ADBS-A3x0

Optical Finger Navigation Sensors

Mechanical Guide

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1.0 Introduction

Avago Technologies has introduced a range of Optical Finger Navigation (OFN) sensors family that is suitable for navigation interface devices and mobile input devices. These OFN sensors are low power sensor and coupled with small form factor package are suitable for hand held devices requiring navigation capabilities. Examples of end user application include integrated input devices, battery-powered input devices and finger input devices.

The OFN devices use an Infra-Red (IR) Light Emitting Diode (LED) as its light source. It has a wavelength of 870nm.

2.0 Mechanical Implementations

This Application Note (AN) will discuss various mechanical implementations for the OFN sensors. This AN will discuss the various options of mechanical customization, customer top cover design and mechanical tolerances considerations.

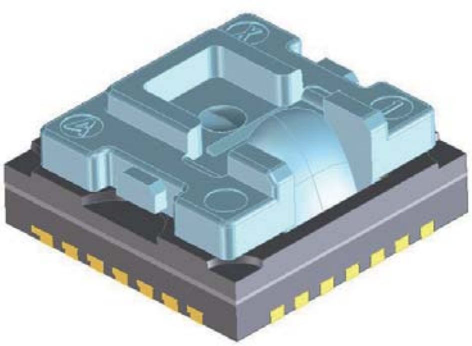


Figure 1. ADBS-A3x0 assembly

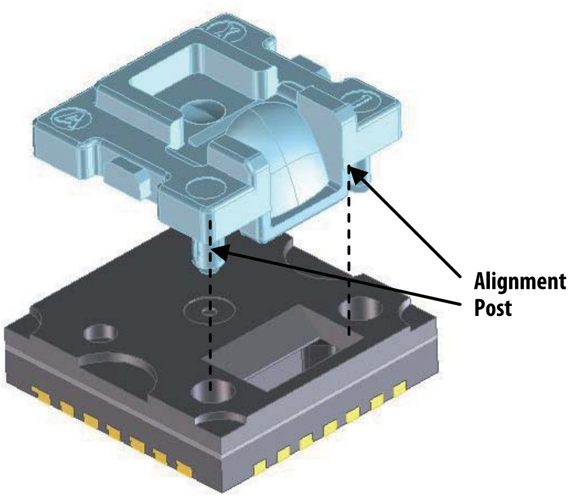


Figure 2. Lens fit into sensor

3.0 ADBS-A3x0 and ADBL-A321 Assembly

The OFN solution has two components which are the ADBS-A3x0 Surface Mount Device (SMD) sensor and ADBL-A321 lens. Figure 1 shows the final assembly of ADBS-A3x0 sensor and ADBL-A321 lens.

Figure 2 shows the lens fitting into the sensor package.

In order to assemble into the complete package, the following assembly guideline can be followed:-

1. Surface mount the sensor and other electrical components onto the PCB.
2. Reflow the entire assembly in a no-wash solder process.
3. Module assembly should be done in Class 10k environment or equivalent laminar flow workbench.
4. Remove the protective Kapton tape from the optical aperture of the sensor and LED. Care must be taken to keep contaminations from entering the aperture. It is recommended to hold the Printed Circuit Assembly (PCA) in vertical position when removing Kapton tape.
5. Press fit the lens onto the sensor. The pressing force range is between 1kgf to 2kgf +/-0.20kgf. Care must be taken to avoid contamination or staining the lens. The lens piece has alignment posts which will mate with the alignment holes on the sensor package. No glue is used. This step 5 and 6 should be done quickly.
6. Place and secure the navigation cover onto the lens to ensure the sensor and lens components are always interlocked to the correct vertical height.
7. The optical position reference for the PCB is set by the sensor package.

For more detailed sensor package and lens dimensions, please refer to the datasheet.

Note that the lens posts are slightly over-sized compared to the mating holes on the sensor. This is to provide limited and temporary hold during assembly process. Please note that the holding force is optimum with the first insertion or mating process. Subsequent removal and insertion of the same lens and/or sensor may exhibit diminished holding force. It is also recommended that, in addition to this 'self-holding' feature, adequate precaution such as fixturing may be employed as required in order to prevent the lens from disengaging from the sensor during assembly.

3.1 ADBS-A3x0 top cover design

There are many choices of designing a top cover for ADBS-A3x0 and several design considerations must be followed. These include optical as well as mechanical considerations.

In terms of optical properties, the top cover navigation window must be uniform so that is does not change the IR LEDs light radiation pattern as well as the received light pattern on the sensor pixel array. The top cover must have a window size to be larger than the optical path of the sensor. This minimum window size or navigation window must be larger than 2mm in diameter. The optical center of the navigation window must refer to the sensor package. See Figure 3 for sensor optical center. Refer to datasheet for PCB land pattern and optical center. The navigation window must also be SPI-A2 or better surface finish. See Figure 4 for this illustration. Outside of this navigation window, the recommended surface finish can be SPI-D3.

The top cover material can use common plastic materials like Polycarbonate and Acrylic materials. These are known in various industrial names like Lexan and Makrolon for Polycarbonates, and Plexiglas and Acrylite for Acrylics. The major difference between the two types of materials is that Polycarbonate is a tougher material and can withstand harsher environmental conditions. Avago Technologies recommends using Lexan 21051 from GE Plastics.

In terms of mechanical properties, the top cover must meet the navigation thickness window of 0.5mm with tolerance of +/-0.02mm. There must be clearance for solder fillet, square opening of 6.20mm and adhesive area for the top cover to fix onto the flexible or PCB. The Datum to cover reference is taken from the top of the lens as shown in Figure 5. See Fig 5 and 6 for dimensions.

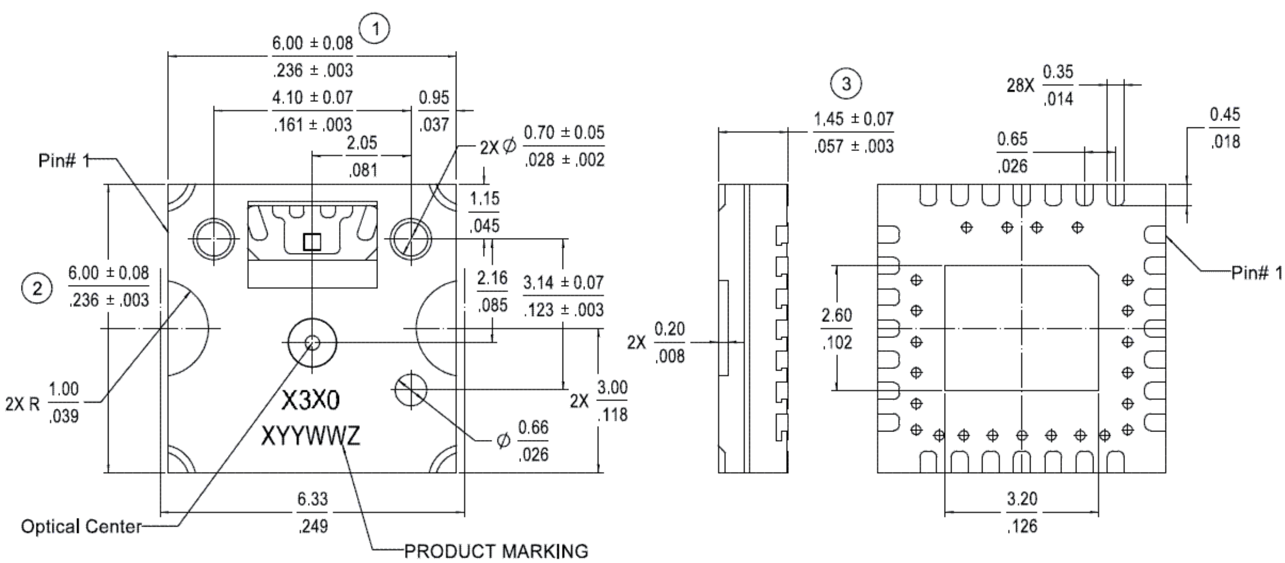


Figure 3. Sensor optical center

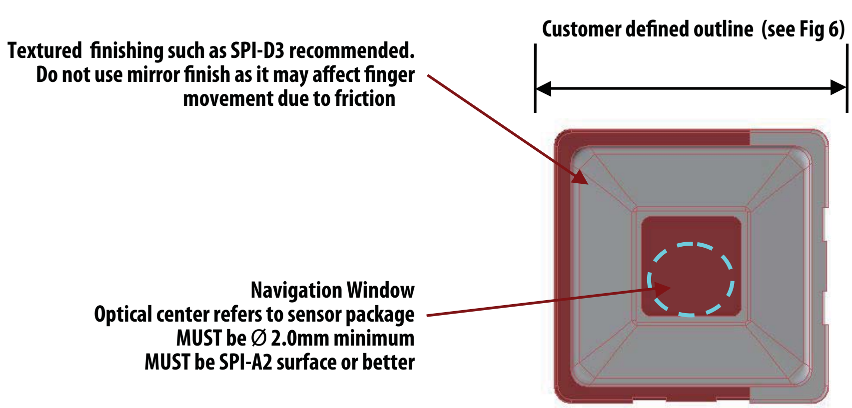


Figure 4. Top cover design

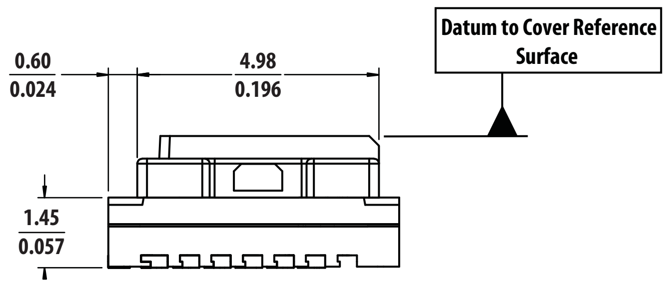


Figure 5. Lens Datum to cover reference

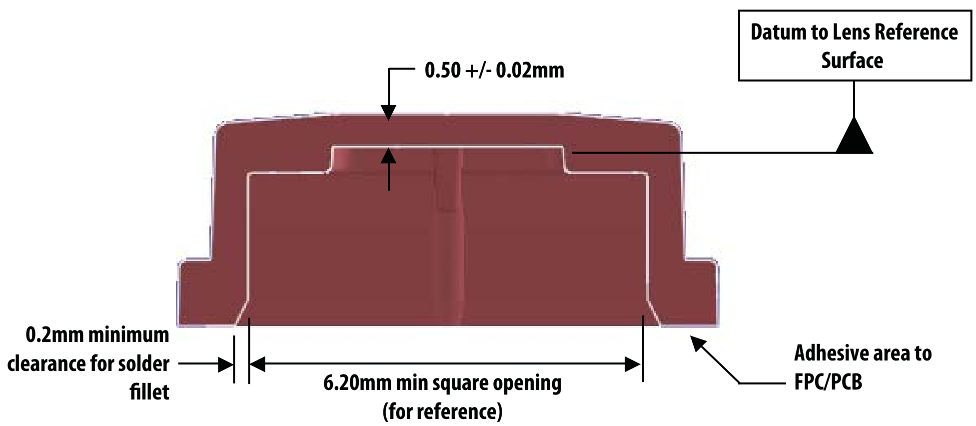


Figure 6. Top cover dimensions

The navigation widow cover, see Fig 4, is designed with Ultra Violet (UV) coating material. This material can be obtained from Fujikura Kasei Company. The coating thickness is at 10 to 20um thickness. The transmissivity curve can be obtained for Lexan121 21051.

