



# ATEX / IECEx Encoder Instructions

## M6C-4, M6C-5

EXPLOSION PROTECTED  
HOLLOW SHAFT

### DESCRIPTION

The Avtron Model M6C-4 and M6C-5 are Hollow Shaft Incremental Encoders (also known as tachometers or pulse generators). This model utilizes flameproof and increased safety construction for suitability in hazardous locations. The M6C is certified for use in CAT 2 (Zone 1) Gas Group IIB potentially explosive atmospheres with ambient temperature range of -20°C to +80°C. A low temperature option with ambient temperature range of -40°C to +80°C is available by specifying Modification Codes 001 or 005. Marking codes are shown below. Compliance with Essential Health and Safety Requirements of 60079-0, 60079-1, and 60079-7 is assured per the approvals listed below.

#### Marking (standard):

II 2 G Ex de IIB T4 Gb (Tamb -20°C to +80°C)

#### Marking (low temperature):

II 2 G Ex de IIB T4 Gb (Tamb -40°C to +80°C)

#### Approvals:

ATEX per Certificate No. TRAC14ATEX0007X  
IECEx per Certificate No. IECEx TRC 14.0005X

When mounted to a motor or machine, the M6C output is directly proportional to shaft position (pulse count) or speed (pulse rate). The M6C can be used for both control and instrumentation applications. Hollow shaft encoders eliminate shaft couplings, adapter flanges, or accessory mounting faces. The M6C employs a hollow shaft and clamping collar to lock the encoder to the shaft. An anti-rotation bracket prevents rotation of the encoder while allowing for shaft end float.

The enclosures on all Model M6Cs are rated IP 66 to protect the internal components from the entry of dust and water. Additionally, the M6C uses magnetoresistive sensing technology, making the M6C ideal for demanding industrial environments.

All M6Cs can be equipped with one or two outputs. Each output is electrically independent and totally isolated.

The outputs can be wired as single ended single phase, single ended two phase (A,B), or differential (A Quad B). Output resolution is determined by the rotor's base PPR (pulses per revolution), times a sensor multiplier. The sensor module can provide: 1/2 the base PPR, the base PPR, or double the base PPR (see table). With two outputs, the same encoder can provide two different PPRs from a given rotor at the same time. Only one rotor per encoder is possible.

Example: an M6C could use a 1024 PPR sensor output on one side for feedback to a drive system, and simultaneously use a 256 PPR sensor on the other side for a process computer.

### INSTALLATION CONSIDERATIONS

The M6C standard flexible anti-rotation bracket will tolerate  $\pm 0.1$ " of shaft end float. Consideration should be taken when positioning the encoder.

### CAUTION

**Be careful not to damage clamping fingers during handling. Do not tighten clamping collar before installation onto motor shaft. Damaging clamping fingers can affect the quality of installation.**

### M6C ENVIRONMENT

The M6C does not produce flammable gasses or dusts in normal operating modes. The M6C does not cause injury or harm when used in conjunction with the installation guide. The M6C does not produce ignition capable electrical sparks or arcs and has been designed not to produce potential ignition sources from electromagnetic, acoustic, optical or other energy sources. The M6C is not considered as a safety device and is not suitable for connection into a safety system. The installer should refer to the latest edition of the following standards before installing or operating in a Hazardous Area:

EN 1127-1 Explosive Atmospheres - Explosion prevention and protection, basic concepts, and methodology.

EN 60079-14 Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines).

The M6C housing and shaft materials are listed in the specifications. These materials are not considered as able to trigger an explosion in normal operating modes and various fault modes in accordance with the requirements for Cat 2 equipment. These materials are not known to react with any explosive atmospheres to which the M6C may be subject. It is however the responsibility of the end user to ensure that the M6C is selected correctly for the potentially explosive atmosphere in which the equipment is to be put into service.

