AVTRON ENCODERS

Nidec-Avtron Makes the Most Reliable Encoders in the World

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Encoder Instructions
MODEL HS6A

HOLLOW SHAFT 6mm-15mm BORE

DESCRIPTION

The Avtron Model HS6A is a light mill duty absolute encoder. It expresses the position of rotation as an output message or value. HS6A can measure a single turn of rotation or multiple rotations. The HS6A measures the shaft rotation and position without the need for external power or internal batteries or capacitors through its internal gearbox system. The HS6A operates down to zero speed and can be used for both control and instrumentation applications.

CAUTION
Do not utilize HS6A in hazardous locations which require ATEX, UL, CUL, CSA, or other explosion protection certification. HS6A is not certified for hazardous locations.

The HS6A is designed for direct mounting on shafts and utilizes a tether mount to secure the housing.

The HS6A features an interchangable set of sizing inserts to allow the same unit to fit shafts over the full size range, 6-15mm. Note that the optional thru-shaft 12mm unit can also be resized 6-12mm using a different set of sizing inserts.

The HS6A uses optical sensors; to protect the optical sensors and bearing systems HS6A features extensive seal systems. (Option "X" unsealed is only available/standard on 12mm thru-shaft).

SAFETY

The HS6A 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:
HS6A Encoder
Standard flat metal tether (2.48" [63mm] BC)

Optional:
Mating plugs
Mating cable assemblies

Not Supplied:
Hex Wrenches
Dial Indicator Gauge
Caliper Gauge

HS6A PART NUMBERS AND AVAILABLE OPTIONS

Model	Sensor	Bus	Style	Shaft Size	Turns/ bits	PPR/bits per turn	Connector	Mounting	Output	IP Rating	Special Option
HS6A	A- Optical	C- CANOpen D- DeviceNet F- CANSafe K- POWERLINK L- Parallel M- ModbusTCP Ethernet N- Profinet IO P- Profibus DP R- Ethernet/IP S- SSI	1- 58mm housing	L- 6mm M- 8mm N- 10mm P- 12mm R- 15mm (EOS only) Z- All mertric sizes	X- 0/0- single turn 2- 4096/12 3- 8192/13 4- 16384/14	2- 4096/12 3- 8192/13 4- 16384/14 6- 65536/16	A- 1xM12/5 pin B- 2xM12/5 pin C- 3xM12 4/4/5 or 4/4/4 pins D- 2xM12/4/5 pin E- M12/8 pin F- M23/12 pin G- M27/26pin J- 2x cable entry K- 3x cable entry M- M23/8pin Hengstler N- M23/8pin Stegmann Q- M23/8pin Kubler W- Cable, 1m	A- Radial (EOS Only) E- Axial (EOS Only) U- EOS or Thru (12mm SSI only)	1- Binary 2- Gray	X- None, IP54 A- IP66 shaft seals S- IP66 seals, stainless housing	000- none 9xx- special cable length xx=length 0.3m/ft

MOUNTING COMPATIBILITY

Housing	Bore Size	Mounting	IP/Sealing
1	M, N, P, R, Z	E	A, S
1	P	U	X

STANDARD CONNECTORS & OUTPUT FORMATS

Bus	Code	Connectors	Output
CANOpen	C	A, B, C, J, K, W	1
DeviceNet	D	A, W	1
CANSafe	F	K	1
POWERLINK	K	C	1
Parallel	L	G, W	1, 2
ModbusTCP	M	D	1
Profinet	N	C	1
Profibus DP	P	C, J, K	1
EtherNet/IP	R	C	1
SSI	S	E, F, W	1, 2

The hollow shaft HS6A 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 screws and lock washers, included with the tether.
6) Loosen clamping collar screw.
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 size, and check for burrs and shaft damage.
8) Slide the HS6A at least 1" [25mm] onto the shaft.
9) Tighten screws on clamping collar. DO NOT USE A STANDARD RIGHT ANGLE WRENCH. Use only a T-handle hex wrench or torque wrench with hex bit.
10) Secure free end of the anti-rotation tether to frame using bolt or T-bolt. 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.
11) 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 is secure and the encoder body cannot rotate.
12) Connect cable as shown in wiring diagram.
13) Apply power to the encoder.
14) Rotate the shaft by hand, or using jog mode of the speed controller and verify proper direction and position output.

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 from mounting point on motor or machine.
2. Loosen clamping collar screw.
3. Slide the encoder off the shaft.

REPLACING PARTS
The HS6A has two items that are user-replaceable in the field in case of damage:
1. Shaft sizing insert: Simply slide the insert out of the HS6A and replace it with the new bore size insert. Insert should remove and install with modest force-do not pound the insert into the HS6A.
2. Tether system: To replace the tether system, remove the retaining screw(s), then replace with the new tether.

CAUTION
Do not attempt to remove, service, or adjust any of the internal components of the HS6A.

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 controller indicates a loss of encoder fault, check the encoder power supply at the encoder. If power is present at the encoder, check polarity. If the wiring appears correct and in good shape, test the wiring by replacing the AV6M. If the controller 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 HS6A encoder at the encoder connector itself and at the drive/ controller cabinet. Depending on the communication method, signals will vary but the oscilliscope 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.

Read each section for specifics about each bus and troubleshooting tips.

SSI TROUBLESHOOTING
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. The encoder data transmit lines should change state as data is clocked out. Note that the varying binary patterns representing position can produce pulses of varying width--this is normal.

PROFIBUS-DP TROUBLESHOOTING
Viewing on oscilliscope: for Profibus DP, 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 placed or activated in the middle of the system. Remove the connections to the master controller and all devices, or power down all devices. Measure the resistance between the communication wires. The value should be ~1/2 of the termination resistor value on the network. If the resistance is greater than the limit, a termination resistor is missing from the network. If the resistance is less than the limit, there are incorrect termination resistors switched on or connected to the system.

CANOPEN TROUBLESHOOTING
For CANOpen: disconnect the power connection, then ensure there are no short circuits between any of the signal or power wires or shield.

Viewing on oscilliscope: for CANOpen 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 CANOpen, ensure termination resistors are in place (or switched on) at each end of the cabling system, and that no termination resistors are in placed or activated in the middle of the system. Remove the connections to the master controller and all devices, or power down all devices. Measure the resistance between the communication wires [Example CANOpen-measure between CAN_L and CAN_H]. The value should be ~1/2 of the termination resistor value on the network. For CANOpen, this value should be >50 ohms, <65 ohms. If the resistance is greater than the limit, a termination resistor is missing from the network. If the resistance is less than the limit, there are incorrect termination resistors switched on or connected to the system.

Flange Option "6" includes a two-color diagnostic LED. Red indicates an error, Green indicates run status. During normal operation, the encoder LED should be continously green. Flash patterns indicate activity as follows:

RED - Error
Flickering - (Autobitrate/LSS services are in process)
Blinking - Configuration error
1)   Flash - CAN bus frame error
2)   Flashes - CAN guard timing or heartbeat error
3)   Flashes - Sync message timeout
4)   Flashes - PDO message timeout
ON - CAN Controller is in bus off state

GREEN - Run
Flickering - (Autobitrate/LSS services are in process)
Blinking - Encoder is in preoperational mode
1)   Flash - Encoder is in stopped mode
3)   Flashes - Software download in progress
ON - Encoder is operating normally with no errors

Nidec-Avtron recommends the use of a simple no-cost debugging tool such as PCAN View.

Ensure the device is set to the proper baud rate (connection cap, or for units with no connection cap, via software)

Ensure the device is set to the proper node address (connection cap or for units with no connection cap, via software)

The encoder will power-up in the pre-operational mode.
The message it will issue is:

ID: 0x07nn   0x00

If you cannot see this message, try power cycling the device.

Note that CANOpen units with a hardware connection cap are typically set to 20K default baud rate. Not all master devices support 20K, so the power-up message may not be displayed. Check the baud rate and node address on the connection cap.

ANALOG TROUBLESHOOTING
For analog output, a multimeter can be used to measure the output signal. Disconnect the encoder outputs (but maintain the power connection) to ensure no interference from field wiring and measure the output voltage or current directly at the encoder 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 accidently 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 1 second or more, then connect them to ground or no connection. The encoder will be reset to use the full scale factory default with the output and position set to the mid-point of the full scale. 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.

ELECTRICAL SPECIFICATIONS

A. Operating Power (Vin = +Vs)
    1. Voltage & Current ....
        SSI ....4.5-30VDC; 300mA @ 5V, 65mA @24V
        Parallel ....10-30VDC; 400mA @ 10V, 180mA @24V
        all other busses ....10-30VDC; 230mA @ 10V, 100mA @24V
    2. Total Current.....................as above plus cable load

B. Output Format
    1. SSI: ....100kHz-2mHz, set by master clock speed
    2. CANOpen/CANSafe ....20kBaud to 1mBaud, node 0-127
        ....Default 20k, node 01 (0x01)
    3. J1939..............................250kBaud to 500kBaud, node 0-127
        ....Default 250k, node 01 (0x01)
    4. DeviceNet........................125kHz-500kHz, MAC-ID 0-63
        .... w/connection cap: Default 20k, node 01 (0x01)
    5. Profibus DP......................9.6kHz-2MHz, Address 0-99
        .... Default Auto-baud detect, node 01 (1FH)
    6. PowerLink ....10/100MHz, IP Address 0-239
        .... Default Auto-baud detect, node 192.168.0.165
    7. Parallel............................Bit-parallel, cycle time 150uSec,
        ....max update rate 4.5kHz (X10 w/o preset input)

C. Direction Counting.................Default up for CCW rotation as viewed
                              from the back of the encoder
D. Counts Per Turn ....4096 - 65536 (12 - 16 bits)
E. Maximum Turns......................4096 - 16384 (12 or 14 bits)
F. Line Driver Specs: ....See table
G. Connectors:...........................See connector options on page 1
H. Accuracy: ....+/-0.04 deg (+/-2.6 arc-min) - 12 bit units
        ....+/-0.02 deg (+/-1.3 arc-min) - 16 bit units

MECHANICAL

A. Shaft Inertia...........................0.00003lb-in-sec2 [30 g-cm2 (dyn)]
B. Acceleration ....6000 RPM/Sec. Max.
C. Speed:..................................6000 RPM Max (EOS model, std seals)
        ....3000 RPM Max. (12mm thru-shaft model)
        ....12000 RPM Max. w/o seals, not recommended
D. Weight:.................................1.2-2.7 lbs [550-1200g]
E. Vibration................................10 Gs, 10-1000 Hz, any orientation
F. Shock....................................100 Gs 6mSec, any orientation

ENVIRONMENTAL

Solid cast aluminum housing
Solid stainless steel housing optional
Operating Temperature:...............-40°C to +85°C.
Finish..Powder Coat
                              Resists mild acids, bases, salt water &
                              hydrocarbons

Electrical Specifications		CANOpen	DeviceNet	J1939	Parallel	Profibus	SSI	Units
Input Voltage		10-30V	10-30V	10-30V	10-30V	5-30V	10-30V	VDC
Cable Drive Capacity		8200' [2500m]***	1650' [500m]**	800'+++ [250m]	150'++ [50m]	4000'**** [1200m]	4000' [1200m]*	feet
Protection	Reverse Voltage	yes	yes	yes	yes	yes	yes	
	Short Circuit	yes	yes	yes	yes	yes	yes	
	Transient	yes	yes	yes	yes	yes	yes	

* @100kbaud w/24 AWG, 52.5 pF/meter (16 pF/foot)
**Using main cable (round, large diameter)
***@20kbaud
****@9.6kbaud
++@12VDC, max 20mA/output
+++@250kbaud

CANOpen Protocol "C"

The CANOpen protocol provides a set of data bits inside a CANOpen message that represent the encoder position (in turns and within 1 turn).

CANOpen may be wired in several different configurations, but the most common is a "Trunk and Drop Line" configuration. The trunk message cable must be terminated at each end with 120 ohm resistors. Note that CANOpen also offers the option to carry device power to each encoder through an additional cable pair of wires.

Avtron CANOpen encoders with connection caps offer the ability to act as a "T" coupling in the bus system. This means that the encoders can effectively be installed in a daisy-chain configuration, with each encoder wired to the next. The first encoder is typically wired to the master/scanner device located at one end of the bus, but the master/scanner device can be located anywhere on the bus system.

Preferred cable: Twisted pair with individual pair and overall shields. Communication pair: 24 AWG, copper conductor, capacitance of 50 pF/meter (15 pF/foot) terminated in a 120 Ohm resistive load. Power pair: 22AWG copper conductor, 17ohms/1000 ft [55 ohms/km]. 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 and number of devices as shown in the figures below.