The transmissivity curve will also not change after going through several abrasion tests. The module passed RCA abrasion test for 200 times at 175g. The module also passed pencil hardness test for 3H and 4H. The curve is shown below. It can be noted from the below graph that the curve did not change from the original curve after applying abrasion test. The transmissivity still maintained above the 90% level. A good material chosen should maintain a tolerance of 6% around its nominal value.

It is recommended to keep the transmissitivity above 80% from 800nm to 940nm.

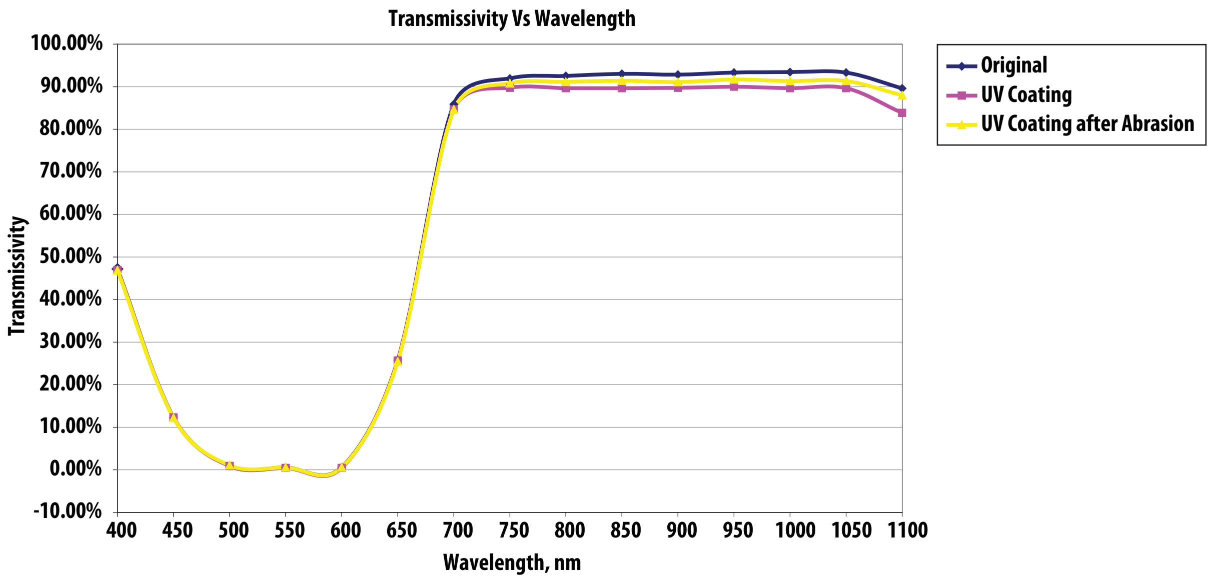


Figure 7. Transmissivity curve after tests

When top covers are designed, it is also advisable to select proper values for the sensor Assert/Deassert registers values. See the OFN A3x0 Firmware design guide Application Note for detailed description of Assert/Deassert.

Several top cover designs can be pursued. For example, it can be circular or square navigation window with circular or square customer defined top cover. See Figure 8.

When the top cover needs to be glued to the FPC assembly, ensure that the top cover is cleaned with air blow to clear all dust particles. A non-hermetic glue is recommended to glue the top cover to the FPC for a complete seal.

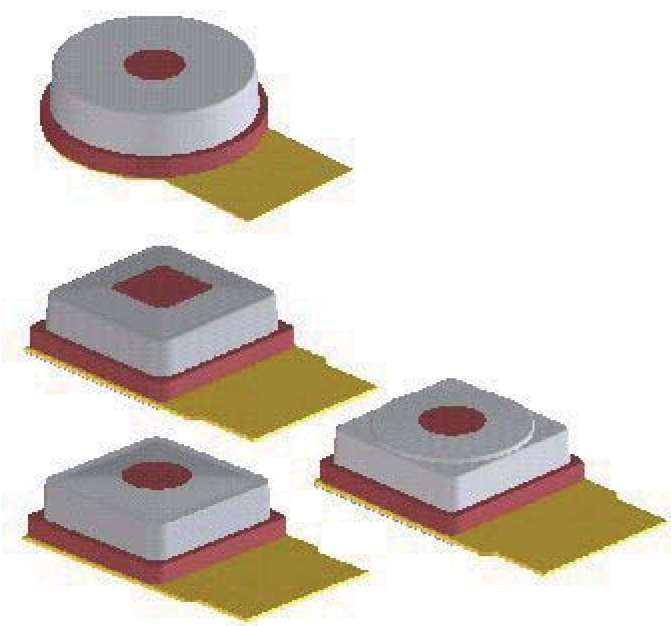


Figure 8. Top cover options

In order to cater to the glue, the top cover tolerance break down is shown in Figure 9a below.

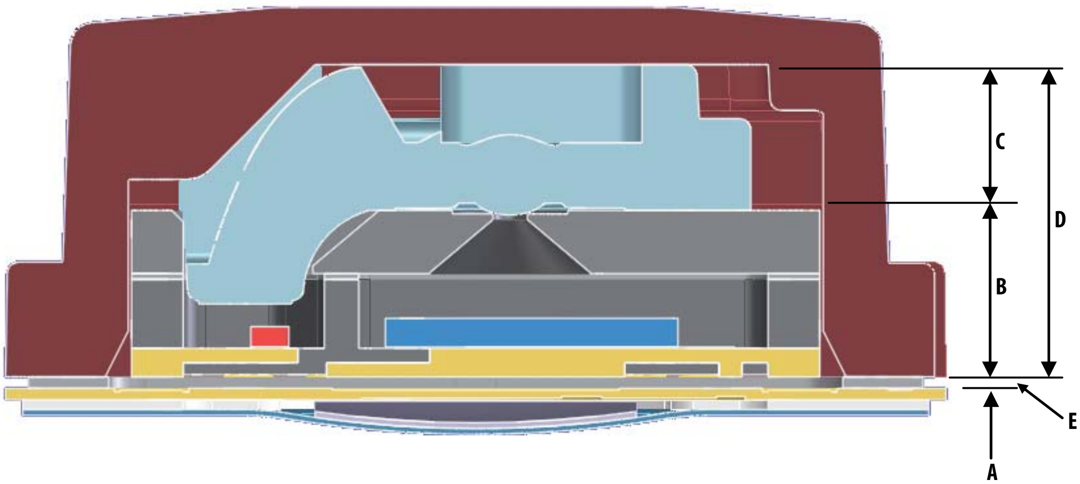


Figure 9a. Top cover tolerance

The tolerances identified for each section is shown below:-

Dimension	Description	Nominal	Tolerance	
			+ve	-ve
A	Solder standoff	0.1	0.025	-0.025
B	Sensor height	1.45	0.065	-0.065
C	Lens height	1.27	0.02	-0.02
D	Housing height	-2.72	0	-0.05
E	Gap for epoxy	0.1	0.11	-0.16
	Worse case gap	–	0.21	-0.06

In addition the OFN sensor performance was evaluated in the event that adhesive tape was used to glue the top cover to the OFN sensor FPC instead of using epoxy. Due to the tolerance stackup of all parts involved and the limited compression rate of the adhesive tape to make up for the tolerance, a gap of about up to 0.2mm maybe induced between the lens and top cover. The performance of the sensor with a 0.2mm gap is was shown below. The OFN sensor was set to a constant resolution of 500 counts per inch and tested up to a velocity of 15 inches per second.

From figure 9b above shows two curves. The first one marked "A320" shows the resolution of the OFN sensor with the cover touching the lens reference surface. The result is a constant resolution between 400cpi and 500cpi with average of 480cpi. The second result marked "A320 with tape 0.2mm gap" shows the performance of the OFN sensor with a gap of 0.2mm between cover and lens. The OFN sensor performance shows a drop in reported resolution. However there is no visible effect on navigation performance when used with human finger. It is recommended to keep the epoxy gap as minimum as possible with a nominal gap of 0.1mm and maximum gap of 0.2mm.

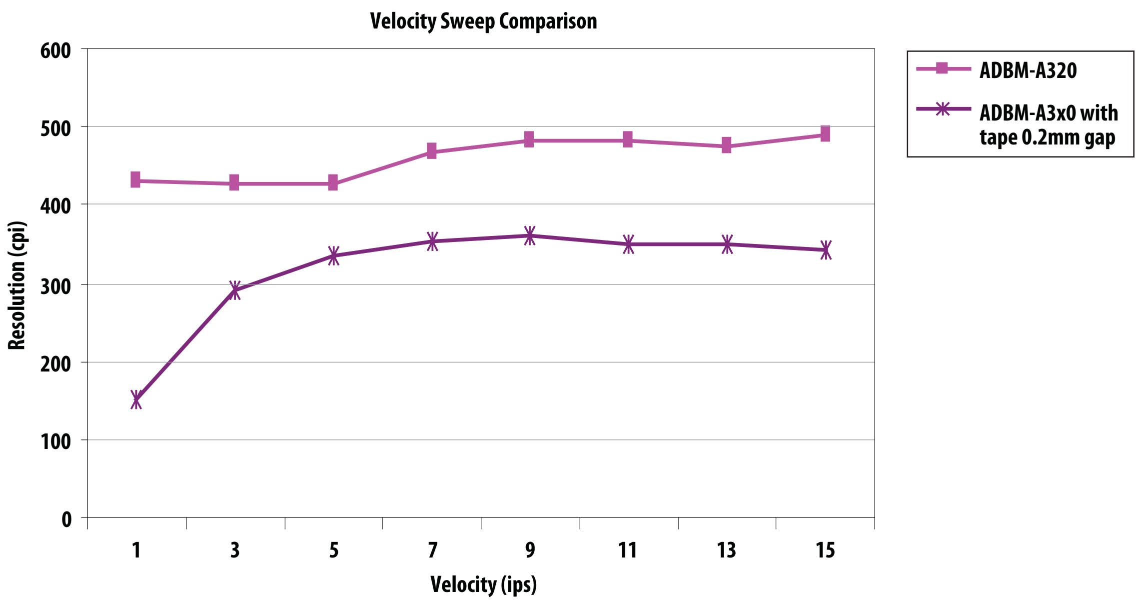


Fig 9b. OFN sensor resolution with and without gap

Shown below is the tolerance analysis when there is a gap of 0.2mm between cover and lens.

