

AVTRON INCREMENTAL ENCODER

Model: AV485 SMARTach™ III 5/8" Solid Shaft

DESCRIPTION

The Avtron Model AV485 SMARTach™ III is a severe duty incremental encoder (also known as tachometer or rotary pulse generator). When coupled to a motor or machine, its output is directly proportional to shaft position (pulse count) or speed (pulse rate). The AV485 operates down to zero speed and can be used for both control and instrumentation applications.

Mechanically, the AV485 mounts on a NEMA 56C adapter flange or it can be foot mounted by using an optional foot mounting bracket kit. The AV485 utilizes magnetoresistive sensors. This proven technology is ideal for rugged environments since it is immune to contaminants that cause optical encoders to fail. These factors, make the AV485 ideal for demanding industries like paper, metals, and chemical processing.

An Avtron AV485 SMARTach III is equipped with one or two AV5 sensor modules. Each module has a two-phase output (A, B) 90° out of phase, with complements (A, B), (A Quad B Output). A marker pulse with complement (Z, Z̄) is also present. Output resolution on the AV485 is determined by the sensor only. Unlike older models, any PPRs can be mixed and matched. Selection of the rotor is based only on the shaft mounting requirements (and not PPR).

NOTE

Special option 4xx selects an alternate PPR code definition. Example: PPR Code 0, special option code 401=1270 PPR (Left) / no right output.

The AV5 removable sensor assembly has a diagnostic package that includes Adaptive Electronics and a Fault-Check output.

ADAPTIVE ELECTRONICS

A perfect duty cycle consists of a waveform whose "high" and "low" conditions are of the same duration (50%/50%). It is possible over time for duty cycle and edge separation to change due to component drift, temperature changes or mechanical wear. The Adaptive Electronics extend the life of the AV485 by constantly monitoring and correcting duty cycle and edge separation over time.

FAULT-CHECK

If the Adaptive Electronics reach their adjustment limit, the Fault- Check alarm and LED will notify the drive and operator of an impending failure. This output can occur before a failure, allowing steps to be taken to replace the unit before it causes unscheduled downtime. Fault-Check annunciation is available as an "alarm" output through the connector or as an integrated LED.

AV485 PART NUMBERS AND AVAILABLE OPTIONS INCLUDING AV5 SENSORS

Model	Temp Rating	Foot Bracket	Style	Left Module			Right Module			Connector Options	Modifications
				Line Driver	PPR		Line Driver	PPR			
AV485	N- -20°C to 80°C C- -40°C to 80°C H- -20°C to 120°C ⁺	X- none 1- A36261 STD 2- BC42/46 style (A25448)	S- single shaft D- dual shaft G- grounding	X- none 6- 5-24V in/out (7272) 8- 5-24V in/out (HX) 9- 5-24V in, 5V out (7272)	X- none F- 60 C- 64 G- 100 H- 120 A- 128 L- 240 N- 256 P- 300 E- 360 B- 480 Q- 500 R- 512 S- 600 U- 720	V- 900 J- 960 W- 1000 Y- 1024 Z- 1200 2- 1500 6- 1800 3- 2000 4- 2048 5- 2500 D- 4096 8- 4800 9- 5000 0-special	X- none 6- 5-24V in/out (7272) 8- 5-24V in/out (HX) 9- 5-24V in, 5V out (7272)	X- none F- 60 C- 64 G- 100 H- 120 A- 128 L- 240 N- 256 P- 300 E- 360 B- 480 Q- 500 R- 512 S- 600 U- 720	V- 900 J- 960 W- 1000 Y- 1024 Z- 1200 2- 1500 6- 1800 3- 2000 4- 2048 5- 2500 D- 4096 8- 4800 9- 5000 0-special	000- none 003- Include analog signal converter (K661) 004- Super magnetic shielding	
+ Contact Factory											

Connector Options

Mounted on Encoder Body				3' Cable			5' Flexible Conduit
Industrial Connector	5 pin MS	10 pin MS	Other	Industrial Connector	Twist Lock	Other	
G- (Northstar™ Pinout) with Plug P- with Plug V- with Plug, w/insulated adapter 1- Mini-Epic with Plug	E- (M737 Pinout) without Plug F- "E" with Plug H- (M727 Pinout) without Plug J- "H" with Plug	A- without Plug B- with Plug & clamp C- with Plug & Flex. Adapter L- with Right Angle Plug	K- Condulet R- Twist Lock Mini MS with Plug 3- 6 Pin MS connector with plug (M940)	Z- with Plug Q- 18" Flex Cable on Remote	S- Mini MS with Plug	W- Leads only	D- 10 pin MS, w/ins. adapter M- w/ins. adapter N- In Flextight T- Terminal box Y- Terminal box, w/ins. adapter