For more details on CANOpen, consult the CiA, CANOpen in Automation:

www.can-cia.org

Network Baud Rate	1M	500K	250K	125K	50K	20K	Units
Max. Length	65 [20]	325 [100]	800 [250]	1600 [500]	3250 [1000]	8200 [2500]	ft [m]
Max. Single Tap Length	1 [0.3]	15 [5]	15 [5]	15 [5]	200 [60]	500 [150]	ft [m]
Max. Total Tap Length	5 [1.5]	100 [30]	200 [60]	400 [120]	1000 [300]	2500 [750]	ft [m]
Min. Tap to Tap Length	- [-]	20 [6]	20 [6]	20 [6]	240 [72]	600 [180]	ft [m]

Number of Nodes	2	16	32	64	Units
Max. Overall Cable Length	750 [229]	690 [210]	640 [190]	560 [170]	ft [m]

Setting Node Number, Baud Rate & Termination Resistor

NOTE: Units with hardware connection caps cannot accept software-commanded address, baud rate or termination resistor changes. These must be made using the switches in the connection cap. Before commencing any changes, check for a connection cap. It is secured to the rear of the encoder with 2 or 3 screws and due to snug fit will require a strong pull to remove it after removing the screws.

NOTE: Any changes to baud rate, node number, or resistor will not take effect until the encoder is reset (typically power cycled).

Power-Up Sequence

The encoder will power-up in the pre-operational mode. The message it will issue is:

ID: 0x07nn 0x00
nn=node number, typically:
0x01 for units with connection cap including hardware node and baud rate selection. (software commands will not change node)
0x20 is the factory default for units with software-selectable addressing. (software commands can change node number)

Setting Node Number:
To set the node number on units with a connection cap: Set the address using the two rotating switches. The node number can be between 0-89. The node address = X10 switch * 10 + X1 + 1 switch value. (The encoder internally adds 1 to the switch value total). Special addresses are shown below:

Address	Function
97	Recovery C2-C5
98	Protocol DS301-V3
99	Protocol DS301-V4

To set the node number on units without a connection cap: write SDO object 0x3000 using command 0x22. The encoder internally adds 1 to the written value.

Example, encoder at node 20, change node address to 02:

ID: 0x620 0x22 0x00 0x30 0x00 0x01 0x00 0x00 0x00

Setting Baud Rate:
To set the baud rate on units with a connection cap: Set the baud rate using the rotating switch marked Bd per the table below.

To set the baud rate on units without a connection cap: write the baud code per the table below to SDO object 0x3001.
Example, encoder at node 20, change baud rate to 125K = 0x03
ID: 0x620 0x22 0x01 0x30 0x00 0x03 0x00 0x00

Network Baud Rate	LSS	1M	500K	250K	125K	50K	20K
Baud Code or Switch Setting	09h	07h	05h	04h	03h	01h	00h

Enabling Termination Resistor:
To enable the termination resistor in units with a connection cap: Turn switch Rt to "On".

To enable the termination resistor in units without a connection cap: write 01 to SDO object 3002h. Ensure any devices on the bus power up at least 700mS after the encoder with the termination resistor activated.

Note that only devices at each end of the bus should have termination resistors enabled--if the master/scanner is at one of the

bus, then only one encoder (at the opposite bus end) will require a termination resistor.

Saving Changes (Required):

To save baud rate/node/resistor changes, write 0x55 0xAA 0xAA 0x55 to SDO object 0x2300
Example, encoder at node 20, store changes
ID: 0x620 0x22 0x00 0x23 0x00 0x55 0xAA 0xAA 0x55

Cycle power after saving changes.

Measuring Position, Speed, and Acceleration

To read position and speed feedback into your device (Acceleration measurement is not supported.): Following the instructions for your master/scanner module for the CANOpen network, load the encoder EDS file into your configuration. Assign it to the correct node number. Store the configuration to the scanner module.
All of the position data and other parameters will be read by the scanner module and placed in registers identified in the configuration package.

Reading data without using the EDS file:
To read position: read SDO object 0x2000 (32 bit unsigned) or SDO object 0x6004.

Speed measurement is deactivated by default.
To enable speed measurement: write 0x01 to SDO object 0x3010, subindex 1, and write the speed modulus to subindex 2.

To read the speed after activation: read SDO object 0x3011 (8 bit unsigned) or SDO object 0x6030.

Acceleration measurement is not supported. SDO object 0x3021 and 0x6040h are reserved for future use but do not indicate acceleration at this time.

Setting Polling, Cyclic and Sync Mode
Polling, cycling and sync mode are supported by the encoder; use the parameters supplied in the EDS file to set the appropriate mode. Store the resulting configuration into the scanner module.

Storing/Saving Encoder Parameters
To store the current encoder operating parameters into non-volatile memory:

Write 0x55 0xAA 0xAA 0x55 to SDO object 0x2300
Example, encoder at node 20, store changes
ID: 0x620 0x22 0x00 0x23 0x00 0x55 0xAA 0xAA 0x55
No reset is triggered.

Cycle power after saving changes to parameters.

Other Parameters

Contact Nidec Avtron for additional parameters, diagnostic registers, cam and programmable limit switch functionality and other advanced features.

CANOPEN TROUBLESHOOTING
For CANOpen: disconnect the power connection, then ensure there are no short circuits between any of the signal or power wires or shield.
Viewing on oscilliscope: for CANOpen 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 CANOpen, ensure termination resistors are in place (or switched on) at each end of the cabling system, and that no termination resistors are in placed or activated in the middle of the system. Remove the connections to the master controller and all devices,

or power down all devices. Measure the resistance between the communication wires [Example CANOpen-measure between CAN_L and CAN_H]. The value should be ~1/2 of the termination resistor value on the network. For CANOpen, this value should be >50 ohms, <65 ohms. If the resistance is greater than the limit, a termination resistor is missing from the network. If the resistance is less than the limit, there are incorrect termination resistors switched on or connected to the system.

CANOpen Diagnostic LEDs		
LED	Status	Meaning
Run ERR	Green Off	Power OK, Operational, CAN Controller on
Run ERR	Flickering Green Flickering Red	LSS or auto-baud detection active
Run	Blinking Green	Encoder in preoperational state
	1X Flash Green	Encoder is stopped
	3X Flash Green	Software download in progress
	Off	No Power
ERR	Blinking Red	Configuration error
	1X Flash Red	CAN Error frames
	2X Flash Red	Guard event or heartbeat error
	3X Flash Red	Sync message timeout
	4X Flash Red	PDO timeout
	On (Red)	CAN controller off

DeviceNet Protocol "D"

The DeviceNet protocol provides a set of data bits inside a DeviceNet message that represent the encoder position (in turns and within 1 turn).

DeviceNet may be wired in several different configurations, but the most common is a "Trunk and Drop Line" configuration. The trunk message cable must be terminated at each end with 120 ohm resistors. Note that DeviceNet also offers the option to carry device power to each encoder through an additional cable pair of wires.

Preferred cable: Nidec Avtron recommends structured DeviceNet wiring systems, available from a broad range of vendors. Large diameter main, small diameter round cable, as well as flat cabling systems are all acceptable.

For more details on DeviceNet, consult the Open DeviceNet Vendor's Association (ODVA):

www.odva.org

Network Baud Rate	500K	250K	125K	Units
Max. Length*	325 [100]	800 [250]	1600 [500]	ft [m]
Max. Single Tap Length	15 [5]	15 [5]	15 [5]	ft [m]
Max. Total Tap Length	100 [30]	200 [60]	400 [120]	ft [m]
Min. Tap to Tap Length	20 [6]	20 [6]	20 [6]	ft [m]

*Using thick cable

Number of Nodes	2	16	32	64	Units
Max. Overall Cable Length*	750 [229]	690 [210]	640 [190]	560 [170]	ft [m]

*Using thick cable

Setting Node (MAC-ID), Baud Rate & Termination Resistor

NOTE: Units with hardware connection caps cannot accept software-commanded address, baud rate or termination resistor changes. These must be made using the switches in the connection cap. Before commencing any changes, check for a connection cap. It is secured to the rear of the encoder with 2 or 3 screws and due to snug fit will require a strong pull to remove it after removing the screws.

NOTE: Any changes to baud rate, node number, or resistor will not take effect until the encoder is reset (typically power cycled)--be sure to store parameters in EEPROM.

NOTE: Baud rate, termination resistor and a values are not stored permanently until they are written to EEPROM. If power is cycled before the values are stored, the encoder will default to the values previously stored in EEPROM.

Setting Node Number:
To set the node number on units with a connection cap: Set the address using the two rotating switches. The node number can be between 0-63. The node address = X10 switch * 10 + X1 switch value.

To set the node MAC-ID number on units without a connection cap: write attribute 6Fh (byte). [(master MAC-ID) 0x10 0x23 0x01 0x6F (node)]. The encoder will reply [0x0A 0x90].

Setting Baud Rate:
To set the baud rate on units with a connection cap: Set the baud rate using the rotating switch marked Bd per the table below.

To set the baud rate: write the baud code to attribute 6Eh (byte). [(master MAC-ID) 0x10 0x23 0x01 0x6E (baud code)]. The encoder will reply [0x0A 0x90].

Network Baud Rate	500K	250K	125K
Baud Code/ Switch Setting	0x02	0x01	0x00

Enabling Termination Resistor:
To enable the termination resistor in units with a connection cap: Turn switch Rt to "On".

To enable the termination resistor: write 01 to attribute 67h. Ensure any devices on the bus power up at least 700mS after the encoder with the termination resistor activated.

Note that only devices at each end of the bus should have termination resistors enabled--if the master/scanner is at one of the bus, then only one encoder (at the opposite bus end) will require a termination resistor.

Measuring Position, Speed, and Acceleration

Only position feedback is supported in DeviceNet; acceleration and speed are not directly supported at this time.

To read position feedback into your device: Following the instructions for your master/scanner module for the DeviceNet network, load the encoder EDS file into your configuration. Assign it to the correct MAC-ID node number. Store the configuration to the scanner module.

All of the position data and other parameters will be read by the scanner module and placed in registers identified in the configuration package.

Setting Polling, Cyclic and Sync Mode

Polling, cycling and sync mode are supported by the encoder; use the parameters supplied in the EDS file to set the appropriate mode.

Store the resulting configuration into the scanner module.

Storing/Saving Encoder Parameters to EEPROM

To store the current encoder operating parameters into non-volatile memory:

Send message [(master MAC-ID) 0x32 0x23 0x01]. A new allocation is then required to resume receiving position values from the encoder.

Other Parameters

Contact Nidec-Avtron or review the EDS file for additional parameters, diagnostic registers, cam and programmable limit switch functionality and other advanced features.

DEVICENET TROUBLESHOOTING

For DeviceNet: disconnect the power connection, then ensure there are no short circuits between any of the signal or power wires or shield.

Viewing on oscilliscope: for 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 DeviceNet, ensure termination resistors are in place (or switched on) at each end of the cabling system, and that no termination resistors are in placed or activated in the middle of the system. Remove the connections to the master controller and all devices, or power down all devices. Measure the resistance between the communication wires [Example DeviceNet-measure between CAN_L and CAN_H]. The value should be ~1/2 of the termination resistor value on the network. For DeviceNet, this value should be >50 ohms, <65 ohms. If the resistance is greater than the limit, a termination resistor is missing from the network. If the resistance is less than the limit, there are incorrect termination resistors switched on or connected to the system.

DeviceNet Diagnostic LEDs		
LED	Status	Meaning
MS	Green	Power OK, Status OK
	Flash Green Then Flash Red	LED test at Power-Up
	1X Flash Green	Encoder Configuration Missing or Incorrect. Encoder in Standby Mode.
	1X Flash Red	Recoverable Network Fault
	Red	Encoder Malfunction
	Off	No Power
NS	Green	Status OK, Connected
	Red	Link Failure (Duplicate MAC or Bus Off)
	Flash Green Then Flash Red	LED test at Power-Up. If Not at Power-Up, Network Access Error
	1X Flash Green	Encoder online (passed Dup_MAC_ID) test, but no connection to other devices
	1X Flash Red	Communications timeout
	Off	Encoder Offline, has not passed Dup_MAC_ID

Ethernet POWERLINK "K"

POWERLINK Ethernet is typically a master-slave network-the master/scanner device gathers data from each (slave) device on the bus. Avtron encoders are POWERLINK slave devices.

POWERLINK Ethernet may be wired in several different configurations, but the best known is a "star" configuration where each device has a "home-run" network cable that connects to a central switch or hub.

To reduce the cabling requirements, Avtron encoders support "Daisy-Chain" configurations. The master device must be at one end of the bus. The signal is repeated by each encoder to it's output port (labelled "Hub"), which can in turn be connected to an input port of another encoder. No external or switched termination resistors are required for POWERLINK Ethernet. Power is carried to the device via a separate set of wires. A maximum of (7) encoders can be daisy-chained together to a single Ethernet master/scanner or switch port.