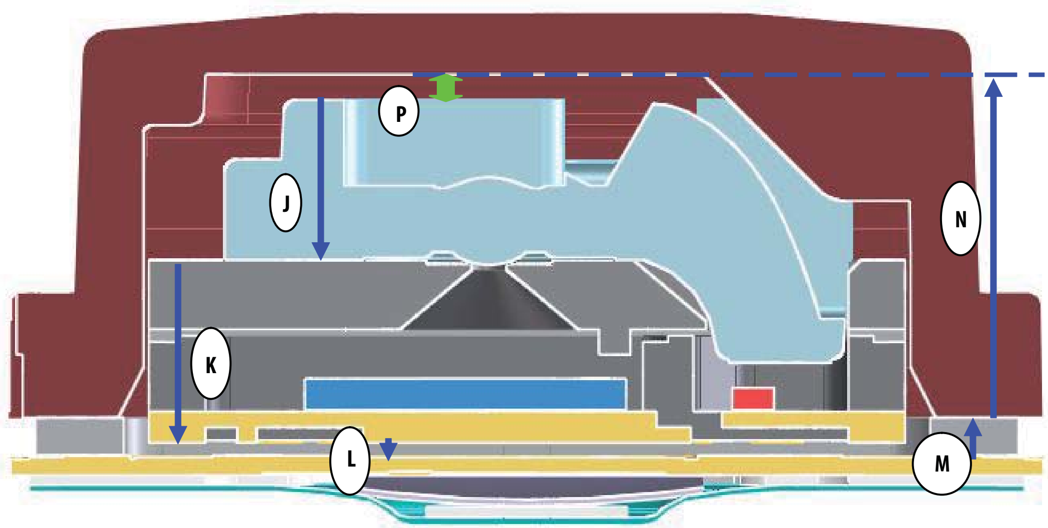


Figure 9c. 0.2mm gap between lens and top cover

The tolerances identified for each section is shown below:-

			Tolerance	
Dimension	**Description**	**Nominal**	**+ve**	**-ve**
J	Lens height	-1.27	0.02	-0.02
K	Sensor height	-1.45	0.065	-0.065
L	Solder standoff	-0.1	0.025	-0.025
M	Tape thickness	0.17	0.017	-0.017
N	Housing height	2.72	0	-0.05
P	Gap between cover and lens	0.07	0.127	-0.177
	Worse case gap	–	0.197	-0.107

3.2 Metal dome sheet design

Customers are also able to design their own metal dome sheet if required. The metal dome sheet is made up of mylar tape, spacer, a metal dome switch and release firm. The side cut metal dome diameter is 4mm while the minimum diameter for adhesive is 8mm. See Figure 10. An integrated dome with plunger can also be used. See Figure 16 for reference.

Figure 12. Dome metal sheet with integrated actuator (bottom view)

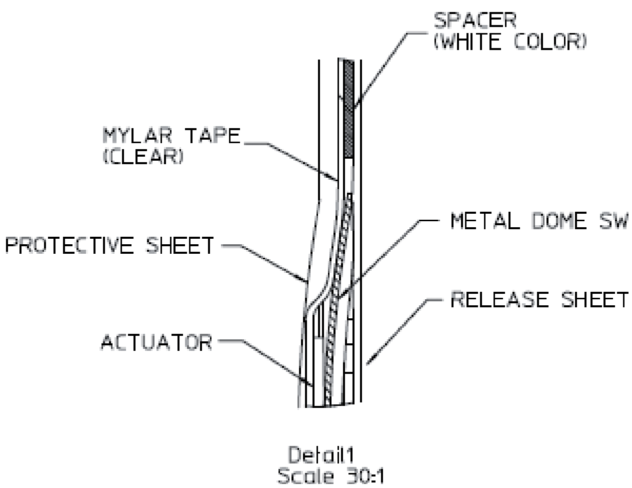


Figure 10. Dome materials

The dome metal sheet must have the following drawings

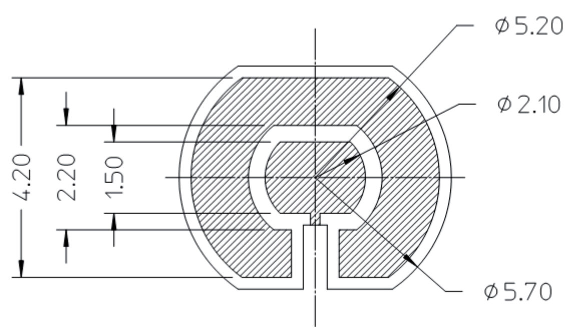


Figure 13. Dome metal switch land pattern

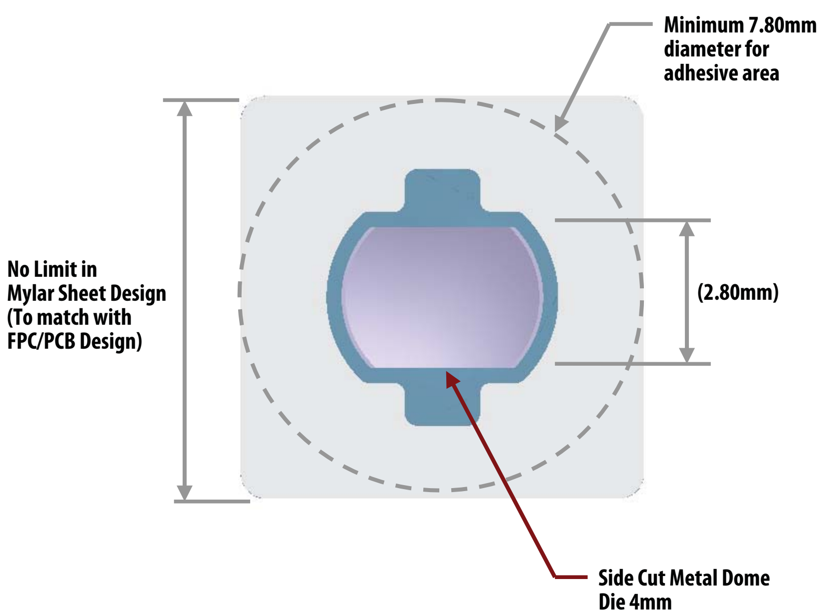


Figure 11a. Dome metal sheet (top view)

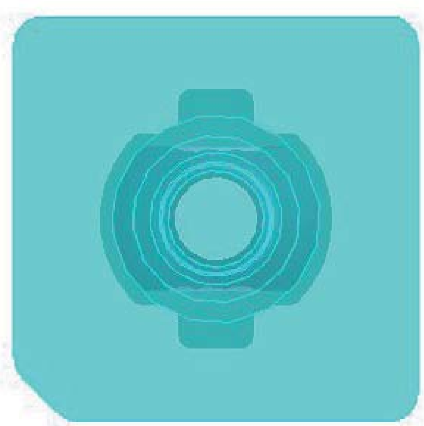


Figure 11b. Dome metel sheet (bottom view)

3.3 Assembly Process Flow

The final ADBS-A3x0 design uses a flexible cable as interconnect to the printed circuit board (PCB). This allows easier mounting, low profile and flexible end product designs. An example of the design is shown in Figure 14.

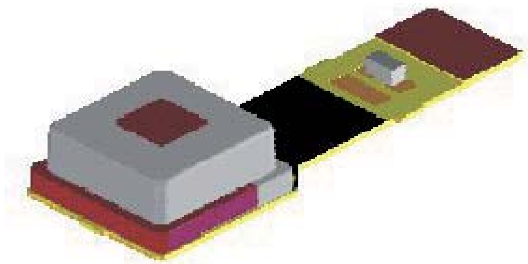


Figure 14. ADBS-A3x0 with FPC top side view

The internal exploded view of the module is shown in Figure 15. Internally the module is made up of top cover, with an optical lens mating to the ADBS-A3x0. This assembly is then adhesively stuck to the flexible cable. A metal dome sheet is also adhesively stuck to the bottom of the module.

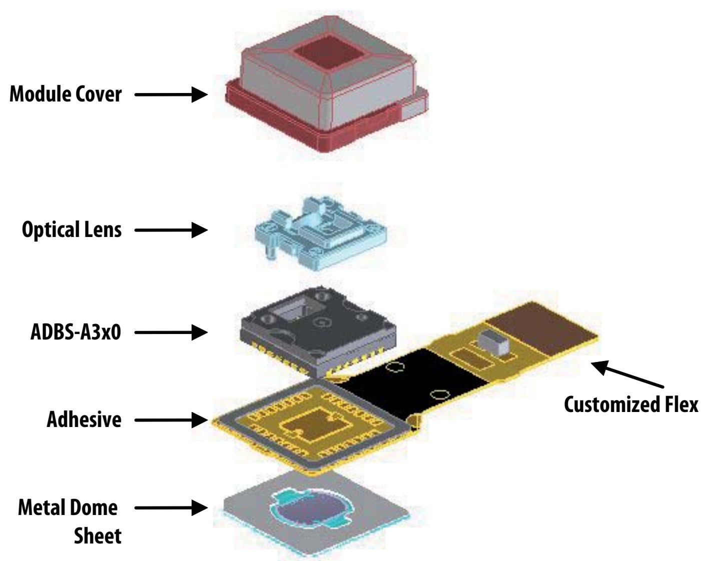


Figure 15. ADBM-A3x0 exploded view

3.4 Casing Design Considerations

The casing design can be an inward concave design or an outward square design following the square share of the module. In a concave design as shown in Figure 16, it is advisable to consider a design where the user's finger must always come into contact with the module navigation window. A concave design can be used to guide a finger but care must be taken to avoid restriction of finger movement. The module cover window should also not the highest surface in the complete assembly so as to avoid scratches to the navigation window.

The casing is recommended to have a textured finishing. This will result in better user feel. The casing can be SPI-D3 surface texture finishing. If mirror finishing is used, this may result in friction during finger movement across the surface.