### INSTALLATION

#### CONDITIONS FOR SAFE USE

- 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.
- Termination instructions on sheet 2 must be followed to ensure "Increased Safety" rating of entry cover
- The M6C "Increased Safety" conduit entry covers must not be opened in Flammable Atmosphere or when energized. Tighten cover screws to 40 in-lb [4.5 N-m] to prevent loosening.
- The ambient temperature range is: -20°C  $\leq$  Tamb  $\leq$  80°C standard. -40°C  $\leq$  Tamb  $\leq$  80°C for modification codes 001 and 005.
- Contact the original manufacturer for information on the flameproof joints.
- Socket head cap screws holding the flameproof cover onto the encoder have a minimum yield strength of 1220 N/mm<sup>2</sup>.
- Do not open the M6C housing. Doing so will void the warranty and may cause the risk of fire or explosion. There are no field replaceable parts in the M6C. The unit should be returned to the factory for all repairs.

## Equipment needed for installation

### Supplied:

1. M6C
2. Clamping Collar
3. Anti-rotation Bracket
4. Thread Locker (blue)
5. Screw, Button Hd
6. Screw, Socket cap 1/4-20 x .62
7. Nut, 1/4-20
8. Washer, Flat 1/4 (2)
9. Washer, Lock, 1/4
10. Washer, Shoulder, Insulating
11. Washer, Flat, Insulating (2) 3/8-16 x .50
12. Anti Seize (copper)

### Not Supplied:

- 7/32" Hex wrench (T-handle style)
- 3/16" Hex wrench (T-handle style)

Clean machine shaft of any dirt and check for any burrs or damage.

The hollow shaft M6C is intended to be installed with a torsionally rigid flexible anti-rotation arm. See specifications for maximum shaft and bearing load ratings. The encoder should not be rigidly mounted.

### Instructions for Installation of the Standard Flexible Anti-Rotation Bracket:

Install the anti-rotation bracket to the motor side of the M6C using two 3/8-16 screws and thread locker.

Remove screws from clamping collar, apply anti-seize compound supplied to the inside of the collar and thread locker supplied to the threads and reinstall. Place clamping collar loosely on the inboard end of the shaft. Carefully slide M6C onto the shaft. **DO NOT FORCE.** Encoder should slide on easily. After verifying M6C fit onto shaft, remove M6C, apply anti seize compound (supplied) to shaft and re-install M6C (see shaft engagement). Tighten screws on clamping collar evenly until snug, then firmly tighten. **DO NOT USE A STANDARD RIGHT ANGLE WRENCH.** Use only a T-handle hex wrench or torque wrench with hex bit.

Secure free end anti-rotation bracket to frame. Use supplied insulating hardware if necessary as shown. Adapter kits are available for NEMA 56C and 8 1/2" mounting faces.

Optional torque arm kits are available (supplied with instructions).

### Shaft Engagement For End-of-Shaft Mounting Applications: See table on last page.

For shaft lengths greater than the maximum engagement allowed, end of shaft mounting may still be employed by locating the encoder away from the motor using a spacer between the motor and anti-rotation bracket.

### Corrective Action for Excess Housing Movement (Wobble)

The hollow shaft M6C design eliminates the potential for bearing and coupling failures from misalignment, however, excessive housing movement (wobble) may cause undesirable vibrations. The higher the RPM, the more severe the vibration will be from housing movement. In a typical installation a housing movement of 0.007" TIR or less (as measured at the outside diameter of the main encoder body) will not have an adverse effect. If excessive housing movement is detected in the installation:

1. Check the shaft the M6C is mounted on for excessive shaft runout. NEMA MG1 calls for 0.002" TIR or less.
2. Verify that the M6C engagement with the motor shaft conforms to the engagement rules on page 4. In general, maximizing engagement will minimize housing movement.
3. Verify that the mounting shaft diameters conform to the rules on page 4. Excessive housing movement occurs when the clearance between the motor shaft and pulse generator shaft allows the two center lines to miss match.
4. Loosen the clamping collar and rotate the motor shaft 180° within the M6C hollow shaft sleeve.

5. Make sure the clamping collar is tightened equally on both sides.
6. Move the split in the clamping collar over a solid portion of the M6C shaft.