Preferred cable: Nidec Avtron recommends structured Ethernet wiring systems, available from a broad range of vendors as well as Avtron.

For more details on POWERLINK, consult the POWERLINK Standardization Group:

http://www.ethernet-POWERLINK.org

Number of Nodes	1-7	Units
Max. Overall Cable Length*	330 [100]	ft [m]

*Using Ethernet standard cable, CAT6 or CAT5e required

NOTE: UNLIKE OTHER AVTRON ABSOLUTE ENCODERS, DO NOT REMOVE THE CONNECTION CAP TO SET THE ADDRESS.

Setting Station/Node, Baud Rate

To set the node number: use the rotating switches on the back of the connection cap. The format is hexidecimal, from 0x00 to 0xEF (0-239 decimal). The left-most switch is the sixteen's switch and the right switch is the one's).
Example: Left-most switch (16s set to 1, right most switch set to A. Address = 0x1A = 1*16 + 10 *1 = 26 decimal

Setting the node number also sets the IP address.
Avtron POWERLINK encoders are located at 192.168.100.Node
For the example above, the IP address would be 192.168.100.26

The address may also be set via software using EPL telegrams. Set the rotating switches to 0, 0 to enable software addressing.

POWERLINK baud rate is auto-detected by the encoder, no settings are required. 100mBit and 10mBit are supported, Gigabit Ethernet is not supported at the encoder level but may be utilized at the switch backbone level.

Measuring Position, Speed, and Acceleration

To read position into your device (acceleration and speed measurement is not supported.): Following the instructions for your master/scanner module for the POWERLINK network, load the encoder XDD file into your configuration. Assign it to the correct node number. Store the configuration to the scanner module. All of the position data and other parameters will be read by the scanner module and placed in registers identified in the configuration package.

For multiturn & single turn encoders: position data provided as

4 bytes, 32 bits: Format is little-endian (lowest bit = right-most bit). Single-turn data/data within 1 turn is provided in the least-significant bits. Multiturn data is provided directly "above" the single turn data, bitwise. Example: 12 turns x 13 bits/turn encoder, lowest 13 bits = position within one turn, next 12 bits (up to bit 25) represent turns position data.

The position data is provided at parameter 0x6004.

Setting Zero Position for Multiturn Encoders and Single turn Encoders:
Using XDD file permits setting of the Preset Value 0x6003 object which will load a value in at powerup of the master system. However, if the machine is not at the home/preset position at master power-up, the system will nonetheless load the Initial Value into the encoder. This can cause a position error.

Setting Direction of Rotation for Count Up/Down:
Object 0x6000, least significant bit (0) can be set to change operation:
bit 0 = 0, Counterclockwise rotation = count up
bit 0 = 1, Clockwise rotation = count up
(rotation as viewed from the back of the encoder)

Scaling Counts:
To use scaling, set bit 2 in object 0x6000 = 1, default value = 0
0x6001 supports scaling of user units per revolution, default value 0x2000
0x6002 enables setting of the total measuring range in user units default value 0x1000

Multiplexed Mode
Multiplexed mode is supported by Avtron encoders. Multiplexing slows the data feed from each encoder to enable other data to pass more quickly to the master/scanner module.

For maximum encoder updates per second in mission critical applications, turn Multiplexed mode off using the master/scanner configuration software.

Other Parameters

Contact Nidec Avtron for additional parameters, diagnostic registers, cam and programmable limit switch functionality and other advanced features.

POWERLINK TROUBLESHOOTING
Viewing on oscilliscope: for POWERLINK/Ethernet, 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.

A software "snoop" or "sniffer" program can also be used to packet-analyze the communication. However due the the extremely high speed of Ethernet communication, and the time-stamped nature of the information on POWERLINK, it may be necessary to use a hardware tool such as the B&R debugger/analyzer.

Ensure there are no more than (7) POWERLINK encoders connected via daisy-chain to a single connection to a switch or bus master device. Note this number is decreased for any hubs between the master/scanner device and the encoder daisy-chain. More than 7 daisy-chained hubs + encoders will violate the Ethernet hub repeater rule and cause Ethernet errors and highly inconsistent data loss.

If the position is changing as the encoder moves, but is reported incorrectly, the Initial Value parameter may have been loaded into the encoder at the wrong physical position of the machine. Drive the machine to the home/preset position, and cycle power to see if the position is correctly reloaded.

POWERLINK Diagnostic LEDs		
LED	**Status**	**Meaning**
LS/DA 1 Error Status	**Green Off Green**	**Input connected to Ethernet, power OK, node address ok, no Ethernet errors, encoder operational**
LS/DA 1 Status	Flashing Green	Active inbound communication
LS/DA 2 Status	Green	Output connected to next encoder
LS/DA 2	Flashing Green	Active communication to next encoder
Error	Red	Ethernet Error or invalid node address
Status	1 Flash	Pre-Operational Mode 1
	2 Flashes	Pre-Operational Mode 2
	3 Flashes	Ready to operate
	Blinking	Stopped

Parallel Outputs "L"

Parallel output encoders represent the encoder position within one turn, and the number of turns using output wires for each measurement bit.

Preferred cable: Nidec Avtron recommends structured cabling wiring systems including overall shielding, available from a broad range of vendors as well as Nidec-Avtron.

Number of Nodes	1	Units
Max. Overall Cable Length*	150 [50]	ft [m]

*Note that maximum cabling length is a function of output resolution per turn * RPM, cable capacitance, and voltage. To increase cable length, decrease supply voltage or measurement resolution if possible.

NOTE: Standard Avtron absolute parallel encoders include preset/zero function. For maximum speed of response, request a special model with no reset/preset function. This increases the overall output response by 10X.

Measuring Position, Speed, and Acceleration

To read position into your device (acceleration and speed measurement is not supported.): Connect the power +V, 0V, and output wires to the measuring PLC or device.

For multiturn & single turn encoders: position data provided as little-endian (lowest bit = right-most bit). Single-turn data/data within 1 turn is provided in the least-significant bits. Multiturn data is provided directly "above" the single turn data, bitwise. Example: 8 bit turns x 12 bits/turn encoder, lowest 12 bits = position within one turn, next 8 bits (up to bit 20) represent turns position data.

Setting Zero Position for Multiturn Encoders and Single turn Encoders:
NOTE: Do not attempt to use zero/preset function while the encoder is rotating. Doing so will produce unpredictable results.

To set zero position, raise the voltage level of the Preset input to +V (supply of the encoder) for at least 0.1sec. The encoder will set the outputs to zero.

Setting Direction of Rotation for Count Up/Down:
Setting the Complement/Direction input will control the direction of counting:
Comp/Dir = 0, Counterclockwise rotation = count up
Comp/Dir = 1, Clockwise rotation = count up
(rotation as viewed from the back of the encoder)

Latching Counts:
Avtron parallel-bit encoders enable a latch input to hold the output constant (typically for slower input systems to measure the output).
Latch = 0, no latching
Latch = 1, latched within 3uS of rising edge

PARALLEL TROUBLESHOOTING
Viewing on oscilliscope: The lowest significant bit can be monitored as the encoder is rotated. As long as the rotation speed is low enough where RPM/60 * counts/turn < maximum output frequency, the output frequency can be measured and compared to the expected RPM/60 * counts/turn. Example: 12bit/4096 count encoder, turn at 60 RPM = 60/60 * 4096 = 4096Hz.

A digital state analyzer can also be connected to monitor some or all of the encoder lines simultaneously.

If the position is changing as the encoder moves, but is reported incorrectly, the zero/preset line may have been activated at the wrong physical position of the machine. Drive the machine to the home/preset position, and cycle power to see if the position is correctly reloaded.

Ethernet Modbus TCP "M"

Modbus TCP Ethernet is typically a master-slave network-the master/scanner device gathers data from each (slave) device on the bus. Avtron encoders are Modbus TCP slave devices.

Modbus TCP Ethernet may be wired in several different configurations, but the best known is a "star" configuration where each device has a "home-run" network cable that connects to a central switch or hub.

Unlike other Avtron Ethernet encoders, Modbus TCP encoders do not support a daisy-chain configuration. Each device must be direclty connected to the master/scanner device or to a switch or hub.

Preferred cable: Nidec Avtron recommends structured Ethernet wiring systems, available from a broad range of vendors as well as Avtron.

For more details on Modbus TCP, consult the Modbus Organization:

www.modbus.org

Number of Nodes	1	Units
Max. Overall Cable Length*	330 [100]	ft [m]

*Using Ethernet standard cable, CAT6 or CAT5e required

Setting Station/Node, Baud Rate

The default hardware address is 10.10.10.10.

NOTE: Rotating switches have NO EFFECT on MODBUS/TCP address. Unlike other Avtron encoders, you cannot change this hardware address using the switches inside the cap.

Instead, to assign any other address, you must use software. To set the node number via software, remove the connection cap from the back of the encoder. Flip dip switch 2 to "Off", reassemble the encoder.

Setting IP Address via utility software:
Begin with a factory-default encoder at 10.10.10.10 address with dip switch 2 set to "on" in the connection cap.
Make a physical Ethernet connection between a PC and the encoder.
Run the utility Mon10.bat (available as zipped folder from www. avtronencoders.com). This will establish a connection to the encoder and allow assignment of the IP address through the hymon. exe software, also included in the zipped folder.
Type the command (all lower case)
set ip xxx.xxx.xxx.xxx (where xxx is the desired IP address)
The encoder will respond "Flash memory update successful"
After assigning the IP address, remove power, then remove the connection cap. Set dip switch 2 to "off", which cycle power to the encoder. The encoder will now respond to the new IP address. (Verify using ping xxx.xxx.xxx.xxx where xxx represents the new ip address from PC)

Ethernet baud rate is auto-detected by the encoder, no settings are required. 100mBit and 10mBit are supported, Gigabit Ethernet is not supported at the encoder level but may be utilized at the switch backbone level.

Measuring Position, Speed, and Acceleration
To read position into your device (acceleration and speed measurement is not supported.):

For multiturn & single turn encoders: position data provided as 4 bytes, 32 bits: Format is little-endian (lowest bit = right-most

bit). Single-turn data/data within 1 turn is provided in the least-significant bits. Multiturn data is provided in adjacent 32-bit words. Example: 12 turns x 13 bits/turn encoder, lowest 13 bits = position within one turn, next 19 bits are unused. Next 12 bits represent turns position data, next 24 bits are unused.

Note velocity output is not accurate during command execution such as setting (zero) position.

Start Address 0000

Register	Data Type	Position
0	Position	Bit 17-32
1	Position	Bit 1-16
2	Velocity	Bit 17-32
3	Velocity	Bit 1-16
4-7	Time Stamp	
14	Preset	Bit 17-32
15	Preset	Bit 1-16
16	Offset	Bit 17-32
17	Offset	Bit 1-16

The position data is provided at parameter 0x6004.

Setting (Zero) Position for Multiturn Encoders and Single turn Encoders:
Start Address 0000, Register 14-15 Preset object which will load a preset value into the encoder. However, if the machine is not at the home/preset position at set position command, the system will nonetheless load the Preset Value into the encoder. This can cause a position error.

Setting Direction of Rotation for Count Up/Down:
Start Address 0000, Register 18, least significant bit (0) can be set to change operation:
bit 0 = 0, Counterclockwise rotation = count up
bit 0 = 1, Clockwise rotation = count up
(rotation as viewed from the back of the encoder)

Scaling Counts:
To use scaling, set bit 2 in object 0x6000 = 1, default value = 0
0x6001 supports scaling of user units per revolution, default value 0x2000
0x6002 enables setting of the total measuring range in user units default value 0x1000

Multiplexed Mode
Multiplexed mode is supported by Avtron encoders. Multiplexing slows the data feed from each encoder to enable other data to pass more quickly to the master/scanner module.

For maximum encoder updates per second in mission critical applications, turn Multiplexed mode off using the master/scanner configuration software.

Other Parameters

Contact Nidec Avtron for additional parameters, diagnostic registers, cam and programmable limit switch functionality and other advanced features.

MODBUS TCP TROUBLESHOOTING
Viewing on oscilliscope: for Modbus TCP/Ethernet, 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.

A simple one-to-one connection can be made to an ordinary PC. Set

the dip switch 2 in the connection cap to "On" to force a hardware address of 10.10.10.10. Reassemble the encoder. Connect the PC to the encoder using standard (not cross-patch) cable. Power the encoder using the second connection port (5-pin). The encoder Link 1 should illuminate green. Use the Ping command, Run "ping 10.10.10.10", and the encoder should reply, and the communication "ping" time will be reported by the PC. The Rx1 should flash briefly during the communication.

