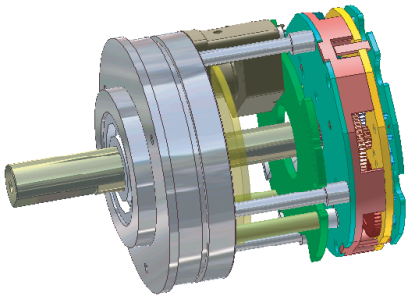
Integration of AEAS-7000 with AEAT-84AD: Mechanical Design Considerations

Application Note 5107



Introduction

The application note is intended to provide a mechanical design overview on integrating Avago's AEAS-7000 and AEAT-84AD into a multiturn absolute encoder.

The integrated multiturn absolute encoder is capable of providing maximal 30-bit or 2^{30} unique positions. This also means that it can provide true absolute positional information at 16-bit resolution within one revolution across 16384 shaft turns.

Functional Description

The AEAS-7000 is a single-turn absolute encoder module in modular form; while AEAT-84AD is a multiturn absolute encoder module *without* built-in controller. Figure 1 shows the functional block diagram of the integration.

The AEAS-7000 is able to provide up to 16-bit resolution with true 65536 unique positional information within one revolution without shaft movement immediately upon power-up. It consists of a low inertial plastic codewheel, with Gray-coded pattern, and an absolute encoder readhead, integrated with highly collimated illumination system and an array of photodetectors.

The AEAT-84AD is used to detect numbers of shaft revolution, by providing multiplexed outputs to the controller. As unique-coded gear-wheels techniques are implemented, the combined output through the controller, together with AEAS-7000 MSB, will generate unambigous positional information.

Controllers like DSP, FPGA, PLA etc., can be used as the controller for such integration dependent on the design requirement. In this application note, MUIC is used for the controller as it cuts short the development time. Figure 2 illustrates the application example using MUIC with AEAS-7000 and AEAT-84AD. Details on the the availability of this controller is within the multiturn absolute encoder module datasheets in Avago website.

An add-on printed circuit board (PCB) interfaces the AEAS-7000 and AEAT-84AD. The controller, in this case - MUIC, seats on the printed circuit board, providing final output from encoding signals of AEAS-7000 and AEAT-84AD.

Other constituent components are equally important in ensuring final performance of the assembled devices. In general, they are:

- Encoder shaft or hub
- Pinion – Module 0.3, 14 teeth
- Bearing stage
- Multiturn Module standoff
- Add-on PCB standoff
- Connectivity for external use
- Enclosure

Encoder shaft or hub provides a transmission medium between motor shaft movement to the encoder systems, allowing positional information to be encoded. Design, precision and torsional stiffness of the shaft or hub will govern the performance of the final product. Please contact the regional support or factory for further details.

This pinion is part of the transmission medium. It is attached at the other end, where AEAT-84AD is located, allowing detection of mechanical revolution through coupling of pinion to first gear wheel within the AEAT-84AD.

Bearing stage serves a mechanical housing for the rest of the components. It also houses bearings, in which shaft or hub is seated. Besides that, the exterior of the bearing stage provides mounting or interface mean to the end user; while the interior of the bearing stage houses the absolute encoder components.

The standoffs, whether they are for multiturn module or add-on PCB, elevate the supported components at required heights.

Add-on PCB provides an interface medium for AEAS-7000, AEAT-84AD and controller (MUIC). The physical outline and the layout of the PCB is dependent of the design requirements of the final assembly. For example, the electronic circuit design affects the space requirement of the PCB. The location and design of the standoffs affects the outline of the PCB.

The connectivity for external use can be of wires in form of shielded cable, industrial connector, pin header, etc. The choice of connectivity will affect the design of other components, especially add-on PCB and the enclosure design.

Enclosure provides ingress protection for the components inside the final assembly. It also provides termination for the connector or cable.

Component Description

The assembly of multiturn absolute encoder comprises the following components, as illustrated in Figure 4. They are as follows:

1. Single turn absolute encoder module – AEAS-7000, namely readhead (1a) and code wheel (1b)
2. Multiturn absolute encoder module – AEAT-84AD
3. Controller - MUIC
4. Encoder shaft or hub
5. Pinion – Module 0.3, 14 teeth
6. Bearing stage
7. Multiturn module standoff
8. Add-on PCB standoff
9. Connectivity for external use.

Figure 3 shows the final assembly of the multiturn absolute encoder, without the enclosure and final connectivity.

For further information on all of the components, please refer to factory.

