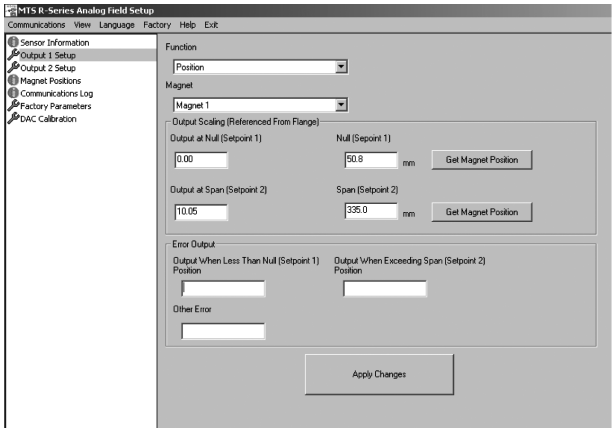
Handheld programmer, part no. 253124

Standard factory settings place the setpoint 1 (Null) and setpoint 2 (Span) at the limits of the sensor's active stroke length. For example, a sensor ordered with 4 - 20 mA output will be factory set for 4 mA output at the bottom limit of the stroke length at the "Null" position. Likewise, the 20 mA output will be factory set at the top limit of the stroke range at the start of the "dead zone".



Setpoint 1 and setpoint 2 can be re-positioned for the actual measuring range needed anywhere within the active stroke length. (Note: The minimum distance allowed between setpoint 1 and setpoint 2 is 25 mm (0.98 in.)). These adjustments are easily performed, even when the sensor is not directly accessible, by connecting the analog handheld programmer to the sensor's integral cable or extension cable.

MTS Sensors Analog Field Setup user interface



CONNECTIONS AND WIRING

Sensor integral connector (D60 Male)

Male Integral D6 connector pin-out as viewed from the end of the sensor

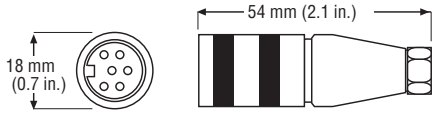
Pin no.	Wire color	Function
		Analog outputs
1	Gray	Output 1/Position #1: 0 to 10, 10 to 0, -10 to +10, +10 to -10Vdc 4 to 20, 20 to 4, 0 to 20, 20 to 0 mA
2	Pink	Return for pin 1
3	Yellow	Output 2/Position #2 or Speed: 0 to 10, 10 to 0, -10 to +10, +10 to -10Vdc 4 to 20, 20 to 4, 0 to 20, 20 to 0 mA
4	Green	Return for pin 3
5	Red or Brown	+24 Vdc (-15 / +20%)
6	White	DC Ground (for supply)

Note:
When using the single channel output (pins 1 and 2), the unused pins for output 2 (pins 3 and 4) should be left floating (unconnected), unless sensor programming is being used.

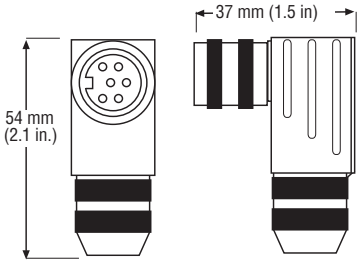
Cable connectors (Field installed 6-pin D6 female)

Mates with sensor's Integral connector

D6 straight-exit connector part no. 560700



D6 90° connector part no. 560778

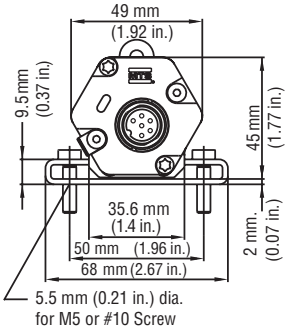


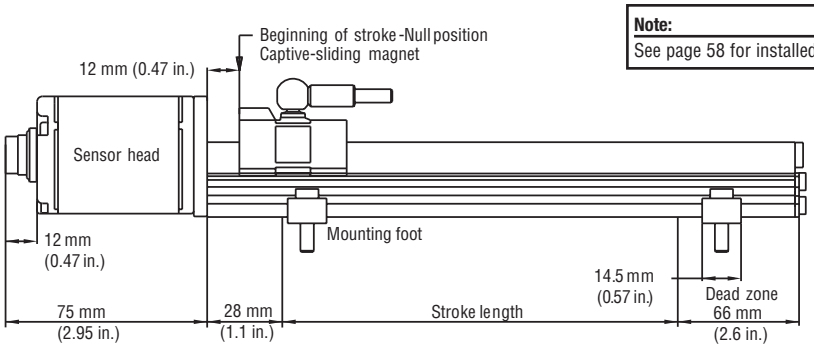
MODEL RP PROFILE-STYLE SENSOR

The profile-style (model RP) sensor offers modular construction, flexible mounting configurations and easy installation.