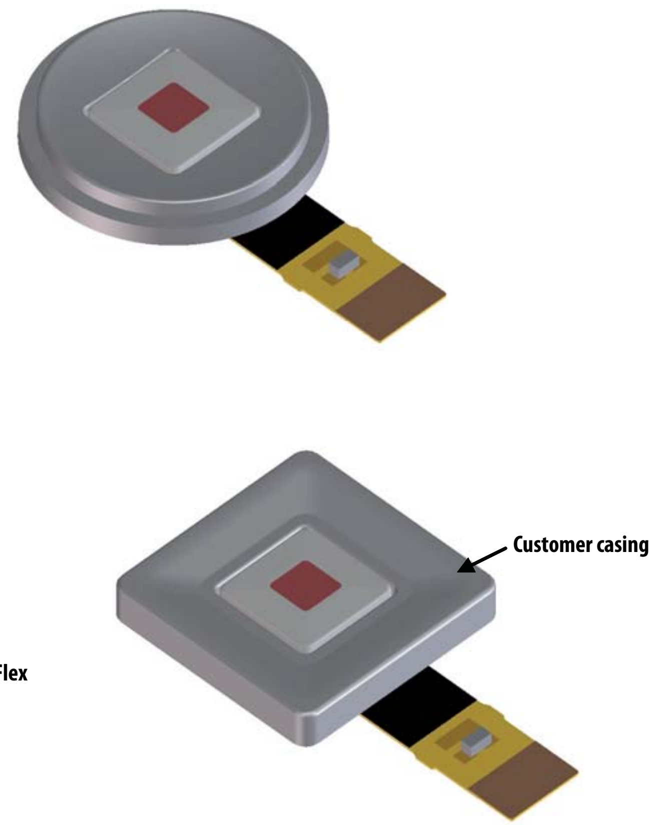


Figure 16. Customer casing design

3.5 Actuator for Dome Switch

The dimensions to be observed for the top casing design are shown in Figure 17a. There are two dimensions for consideration. Firstly, the recommended protrusion for the module is 0.3mm above the edge of the casing opening. Secondly, the recommended clearance is 0.1mm between the module and casing. Note for A320 there is a 4.7uF Surface Mount (SMT) capacitor with the size of 0603 on the FPC. See section 5.0 for FPC design consideration and Appendix A for FPC schematic.

Figure 17a also shows the integrated dome with actuator.

3.5.1. Dome with External Actuator Design

While designing dome switch with an external actuator, customers are advised to take into several design considerations when designing modules. The following should be considered referenced to Figure 17b:-

1. the external actuator height, H must be equivalent or below that of dome stroke height, SH. See figure 17b and 17d. This is to avoid excessive actuating force from the actuator to the underside of the module and OFN sensor.
2. similarly the dome height, M can be greater than external actuator height, H. This is to avoid excessive actuating force from the actuator to the underside of the module and OFN sensor.
3. press force must not exceed dome click force as specified in dome datasheet or up to 4kgf (40N) typical finger force to avoid excessive force on the module.
4. it is recommended to select the actuator material type to be silicone rubber. This silicone rubber can provide cushioning to the module.
5. dimension of external actuator base, L to be larger than module. This is to limit the stroke travel of the module.
6. it is recommended to add a stiffener in the FPC to strengthen the FPC.

These design considerations will ensure that during normal operation, the actuator and dome will not damage the OFN module.

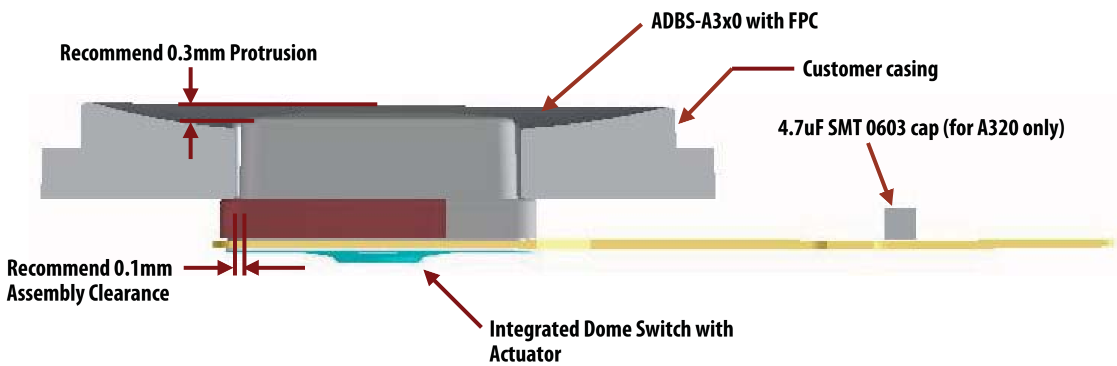


Figure 17a. Protrusion, clearance and Dome switch

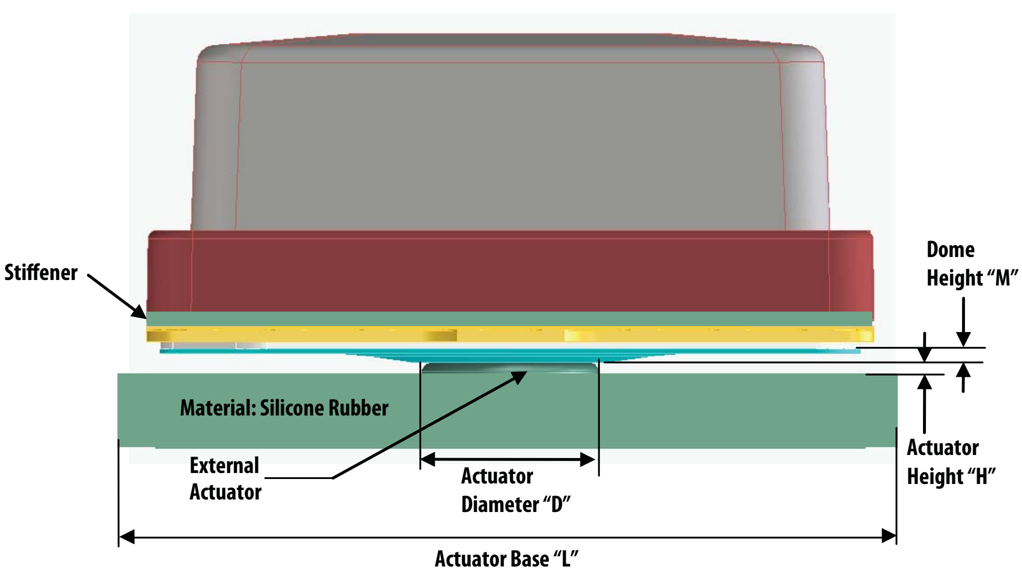


Figure 17b. External Actuator

An example of dimensions is shown in Figure 17c below using dome switch stroke height specification shown in Figure 17d.

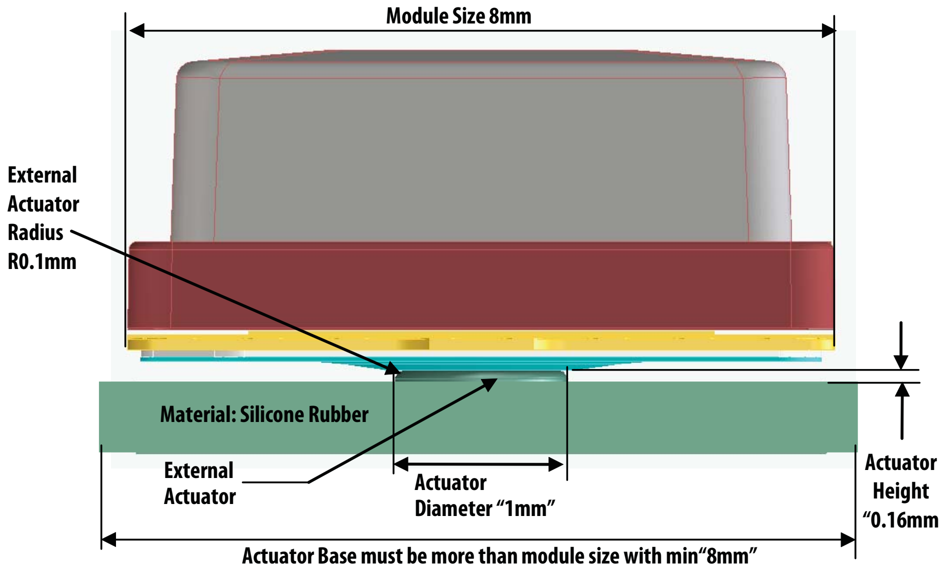


Figure 17c. External Actuator dimension examples

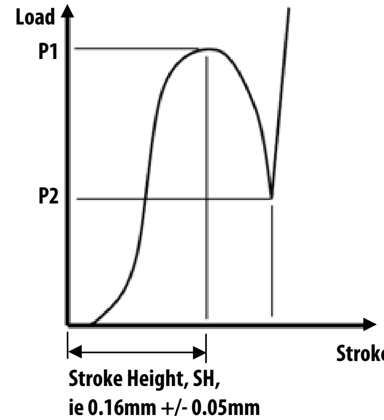


Figure 17d .Dome load-stroke curve

4.0 Electrostatic Discharge considerations

Customers can improve the ESD performance of the sensors by implementing a few of these methods in combination as it will result in better ESD immunity. On the casing and top cover, a properly grounded conductive ring around the module will help to discharge the ESD pulses effectively. This guide ring will provide a lower impedance discharge path during ESD events and thus act as a shield to the module. In addition a grounded conductive module cover will minimize the possibility of ESD going through the module. See Figure 18 and 19 below two implementations.

The system grounding is another area which can be implemented to improve ESD immunity. On the customer board, it is suggested to have exposed ground pads on the host printed circuit board. See Figure 19 below. The exposed ground pads must be larger than the module size of 8.2mm by 8.2mm. Similarly the sensor FPC can have an exposed shield pad which is connected to the host PCB ground to provide a low impedance path to drain the ESD charge.

