**MODEL HS40**

5/8”-1-1/8” [16-30mm]  
HOLLOW SHAFT

**DESCRIPTION**

The Avtron Model HS40 is a severe duty absolute encoder. It expresses the position of rotation as an output message or value. HS40 can measure a single turn of rotation or multiple rotations. The HS40 measures the shaft rotation and position without the need for external power or internal batteries through its innovative Wiegend wire energy system. The HS40 operates down to zero speed and can be used for both control and instrumentation applications.

**CAUTION**

Do not utilize HS40 in hazardous locations which require ATEX, UL, CUL, CSA, or other explosion protection certification. HS40 is not certified for hazardous locations.

When mounted to a machine shaft, the HS40 design eliminates the need for shaft couplings, adapter flanges, or accessory mounting faces. The ultra high clamping-force collar holds the HS45 in place, even under severe vibration & shock. A high-performance composite shaft insert provides electrical isolation from motor shaft currents. The shaft insert permits models to fit a range of shaft sizes from 5/8” to 1 1/8” [16mm - 30mm]; additional sizes available upon request. An anti-rotation arm prevents housing rotation while allowing for shaft end float.

The HS40 housing features non-contacting labyrinth seals. It can withstand rough environments, shock, and vibration in any orientation.

The HS40 utilizes magnetic sensors. This proven technology is ideal for rugged environments since it is immune to many contaminants that cause optical encoders to fail.

**SAFETY**

The HS40 is not considered as a safety device and is not suitable for connection into a safety system.

**CAUTION**

Be careful not to damage clamping fingers of hollow shaft during handling. Do not tighten clamping collar before installation onto motor shaft.

**WARNING**

Installation should be performed only by qualified personnel. Safety precautions must be taken to ensure machinery cannot rotate and all sources of power are removed during installation.

**INSTALLATION**

Refer to the back page of these instructions for outline and mounting dimensions.

**Equipment needed for installation**

**Supplied:**
- HS40 Encoder
- Shaft Sizing Insert

**Optional:**
- Anti-Rotation Arm Kit
- Thread Locker (blue)

**Not Supplied:**
- Open Wrenches
  - “C, D, E, F, G”
  - “S, V, W, Y, 3”
- Dial Indicator Gauge
- Caliper Gauge

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<table>
<thead>
<tr>
<th>Model</th>
<th>Bus</th>
<th>Future</th>
<th>Shaft Bore</th>
<th>MT Turns</th>
<th>ST</th>
<th>Conn</th>
<th>Mounting</th>
<th>Coding</th>
<th>Tethers</th>
<th>Mods</th>
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<tbody>
<tr>
<td>HS40</td>
<td>A-</td>
<td>Analog</td>
<td>X-Standard</td>
<td>C- 5/8”</td>
<td>2-</td>
<td>0-086/72</td>
<td>3-</td>
<td>8150/73</td>
<td>E- EOS only</td>
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<td></td>
<td>C-</td>
<td>CANOpen</td>
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<td>D- 3/4”</td>
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<td>4096/12</td>
<td>3-</td>
<td>8192/13</td>
<td>F- M12/8 pin</td>
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<td>D-</td>
<td>DeviceNet</td>
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<td>E- 7/8”</td>
<td>4-</td>
<td>16/4 (analog)</td>
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<td>F-</td>
<td>Profibus DP</td>
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<td>F- 1”</td>
<td>5-</td>
<td>6-4096/12</td>
<td>3-</td>
<td>8192/13</td>
<td>H- M23/12 pin</td>
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<td></td>
<td>G-</td>
<td>SQL</td>
<td></td>
<td>G- 1.1/8”</td>
<td>6-</td>
<td>4-8192/13</td>
<td>4-</td>
<td>1638/14</td>
<td>K- 3x cable entry</td>
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<td>U- All USA Sizes</td>
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<td>7-</td>
<td>4-8192/13</td>
<td>5-</td>
<td>3276/15</td>
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<td>S- 16mm</td>
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<td>“S, V, W, Y, 3”</td>
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<td>Z- ALL Metric Sizes</td>
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</table>
The hollow shaft HS40 design eliminates the potential for coupling failures from misalignment, however, excessive housing movement (wobble) may cause undesirable vibrations and bearing damage. The higher the RPM, the more severe the vibration will be from housing movement. In a typical installation a housing movement of 0.007" [0.18mm] TIR or less (as measured at the outside diameter of the main encoder body) will not have an adverse effect.