SPECIAL PPR OPTION CODES
See table on page 4

ELECTRICAL**

- A. Operating Power (Vin)
- Volts 5-24 VDC
 - Current 100mA, nominal, no load
- B. Output Format
- 20/ & Comp A, A, B, B (differential line driver)
 - Marker 1/Rev, Z, Z
- C. Signal Type Incremental, Square Wave, 50 ±10% Duty Cycle.
- D. Direction Sensing 0/ A leads 0/ B for CW rotation as viewed from the back of the tach looking at the non-drive end of the motor.
- E. Phase Sep 15% minimum
- F. Frequency Range @5V, @1m cable, 250 kHz Max
@24V, @300m cable, #8 output, 45 kHz Max
- G. PPR 4-5000***
- H. Line Driver Specs See table
- I. Connectors See connector options on page 1
- J. LED Indicator GREEN: power on, unit ok.
RED: alarm on
ORANGE: wiring fault (Thermal Overload; Under-voltage)

MECHANICAL

- A. Shaft Inertia21 Oz. In. Sec.2
- B. Acceleration 5000 RPM/Sec. Max.
- C. Speed: 5000 RPM Max or 165 kHz****
- D. Weight: 14-16 lbs [6-7.5 kg.]
- E. Radial Load 350 lbs [1500N] at 1E08 revolutions
(900 hrs at 1800 RPM) 35 lbs [150N] at 5E09 resolutions (5000 hrs at 1800 RPM)
- F. Axial Load 115 lbs [510N] at 1E08 revolutions
12 lbs [51N] at 5E09 revolutions

ENVIRONMENTAL

Solid cast aluminum stator and rotor
Fully potted electronics } protects against oil and water spray
V-Ring shaft seals }
Operating Temperature: See Temp Rating on Page 1.

		LINE DRIVER OPTIONS			
Electrical Specifications		6	8	9	Units
Input Voltage		5-24	5-24	5-24	VDC
Nom Output Voltage		5-24	5-24	5	VDC
Line Driver		7272	Hx	7272	
Output Resistance Typ		13	75	13	ohms
Maximum Peak Current		1500	800	1500	mA
Max Average Current		120	200	120	mA
Voh Typ		VIN-1	VIN-1	VIN-1	VDC
Vol Typ		0.5	0.2 @ 10mA line current	0.5	VDC
Cable Drive Capacity		1000' @ 5V 500' @ 12V 200' @ 24V	1000'	1000'	feet
Protection	Reverse Voltage	yes	yes	yes	
	Short Circuit	yes	yes	yes	
	Transient	yes	yes	yes	
	Power to A, Gnd to A/	yes	yes	yes	
Alarm	+V(out)	Output voltage equal to input voltage.			
	Alarm*	Open collector, normally off, goes low on alarm, sink 100mA max, 50VDC max Green=power on, Red=Alarm Orange=Wiring Error (Thermal Overload; Under-voltage)			
Marker		One per revolution. Pulse width approximately 2° (1/128 of a revolution)			

*Alarm not available on connector option "G" (NorthstarTM compatible pinout)

** Electrical specifications for SMARTach III model (rev BA or later), consult Nidec Industrial Solutions for earlier model specifications.

***(PPR) Standard maximum PPR is 5000. Consult Factory with your application for PPRs up to 50,000.

**** (Speed) Maximum RPM may be limited for PPR > 2,500. Consult Factory with your application.

Equipment Needed for Installation

Provided	Not Provided
1. AV485 Encoder	- Socket Hd. Cap Screw 3/8-16 x 0.75 (4)
2. Threadlocker (blue)	- 5/16" Hex Wrench (T-Handle style)
3. Anti-seize (copper)	- Shaft Coupling; Washer, Flat 5/16 (4)
	- Motor Adapter Flange
	- Washer, Lock 5/16 (4)
	- Dial Indicator

DRIVE INSTALLATION INSTRUCTIONS

The encoder must be driven by a positive drive rather than a friction drive. The following means of coupling are acceptable when properly installed: Direct Coupling, Timing Belt/Pulleys, Chain/Sprockets.

With a direct drive, use a flexible disc coupling and align the shafts as accurately as possible. EXAMPLE: For a size 62 Thomas Miniature Coupling angular misalignment must be less than 1.34°, parallel misalignment less than 0.028", and axial float less than ±0.031". The encoder should not be subjected to any axial thrust. Overhung loads should also be minimized. Installations using timing belts/pulleys should have just enough belt tension to eliminate belt sag. Excessive tension will shorten belt and bearing service life. If a rubber slinger disc is used, position it on the shaft so it will rotate freely.

CAUTION

Do not force or drive the coupling onto the shaft, or damage to the bearings may result. The coupling should slide easily on the shaft. Remove nicks and burrs if necessary. Consider driving shaft endplay when positioning coupling.

For more details on alignment specifications, measurement techniques, and special considerations in specifying and installing drive components, refer to separate installation instructions in the Avtron PULSE GENERATOR HANDBOOK.