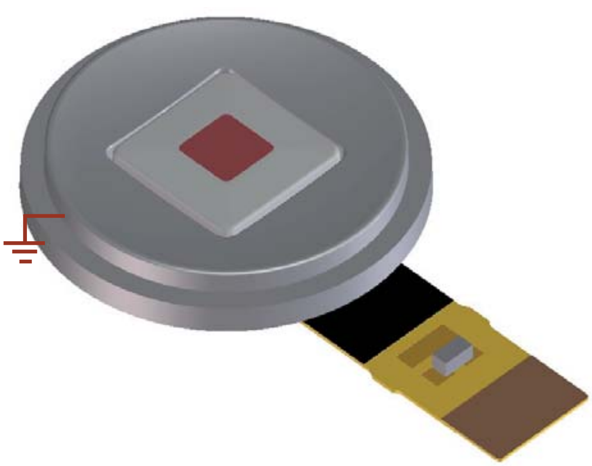


Figure 18. Casing grounding

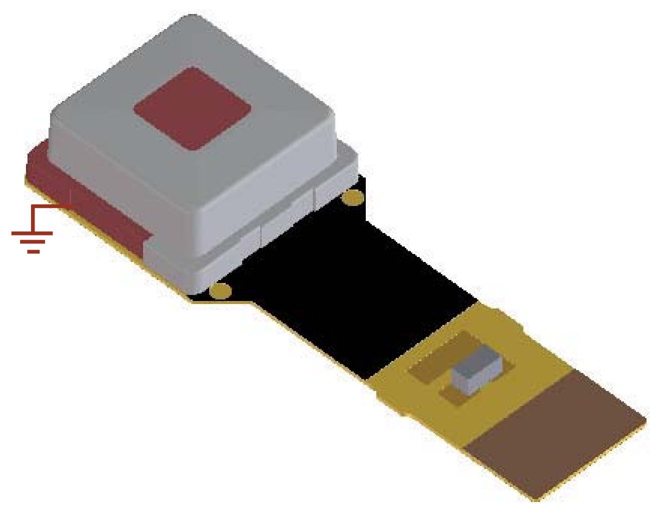


Figure 19. Module cover grounding

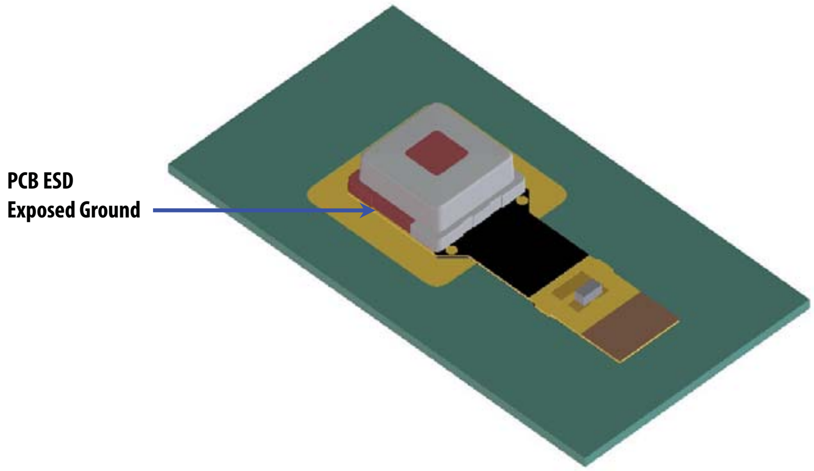


Figure 20. Host PCB grounding

Another example the FPC can have exposed ground pads on its side to provide a surface area where the ESD can discharge. Refer to Figure 21 below. Similarly the FPC can be designed in such a way that exposes a shield ring around the sensor. A dedicated discharge path from this ring to the system ground via the FPC connector is recommended. See Figure 22 below that shows the yellow zone as exposed ground.

Also on the FPC, there can be an allocation of top layer as the ESD shield ground and the internal are as IC system ground. These are separated at the pinouts. This is shown below in Figure 23 and 24. Note that the EMI shielding is on top and bottom of layers which are connected through via holes. This is to provide more contact surface area to discharge the ESD pulses.

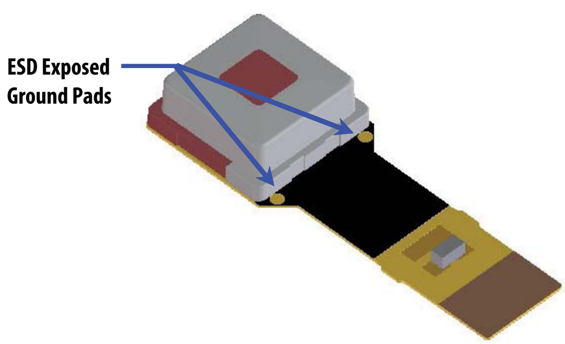


Figure 21. FPC grounding pads

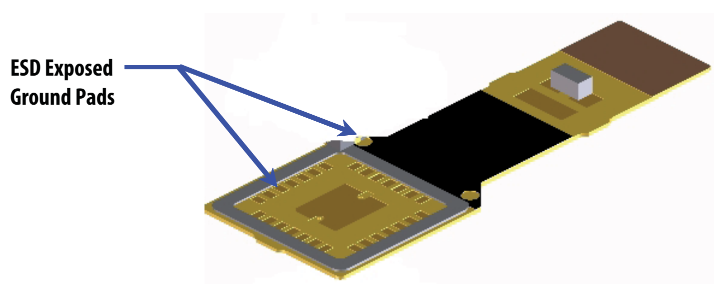


Figure 22. FPC grounding plane

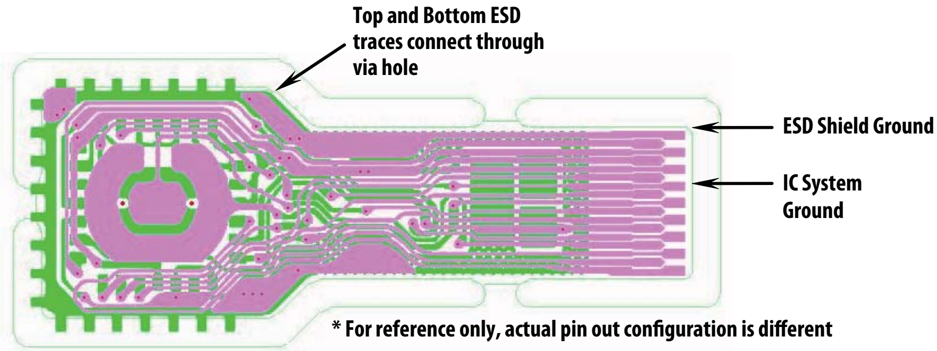


Figure 23. FPC layers bottom view

Figure 24. FPC layers cross section view

On the module FPC, several other improvements can be made to the FPC. An example is adding a ESD ground plane in the FPC and one or more ground connections at the pinout. This ESD ground shield must be separated from the sensor ground and likewise for the pinout as well. These two separate grounds must then be connected in a star connection at the grounding point which is at the system chasis ground.

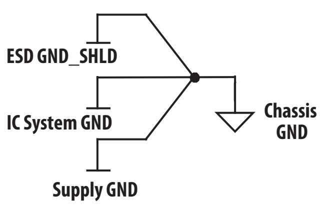


Figure 25. ESD grounding

In production, the general ESD guidelines should be followed. Areas that are considered and the need for ensuring ESD safe environment are listed below.

1. Workstations and areas for example work benches, surface coverings that are non conductive, vinyl and all waxed floors and chairs that are grounded.
2. Operator clothing for example clean-room garments and personal clothing for example synthetics, silk and wool.
3. Part and assembly packaging materials such as polyethylene bags and films, polyethylene bubble pack and foam, and plastic boxes, trays and cabinets.
4. Cleaning and test areas such as high velocity gas flow temperature chambers for drying.

Therefore each workstation and personnel must be grounded via a ground terminal or wrist strap. The wrist strap and grounding path must be checked frequently. Wrist straps must be touching the skin firmly for adequate connection. Further references can be found in MIL-STD-1686A, Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment.

5.0 FPC design considerations

The Flexible Printed Circuit interconnect can be designed to connect the sensor to a connected on the customer PCB. Customers can follow several guidelines listed below.

1. Ensure the ESD Shield Ground is separated from the sensor Integrated Circuit (IC) Ground on the FPC. This is to prevent any stray ESD charge from coupling into the sensor IC.
2. Avoid have the VDDA trace running in parallel to the ESD Shield Ground. This is also to minimize coupling of ESD charges to the VDDA.
3. The GND_SHIELD trace to be designed as wide as possible with minimum 0.3mm width.
4. The GND_SHLD traces can be design in 5 straight traces in order to produce a flexible FPC instead of a stiff one. See Figure 26a.
5. Avoid having MISO and NCS traces in parallel. This is to avoid pulsing signals from coupling with each other.
6. The traces can follow the guideline below:-

Trace	Min width thickness
GND_SHLD	0.3mm
VDDA	0.2mm
Others	0.1mm

The FPC schematic is shown in Appendix A.

When handling the FPC, it is advisable not to bend the FPC excessively. There are several other areas on the FPC that cannot be bent such as area on the stiffener and gold fingers. If these areas are bent, this may cause broken traces on the gold fingers. See figure 26b and 26c.

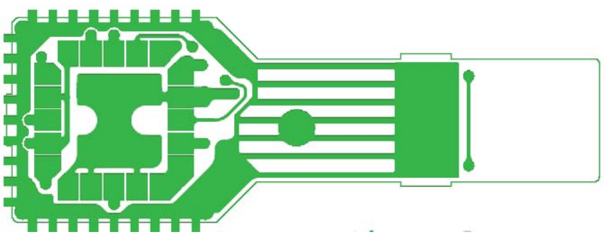


Figure 26a. Flexible Ground traces

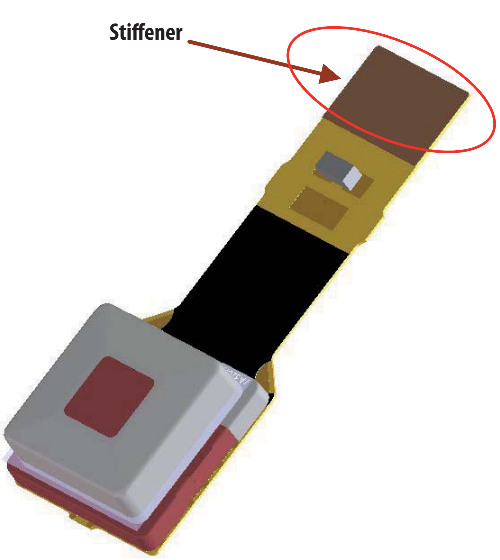


Figure 26b. FPC stiffener

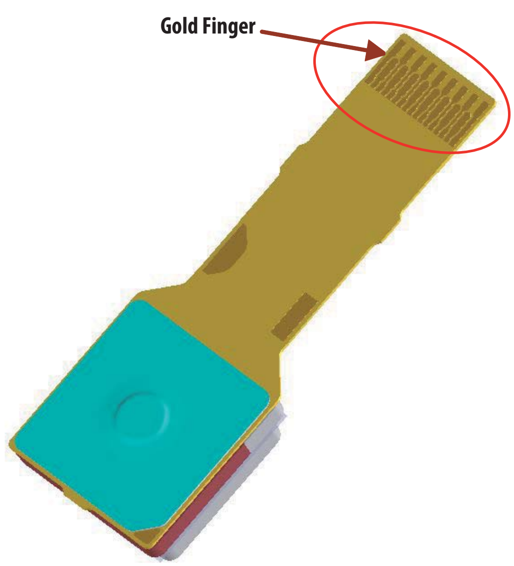


Figure 26c. FPC gold fingers.