1) Disconnect power from equipment and encoder cable.
2) Use caliper gauge to verify motor shaft is proper diameter and within allowable tolerances: +0.000", -0.0005" [+0.00, -0.013mm].
3) Clean machine shaft of any dirt and remove any burrs.
4) Use dial indicator gauge to verify the motor shaft: Total Indicated Runout (TIR) <0.002" [0.05mm].
5) Install the anti-rotation bracket tether to the face of the encoder using M6 Hex screws and lock washers, included with the tether. Tighten to 65 in-lbs [7.5N-m] using M6 Hex screws and lock washers, included with the tether.

CAUTION
Do not attempt to remove, service, or adjust any of the internal components of the HS40.

WIRING INSTRUCTIONS
CAUTION
Remove power before wiring.

Interconnecting cables specified in the wire selection chart are based on typical applications. Refer to the system drawing for specific cable requirements where applicable. Physical properties of cable such as abrasion, temperature, tensile strength, solvents, etc., are dictated by the specific application and communications bus. Do not use unshielded cable. Ground one end (only) of the shield to earth ground.

Do not run encoder wiring parallel to power cable wiring for extended distances, and do not wrap encoder cable around power cables.

TROUBLESHOOTING:
If the drive indicates a loss of encoder fault, check the encoder power supply. If power is present, check polarity. If the wiring appears correct and in good shape, test the wiring by replacing the HS40. If the the drive still shows encoder loss/fault, then the wiring is faulty and should be repaired or replaced.

An oscilloscope can also be used to verify output of the HS40 encoder at the encoder connector itself and at the drive/controller cabinet. Depending on the communication method, signals will vary but the oscilloscope should show the output signals varying. Keep in mind that SSI and Profibus DP are master-slave systems and require the controller to signal the encoder to transmit position.

For SSI, monitor the clock input line to ensure the controller is triggering the encoder to send position. The clock should obey the signal requirements shown in the SSI signal section, and should appear as a rapid set of transitions on the clock line. For Profibus DP, CANopen, and DeviceNet, the transmit and receive signal pairs should change state rapidly as the controller transmits messages to the encoder and the encoder replies. Transmission rates vary, but these messages can be extremely short and typically require scope triggering to spot them.

For Profibus DP, ensure termination resistors are in place (or switched on) at each end of the cabling system, and that no termination resistors are in place in the middle of the system.

For analog output, a multimeter can be used to measure the output signal. Disconnect the encoder outputs to ensure no interference from field wiring and measure the output voltage or current depending on the output style selected. Rotating the shaft should produce a change in output value.

For analog output: If the output is within the expected range but does not seem to change, the analog value may have been accidentally scaled to a tiny fraction of a revolution or such a huge number of turns that the output change cannot be detected. Connect both Set End Point 1 and Set End Point 2 to +Vs for 1 second or more, then connect them to ground. The encoder will be reset to the factory default 16 turn output range scale, and the output will be set to the mid-point of the maximum output. Now monitor output voltage or current while rotating. You should observe a voltage or current change. Now follow the instructions in the analog section to properly reset the analog minimum and maximum values.

REPLACING PARTS
The HS40 has two items that are user-replaceable in the field in case of damage, or to change the encoder electrical or mechanical interface:
1. Shaft sizing insert: Simply slide the insert out of the HS40 and replace it with the new bore size insert. Insert should remove and install with modest force—do not pound the insert into the HS40.
2. Tether system: To replace the tether system, remove the retaining screw(s), then replace with the new tether.

ENVIRONMENTAL CONSIDERATIONS
Follow these steps to reduce potential problems:
1) Always mount connection points, conduit couplings, junction boxes, etc., lower than actual encoder.
2) For washdown areas, shroud or otherwise cover the encoder to prevent direct water spray. Do not attach the shroud directly to the encoder.

REPAIRS
REMOVAL INSTRUCTIONS:
1. Unbolt tether arm from mounting point on motor.
2. Loosen both clamping collar screws.
3. Slide the encoder off the motor.