Captive-sliding magnet

D60 connector option

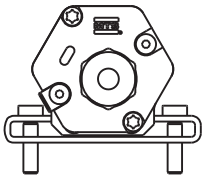


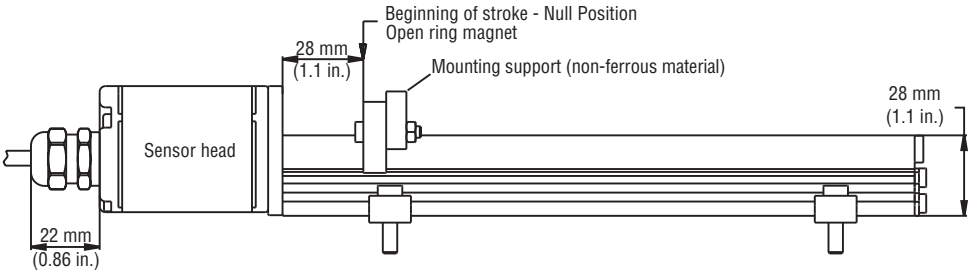


Note:
See page 58 for installed magnet dimensions.

Open-ring magnet

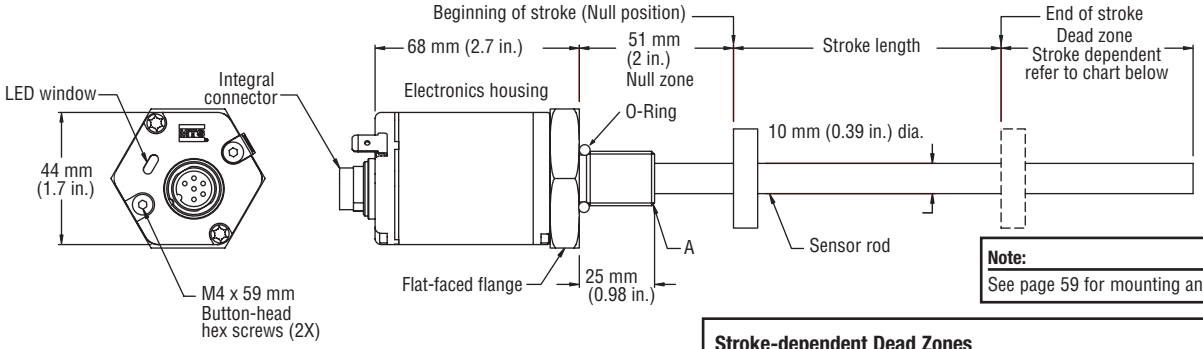
R05 integral cable option



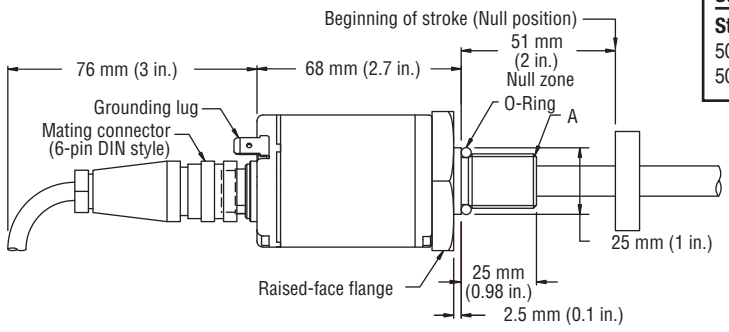


MODEL RH ROD-STYLE SENSOR

The rod-style (model RH) sensor offers modular construction, flexible mounting configurations, and easy installation. It is designed for internal mounting in applications where high pressure conditions exist, (5000 psi continuous, 10,000 psi spike), such as hydraulic cylinders. The Model RP sensor may also be mounted externally in many applications.

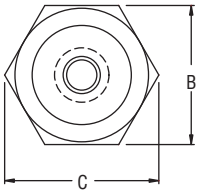


Note:
See page 59 for mounting and magnet details.



Stroke-dependent Dead Zones

Stroke length	Dead zone
50 mm (2 in.) - 5000 mm (197 in.)	63.5 mm (2.5 in.)
5005 mm (197.1 in.) - 7620 mm (300 in.)	66 mm (2.6 in.)