6.0 Module Bill Of Materials

The BOM list to build from sensor to module level for A320 is shown below.

No.	Component	Typical Part / Supplier	Qty	Comment
1	FPC	PCB/FPC supplier	1	Customized part from FPC supplier. Avago provides a standard straight flex design.
2	Sensor	ADBS-A320-SQ /, ADBS-A320-RD	1	Avago provides two standard IDs, square & round.
3	Metal Dome Switch	Avago typical supplier: Fujikura	1	Avago provides standard metal dome sheet with plunger
4	Capacitor SMT	4.7uF	1	0603 or smaller
5	Lens	ADBL-A321	1	Avago OFN Lens
6	Lead Free Solder Paste	Pb-Free, Sn/Bi series	1	For conductive attachment of ESD Bracket
7	Cover	Plastic Housing Manufacturers , (Precision Plastic Molders with capability up to 0.05mm tolerance)	1	Customized part from plastic parts supplier. Material: PC
8	Adhesive	Loctite product 3118 (lpd-4174)	1	

7.0 Manufacturing considerations

There are several precautions which customers need to observe when using the sensors. For ADBS-A3x0, the lens is stored in hard tray. It is advisable to keep the lens inside the tray at all times. Avoid loading the lens into storing baskets or leaving the lens in an unclosed environment such as assembly work station.

The lens must be picked up using a plastic tweezer since the lens is packed in a hard tray without orientation. The plastic tweezer should grip the side of the lens. Avoid handling the lens using bare hands.

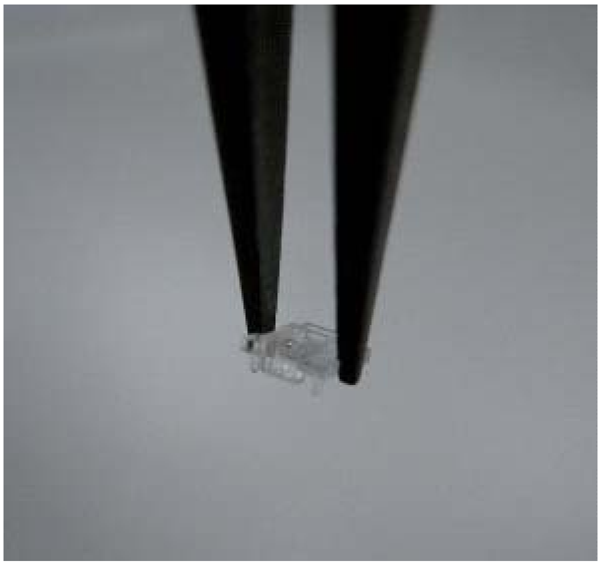


Figure 27. Tweezer

Figure 28. Hard tray

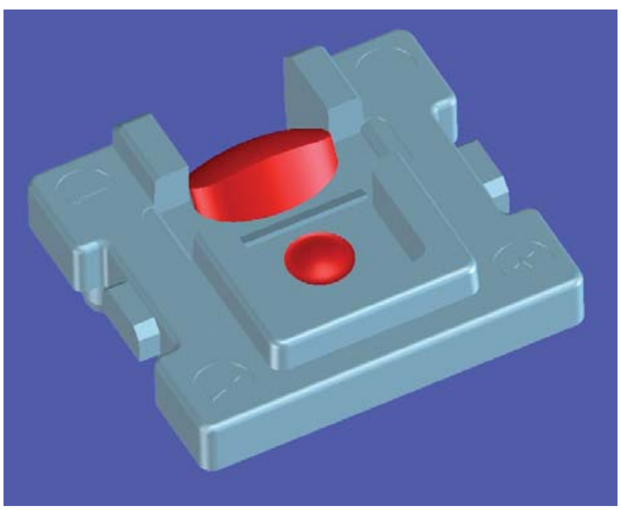


Figure 29. Lens top view

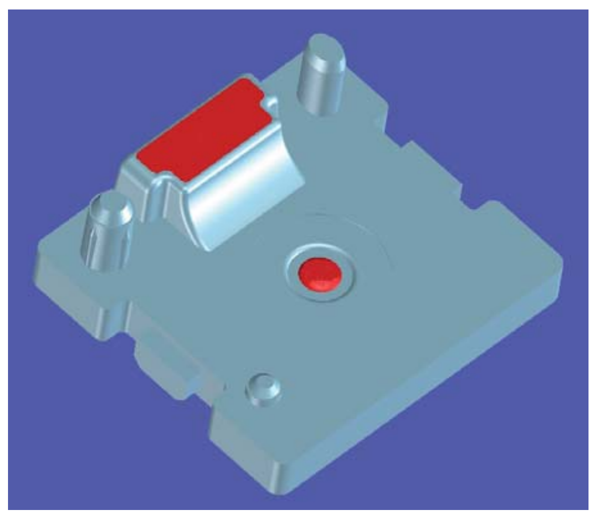


Figure 30. Lens bottom view

There are optical areas on the lens which must be kept clean and should not be touched to avoid scratches. Note the red areas are surfaces to avoid any touch. It is recommended to blow the lens before and after assembly into the sensor. If there is dust on the lens, a simple air blow using can be used to clean the lens. An example for air blow is Chemtronics UltraJet part number ES1520E.

8.0 Illumination Ring

An illumination ring can be placed around the OFN sensor. The illumination ring can be made of translucent or opaque material. The light emitting diode (LED) used should not be in the red light wavelength of 650nm as this will interfere with the OFN sensor.