If excessive housing movement still exists after the above steps, it may be necessary to physically bias the attitude of the encoder on the motor shaft while the clamping collar is being tightened. Either by eye or using dial indicators, note the position around the outside diameter of the encoder that is most out of position from true while turning the motor shaft slowly. With the motor shaft no longer turning, loosen the clamping collar. While applying moderate force by hand against the outside diameter of the encoder on the side opposite where the out of true position was observed, retighten the clamping collar. Several iterations may be necessary if the first attempt under or over compensates. This method may be used to help compensate for undersized shafts, shaft runout, bent clamping fingers, and other problems.

### WIRING INSTRUCTIONS

The M6C can be wired for single phase, two-phase, with or without complements, with or without markers. See wiring diagram.

#### WARNING

- **Do not wire the M6C Encoder while energized. Doing so may damage the encoder, and/or cause risk of fire or explosion.**
- **All cable entry devices used in the increased safety enclosure shall be certified for the type of increased safety enclosure "e" rated IP66, suitable for the conditions of use and correctly installed.**
- **Unused apertures in the increased safety enclosure shall be closed with a suitably certified Ex "e" blanking elements , rated IP66**
- **For ambient temperatures below -10°C and above + 60°C use wiring suitable for both minimum and maximum ambient temperatures. At maximum ambient wire & cable glands must be rated 100°C or better**

#### Termination Instructions

- Wire conductor size shall meet the following cross-section requirements:
  - Solid wire range: AWG 20 to 12 [0.52 to 4.0mm<sup>2</sup>]
  - Stranded wire range: AWG 20 to 14 [0.52 to 2.5mm<sup>2</sup>]
- Wire strip length: 0.32 inch to 0.50 inch [8mm to 12.7mm]
- Push terminal screw driver in access hole (near terminal middle) to open the terminal.
- Insert stripped wire in the terminal until wire bottoms when using stranded wire make sure all strands are captured in terminal.
- While keeping wire in position remove screw driver to close the terminal.

For bidirectional operation of the encoder, 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 (M6C mounting end).

#### 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  $\bar{A}$  in the phase A pair **OR** B with  $\bar{B}$  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.

Refer to the system drawing for specific cable requirements where applicable.

Physical properties of cable such as abrasion, tensile strength, solvents, marine applications, etc., are dictated by the specific application. Requirements for hazardous locations are dictated by the relevant codes. General wire electrical requirements wire each pair individually shielded with braid or foil with drain wire, 0.05 uF maximum total mutual or direct capacitance, outer sheath insulator, 2,000 ft. max. (see line driver specifications.) Temperature ratings of wire and wire glands should be 20°C over the maximum expected ambient or motor temperature to allow for temperature rise in the M6C itself. Ground wires must be a minimum of 14AWG.

There are no field replaceable parts in an M6C. The unit should be returned to the factory for all repairs.

Build up of large amounts of contamination are to be avoided, therefore periodic external cleaning is recommended. The condition of the bearings is important to the safety of the explosion-proof housing. The bearing manufacturer's rated life (see specifications) can be adversely affected by application specific conditions. If the unit shows signs of bearing wear indicated by noise or degradation of the electrical signal output, it should be returned to the factory for repair.

**MAINTENANCE**

**CAUTION**

**Do not open the M6C housing. Doing so will void the warranty and may cause the risk of fire or explosion.**

M6C PART NUMBERS AND AVAILABLE OPTIONS								
Model	Bore Size	Mounting Style	Line Driver	Left & Right Output Range	Base PPR	Marker	Connector	Modifications
M6C-	0- Non-Standard 4- 1" 5- 1 1/8"	S- End of Shaft	1- 5 to 24 VDC 2- 5 to 18 VDC 3- 12 to 24 VDC 8- 6.5 to 24 VDC	X- None L- Low Range (Base PPR x 1/2) M- Medium Range (Base PPR x 1) H- High Range (Base PPR x 2)	48- 480 51- 512 60- 600	Z- Marker -- None	T- Conduit Box, Terminal Block, 3/4" NPT W- Conduit Box, Terminal Block and Wire Gland	000- None 001- Low Temp (-40°C) 003- Torque Arm B28390 005- Low Temp (-40°C) & Torque Arm