Check that only one Modbus TCP encoder is connected to each cable. Use hubs or switches to connect multiple Modbus TCP encoders to the master device.

A software "snoop" or "sniffer" program can also be used to packet-analyze the communication.

If the position is changing as the encoder moves, but is reported incorrectly, the Initial Value parameter may have been loaded into the encoder at the wrong physical position of the machine. Drive the machine to the home/preset position, and cycle power to see if the position is correctly reloaded.

MODBUS/TCP Diagnostic LEDs		
LED	**Status**	**Meaning**
Link 1	**Green**	**Input connected to Ethernet, power OK, node address ok, no Ethernet errors, encoder operational**
Rx1	Flashing Yellow	Active inbound communication
Col1	Red	Ethernet Collision Errors

Profinet IO "N"

Profinet IO is typically a master/slave network-the master/scanner device gathers data from each (slave) device on the bus. Avtron encoders are Profinet IO slave devices. Profinet IO commands include a subset of Profidrive commands-these commands are also supported by Avtron encoders. Avtron encoders support RT (real time) and IRT (isochronous real time) functions.

Profinet IO may be wired in several different configurations, but the best known is a "star" configuration where each device has a "home-run" network cable that connects to a central switch or hub.

To reduce the cabling requirements, Avtron encoders support "daisy-chain" configurations. The master device must be at one end of the bus or connected to a hub or switch. The input signal from the master or switch is repeated by each encoder to its output port (labelled "Port 2"), which can in turn be connected to an input Port 1 of another encoder. No external or switched termination resistors are required for Profinet IO. Power is carried to the device via a separate set of wires. A maximum of (7) encoders can be daisy-chained together to a single EtherNet/IP master/scanner or switch port.

Preferred cable: Nidec Avtron recommends structured Ethernet wiring systems, available from a broad range of vendors as well as Avtron.

For more details on Profinet, consult the Profibus Users Association (PI):

http://www.profibus.com/

Number of Nodes	1-7	Units
Max. Overall Cable Length*	330 [100]	ft [m]

*Using Ethernet standard cable, CAT6 or CAT5e required

Setting Station/Node, Baud Rate, Duplex

NOTE: There is no hardware method to set the Station/Node number (IP address) for Avtron EtherNet/IP address.

Setting IP Address via STEP7 (Siemens) software:
Begin with a factory-default encoder. Make a physical Ethernet connection between a PC and the encoder. Run the STEP7 software. Under menu item PLC->Ethernet->Edit Ethernet Mode->Browse. STEP7 will produce a list of all encoders via MAC-address. Optional: use the flash LED button to cause the LED to flash to verify communication with the encoder. Select menu item Use IP Parameters, enter the IP address then->Assign IP Configuration. Enter the device name. Any IP address from 0.0.0.0 to 223.255.255.255 (excluding 127.x.x.x) is permitted. Cycle power.

The encoder should now operate at the assigned IP address, which can be validated using the ping command from the PC. The assigned name can be used throughout STEP7 software to address the encoder.

Note that if more than one encoder is to be used on the same Profinet IO network, each encoder must be assigned a unique name, and individual encoders must be connected one-by-one to assign names using STEP7 software during setup.

Ethernet baud rate and duplex are auto-detected by the encoder, no settings are required. 100mBit and 10mBit are supported, Gigabit Ethernet is not supported at the encoder level but may be utilized at the switch backbone level. Consult Nidec Avtron if manual forcing of duplex is required.

Measuring Position, Speed, and Acceleration

Avtron encoders support three modes of operation:
Standard
Profile (Profidrive) 4.0 (supports DP-V2 commands)
Profile (Profidrive) 4.1 (supports DP-V2 commands)
Profile 4.0 and 4.1 require a special GSDML file, contact factory.

To read position and speed into your device (acceleration measurement is not supported directly):

Following the instructions for your master/scanner module for the Profinet IO network, load the encoder GSDML file into your configuration. Assign it to the correct IP address node number. Store the configuration to the scanner module.

All of the position data and other parameters will be read by the scanner module and placed in registers identified in the configuration package.

Cyclic Data			
ID (dec)	Function	Type	Notes
3	Master heartbeat	UINT	
4	Slave heartbeat	UINT	
6	Velocity	INT	
8	Velocity	DINT	
9	Ctl Word	UINT	bit 11=preset/zero bit 12=capture position bit 13=enable cyclic xmit bit 14=disable error xmit bit 15=clear errors
10	Status	UINT	Bit 12=ack capture position Bit 13=ack cyclic xmit req Bit 14=ack disable error Bit 15=encoder error
11	Position 1*	DINT	
12	Position 2*	DINT	If encoder error (bit 15, ID10), error message output to Position 2 instead of position.
39	Position 3	DINTx2	right-aligned
19	Vel. Update	EUINT	0=1sec, 1=0.1s, 2=0.01s, 3=RPM
29	Status	BYTE	
2A	Units per span	UDINT	read only, set w/0x10
2B	# Spans	UINT	# revolutions
33	Offset	DINT	Position+offset
64	Device Type	DINT	0x22 = Encoder
65	Rollover	DINT	0=off, 1=on, 2=auto
66	Vel'cty Filter	DINT	0=low pass, 1=mid, 2=off

* Depending on the mode of operation selected, the position data is aligned differently, but always presented little-Endian (right most bit is least significant):

Standard Profile: data is right-justified: Single-turn data/data within

1 turn is provided in the least-significant bits. Multiturn data is provided directly "above" the single turn data, bitwise. Example: 12 bit turns x 12 bits/turn encoder, lowest 12 bits = position within one turn, next 12 bits (up to bit 24) represent turns position data, most significant 8 bits unused.

Profile 4.0: data is left-justified within Position 1 register: Multi-turn data is provided in the most-significant bits. Singleturn/data within one turn is provided directly "below" the multiturn data, bitwise. Example: 12 bit turns x 12 bits/turn encoder, lowest 8 bits unused, next 12 bits (up to bit 20) = position within one turn, next 12 bits (up to bit 32) represent turns position data.

Profile 4.1: data is right-justified: Single-turn data/data within 1 turn is provided in the least-significant bits. Multiturn data is provided directly "above" the single turn data, bitwise and fills entire remaining number of bits. Example: 12 bit turns x 12 bits/turn encoder, lowest 12 bits = position within one turn, next 20 bits represent turns position data.

Setting (Zero) Position for Multiturn Encoders and Single turn Encoders:
This can be done manually via the master/scanner software, or via programmed code in the master device:
Use manufacturer-specific telegram 860: (all data little-Endian)
Data from encoder: 32 bits UDINT, Position, 32 bits UDINT Velocity
Data to encoder: 32 bits: bit 32 = 1, set preset/zero position, bits 1-31 = preset value.

Alternatively, set bit 11 of Control Word (ID=9) = 1.

Setting Direction of Rotation for Count Up/Down:
Parameter Code Sequence (from the GSDML file) contains a Direction Counting Toggle for the count direction. Use the Online Parameters tab to change the value. Note that this is REVERSED from standard Avtron nomenclature--the encoder is viewed from the front.

Setting Polling, Cyclic, Sync, and Implicit Messaging Mode
Polling, cycling, sync, and implicit messaging modes are supported by the encoder; use the parameters supplied in the GSDML file to set the appropriate mode. Store the resulting configuration into the scanner module.

Storing/Saving Encoder Parameters to EEPROM
To store the current encoder operating parameters into non-volatile memory:

Other Parameters

Contact Nidec Avtron for additional parameters, diagnostic registers, cam and programmable limit switch functionality and other advanced features.

PROFINET IO/ PROFIDRIVE TROUBLESHOOTING
Viewing on oscilliscope: for Profinet IO/Profibus IRT 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.

A simple one-to-one connection can be made to an ordinary PC. Connect the PC to the encoder using standard (not cross-patch) cable. Power the encoder using the power connector. The encoder Link 1 should illuminate green. Use the Ping command, Run "ping xxx.xxx.xxx.xxx" where xxx represents the IP address that has been assigned to the encoder. The encoder should reply, and the communication "ping" time will be reported by the PC. The Active 1 LED should flash briefly during the communication.

A software "snoop" or "sniffer" program can also be used to packet-analyze the communication.

If the position is changing as the encoder moves, but is reported

incorrectly, the Preset parameter may have been loaded into the encoder at the wrong physical position of the machine. Drive the machine to the home/preset position, and cycle power to see if the position is correctly reloaded.

Profinet IO Diagnostic LEDs		
LED	**Status**	**Meaning**
Stat 1 **Stat 2** **Link 1**	**Green** **Off** **Green**	**Input connected to Ethernet, power OK, node address ok, no Ethernet errors, encoder operational, Profinet IO connection established**
Link 2	Green	Output connected to next encoder
Stat 2	Flashing Red	IP address established, but no Profinet IO connection established
Active 1	Flashing Yellow	Active inbound communication
Active 2	Flashing Yellow	Active communication to next encoder

Profibus DP Protocol "P"

Profibus DP is typically a master-slave network-the master/scanner device gathers data from each (slave) device on the bus. Avtron encoders are Profibus DP slave devices.

Profibus may be wired in several different configurations, but the most common is a "Daisy-Chain" configuration. The master/scanner device may be located at any point along the bus. The cable must be terminated at each end with 150 ohm resistors. These resistors can be present in the D-sub cable connectors, in the master controller, and in the encoder, but only one at each end of the bus, two total should be connected/enabled. Note that Profibus DP also offers the option to carry device power to each encoder through an additional cable pair of wires.

Preferred cable: Nidec Avtron recommends structured Profibus DP wiring systems, available from a broad range of vendors.

For more details on Profibus, consult the Profibus Users Association (PI):

http://www.profibus.com/

Number of Nodes	2	16	32	64	Units
Max. Overall Cable Length*	750 [229]	690 [210]	640 [190]	560 [170]	ft [m]

Network Baud Rate	12M 6M 3M	1.5M	500K	187.5K	93.75K 45.45K 19.2K 9.6K	Units
Max. Length*	325 [100]	650 [200]	1300 [400]	3250 [1000]	4000 [1200]	ft [m]

*Using Profibus standard cable, 150 ohm impedance 3-20mHz,

<30pf/m, <110 ohms/km loop resistance

Setting Station/Node, Baud Rate & Termination Resistor

To set the node number: use the rotating switches in the connection cap. The format is decimal, from 0-99 (ten's switch and one's switch). Software/master address changes are not supported. NOTE: Each device must have a unique node address, and this address must be different than the master/scanner module.

Profibus DP baud rate is auto-detected by the encoder, no settings are required. 12 MBaud, 6 MBaud, 3 MBaud, 1.5 MBaud, 500 kBaud, 187.5 kBaud, 93.75 kBaud, 45.45 kBaud, 19.2 kBaud, 9.6 kBaud are all supported.

To enable the termination resistor: Move the switch "R" to the "On" Position on the connection board. The termination resistor should be turned on/enabled when the encoder is the last/only device on the bus. Note that standard 9 pin DIN connectors used for Profibus DP also offer a termination resistor. Be sure NOT to enable both the encoder termination resistor and the 9-pin connector resistor, use one or the other for an encoder at the end of a bus.

Measuring Position, Speed, and Acceleration

To read position and speed feedback into your device (Acceleration measurement is not supported directly): Following the instructions for your master/scanner module for the Profibus DP network, load the encoder GSD file into your configuration. Assign it to the correct node number. Store the configuration to the scanner module. All of the position data and other parameters will be read by the scanner module and placed in registers identified in the configuration package.

For multiturn & single turn encoders: position data provided as 4 bytes, 32 bits: Format is little-endian (lowest bit = right-most bit). Single-turn data/data within 1 turn is provided in the least-significant bits. Multiturn data is provided directly "above" the single turn data, bitwise. Example: 12 turns x 13 bits/turn encoder, lowest 13 bits = position within one turn, next 12 bits (up to bit 25) represent turns position data.

Setting Zero Position for Multiturn Encoders and Single turn Encoders Using 32 Bit Feedback:
Write 1 to the highest bit (31)-write 128 (80H) to top-most-byte of the position register.

For single turn encoders: position data can instead be provided as 2 bytes, 16 bits: Format is little-endian (lowest bit = right-most bit).

Setting Zero Position for Single turn Encoders Using 16 Bit Feedback :
Write 1 to the highest bit (15)-write 128 (80H) to top-most-byte of the position register.

Isochronous (Auto-Transmit) Mode
DPV2 Isochronous communication can be configured using the optional DPV2 GSD file. Load the encoder GSD file into your master/scanner software. Assign it to the correct node number. Store the resulting configuration into the scanner module. Note many Profibus master devices do not support isochronous mode-check the master device manual before utilizing this encoder mode and GSD file.

Other Parameters

Contact Nidec Avtron for additional parameters, diagnostic registers, cam and programmable limit switch functionality and other advanced features.