NEMA 56C FACE MOUNTING INSTRUCTIONS

- Apply anti-seize compound [copper], included, to inner circumference of coupling (both motor and encoder side).
- Loosen set screws in coupling and apply thread locker to set screws.
- Place coupling on motor shaft, inserting to depth per manufacturer's instructions.
- Attach coupling to motor shaft using set screws per manufacturer's instructions.
- Bolt mounting flange (flowerpot) to motor C-Face, using thread locker with fasteners, included.
- Slide encoder shaft into other side of coupling. DO NOT FORCE. Ensure 1/4" keyway aligns with coupling set screw location.
- Ensure C-Face on mounting flange matches and aligns with encoder C-Face precisely.
- Apply thread locker to hex cap screws.
- Align bolt holes of encoder and flange, thread in (4) hex cap screws, using lock washers.
- Tighten set screws on encoder side of coupling.

FOOT MOUNTING INSTRUCTIONS

Provided	Not Provided
1. Foot Bracket (A36261/A25448)	1. 1/2" Wrench 5/16"
2. Soc. Hd. Cap Screw 3/8-16 x .75 (4)	2. Hex Wrench (T-Handle style)
3. Hex Hd. Cap Screw 5/16-18 x 1.50 (4)	3. Dial Indicator
4. Nut, Hex 5/16-18 (4)	
5. Washer, Flat 5/16 (4)	
6. Washer, Lock 5/16 (4)	
7. Threadlocker (blue)	

The NEMA 56C face is the preferred mounting method for the AV485. In certain cases, however, it may be necessary to foot-mount this unit. The optional foot mounting bracket kit, Option 1, will be required for standard installations or replacement of Northstar RIM6200 units. To replace BC42 or BC46 units, use Option 2 foot mount kit. Read all of the following instructions and the Avtron PULSE GENERATOR HANDBOOK prior to beginning any work.

The AV485 performance and life will be directly affected by the installation. Following this sequence of steps is recommended.

- 1) Clean and inspect motor/driver shaft. Do not use force to assemble coupling onto motor/driver shaft. The foot mounting bracket must be secured to a flat, rigid, vibration free steel or aluminum base which can be machined to accept 5/16-18 mounting hardware.
- 2) Temporarily mount the AV485 to the foot bracket, install the coupling to the AV485 and driver, and verify that the location is suitable for installation.
- 3) If the AV485 encoder, bracket and coupling are suited to the area, check motor/encoder shaft alignment with a straight edge from multiple positions around the shaft circumference to verify that it meets specifications.
- 4) While maintaining alignment, precisely mark the position of the foot bracket on its mounting base.
- 5) Remove the AV485. Transfer punch or layout the mounting hole pattern as indicated on outline drawing.
- 6) Machine four, 3/8" dia through holes or tap four, 5/16-18 holes in center of base slots to give some degree of freedom in final alignment.
- 7) Reinstall the AV485 with the flexible coupling loosely in place, and tighten down all mounting hardware. Check motor/encoder shaft alignment with a straight edge from multiple positions around the shaft circumference to verify that it meets specifications. Use thread locker supplied on cap screws which mount AV485 to foot bracket.
- 8) Ensure any flat or keyway on the motor and encoder shaft are aligned with the set screw holes of the flexible coupling. Apply thread locker to coupling set screws and tighten per manufacturer's recommendations.
- 9) Recheck alignment and tighten all hardware after first several hours of operation.

MINIMIZE DOWN-TIME:

Should AV485 replacement be required, leave the foot mounting bracket installed on its base and mount the new AV485 to the bracket. This maintains the original alignment.

WIRING INSTRUCTIONS

CAUTION

Remove power before wiring.

For bidirectional operation of the 2-phase SMARTach III, proper phasing of the two output channels is important. Phase A channel leads Phase B channel for clockwise shaft rotation as viewed from the anti-drive or accessory end of the motor (AV485 mounting end).

Wiring option "G" provides a pinout compatible with Northstar encoders, with a cable shield connection on pin 10. Note that this option does not ground the shield; Avtron still recommends grounding the shield at the drive end of the cable for all wiring options.

CORRECTIVE ACTION FOR PHASE REVERSAL

- 1) Remove Power.
- 2) Exchange wires on cable, either at encoder cable end, or at speed controller end (but not both).
 - a) Single Ended 2 Phase Wiring (see wiring diagram) Exchange A and B at the use end of the wires.
 - b) Differential 2 Phase Wiring (see wiring diagram) Exchange either A with A in the phase A pair OR B with B in the phase B pair but NOT both.
- 3) Apply Power.
- 4) Verify encoder feedback is correct, using hand rotation of shaft, or jog mode of the speed controller.

Interconnecting cables specified in the wire selection chart below 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. General electrical requirements are: stranded copper, 22 thru 16 gauge (Industrial EPIC options can use 14-20 AWG), each wire pair individually shielded with braid or foil with drain wire, 0.05 uF maximum total mutual or direct capacitance, outer sheath insulator, 1,000 ft. max. See Wire Selection Chart below for some suggested cables.