AVAILABLE RESOLUTIONS			
	-48 OPTION	-51 OPTION	-60 OPTION
LOW	240	256	300
MEDIUM	480	512	600
HIGH	960	1024	1200

**SPECIFICATIONS**

**ELECTRICAL**

- A. Operating Power (Vin)
  - 1. Volts.....See Line Driver Options
  - 2. Current.....120mA, no load, typ. each output
- B. Output Format
  - 1. 2Ø & Comp (A,Ā, B,Ī)
  - 2. Marker .....1/Rev (Z,Ī)
- C. Signal Type .....Incremental, Square Wave, 50 ±10% Duty Cycle
- D. Direction Sensing.....ØA leads ØB for CW rotation as viewed from the back of the tach looking at the non-drive end of the motor.
- E. Transition Sep.....15% minimum
- F. Frequency Range.....0 to 150,000 Hz.
- G. PPR.....240, 256, 300, 480, 512, 600, 960, 1024, 1200
- H. See Line Driver Options

**MECHANICAL**

- A. Shaft Inertia.....0.8 to .23 oz. In. sec.<sup>2</sup>
- B. Acceleration .....5,000 RPM/Sec. Maximum
- C. Starting Torque .....1.5 to 20 Oz. In.
- D. Speed.....5,000 RPM Max.
- E. Weight.....18 lbs. Maximum
- F. Shaft Diameter
  - Tolerance.....See drawing on page 5.
- G. Shaft Engagement .....See drawing on page 5.
- H. Bearing Protection: Shaft seal & double bearing seal.
- I. Bearing Life with No Additional Loading: 6.1 x 10<sup>9</sup> Revolutions
- J. Maximum Additional Bearing Load:
  - 1. 10 pounds axial or 30 pounds radial
- K. Shaft Material: Black Oxide treated steel.
- L. Housing Material: Cast aluminum with Polane S Plus polyurethane enamel finish.

**ENVIRONMENTAL**

- A. Enclosure Rating: IP66
- B. Operating Temperature: 80°C to -40°C (-40°C optional, -20°C standard)
- C. Hazardous Locations: Ex de IIB T4 Gb (Tamb -20°C to +80°C Standard, -40°C to +80°C Optional use Modification "001" or "005")

**OUTPUT TERMINATIONS**

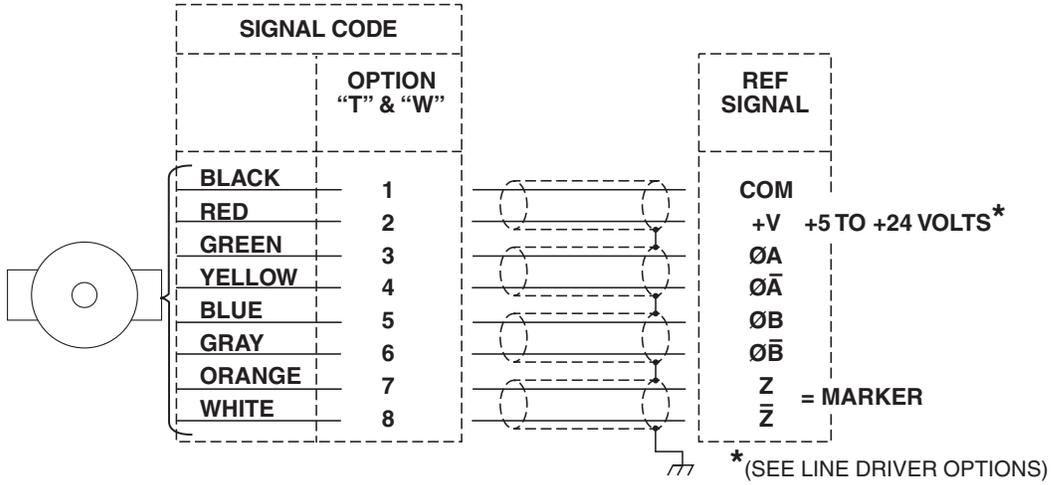
Terminal Block: EEx e II compression type. Accepts AWG 16 (1.5mm<sup>2</sup>) to AWG 20 (.52mm<sup>2</sup>) stranded wire. Housing available with 3/4 NPT or optional armored cable gland available (at maximum ambient wire and cable glands must be rated 100°C or better.)