Mechanical Design Considerations

The AEAT-84AD is designed to be integrated to AEAS-7000, via an interface board, which seats the controller (MUIC). This enables design flexibility to cater to different design requirements of the end user.

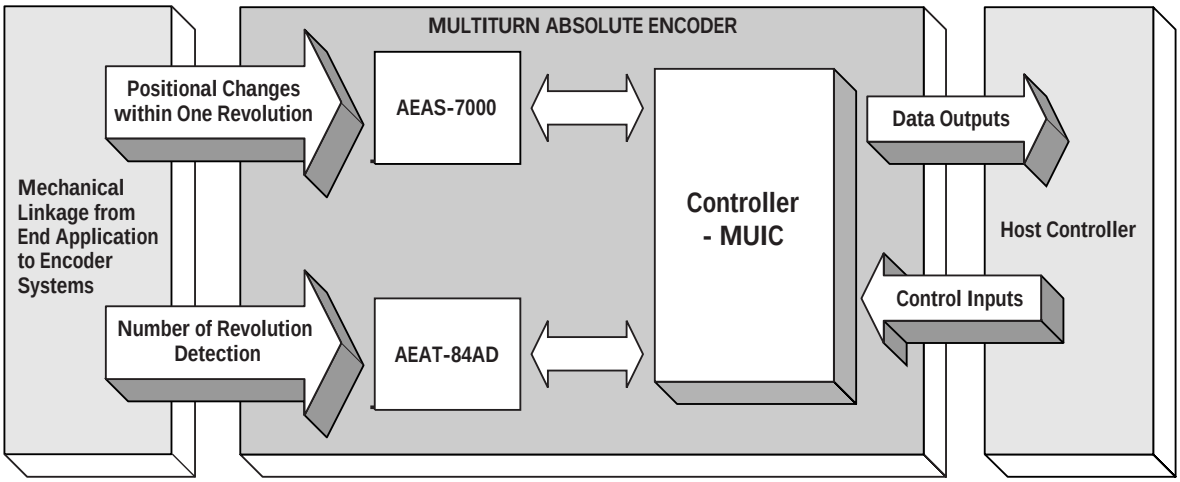


Figure 1. Functional block diagram.