PROFIBUS-DP TROUBLESHOOTING
Viewing on oscilliscope: for Profibus DP, 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 placed or activated in the middle of the system. Remove the connections to the master controller and all devices, or power down all devices. Measure the resistance between the communication wires. The value should be ~1/2 of the termination resistor value on the network (typically = 75 ohm measurement). If the resistance is greater than the limit, a termination resistor is missing from the network. If the resistance is less than the limit, there are incorrect termination resistors switched on or connected to the system.

Profibus DP Diagnostic LEDs		
LED	**Status**	**Meaning**
STATUS ERROR	**Green Off**	**Power Ok, Status OK**
STATUS ERROR	Green Red	No Configuration Data Received
STATUS ERROR	Green Flashing Red	Encoder Bus Address Set Incorrectly
STATUS ERROR	Flashing Green Red	Parameters Received With Incorrect Length
STATUS ERROR	Flashing Green Off	Commissioning Mode Active
STATUS ERROR	Off Red	No Data Received, Bus Inactive
STATUS ERROR	Off Off	No Power

EtherNet/IP "R"

EtherNet/IP is typically a producer/consumer network-the master/scanner device gathers data from each (slave) device on the bus. Avtron encoders are Ethernet/IP slave devices. Unlike simple master/slave systems, however, EtherNet/IP permits multiple devices to Listen Only or use Input Only to receive the encoder position directly.

EtherNet/IP may be wired in several different configurations, but the best known is a "star" configuration where each device has a "home-run" network cable that connects to a central switch or hub.

To reduce the cabling requirements, Avtron encoders support "Daisy-Chain" configurations. The master device must be at one end of the bus. The signal is repeated by each encoder to its output port (labelled "Port 2"), which can in turn be connected to an input Port 1 of another encoder. No external or switched termination resistors are required for EtherNet/IP. Power is carried to the device via a separate set of wires. A maximum of (7) encoders can be daisy-chained together to a single EtherNet/IP master/scanner or switch port.

Preferred cable: Nidec Avtron recommends structured Ethernet wiring systems, available from a broad range of vendors as well as Avtron.

For more details on EtherNet/IP, consult the Open DeviceNet Vendor's Association (ODVA):
www.odva.org

Number of Nodes	1-7	Units
Max. Overall Cable Length*	330 [100]	ft [m]

*Using Ethernet standard cable, CAT6 or CAT5e required

Setting Station/Node, Baud Rate, Duplex

NOTE: There is no hardware method to set the Station/Node number (IP address) for Avtron EtherNet/IP address.

Setting IP Address via BOOTP software:
Begin with a factory-default encoder. Make a physical Ethernet connection between a PC and the encoder. Run the utility BOOTP/DCHP Server. BOOTP will produce a list of all encoders via MAC-address. Use BOOTP to assign the IP address, subnet mask, etc. Any IP address from 0.0.0.0 to 223.255.255.255 (excluding 127.x.x.x) is permitted.
Disable the BOOTP and DHCP mode in the encoder using BOOTP. Cycle power.
The encoder should now operate at the assigned IP address, which can be validated using the ping command from the PC.

Ethernet baud rate and duplex are auto-detected by the encoder, no settings are required. 100mBit and 10mBit are supported, Gigabit Ethernet is not supported at the encoder level but may be utilized at the switch backbone level. Consult Nidec Avtron if manual forcing of duplex is required.

Measuring Position, Speed, and Acceleration

To read position and speed into your device (acceleration measurement is not supported):

Following the instructions for your master/scanner module for the EtherNet/IP network, load the encoder EDS file into your configuration. Assign it to the correct IP address node number. Store the configuration to the scanner module.

All of the position data and other parameters will be read by

the scanner module and placed in registers identified in the configuration package.

Class Code 0x23 Position Sensor Objects				
ID (hex)	R/W	Function	Type	Notes
01	R	# Attributes	UINT	
02	R	Attrib.List	UINT	Array
0A	R	Position	DINT	
0B	R	Sensor Type	UINT	
0E	W	Scaling	BOOL	Scaling on/off
10	W	Units per span	UDINT	Units per revolution
11	W	Total span	UDINT	Total units
13	W	Preset	DINT	Set position
18	R	Velocity	DINT	
19	W	Vel. Format	EUINT	
29	R	Status	BYTE	
2A	R	Units per span	UDINT	read only, set w/0x10
2B	R	# Spans	UINT	# revolutions
33	R	Offset	DINT	Position+offset
64	W	Device Type	DINT	0x22 = Encoder
65	W	Rollover	DINT	0=off, 1=on, 2=auto
66	W	Vel'cty Filter	DINT	0=low pass, 1=mid, 2=off

Setting (Zero) Position for Multiturn Encoders and Single turn Encoders:
This can be done manually via the master/scanner software, or via programmed code in the master device:
Write to the Preset: Class 0x23, Instance 0x01, Attribute 0x13.
The Preset register can be forced to any valid value using the Online Parameters tab for the device from the configuration software. The units for the preset are steps (counts per revolution x revolutions + counts in the final turn). Note: if the machine is not at the home/preset physical position during set position command, this can cause a position error.

Setting Direction of Rotation for Count Up/Down:
Parameter 0 (from the EDS file) contains a Direction Counting Toggle for the count direction. Use the Online Parameters tab to change the value. Note that this is REVERSED from standard Avtron nomenclature--the encoder is viewed from the front.

Setting Polling, Cyclic, Sync, and Implicit Messaging Mode
Polling, cycling, sync, and implicit messaging modes are supported by the encoder; use the parameters supplied in the EDS file to set the appropriate mode. Class 0 and Class 1 implicit messaging is supported. Store the resulting configuration into the scanner module.

Storing/Saving Encoder Parameters to EEPROM
To store the current encoder operating parameters into non-volatile memory:

Send explicit message CIP service 0x16 (Save). A new allocation is then required to resume receiving position values from the encoder and a power cycle is recommended.

Other Parameters

Contact Nidec Avtron for additional parameters, diagnostic registers, cam and programmable limit switch functionality and other advanced features.

ETHERNET/IP TROUBLESHOOTING

Viewing on oscilliscope: for EtherNet/IP 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.

A simple one-to-one connection can be made to an ordinary PC. Connect the PC to the encoder using standard (not cross-patch) cable. Power the encoder using the power connector. The encoder Link 1 should illuminate green. Use the Ping command, Run "ping xxx.xxx.xxx.xxx" where xxx represents the IP address that has been assigned to thee encoder. The encoder should reply, and the communication "ping" time will be reported by the PC. The Active 1 LED should flash briefly during the communication.

A software "snoop" or "sniffer" program can also be used to packet-analyze the communication.

If the position is changing as the encoder moves, but is reported incorrectly, the Preset parameter may have been loaded into the encoder at the wrong physical position of the machine. Drive the machine to the home/preset position, and cycle power to see if the position is correctly reloaded.

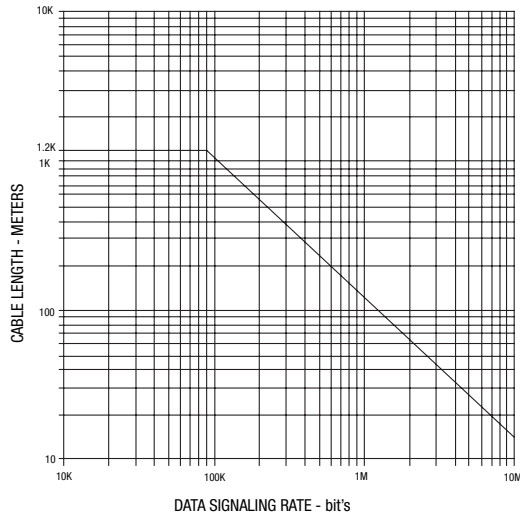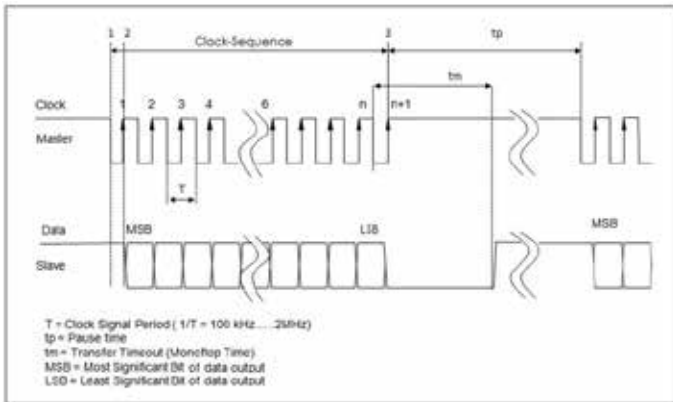| EtherNet/IP Diagnostic LEDs		
LED	**Status**	**Meaning**
Stat 1 **Stat 2** **Link 1**	**Green** **Green** **Green**	**Input connected to Ethernet, power OK, node address ok, no Ethernet errors, encoder operational, EtherNet/IP connection established**
Link 2	Green	Output connected to next encoder
Stat 1	Flashing Green 1Hz	Encoder in standby, not configured
	Flashing Green 4Hz	Encoder IP address not set
	Flashing Red	Configuration error
	Red	Major internal fault
	Alternating Red/Green	Power-up testing
Stat 2	Flashing Green	IP address established, but no EtherNet/IP connection established
	Flashing Yellow	Connection (message) timeout
	Yellow	Duplicate IP address on bus
	Alternating Red/Green	Power-up testing
Active 1	Flashing Yellow	Active inbound communication
Active 2	Flashing Yellow	Active communication to next encoder

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.

For more details on SSI, consult Wikipedia:

http://en.wikipedia.org/wiki/Synchronous_Serial_Interface

T = Clock Signal Period (1/T = 100 kHz....2MHz)
tp = Pause time
tm = Transfer Timeout (Monoflop Time)
MSB = Most Significant Bit of data output
LSB = Least Significant Bit of data output

SSI TROUBLESHOOTING

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. The encoder data transmit lines should change state as data is clocked out. Note that the varying binary patterns representing position can produce pulses of varying width--this is normal.

SSI Diagnostic LEDs		
LED	**Status**	Meaning
PWR	Green	Power OK, Status OK
	Off	No Power or Preset Button Pressed
ALARM	Off	Status OK
	Red	Internal Fault (All output bits are set =1)

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.
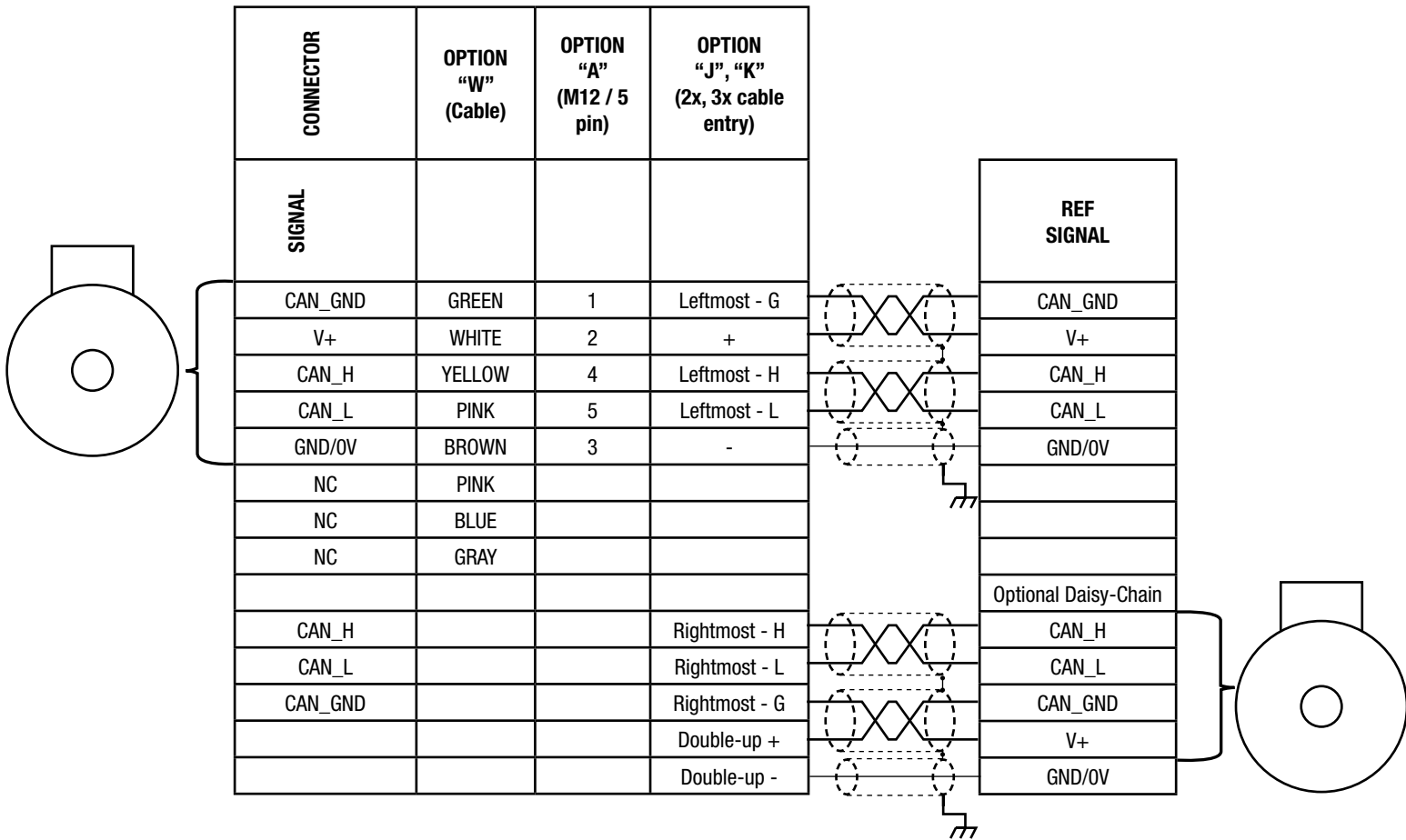
HS6A WIRING DIAGRAMS