NOTE

When using the industrial connector ("G", "P", "V", or "Z" options), the minimum wire size is 20 gauge, and 20 gauge (only) wire ends must be tinned with solder before connection at the screw terminals.

MAINTENANCE

GENERAL

This section describes routine maintenance for the Avtron AV485 Encoder. For support, contact Avtron's field service department at 216-642-1230. For emergency after hours service contact us at 216-641-8317.

The AV485 SMARTach III circuitry includes a diagnostic package that includes Adaptive Electronics and a Fault-Check output.

ADAPTIVE ELECTRONICS

A perfect duty cycle consists of a waveform whose "high" and "low" conditions are of the same duration (50%/50%). It is possible, over time, for duty cycle to change due to component drift, temperature changes, and mechanical wear. The AV485 adaptive electronics extends the life of the AV485 by constantly monitoring and correcting duty cycle over time.

FAULT-CHECK

After power-up and the internal rotor position is checked by the sensor, the Fault-Check LED will turn GREEN.

If the adaptive electronics reach their adjustment limit for any reason, the Fault-Check alarm and LED will notify the drive and operator of an impending failure. The LED will turn RED if the Adaptive Electronics reach their adjustment limit. This output occurs before an actual failure, allowing steps to be taken to replace the unit before it causes unscheduled downtime. Fault-Check annunciation is available as an "alarm" output through the connector and as an integral LED.

TROUBLESHOOTING:

If the drive indicates a loss of encoder/tach fault and the AV485 fault-check LED is not illuminated, check the encoder power supply. If power is present, check polarity: one indicator of reversed power supply is that all outputs will be high at the same time. If the drive indicates encoder fault, but the LED shows GREEN, then check the wiring between the drive and the encoder. If the wiring appears correct and in good shape, test the wiring by replacing the AV5 sensor module. If the new module shows GREEN, and the drive still shows encoder loss/tach fault, then the wiring is faulty and should be repaired or replaced.

If the alarm output and/or LED indicate a fault (RED):

1. Remove an end sensor plate or the second sensor, and use the built-in gauge to check the location of the rotor (see Figure 1).
2. Remove the AV5 sensor from the housing. Clean the housing mounting surface for the AV5 sensor and the AV485 housing.

If the alarm output and/or LED indicate a fault (RED) on a properly mounted AV5 sensor and the rotor is properly located, replace the AV5 sensor.

An oscilloscope can also be used to verify proper output of the AV5 encoder at the encoder connector itself and at the drive/controller cabinet. If the outputs show large variations in the signals at steady speed (jitter or “accordion effect”, figure 1), check rotor position. If the rotor position is correct, the motor or shaft may be highly magnetized. Replace any magnetized shafts with non-magnetic material (stainless/aluminum). Consider replacing the sensors with super-shielded models, option -004.

If the alarm output and/or LED indicate a wiring fault (ORANGE):

Remove all output wires/connections (A, \bar{A} , B, \bar{B} , Z, \bar{Z}). The LED should turn GREEN. If the LED does not turn GREEN, the encoder is not receiving enough voltage at +V to properly operate. Correct input voltage problem at power supply or cabling.

If the LED turns GREEN once all outputs are disconnected, reconnect each output, one at a time, monitoring for ORANGE LED. For partial/resistive short circuits, the LED may take a few minutes to turn ORANGE. To speed the troubleshooting process, if possible, spin the encoder while replacing individual output connections. This will make the ORANGE LED condition occur faster. Once the shorted output(s) are located, correct the shorting condition, and the encoder LED should remain GREEN.

If the LED is OFF, but power is being applied to the encoder, check the output voltage level at A, \bar{A} , B, \bar{B} . If all outputs are ON ($\approx +V$), the connections to +V and COM are reversed. Swap connections between +V and COM; the LED should turn GREEN.

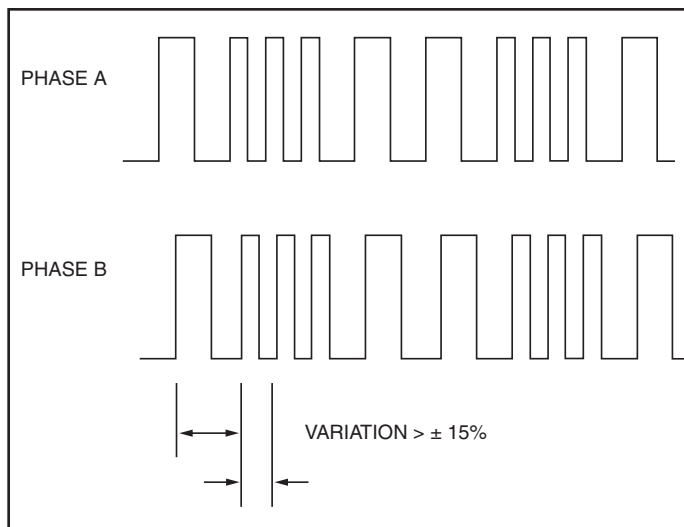


Figure 1 Excessive Signal Variation (“Jitter”)