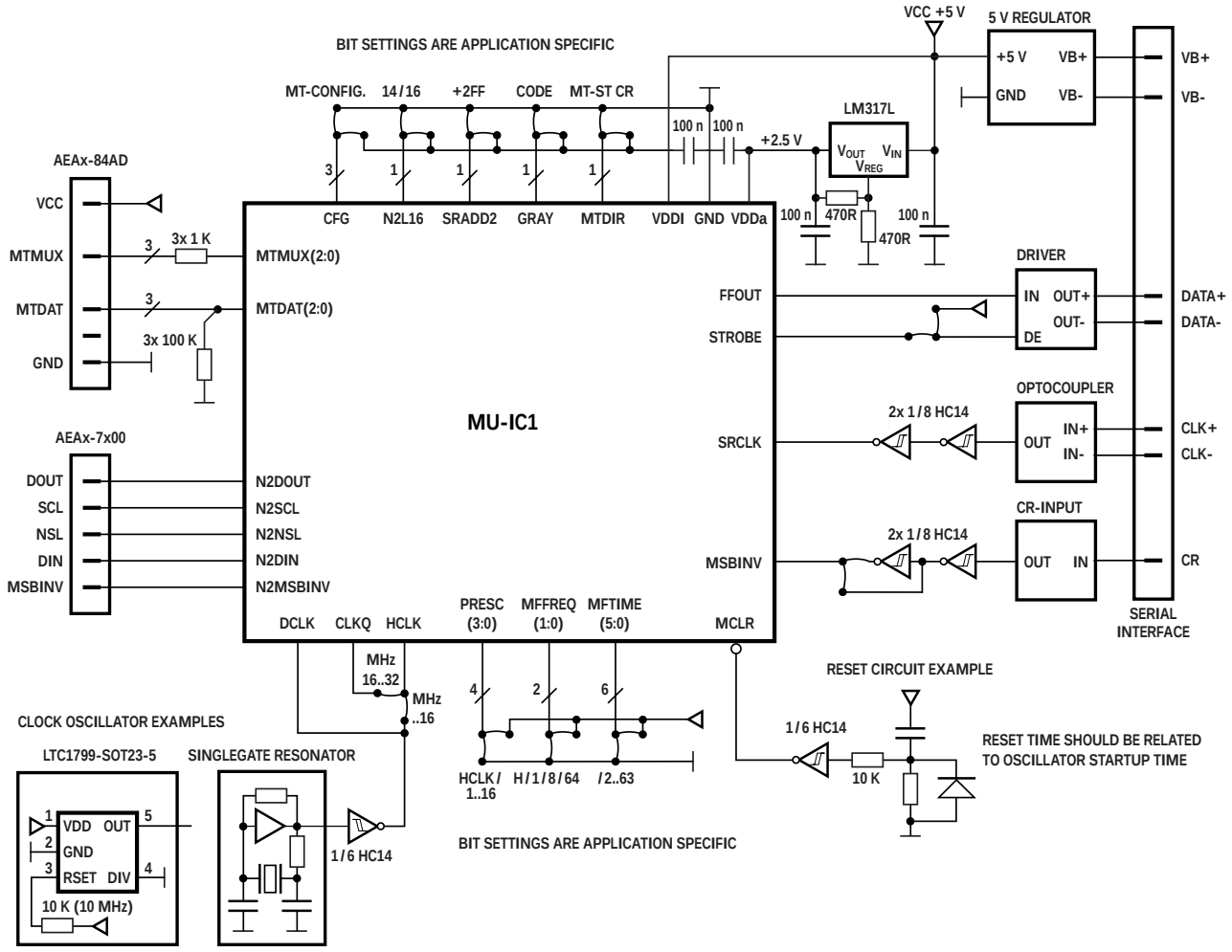


Figure 2. Application example of integration of single-turn absolute encoder module and multiturn module using MUIC.

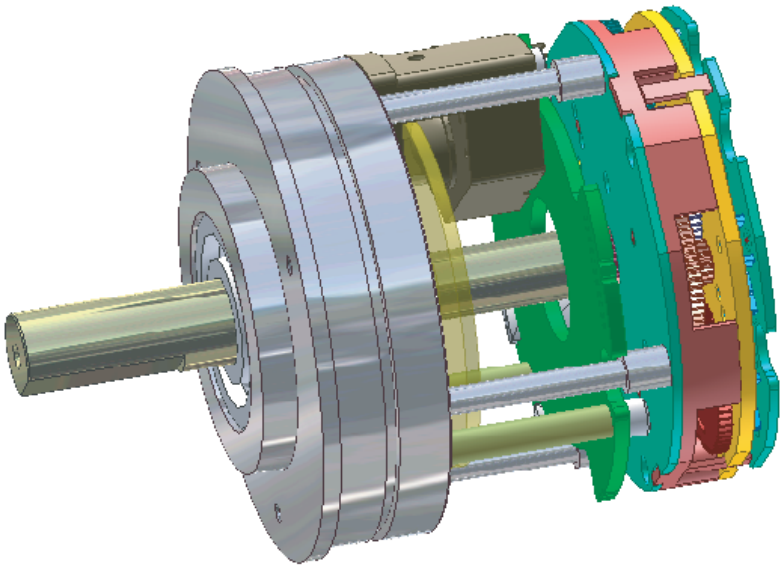


Figure 3. Assembly of multiturn absolute encoder.