Housing style Flange type	Description	A Flange threads	B Dimensions	C Dimensions
T	US customary threads with raised-face flange	3/4"-16 UNF-3A	44.5 mm (1.75 in.)	51 mm (2 in.)
S	US customary threads with flat-faced flange	3/4"-16 UNF-3A	44.5 mm (1.75 in.)	51 mm (2 in.)
M	Metric threads with flat-faced flange	M18 x 1.5	46 mm (1.81 in.)	53 mm (2.1 in.)

HOW TO ORDER

3 to 7 digit code depending on output selected

R																		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

SENSOR MODEL
RP = Profile style
RH = Hydraulic rod-style
RF = Flexible style

HOUSING STYLE
Model RP profile-style sensor only (magnet included):
S = Captive-sliding magnet with joint at top (part no. 252182)
V = Captive-sliding magnet with joint at front (part no. 252184)
M = Open-ring magnet (part no. 251416-2)

Model RH rod-style sensor only (magnet must be ordered separately):
T = US customary threads, raised-faced flange and pressure tube, standard
S = US customary threads, flat-faced flange and pressure tube, standard
U = Same as option "T", except uses fluoroelastomer seals for the electronics housing
H = Same as option "S", except uses fluoroelastomer seals for the electronics housing
M = Metric threads, flat-faced flange and pressure tube, standard
V = Same as option "M", except uses fluoroelastomer seals for the electronics housing
B = Sensor cartridge only (no flange and pressure tube, stroke length < 1830 mm (72 in.))

Model RF flex sensor only, (reference page 41 for flex housing style) magnet must be ordered separately:
S = US customary threads, flat-faced flange
M = Metric threads, flat-faced flange

STROKE LENGTH
— — — — M = Millimeters (Encode in 5 mm increments)
— — — . — U = Inches and tenths (Encode in 0.1 in. increments)

Stroke length notes:
1. Profile-style sensor (model RP) stroke length = 50 mm (2 in.) - 5080 mm. (200 in.)
2. Rod-style sensor (model RH) stroke length = 50 (2 in.) - 7620 mm (300 in.)

CONNECTION TYPE
Integral connector:
D60 = 6-pin DIN (M16), male, standard
Integral cables:
R — — = Integral cable, PVC jacket, pigtail termination, standard
F — — = Integral cable, black polyurethane jacket with pigtail termination

Cable length:
— — = 1 (01) to 99 (99) ft. or 1 (01) to 30 (30) meters. Encode in feet if using US customary stroke length, encode in meters if using metric stroke length

Cable length note:
MTS recommends the maximum integral cable length to be 10 meters (33 ft.). Cables greater than 10 meters (33 ft.) in length are available, however, proper care must be taken during handling and installation.

INPUT VOLTAGE
1 = +24 Vdc (+20% - 15%)
A = Same as option "1" except includes the High Vibration-Resistant (HVR) option
Model RH only, stroke range = 50 mm (2 in.) - 2000 mm (78.7 in.), see note below

OUTPUT
(13 - 19) 3 to 7 digit code depending on output selected (**Please note that selections below are continued on page 12**)

1 output channel with 1 magnet (3 digit code)

Output #1 = magnet position

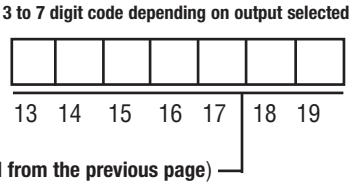
V01 = 0 to +10 Vdc	**A01** = 4 to 20 mA
V11 = +10 to 0 Vdc	**A11** = 20 to 4 mA
V21 = -10 to +10 Vdc	**A21** = 0 to 20 mA
V31 = +10 to -10 Vdc	**A31** = 20 to 0 mA

Note:
The High Vibration-Resistant (HVR) option provides the model RH rod-style sensors with increased resistance to shock and vibration for use in heavy duty machinery. Refer to "G-Series and R-Series Sensors for High Shock and Vibration Applications", part no. 551073 for more information.