Table 2

AV5 MAINTENANCE AND REPLACEMENT PART NUMBERS

AV5 Sensor							
Model	Line Driver	PPR			Connector Options	Modifications	
AV5	6- 5-24V in/out (7272) 8- 5-24V in/out (HX) 9- 5-24V in, 5V out (7272)	X- none F- 60 C- 64 G- 100 H- 120 A- 128	L- 240 N- 256 P- 300 E- 360 B- 480 Q- 500	R- 512 S- 600 U- 720 V- 900 J- 960 W- 1000	Y- 1024 Z- 1200 2- 1500 6- 1800 3- 2000 4- 2048	5- 2500 D- 4096 8- 4800 9- 5000 0- special	000- none 004- Super magnetic shielding 4xx- Special PPR (See Table)

Connector Options							
Mounted on Encoder Body				3' Cable			5' Flexible Conduit
Industrial Connector	5 pin MS	10 pin MS	Other	Industrial Connector	Twist Lock	Other	
G- (Northstar™ Pinout) with Plug P- with Plug V- with Plug, w/insulated adapter	E- (M737 Pinout) without Plug F- “E” with Plug H- (M727 Pinout) without Plug J- “H” with Plug	A- without Plug B- with Plug & clamp C- with Plug & Flex. Adapter L- with Right Angle Plug	K- Condulet R- Twist Lock Mini MS with Plug 3- 6 Pin MS connector (M940)	Z- with Plug Q- 18" flex cable, on remote base	S- Mini MS with Plug	W- Leads only	D- 10 pin MS, w/ins. adapter M- w/ins. adapter N- In Flextight T- Terminal box Y- Terminal box, w/ins. adapter

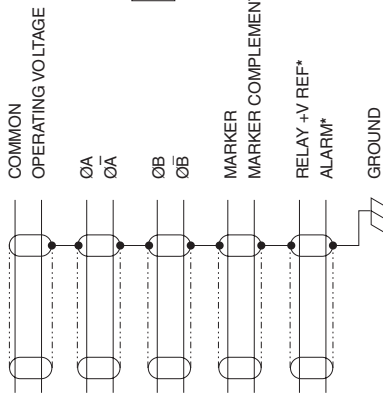
SPECIAL PPR OPTION CODES								
4xx Code	PPR (Left)	PPR (Right)	4xx Code	PPR (Left)	PPR (Right)	4xx Code	PPR (Left)	PPR (Right)
401*	1270	None	408	1400	None	415	3000	None
402*	150	None	409*	30	None	416	3600	None
403*	50	None	410	None	6000	417	1250	None
404	None	16	411	12000	None	418	2400	2400
405	16	None	412	200	None	419	160	160
406	6000	None	413*	30	30	420	450	None
407	2800	None	414	1500	None			

WIRING DIAGRAMS

FOR DIFFERENTIAL APPLICATIONS

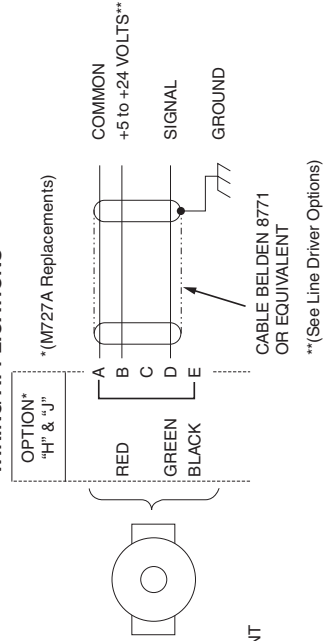
OPTION "N", "K", "M", "W"		OPTION "C", "D", & "L"		OPTION "P" & "V"		OPTION "S" & "T"		OPTION "G"	
PIN IN		PIN OUT		PIN OUT		PIN OUT		PIN OUT	
BLACK	A	1	COM	1	6	1	6	1	6
RED	B	6	+V	6	+V	6	+V	6	+V
GREEN	D	2	A	2	A	2	A	2	A
YELLOW	G	7	A	7	A	7	A	7	A
BLUE	E	3	B	3	B	3	B	3	B
GRAY	H	8	B	8	B	8	B	8	B
ORANGE	C	4	Z	4	Z	4	Z	4	Z
WHITE	I	9	Z	9	Z	9	Z	9	Z
BROWN	F	5	+V (OUT)	5	+V (OUT)	5	+V (OUT)	5	NC*
VIOLET	J	10	ALM	10	ALM	10	ALM	10	NC*

FUNCTION



*FOR OPTION "G" Pin 5 is not used and Pin 10 is cable shield.