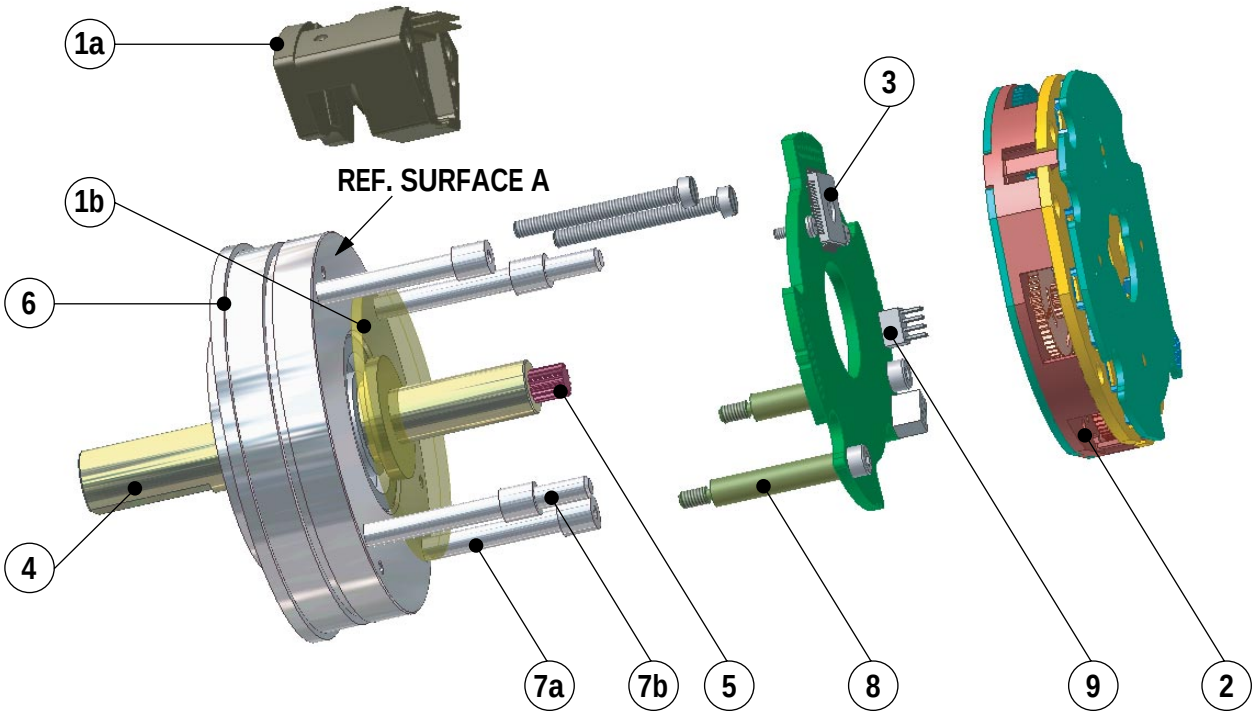


Figure 4. Exploded view of multiturn absolute encoder assembly.

Package Dimensions – AEAT-84AD

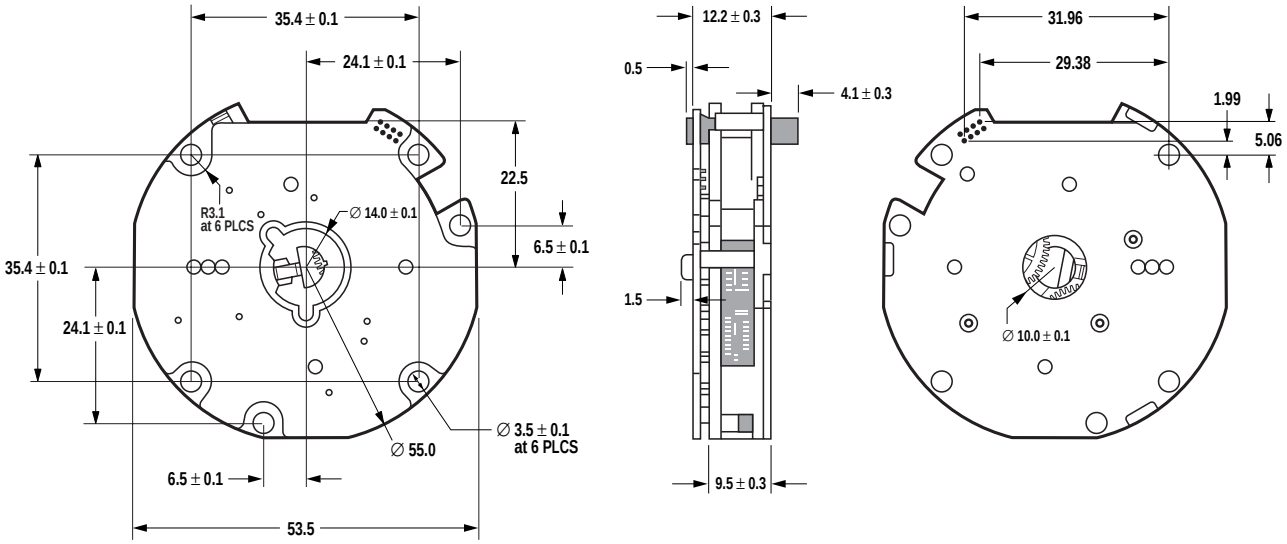


Figure 5. Package dimensions of multiturn absolute module – AEAT-84AD.