**LINE DRIVER OPTIONS**

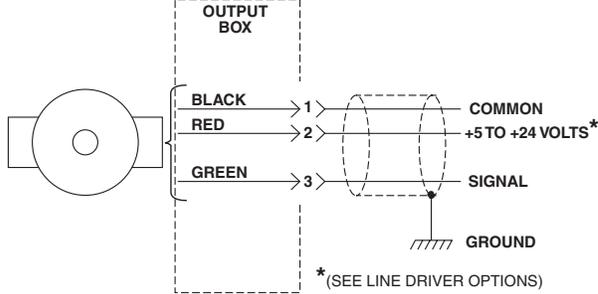
	Output Options			
	1	2	3	8
Voltage Input (Vin)	5-24 VDC	5-18 VDC	12-24 VDC	6.5-24VDC
Output High (Volts)	(Vin)-2 (typ.)	(Vin)-1 (typ.)	330 ohm pull up	(Vin)-1 (typ.)
Output High (milliamps)	80 (peak)	80 (avg.), 1500 (peak)	330 ohm pull up	150 (avg.), 1500 (peak)
Output Low (Volts)	0.5 (typ.)	0.5 (typ.)	1 (max.)	0.5 (typ.)
Output Low (milliamps)	80 (peak)	80 (avg.), 1500 (peak)	50 (avg.)	80 (avg.), 1500 (peak)
Protection	GOOD Reverse Voltage, Transient, Short Circuit (high & low@5-15V)	Reverse Voltage, Transient, Short Circuit (none)	Reverse Voltage, Transient, Short Circuit (low)	BEST Reverse Voltage, Transient, Short Circuit (high & low)
Maximum Cable Drive(Feet)	1000 ft. @ 5 V 500 ft. @ 12 V 200 ft. @ 24 V	1000 ft.	1000 ft.	1000 ft.