FOR SINGLE ENDED SINGLE PHASE WIRING APPLICATIONS



*(M727A Replacements)

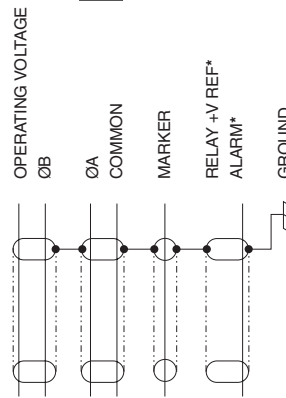
CABLE BELDEN 8771 OR EQUIVALENT

** (See Line Driver Options)

FOR SINGLE ENDED APPLICATIONS

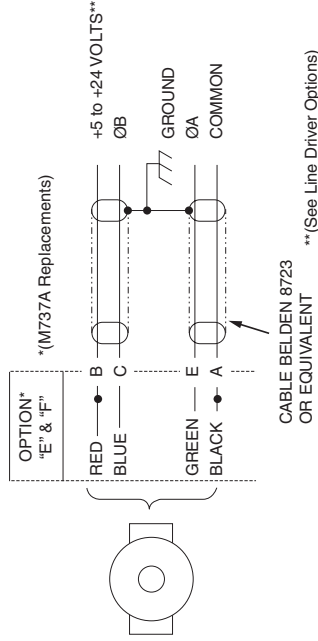
OPTION "N", "K", "M", "W"		OPTION "C", "D", & "L"		OPTION "P" & "V"		OPTION "S" & "T"		OPTION "G"	
PIN IN		PIN OUT		PIN OUT		PIN OUT		PIN OUT	
RED	B	6	+V	6	+V	6	+V	6	E
BLUE	E	3	B	3	B	3	B	3	D
GREEN	D	2	A	2	A	2	A	2	A
BLACK	A	1	COM	1	COM	1	COM	1	F
ORANGE	C	4	Z	4	Z	4	Z	4	NC
BROWN	F	5	+V (OUT)	5	+V (OUT)	5	+V (OUT)	5	NC*
VIOLET	J	10	ALM	10	ALM	10	ALM	10	NC*

FUNCTION



*FOR OPTION "G" Pin 5 is not used and Pin 10 is cable shield.

FOR SINGLE ENDED TWO PHASE WIRING APPLICATIONS



*(M737A Replacements)

CABLE BELDEN 8723 OR EQUIVALENT

** (See Line Driver Options)

TYPICAL WIRE SELECTION CHART for 18 AWG, multiple pair, individually shielded

	BELDEN	ALPHA
2 PAIR	9368	6062
3 PAIR	9369	6063
4 PAIR	9388	6064
6 PAIR	9389	6066

NOTES: Marker output for connector options "E" & "F" - Pin "D"
 Marker output for connector options "H" & "J" - Pin "C"

SMARTach™ III

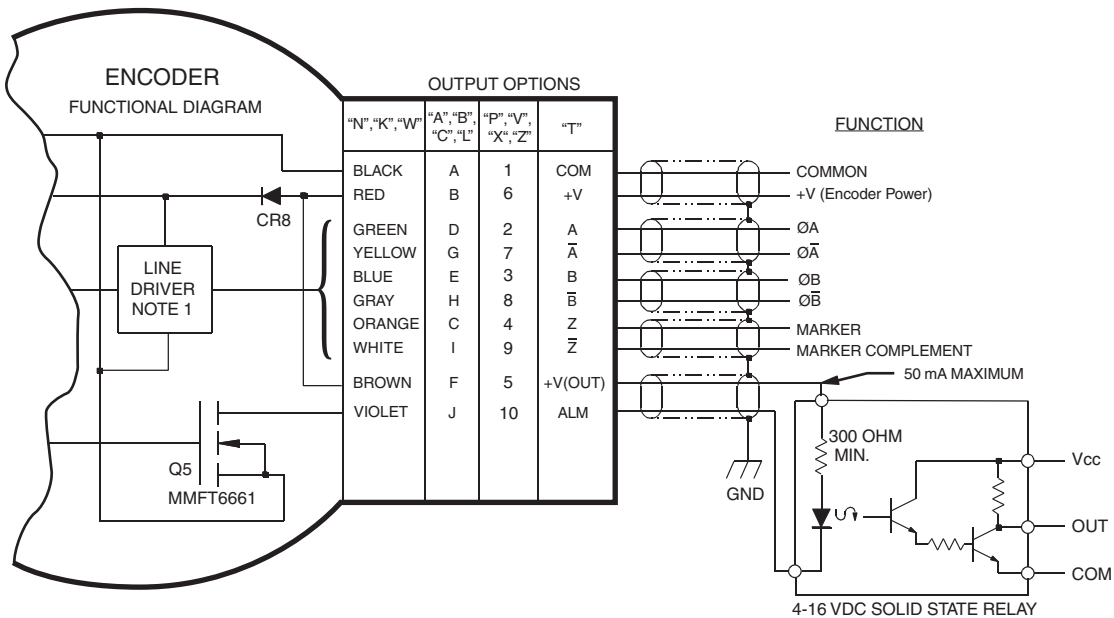
Application Examples

Applies to all Model AV485 Encoders except connector styles E, F, G, H, J, R.