2 output channels with 2 magnets * (3 digit code)

Output #1 = magnet #1 position	Output #2 = magnet #2 position
V02 = 0 to +10 Vdc	0 to +10 Vdc
V12 = +10 to 0 Vdc	+10 to 0 Vdc
V22 = -10 to +10 Vdc	-10 to +10 Vdc
V32 = +10 to -10 Vdc	+10 to -10 Vdc
A02 = 4 to 20 mA	4 to 20 mA
A12 = 20 to 4 mA	20 to 4 mA
A22 = 0 to 20 mA	0 to 20 mA
A32 = 20 to 0 mA	20 to 0 mA

* Standard factory settings for the setpoint values are the same for both magnets, i.e. both magnets have setpoint 1 at the null position, and setpoint 2 at the start of the dead zone. If needed, the setpoint values for each magnet can be reprogrammed in the field to best fit the application, (see page 8 for more information). For proper sensor output, the minimum allowed distance between the magnets is 3 in. (76 mm).



OUTPUT (13 - 19) 3 to 7 digit code depending on output selected (**Please note that selections below are continued from the previous page**)

2 output channels with 1 magnet (7 digit code, fill in the blanks with the desired maximum speed value as described below)

Output #1 = magnet position	Output #2 = speed magnitude		
V01 __ __ __ __ = 0 to +10 Vdc	+10 (towards head)	0 (at rest)	+10 (towards tip) Vdc
V11 __ __ __ __ = +10 to 0 Vdc	+10 (towards head)	0 (at rest)	+10 (towards tip) Vdc
A01 __ __ __ __ = 4 to 20 mA	20 (towards head)	4 (at rest)	20 (towards tip) mA
A11 __ __ __ __ = 20 to 4 mA	20 (towards head)	4 (at rest)	20 (towards tip) mA

Output #1 = magnet position	Output #2 = Velocity (speed with direction)		
V41 __ __ __ __ = 0 to +10 Vdc	0 (towards head)	5 (at rest)	+10 (towards tip) Vdc
V51 __ __ __ __ = +10 to 0 Vdc	+10 (towards head)	5 (at rest)	0 (towards tip) Vdc
V61 __ __ __ __ = 0 to +10 Vdc	-10 (towards head)	0 (at rest)	+10 (towards tip) Vdc
V71 __ __ __ __ = +10 to 0 Vdc	+10 (towards head)	0 (at rest)	-10 (towards tip) Vdc
V81 __ __ __ __ = -10 to +10 Vdc	-10 (towards head)	0 (at rest)	+10 (towards tip) Vdc
V91 __ __ __ __ = +10 to -10 Vdc	+10 (towards head)	0 (at rest)	-10 (towards tip) Vdc
A41 __ __ __ __ = 4 to 20 mA	4 (towards head)	12 (at rest)	20 (towards tip) mA
A51 __ __ __ __ = 20 to 4 mA	20 (towards head)	12 (at rest)	4 (towards tip) mA

Output #1 = magnet position (forward-acting)	Output #2 = magnet position (reverse-acting)
V03 = 0 to +10 Vdc (3 digit code)	+10 to 0 Vdc

For sensor models with speed output, fill in the blanks for the desired maximum speed value as shown below.

For US customary stroke lengths, encode speed for in./s as follows:
__ __ __ __ = Speed output max. (fill in remaining 4 blanks with desired max. speed value)
Available range for US customary stroke lengths is 1.0 to 400.0 in./s, (0010 … 4000)
Example: For max. speed of 12.0 in./s, and output produced =
[-10(towards head) … 0(at rest) … +10(towards tip) Volts] Encode: V 6 1 0 1 2 0 or V 8 1 0 1 2 0

For metric stroke lengths, encode speed for m/s (range 1) or mm/s (range 2) as follows:
Speed range #1, (0 __ __ . __)
0 __ __ . __ = Speed output max. (fill in the remaining 3 blanks with desired max. speed value)
Speed range 1 for metric stroke lengths is 0.1 to 10.0 m/s, (0001 … 0100)
Example: For max. speed of 5.5 m/s, and output produced =
[+10(towards head) … 0(at rest) … +10(towards tip) Volts], Encode: V 0 1 0 0 5 5

Speed range #2, (1 __ __ __)
1 __ __ __ = Speed output max. (fill in remaining 3 blanks with desired max. speed value)
Speed range 2 for metric stroke lengths is 25 to 90 mm/s, (1025 … 1090)
Example: For max. speed of 50 mm/s, and output produced =
[4(towards head) … 12(at rest) … 20(towards tip) mA], Encode: A 4 1 1 0 5 0

Field programming notes:
1) Sensor models ordered with one output channel can not be reprogrammed in the field to provide a second output channel.
2) Sensor models ordered with positive only output voltages can not be reprogrammed in the field to include negative output voltages.
3) Sensor models ordered with both positive and negative output voltages can be reprogrammed in the field for positive only voltages, or negative only voltages, however, output resolution is then reduced.