# WIRING DIAGRAMS

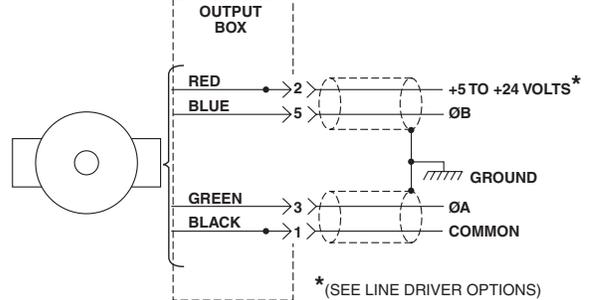
## DIFFERENTIAL APPLICATIONS



## SINGLE ENDED SINGLE PHASE APPLICATIONS



## SINGLE ENDED TWO PHASE APPLICATIONS

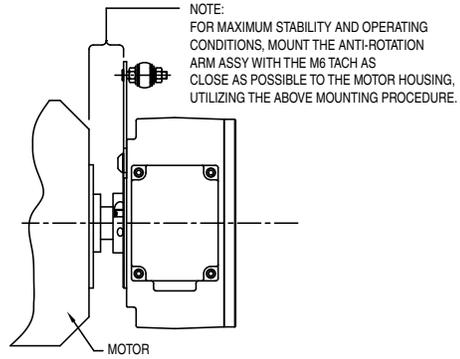
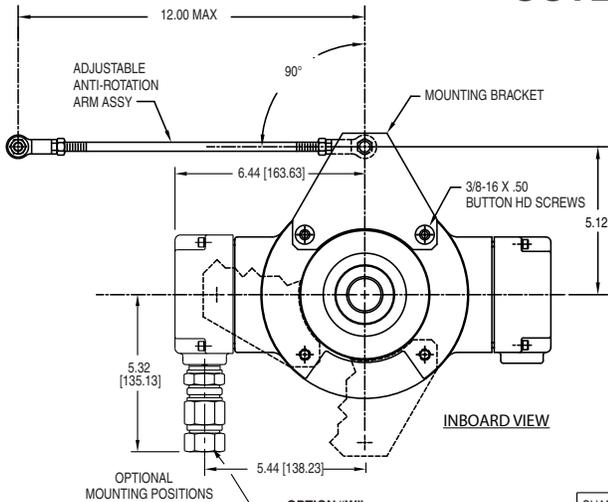


Line driver option "1" recommended for single ended applications

**NOTE:** Avtron standard warranty applies. Copies available upon request.  
Specifications subject to change without notice.

**TYPICAL WIRE:**  
18 AWG (.82mm<sup>2</sup>), multiple pair,  
individually shielded.  
Ground wire 14AWG minimum

# OUTLINE DRAWING

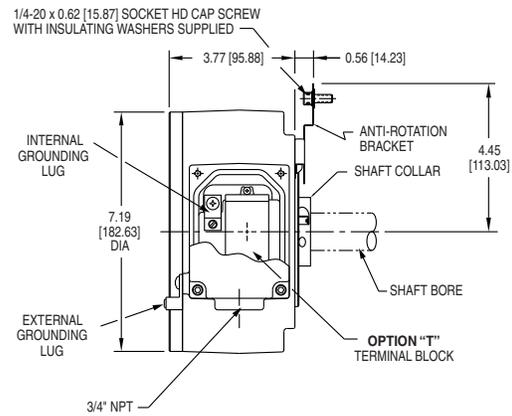


SHAFT OPTION	DIMENSION		
	AA MOTOR SHAFT OD	BB LENGTH	CC MIN/MAX ENGAGEMENT
4	1.0000/0.9995 [25.4000/25.3873]	4.30 [109.22]	2.000/2.620 [50.800/66.548]
5	1.1250/1.1245 [28.5750/28.5623]	4.30 [109.22]	2.000/2.620 [50.800/66.548]
6	2.0000/1.9990 [50.8000/50.7746]	4.48 [113.79]	2.250/2.750 [57.150/69.850]
7	2.3750/2.3740 [60.3250/60.2996]	4.58 [116.33]	2.500/3.000 [63.500/76.200]



\* "VDC" to be "5-18" or "5-24", "12-24" or "6.5-24"  
\*\* Tamb -20°C to +80°C standard, optional Tamb -40°C to +80°C available with modification codes 001 and 005.

- 4 – IDENTIFICATION LABEL: SEE ABOVE
- 3 – DIMENSIONS IN PARENTHESIS ARE MILLIMETERS
- 2 – ALL DIMENSIONS ARE APPROX.
- 1 – WEIGHT: 18 LBS. MAX.



Features and specifications subject to change without notice.  
Nidec- Avtron standard warranty applies.  
All dimensions are in inches [mm] approx.

**EC DECLARATION OF CONFORMITY:** The Model M6C Encoder has been assessed and type tested against the following Harmonized European Standards: EN61000-6-4:2007, EN61000-6-2:2005. The Model M6C has been found to be compliant with the requirements of EMC directive 2004/108/EC provided that the following conditions are met: The electrical supply to the M6C must be within specified limits. The electrical supply must offer suitable protection from voltage surges unless the application does not require such protection. On behalf of Nidec-Avtron: Owen Patton, Senior Design Engineer.

These instructions have been reviewed and the product evaluated as suitable for our application.

Company Name \_\_\_\_\_

Authorized Company Representative \_\_\_\_\_

Title \_\_\_\_\_ Date \_\_\_\_\_