CANOpen Bus "C"

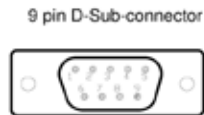| CONNECTOR	OPTION "W" (Cable)	OPTION "A" (M12 / 5 pin)	OPTION "J", "K" (2x, 3x cable entry)		REF SIGNAL
SIGNAL					
CAN_GND	GREEN	1	Leftmost - G		CAN_GND
V+	WHITE	2	+		V+
CAN_H	YELLOW	4	Leftmost - H		CAN_H
CAN_L	PINK	5	Leftmost - L		CAN_L
GND/0V	BROWN	3	-		GND/0V
NC	PINK				
NC	BLUE				
NC	GRAY				
					Optional Daisy-Chain
CAN_H			Rightmost - H		CAN_H
CAN_L			Rightmost - L		CAN_L
CAN_GND			Rightmost - G		CAN_GND
			Double-up +		V+
			Double-up -		GND/0V

* NOTE: CAN cable required with individual and overall shields. Obey pairing as shown.

Pinouts

5 pin M12 connector female/male

9 pin D-Sub-connector

Switches

Term Strip

+	−	G	L	H	G	L	H
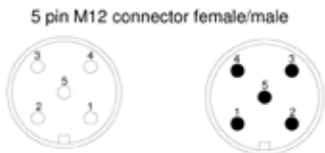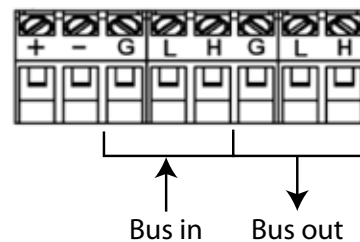
Bus in   Bus out

HS6A WIRING DIAGRAMS

DeviceNet Bus "D"
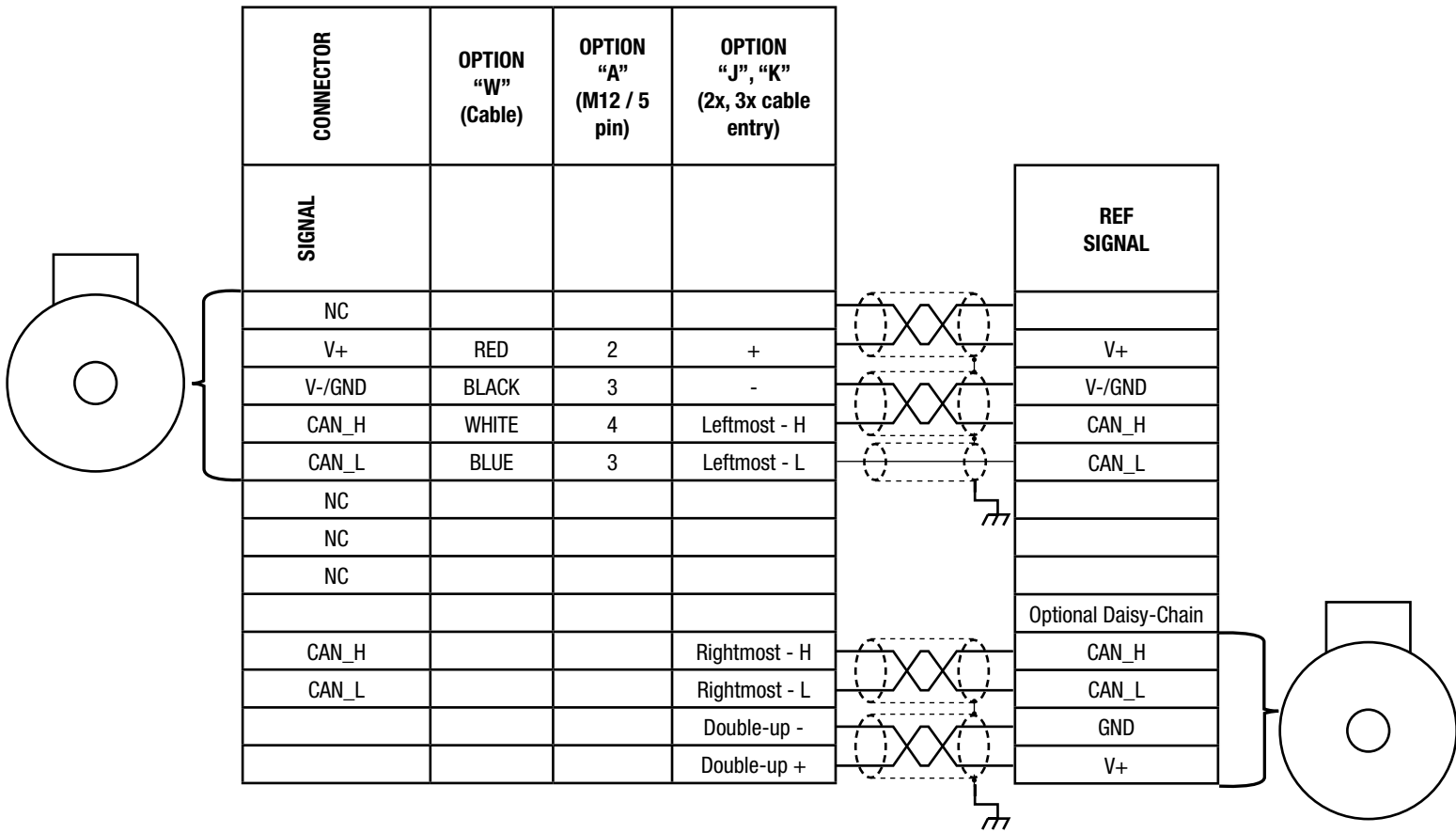
| CONNECTOR	OPTION "W" (Cable)	OPTION "A" (M12 / 5 pin)	OPTION "J", "K" (2x, 3x cable entry)		REF SIGNAL
SIGNAL					
NC					
V+	RED	2	+		V+
V-/GND	BLACK	3	-		V-/GND
CAN_H	WHITE	4	Leftmost - H		CAN_H
CAN_L	BLUE	3	Leftmost - L		CAN_L
NC					
NC					
NC					
					Optional Daisy-Chain
CAN_H			Rightmost - H		CAN_H
CAN_L			Rightmost - L		CAN_L
			Double-up -		GND
			Double-up +		V+

* NOTE: CAN cable required with individual and overall shields. Obey pairing as shown.

Pinouts

5 pin M12 connector female/male

9 pin D-Sub-connector

Switches
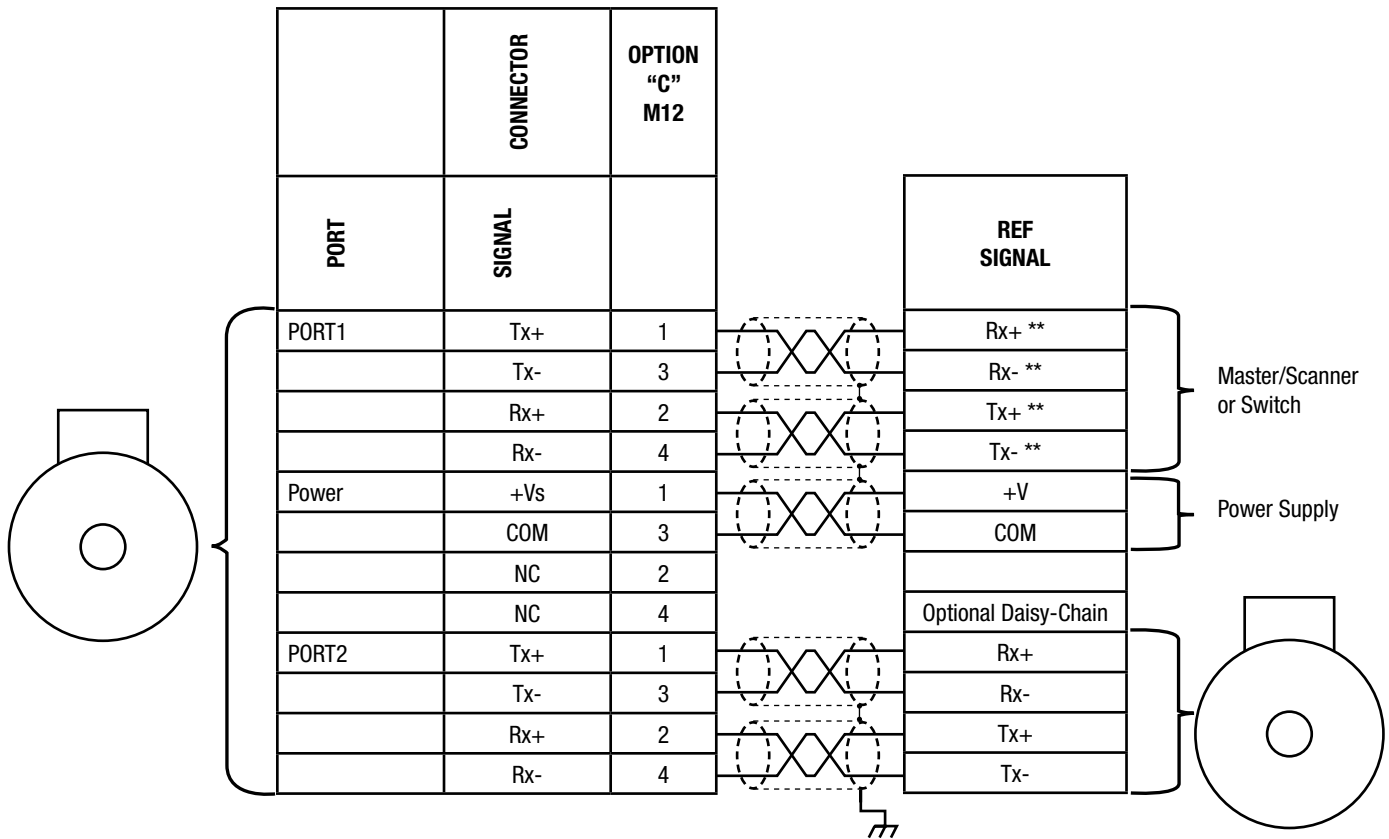
Term Strip

| + | – | G | L | H | G | L | H |
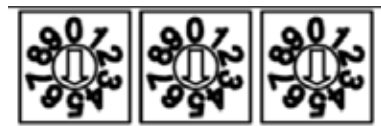
Bus in   Bus out

HS6A WIRING DIAGRAMS

Communication Bus "K", "N", "R": POWERLINK, Profinet IO, EtherNet/IP Pinout

PORT	CONNECTOR SIGNAL	OPTION "C" M12		REF SIGNAL	
PORT1	Tx+	1		Rx+ **	Master/Scanner or Switch
	Tx-	3		Rx- **	
	Rx+	2		Tx+ **	
	Rx-	4		Tx- **	
Power	+Vs	1		+V	Power Supply
	COM	3		COM	
	NC	2			
	NC	4		Optional Daisy-Chain	
PORT2	Tx+	1		Rx+	
	Tx-	3		Rx-	
	Rx+	2		Tx+	
	Rx-	4		Tx-	

* NOTE: Twisted pair cable CAT6, CAT5E. Obey pairing as shown, optional overall shield may be used for high noise environments