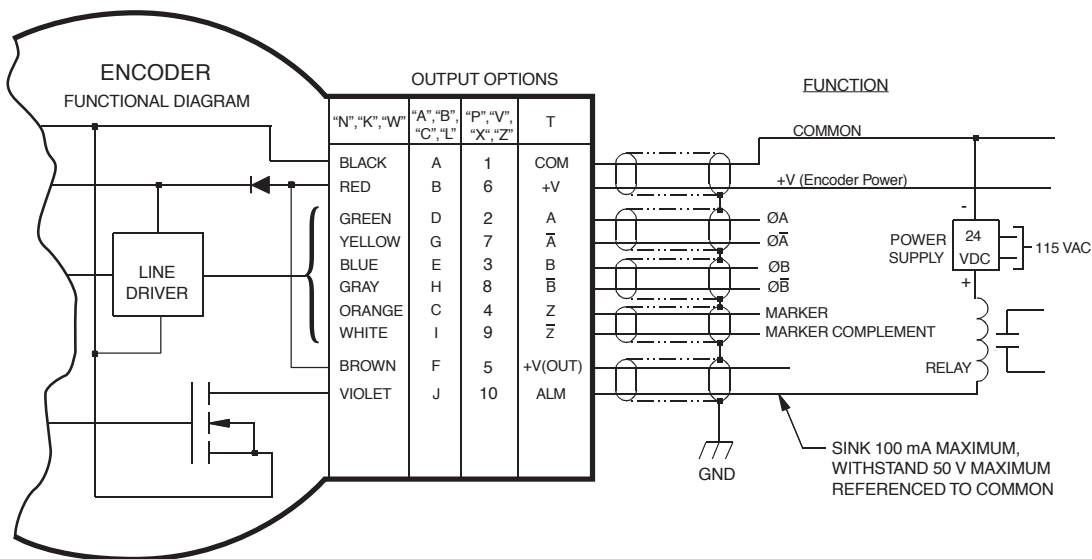
ALARM OUTPUT CONNECTION

Avtron SMARTach III encoders provide an alarm signal if maintenance is required under specific circumstances. A green LED indicates power on and proper operation, red indicates alarm on. Green indicates power on, red indicates alarm on. Following are application examples provided to help install the alarm output.

Example 1. Alarm output using +V(OUT). +V(OUT) is equal to +V, the encoder power supply.

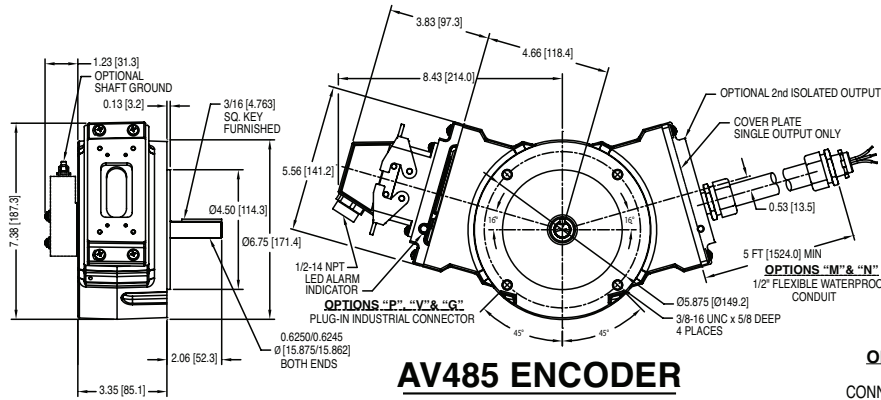


Example 2. Alarm Output Using Separate 24 VDC Power Supply and Relay.