NOTE
These screws have factory applied thread locker, no further thread locker application is required.

7) Test Fitting: carefully slide the encoder onto the shaft to verify fit. Ensure a minimum of 1/8" [2mm] between encoder and mounting surface. DO NOT FORCE. Encoder should slide on easily. If the encoder does not fit easily, remove it, verify shaft mounting surface. DO NOT FORCE. Encoder should slide on easily.

10) For threaded rod tethers, adjust to proper length by selecting combinations of short and long piece as required and thread together for final length adjustment. Attach free end of the anti-rotation bracket to the bracket tether using the shoulder bolt provided.
11) Secure free end of the anti-rotation bracket to frame using bolt or T-bolt provided. The bracket should be parallel to the encoder face, 90 degrees to the shaft to avoid encoder bearing damage. Use additional washers as needed to ensure the tether is parallel to the encoder face.
12) Turn shaft by hand and verify the shaft turns freely and does not produce excessive runout/wobble of the encoder (<0.007" TIR [0.18mm]. Total Indicated Runout.) Ensure the tether arm is secure and the encoder body cannot rotate.
13) Connect cable as shown in wiring diagram.
14) Apply power to the encoder.
15) Rotate the shaft by hand, or using jog mode of the speed controller and verify proper direction and position output.

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**ELECTRICAL SPECIFICATIONS**

A. Operating Power (Vin)

1. Voltage & Current 
   - Analog V Out: 12-30VDC; 15mA @ 24V
   - Analog I Out: 15-30VDC; 40mA @ 24V
   - CANOpen: 10-30VDC; 100mA @ 10V, 50mA @ 24V
   - DeviceNet: 10-30VDC; 100mA @ 10V, 50mA @ 24V
   - J1939: 10-30VDC; 100mA @ 10V, 50mA @ 24V
   - SSI: 5-30VDC; 125mA @ 5VDC, 30mA @ 24V
2. Total Current: as above plus cable load

B. Output Format

1. Analog Voltage: 0.5-4.5V; 0-5V; 0.5-9.5V; 0-10V
   - Current: 0-20mA or 4-20mA
2. SSI: 0-2mHz, set by master clock speed
3. CANOpen, J1939: 20 K to 1MBaud, node 0-127
   - Default 125K, node 32
4. DeviceNet: 125 K to 500K baud

C. Direction Counting: Default UP for CCW rotation as viewed from the back of the encoder

D. Counts Per Turn: 4096 or 8192 (12 or 13 bits)

E. Maximum Turns: 4096 - 32768 (12-15 bits)

F. Line Driver Specs: See table

G. Connectors: See connector options on page 1

H. Accuracy: +/-0.35 deg (+/-21 arc-min)
   - Analog Output: 0.15%

**MECHANICAL**

A. Shaft Inertia: 2.86lb-in-sec² [3285 g-cm² (dyn)]

B. Acceleration: 5000 RPM/Sec. Max.

C. Speed: 8-10 lbs [3.5-4.5kg]

D. Vibration: 20 Gs, 5-2000 Hz (any orientation)

E. Shock: 100 Gs, any orientation

F. Shaft Engagement
   - 5/8” - 7/8” bore: 2” [51mm] min.
   - 16-20mm bore: 51mm min.
   - 1” - 1 1/8” bore: 1.75” [45mm] min.
   - 25-30mm bore: 45mm min.

**ENVIRONMENTAL**

Solid cast aluminum housing

Operating Temperature: -40°C to +85°C.

**BUS OPTIONS**

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<thead>
<tr>
<th>Electrical Specifications</th>
<th>Analog</th>
<th>CANopen</th>
<th>DeviceNet</th>
<th>J1939</th>
<th>Profinet</th>
<th>SSI</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>12-30V</td>
<td>10-30V</td>
<td>TBD</td>
<td>10-30V</td>
<td>TBD</td>
<td>10-30V</td>
<td>VDC</td>
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<tr>
<td>Cable Drive Capacity</td>
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<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>4000’</td>
<td>[1200m]</td>
</tr>
</tbody>
</table>

Protection

| Reverse Voltage | yes | yes | TBD | TBD | TBD | yes |
| Short Circuit   | yes | yes | TBD | TBD | TBD | yes |
| Transient       | yes | yes | TBD | TBD | TBD | yes |

* @90kbaud w/24 AWG, 52.5 pF/meter (16 pF/foot)
SSI Protocol “S”

The SSI Protocol “S” provides a clocked set of data bits that represent the encoder position (in turns and within 1 turn). Each bit is output by the encoder as the clock input transitions.