** NOTE: For encoder switch connections use the "crossover" pinout shown for encoder-PC or encoder-PLC direct wiring use a "Straight through" connection (Tx+ ➤ Tx-, Rx+ ➤ Rx-, Rx- ➤ Rx-)
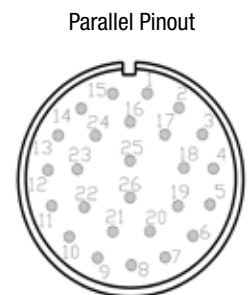
Pinouts for Ethernet

Switches

Port 1

Power
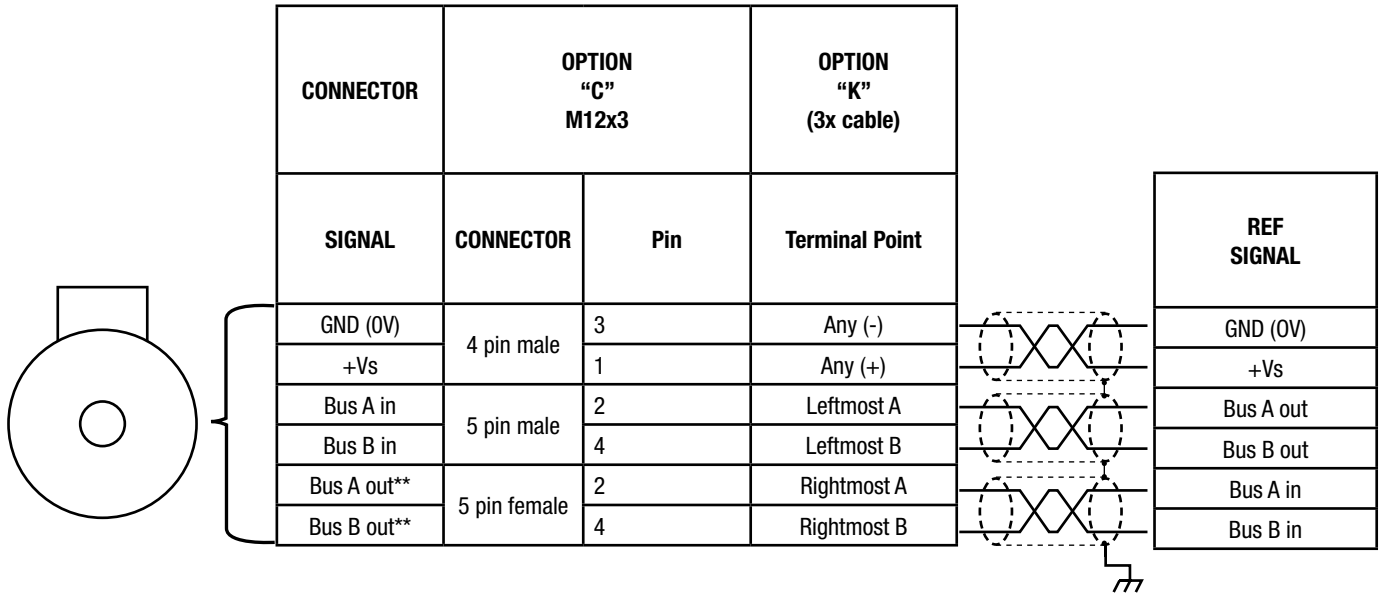
Port 2
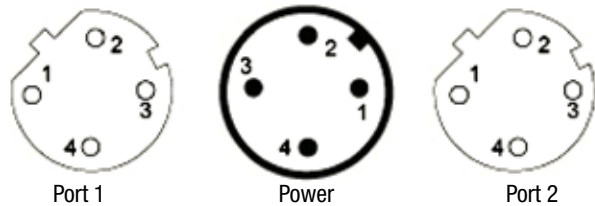
HS6A WIRING DIAGRAMS

Communication Bus "P": Parallel Pinout

CONNECTOR SIGNAL	OPTION "W" (Cable)	OPTION "G" M27/26		REF SIGNAL SIGNAL
GND	YELLOW-PINK	26		GND
+Vs	PINK-GREEN	25		+Vs
DIRECTION	YELLOW-GREY	24		DIRECTION
LATCH	GREY-GREEN	23		LATCH
PRESET	BROWN-BLACK	22		PRESET
BIT 25 (MSB)	WHITE-BLACK	NC		BIT 25 (MSB)
BIT 24	BROWN-RED	NC		BIT 24
BIT 23	WHITE-RED	NC		BIT 23
BIT 22	BROWN-BLUE	NC		BIT 22
BIT 21	WHITE-BLUE	21		BIT 21
BIT 20	PINK-BROWN	20		BIT 20
BIT 19	WHITE-PINK	19		BIT 19
BIT 18	GREY-BROWN	18		BIT 18
BIT 17	WHITE-GREY	17		BIT 17
BIT 16	YELLOW-BROWN	16		BIT 16
BIT 15	WHITE-YELLOW	15		BIT 15
BIT 14	BROWN-GREEN	14		BIT 14
BIT 13	WHITE-GREEN	13		BIT 13
BIT 12	BLUE-RED	12		BIT 12
BIT 11	GREY-PINK	11		BIT 11
BIT 10	VIOLET	10		BIT 10
BIT 9	BLACK	9		BIT 9
BIT 8	RED	8		BIT 8
BIT 7	BLUE	7		BIT 7
BIT 6	PINK	6		BIT 6
BIT 5	GREY	5		BIT 5
BIT 4	YELLOW	4		BIT 4
BIT 3	GREEN	3		BIT 3
BIT 2	BROWN	2		BIT 2
BIT 1 (LSB)	WHITE	1		BIT 1 (LSB)

* NOTE: Cable with overall shield required

Parallel Pinout

HS6A WIRING DIAGRAMS

Communication Bus "M": Modbus TCP Pinout
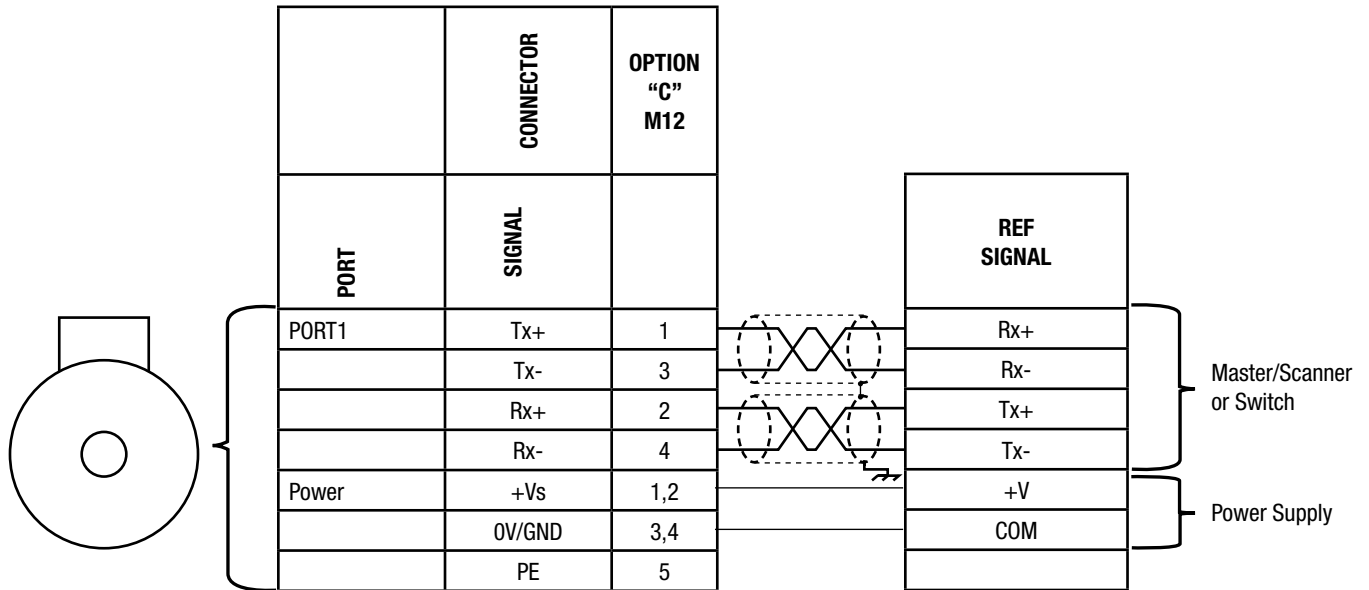
PORT	SIGNAL	CONNECTOR / OPTION "C" M12		REF SIGNAL	
PORT1	Tx+	1		Rx+	Master/Scanner or Switch
	Tx-	3		Rx-	
	Rx+	2		Tx+	
	Rx-	4		Tx-	
Power	+Vs	1,2		+V	Power Supply
	0V/GND	3,4		COM	
	PE	5			

* NOTE: Twisted pair cable CAT6, CAT5E. Obey pairing as shown, optional overall shield may be used for high noise environments

** NOTE: For encoder switch connections use the "crossover" pinout shown for encoder-PC or encoder-PLC direct wiring use a "Straight through" connection (Tx+ → Tx-, Rx+ → Rx-, Rx- → Rx-
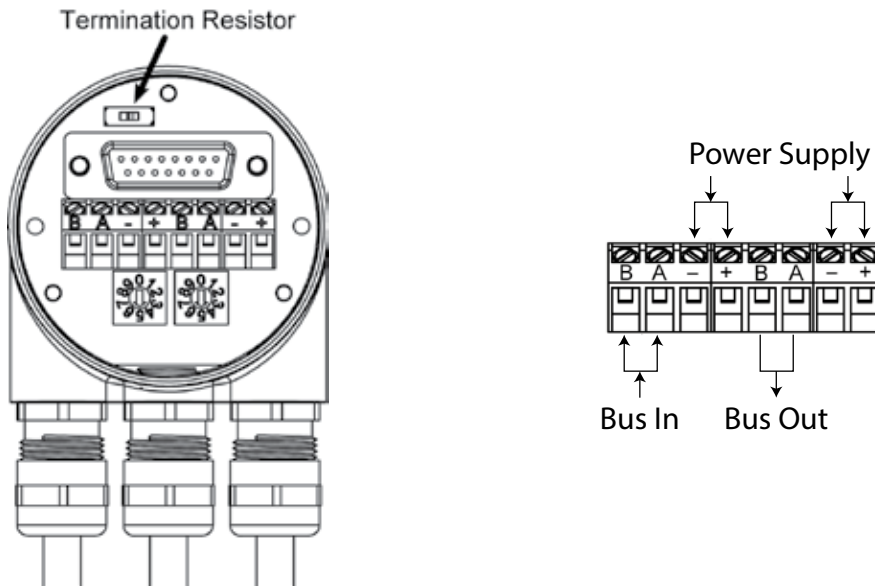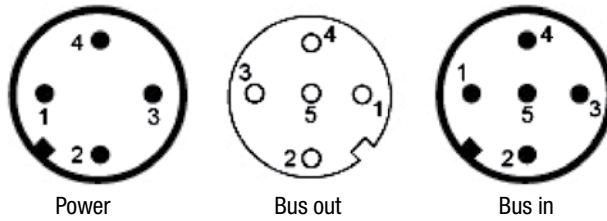
Pinouts for Ethernet

Port 1   Power
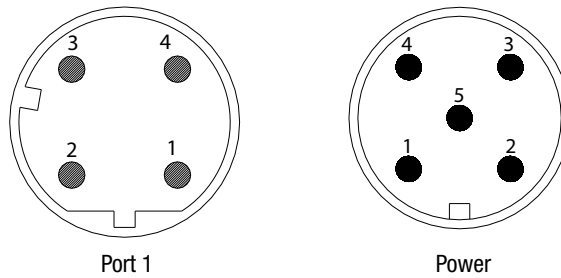
HS6A WIRING DIAGRAMS

Communication Bus "P": Profibus Pinout

CONNECTOR	OPTION "C" M12x3		OPTION "K" (3x cable)		REF SIGNAL
SIGNAL	CONNECTOR	Pin	Terminal Point		REF SIGNAL
GND (0V)	4 pin male	3	Any (-)		GND (0V)
+Vs	4 pin male	1	Any (+)		+Vs
Bus A in	5 pin male	2	Leftmost A		Bus A out
Bus B in	5 pin male	4	Leftmost B		Bus B out
Bus A out**	5 pin female	2	Rightmost A		Bus A in
Bus B out**	5 pin female	4	Rightmost B		Bus B in

* NOTE: Profibus cabling required. Obey pairing as shown
**If termination resistor "R" is enabled/"on", bus out terminals are disabled
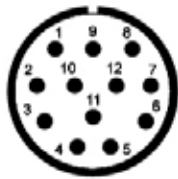
Pinouts for Profibus