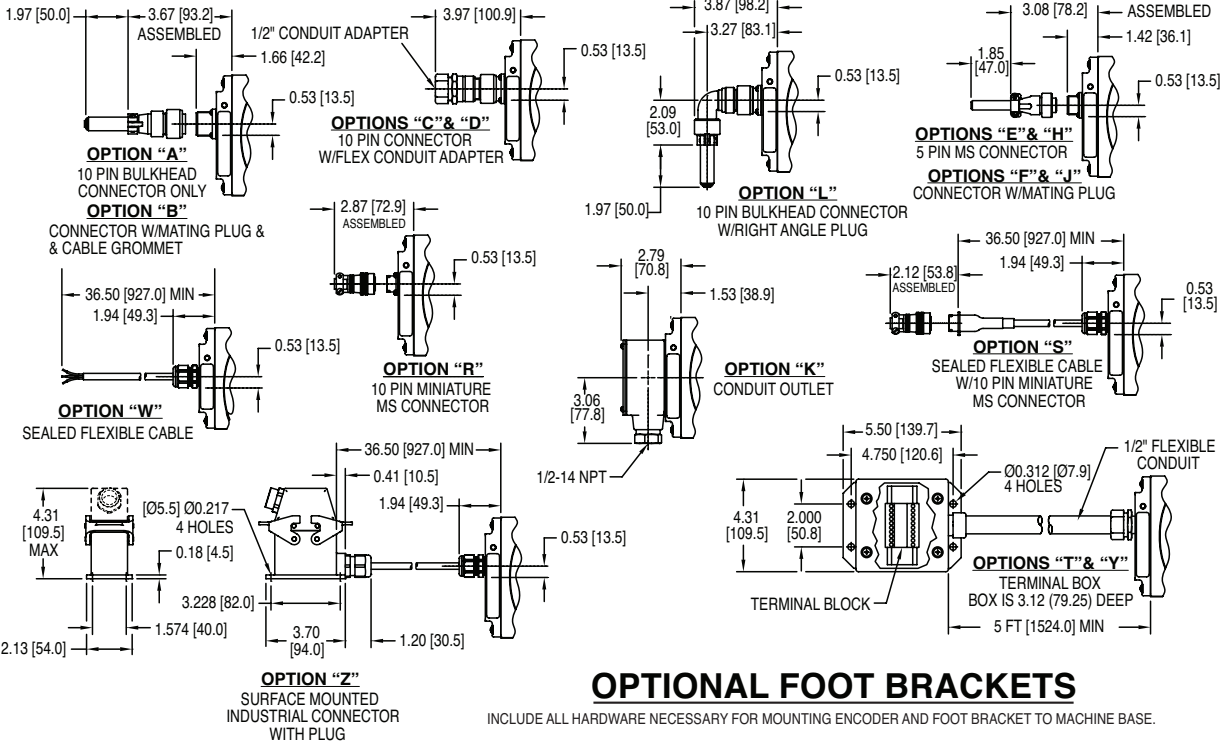


Note: Alarm output is "low true" ; i.e. it goes to 0V when activated

OUTLINE DIMENSIONS AND OPTION DETAILS

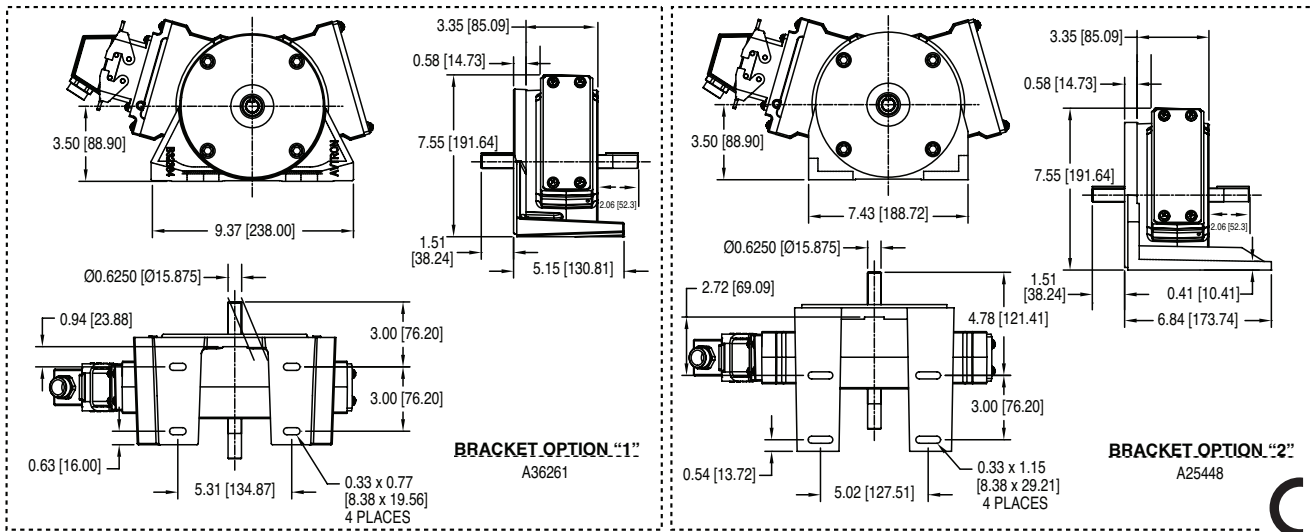


AV485 ENCODER



OPTIONAL FOOT BRACKETS

INCLUDE ALL HARDWARE NECESSARY FOR MOUNTING ENCODER AND FOOT BRACKET TO MACHINE BASE.



Avtron Encoders are the Most Reliable Encoders in the World

Nidec Industrial Solutions
8901 E. Pleasant Valley Road • Independence, Ohio 44131-5508
E-mail: helpdesk@nidec-industrial.com • Web: www.avtronencoders.com
Phone: (216) 642-1230 • Fax: (216) 642-6037

Features and specifications subject to change without notice.

Avtron Encoder standard warranty applies. All dimensions are in inches [mm].

REV DATE: 01/06/2020

REV: 002