Preferred cable: Twisted pair with individual and overall shield grounded at one end only. 24 AWG, copper conductor, capacitance of 52.5 pF/meter (16 pF/foot) terminated in a 100 Ohm resistive load. Note that resistive losses in long cables may decrease actual voltage (+Vs) available at the encoder; larger conductors can be used or the encoder can be powered locally and signal GND brought through the cable. Maximum transmission speed is limited by cable length as shown in the figure below.


Analog Protocol “A”

The analog protocol provides a steady-state analog output which represents the encoder position, over a portion of a turn, or any portion of a turn plus a number of turns. The factory default is 0-16 turns = min/max output. This can be modified by using the Set Lower and Set Upper End Point inputs similar to most electronic cam-setting systems (described below.)

Preferred cable: Overall shield grounded at one end only. Twisted pair cable acceptable but not required. Note that resistive losses in long cables may decrease actual voltage (+Vs) available at the encoder; larger conductors can be used or the encoder can be powered locally and signal GND brought through the cable.

Set Zero

(input, ACTIVE HIGH, Falling Edge, 10K resistance)

To set the encoder count value to zero, raise Set Zero> 10V, < Vs for more than 1 second. Upon the Set Zero signal returning to logic zero (falling edge), the encoder count value will be set to zero.

Set Direction

(input, 10K resistance)

For input logic zero or no connection, the encoder will count UP for CCW rotation as viewed from the rear end of the encoder.

For input logic 1 (>10V, <Vs), the encoder will count DOWN for CCW rotation as viewed from the rear of the encoder.

Set Lower End Point 1

(input, ACTIVE HIGH, Falling Edge, 10K resistance)

To set the encoder output to the minimum value at the present position of rotation, raise Set Lower End Point 1> 10V, < Vs for more than 1 second. Upon the Set Lower End Point 1 signal returning to logic zero (falling edge), the encoder output will be set to the minimum output shown in the output table.

Set Upper End Point 2

(input, ACTIVE HIGH, Falling Edge, 10K resistance)

To set the encoder output to the maximum value at the present position of rotation, raise Set Upper End Point 2> 10V, < Vs for more than 1 second. Upon the Set Upper End Point 2 signal returning to logic zero (falling edge), the encoder output will be set to the maximum output shown in the output table.

Reset Upper and Lower End Points to Factory Default (16 turn scaling)

Raise both Set Lower End Point 1 and Set Upper End Point 2> 10V, < Vs for more than 1 second. Upon both signals returning to logic zero, the encoder output will be reset to the factory default scaling of maximum output over 16 turns, and the present position and the encoder will be set to the mid-point (8 turns) and 1/2 of the maximum output.
HS40 WIRING DIAGRAMS

Communication Bus “A”: Analog Pinout

<table>
<thead>
<tr>
<th>CONNECTOR</th>
<th>OPTION “W” (Cable)</th>
<th>OPTION “S” (1x Cable Entry Terminal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNAL</td>
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</tr>
<tr>
<td>GND</td>
<td>BLACK</td>
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</tr>
<tr>
<td>+Vs</td>
<td>RED</td>
<td>8</td>
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<tr>
<td>Set Upper End Point 2</td>
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<td>Set Lower End Point 1</td>
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<td>Analog Out</td>
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</table>

* Note: Overall shield required; twisted pair cable not required, pairs shown only for convenience

Communication Bus “S”: SSI Pinout

<table>
<thead>
<tr>
<th>CONNECTOR</th>
<th>OPTION “W” (Cable)</th>
<th>OPTION “E” M23</th>
<th>OPTION “E” M12</th>
<th>OPTION “S” (1x Cable Entry Terminal)</th>
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<td>GND</td>
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* NOTE: Twisted pair cable required with overall shield; individual pair shielding recommended. Obey pairing as shown