Power   Bus out   Bus in

Termination Resistor

Power Supply

B A - + B A - +

Bus In   Bus Out
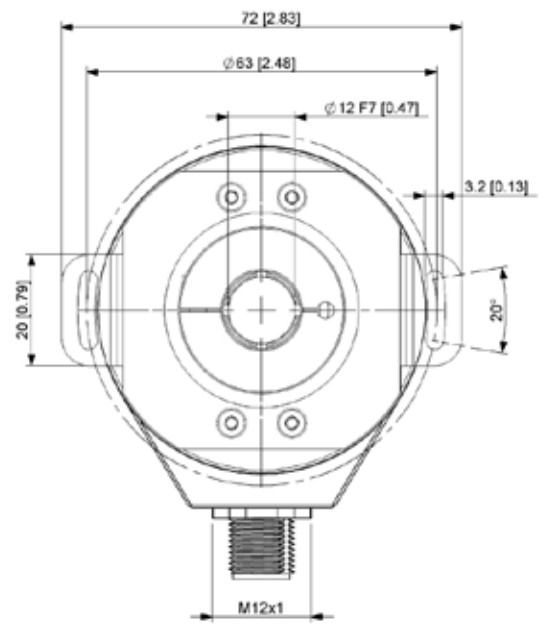
HS6A WIRING DIAGRAMS

Communication Bus "S": SSI Pinout

CONNECTOR	OPTION "W" (Cable)	OPTION "F" M23/12	OPTION "E" M12/8		REF SIGNAL
SIGNAL					
GND	WHITE	12	1		GND
+Vs	BROWN	11	2		+Vs
CLK+	GREEN	2	3		CLK+
CLK-	YELLOW	1	4		CLK-
DAT+	GRAY	3	5		DAT+
DAT-	PINK	4	6		DAT-
SET ZERO	BLUE	9	7		SET ZERO
SET DIRECTION	RED	8	8		SET DIRECTION
NC		5			NC
NC		6			NC
NC		7			NC
NC		10			NC
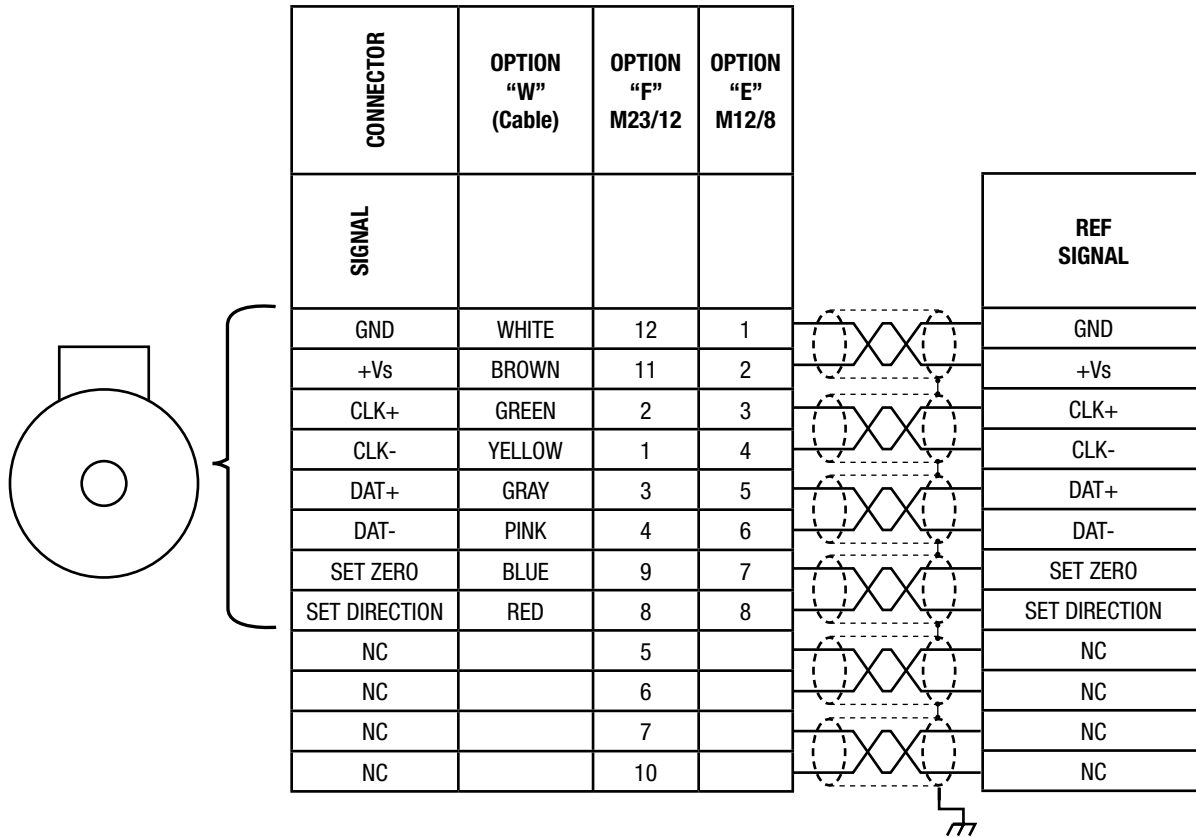
* NOTE: Twisted pair cable required with overall shield; individual pair shielding recommended. Obey pairing as shown
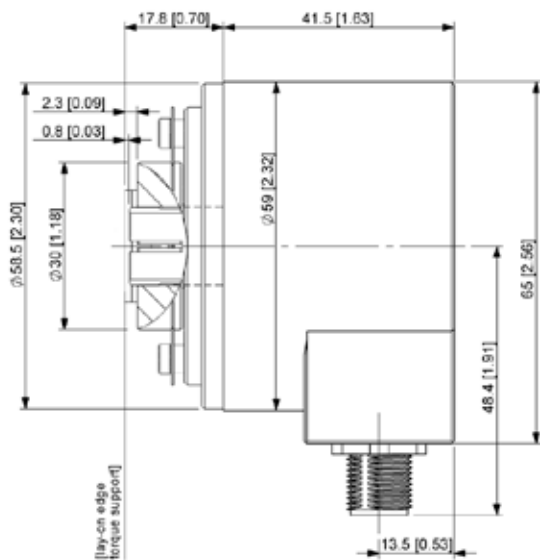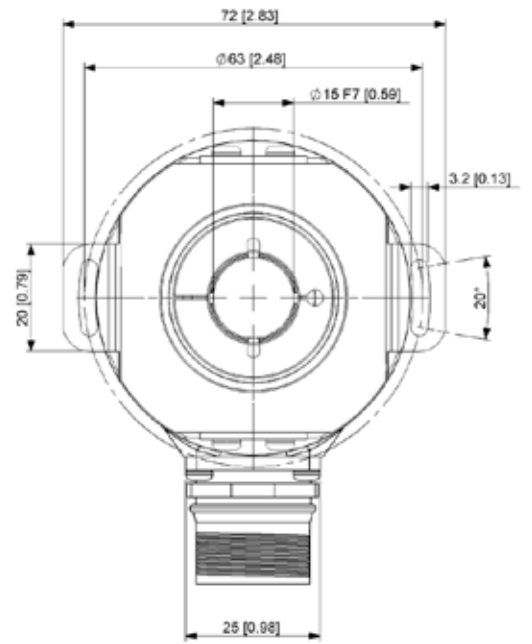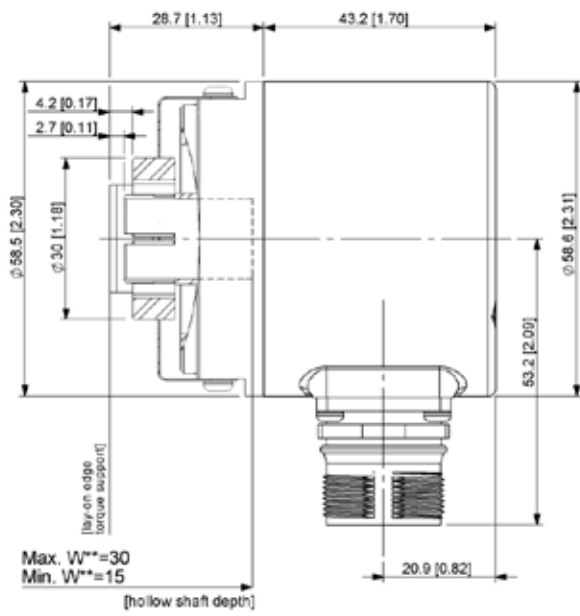
Pinouts for SSI

Option "F" M23/12   Option "E" M12/8

17.8 [0.70]
41.5 [1.63]
2.3 [0.09]
0.8 [0.03]
Ø58.5 [2.30]
Ø30 [1.18]
Ø59 [2.32]
65 [2.56]
48.4 [1.91]
13.5 [0.53]

[lay-on edge torque support]

72 [2.83]
Ø63 [2.48]
Ø12 F7 [0.47]
3.2 [0.13]
20 [0.79]
20°
M12x1

HS6A, SSI "S", 15mm Bore "R", End of Shaft Mounting "E", Connector M23/12 "F"

HS6A, Profibus DP "P", 15mm Bore "R", End of Shaft Mounting "E", Connector M12x3 "C"

28.7 [1.13]

70.3 [2.77]

4.2 [0.17]

2.7 [0.11]

27.5 [1.08]

Ø58.6 [2.31]

Ø58.5 [2.30]

Ø30 [1.18]

46 [1.81]

(lay-on edge torque support)

14.8 [0.58]

Max. W**=30
Min. W**=15

[hollow shaft depth]

72 [2.83]

Ø63 [2.48]

Ø15 F7 [0.59]

3.2 [0.13]

20 [0.79]

20°

40 [1.57]

Ø60 [2.36]
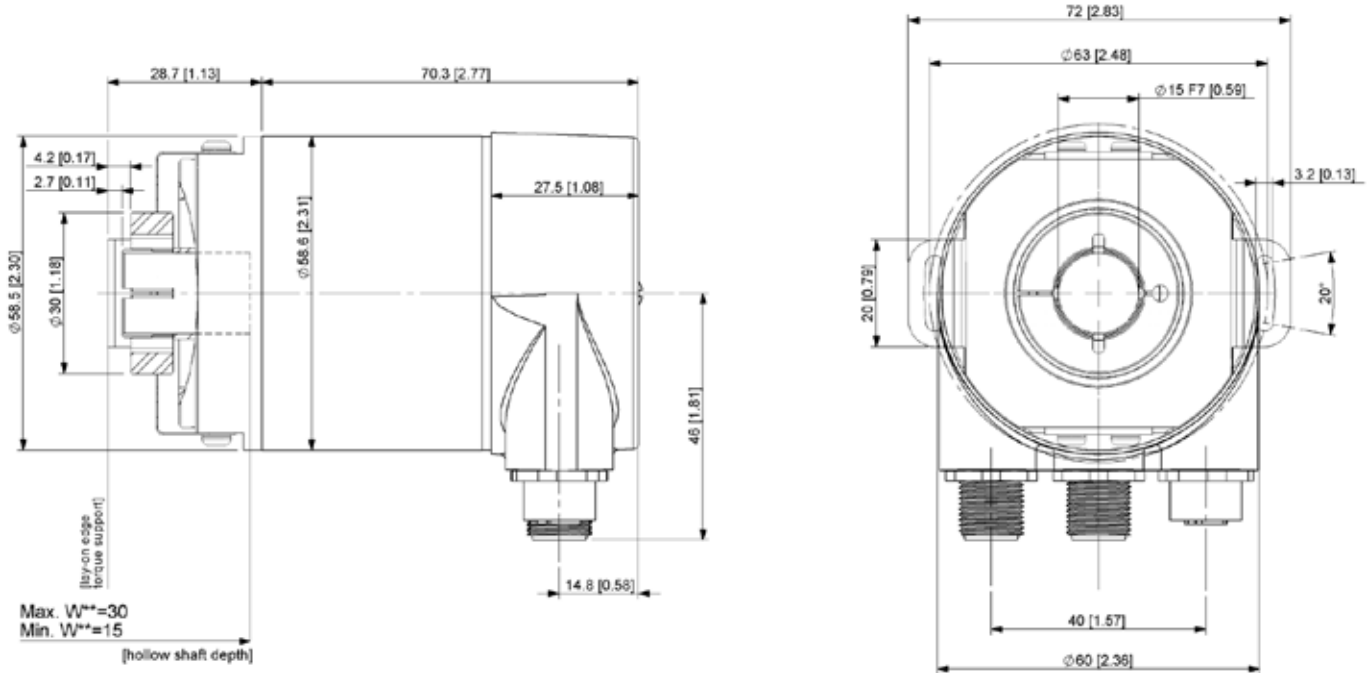
DIMENSIONS IN INCHES
[MILLIMETERS]

ALL DIMENSIONS ARE
APPROXIMATE

Features and specifications subject to change without notice.
Avtron standard warranty applies. All dimensions are in millimeters approx.