Package Dimensions – AEAS-7000

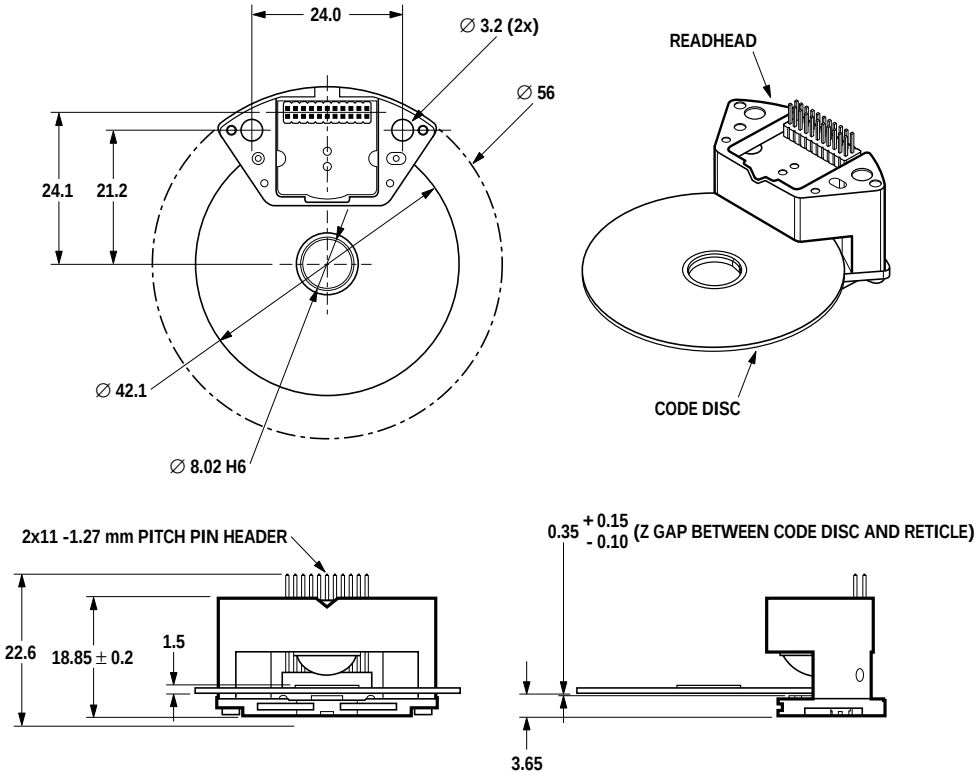


Figure 6. Package dimensions of single turn absolute module – AEAS-7000.

The recommended height of AEAT-84AD is typically at 25.6 mm, from Ref. Surface A.

The add-on PCB can rest on top of the AEAS-7000 readhead, with the standoff effective length at typically at 19 mm.

The multiturn module standoffs design is as shown in Figure 7. The guide standoffs refrain the rotational movement along the shaft axis, while guiding the multiturn module in X-Y position at plane parallel to Ref. Surface A at pre-defined height.

The standoffs are for mounting of M2.5 or smaller cap screws to hold the multiturn module in place.

Shaft or hub specification is as recommended in the AEAS-7000 datasheet. (See Application Note 5048 for more details.)

Mounting distance of codewheel is crucial as it will impact the Z-gap between the codewheel to the AEAS-7000 readhead. The AEAS-7000 mounting recommendation is as indicated in Figure 6. (See Application Note 5048 for more details.)

Pinion is of module 0.3 and 14 teeth. The length is recommended to be 4.5 mm as illustrated in Figure 8.

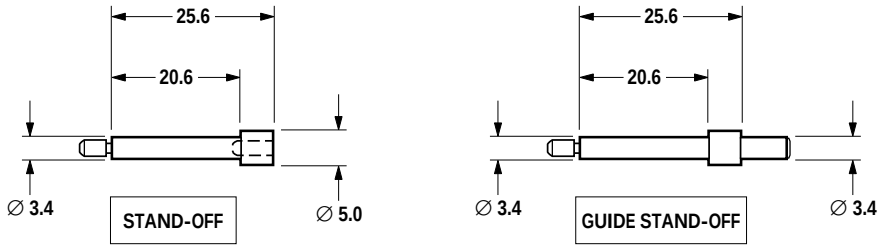


Figure 7. Multiturn module standoffs design.

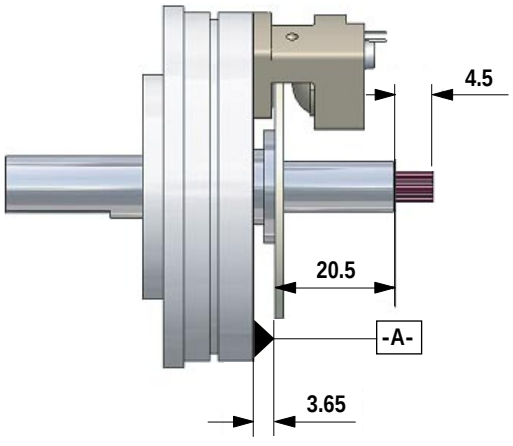


Figure 8. Pinion length, codewheel distance from Ref. Surface A, and inner shaft length.

Assembly Considerations

The assembly procedure of multiturn absolute encoder is as follows:

1. First, bearing stage is installed with bearings
2. Shaft is assembled later
3. All standoffs are installed
4. Single turn encoder module is assembled and aligned, by attaching the code wheel first and then the readhead
5. Add-on PCB is attached and soldered to the single turn encoder module and tightened through cap screws to the add-on PCB standoffs
6. Attach the pinion onto the shaft
7. Insert the multiturn module in place – ensure proper mating of connectivity to add-on PCB, proper meshing of pinion to first gear wheel of multiturn module, and proper seating onto/into the multiturn module standoffs
8. Tighten the cap screw to secure the multiturn module to the standoffs
9. Establish the connectivity for external use
10. Unplug the plastic plug as illustrated in Figure 9, before rotating the shaft
11. Place in the enclosure

For further information on all the above mentioned assembly procedure, please refer to factory.

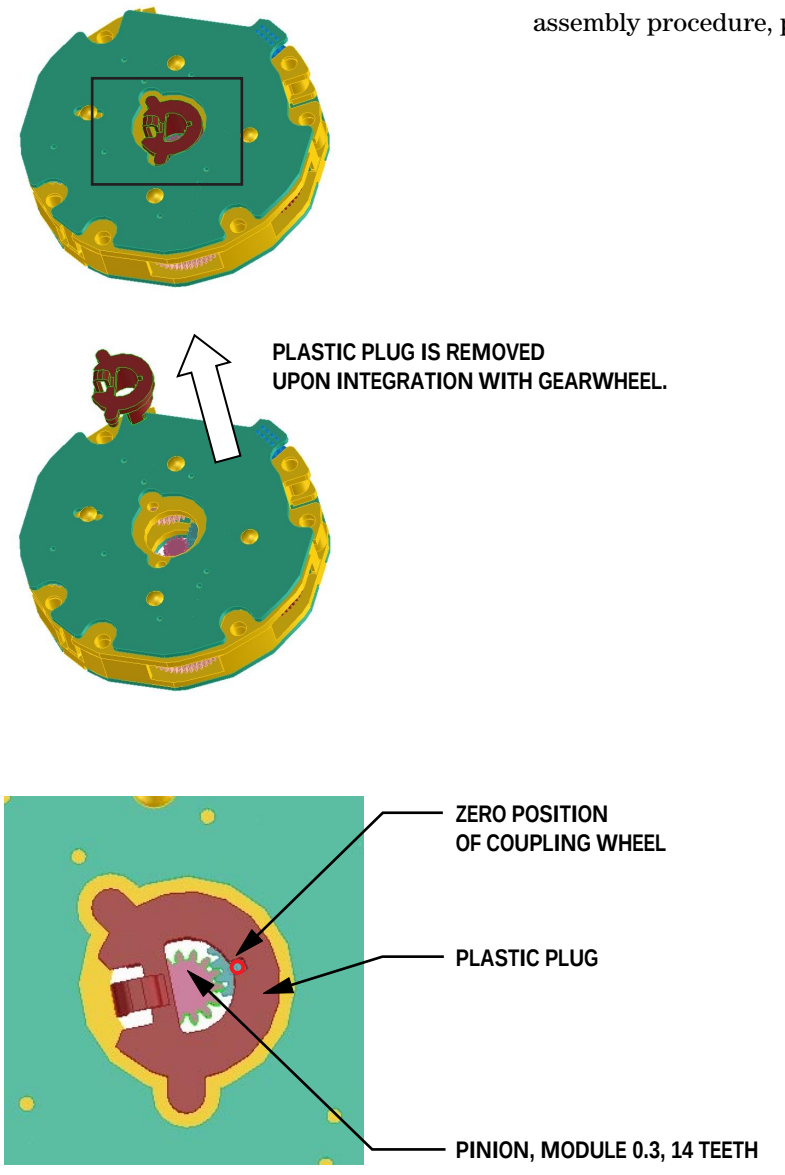


Figure 9. Mechanical coupling with multiturn encoder module.

For product information and a complete list of distributors, please go to our website: **www.avagotech.com**

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