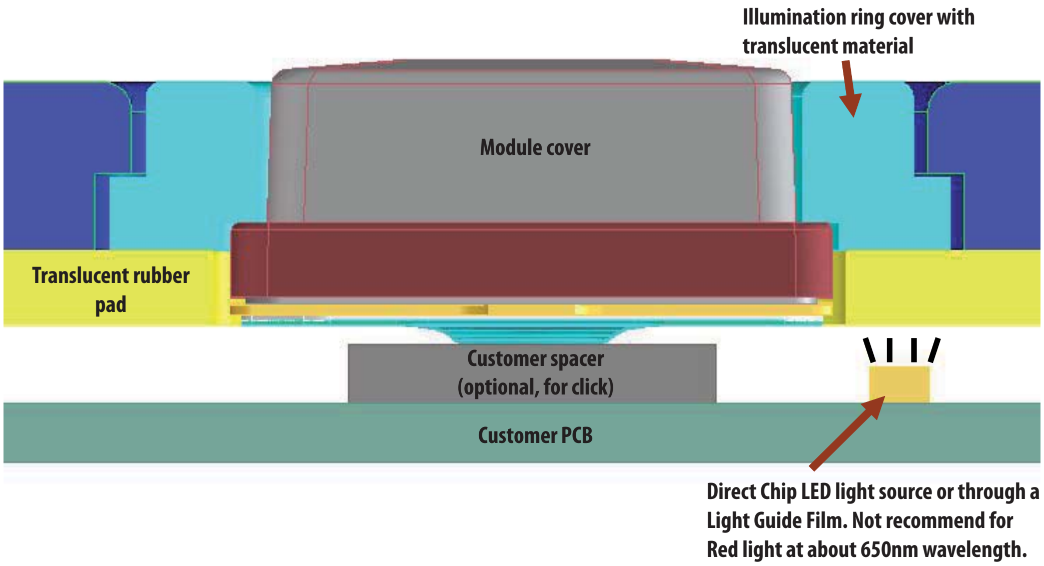


Figure 31. Illumination design side view

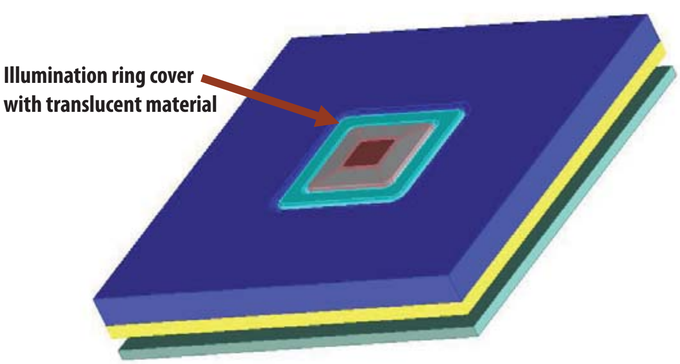


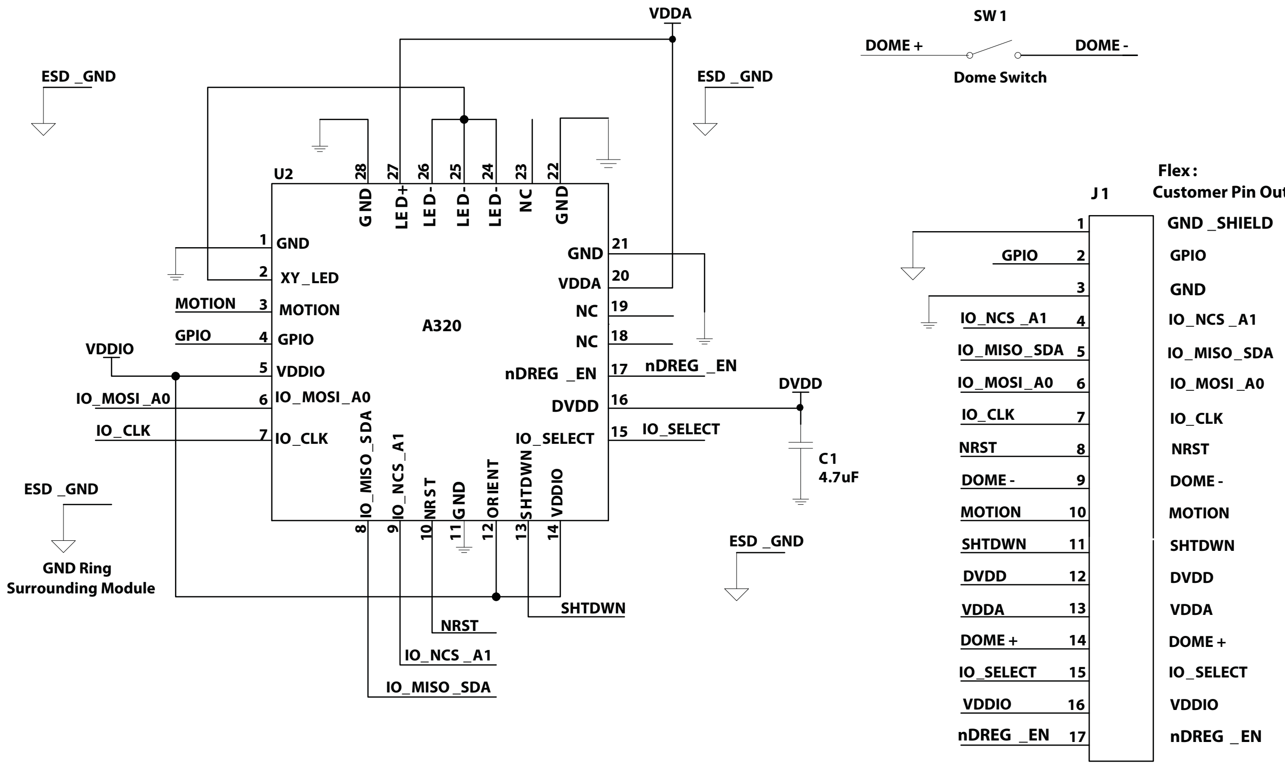
Figure 32. Illumination design top view

Summary

This Application Note has discussed various mechanical design considerations that are useful when designing using Avago Technologies Optical Finger Navigation. Due to the flexibility of the design, customers can implement any design according to their own specification giving rise to flexibility, customization and ease of design.

Appendix A

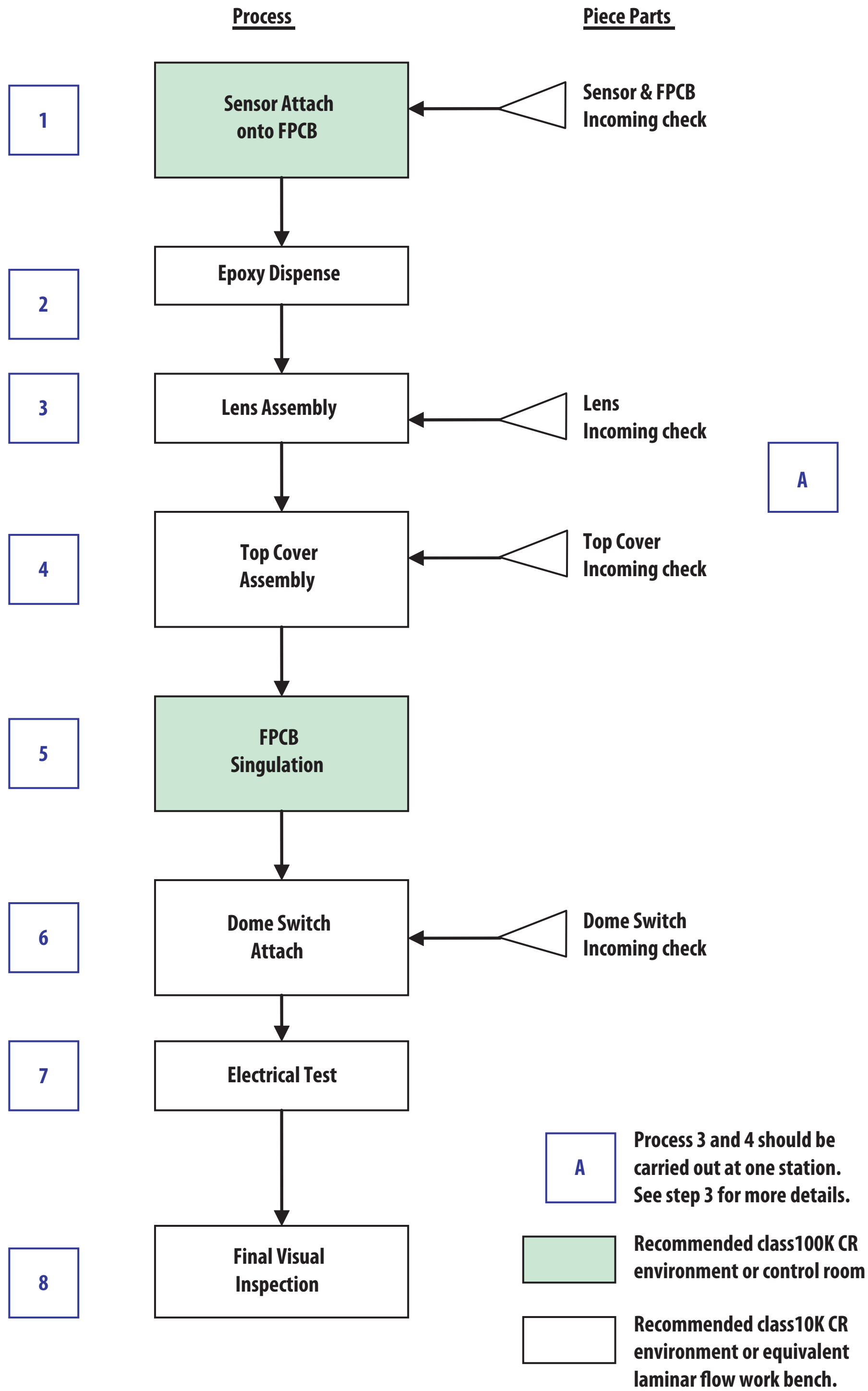
Example of FPC Schematic for A320



Appendix B – Assembly Guide

This appendix shows the A3x0 assembly and inspection guidelines.

Below is the assembly process flow.



1. Sensor Attach Process

1.1. Incoming sensor check. Refer sample criteria 'A'.

1.2. Avago sensor ADBS-A3x0 will be delivered in Tape & Reel (T&R) packaging.

1.3. Screen print solder paste onto FPCB pads. Recommended stencil design: for a nominal standoff of 0.1mm, the stencil thickness should be 5 to 8mils. Stencil aperture should be 1:1 to PCB pad sizes.

1.4. Pick and place sensor onto FPCB pads.

1.4.1. Vacuum suction cup is recommended to be used to pick up the sensor by touching the Kapton tape surface.

1.4.2. Sensor orientation to be checked by machine visual system before it is placed onto the FPC.

1.5. Perform reflow soldering process:

1.5.1. Reflow profile and peak temperature have a strong influence on void formation. Typical reflow profile consists of four sections.

1.5.2. Assembly should be preheated at the rate of 2 to 3°C/sec to start the solvent evaporation and to avoid thermal shock in preheat section.

1.5.3. Assembly should then be thermally soaked for 60 to 120 seconds to remove solder paste volatiles and for activation of flux.

1.5.4. In reflow section, the time above liquidus should be between 30 to 60 seconds with a peak temperature.

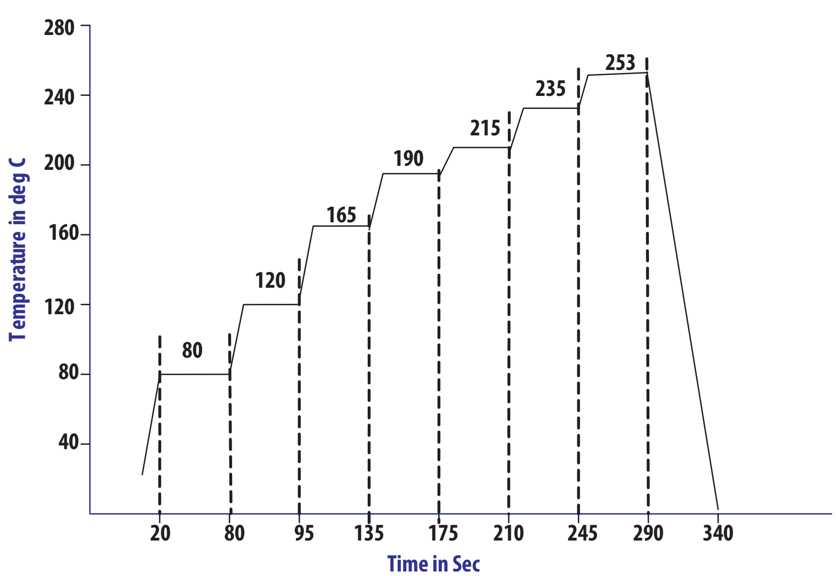
1.5.5. Finally, the assembly should undergo cool down in the fourth section of the profile.

1.5.6. Actual profile parameters depend upon the solder paste used and recommendations from paste manufacturers should be followed.

1.5.7. Example of Reflow process window using Pb- free solder paste LF310:

Profiling information

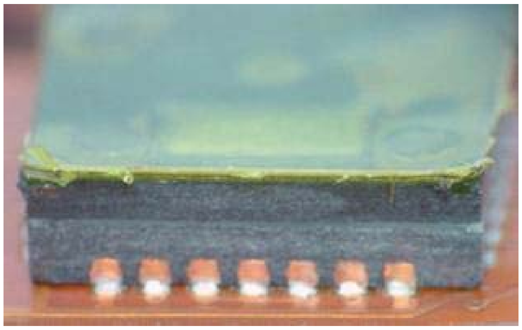
Max rising slope	max 3°C/sec
Preheat time 150–200°C	60 – 90 sec
Time above Reflow (220 to 245°C)	50 – 100 sec
Peak Temperature	225 – 260°C



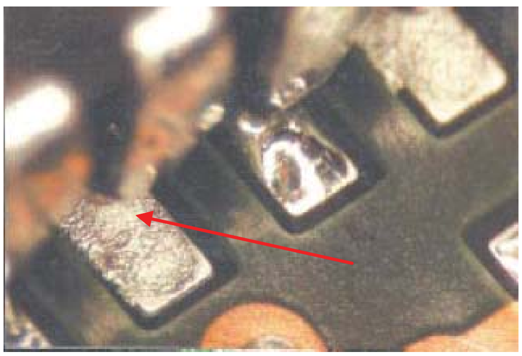
Examples of Pb-free reflow cycle & profile

1.6. Examples of some inspection criteria after reflow under 10x microscope:

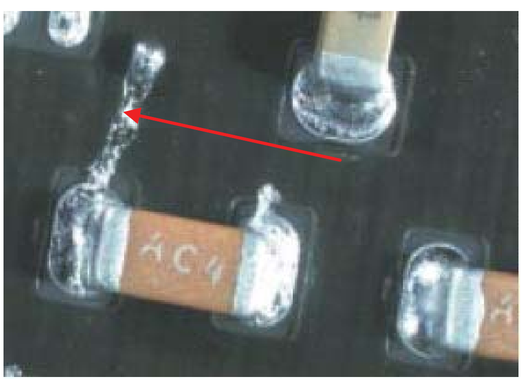
1.6.1. Example of good solder joint below:



1.6.2. Example of incomplete reflow of solder paste below:

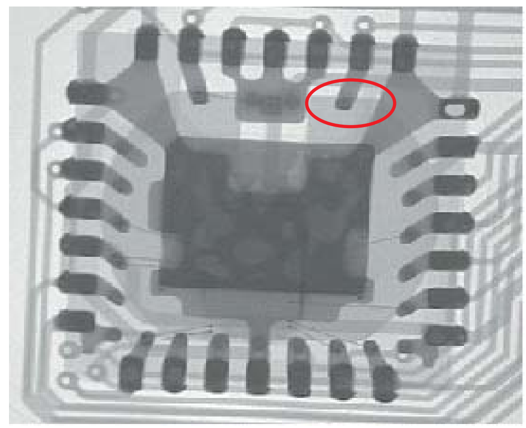


1.6.3. Example of reject below because of solder splash/webbing



1.6.4. Example of reject below with fractured or cracked solder

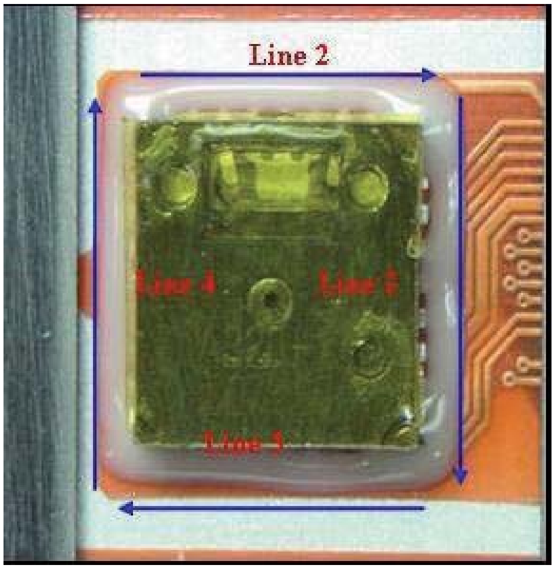
1.6.5. Reject if >25% void in ball x-ray image area below:



2. Epoxy Dispense Process

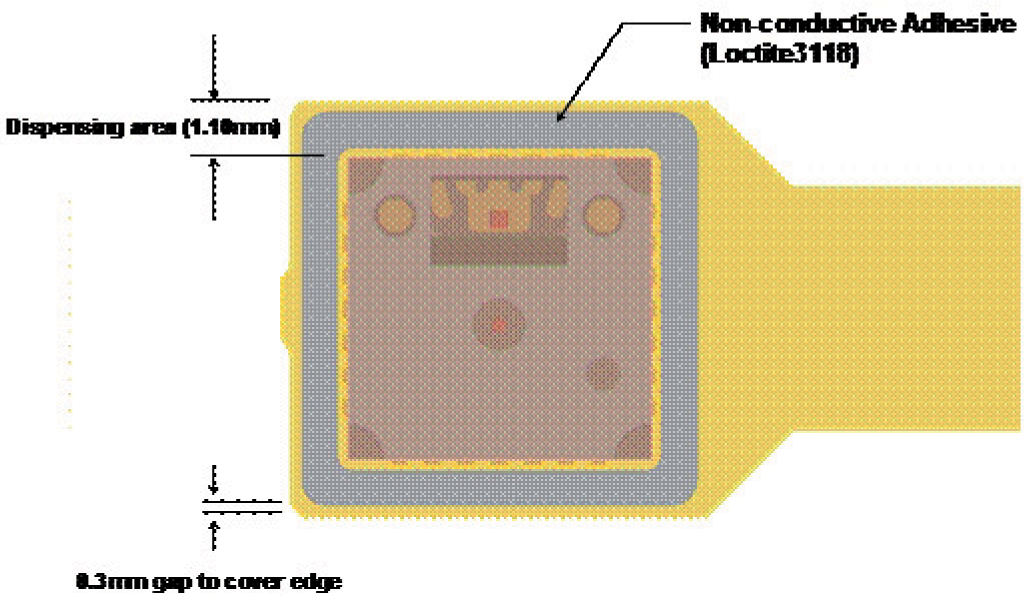
2.1. Dispense non-conductive epoxy on the FPCB around 4 sides of sensor.

2.2. Ensure full epoxy coverage on all 4 sides show below.



View after dispensing glue on the FPC

2.3. The amount of epoxy dispensed should be optimized such that overflow of epoxy outside of top cover is controlled after top cover assembly. Recommended guidelines are shown below:



2.4. Avago uses Loctite 3118 epoxy for its ADBM-A3x0 module samples. Customers are advised to select epoxy of their choice depending on the type of FPCB materials and any special qualification requirements.

3. Lens Assembly Process

NOTE :- Process 3 Lens assembly process and Process 4 Top cover assembly process should be carried out at one station by one operator without interruption. The total process duration depends on inspection process and jigs used but the time should be kept as short as possible. This is to minimize contamination from entering the sensor, lens and top cover.

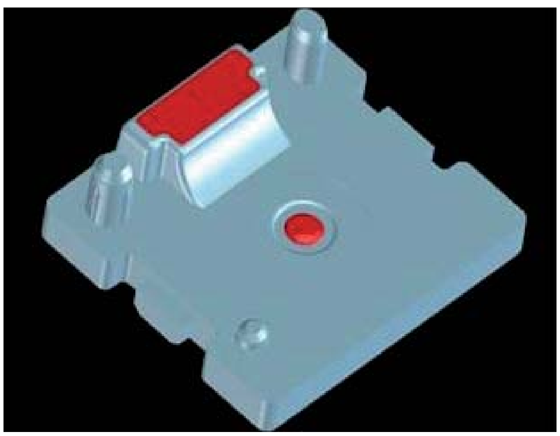
3.1. Operators are required to wear finger cots or glove and ESD wrist strap in a class 10K clean room environment during all manual assembly process.

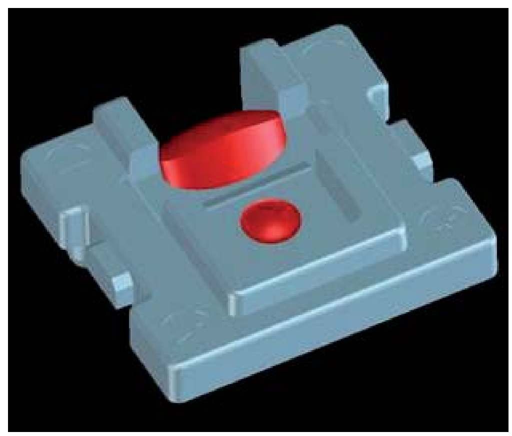
3.2. Remove Kapton tape from one of the sensor corners using a pair of tweezers as shown by the red circles below. The ADBS-A3x0 sensor has steps at the 4 corners to facilitate Kapton tape peeling. Make sure the sensor/FPCB assembled parts are well supported during peeling.

3.3. Immediately after Kapton tape peeling, proceed to lens attach process to avoid particles contamination on the sensor.

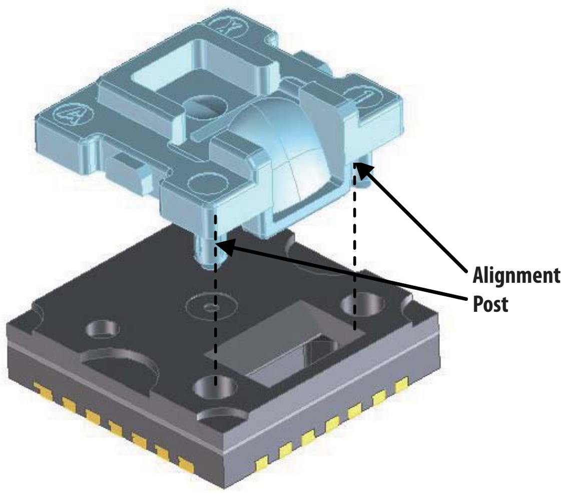
3.4. Lens (ADBL-A321) is shipped in hard tray of 100 units per tray (10x10 cavity) shown below. The lens can shift in orientation on the horizontally in the cavity but will not flip up side down. Customized hard trays solution with fixed lens orientation is available at a slight cost adder.

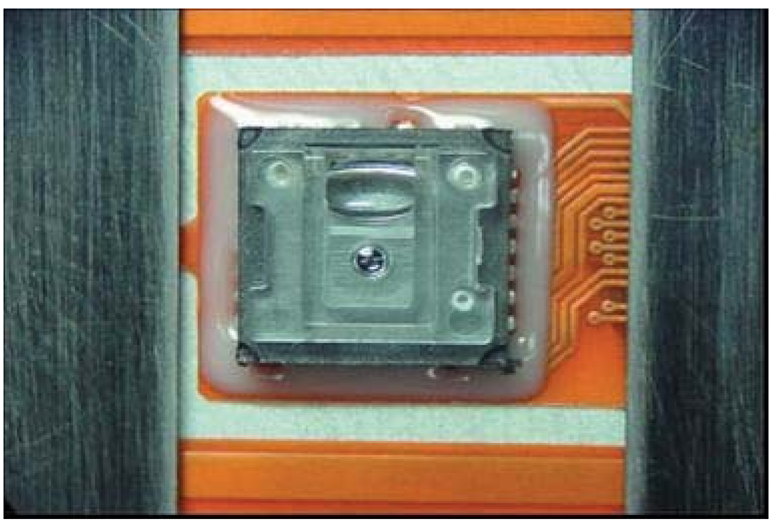
3.5. Lens assembly should be done immediately after the epoxy dispense process to minimize contamination. Pick up a lens (ADBL-A321) at the sides using a pair of tweezers from the hard tray shown below. Avoid touching the optical surfaces on the lens as highlighted in red color below. It is recommended to use CDA air blow system to clean the lens before assembly to minimize particle contamination. Recommended inspection specification for lens is "no non-removable particle and no visible scratches are allowable on the optical surfaces under 10x magnification microscope.





3.6. Place the lens onto the sensor and press down. Apply force ranging between 1kgf to 2kgf +/-0.20kgf. Care must be taken to avoid contamination or staining the lens. The lens piece has two alignment posts which will mate with the alignment holes on the sensor package with an interference fit. A jig can be employed for press fitting in high volume manufacturing.





View after completing lens assembly

4. Top Cover Assembly Process

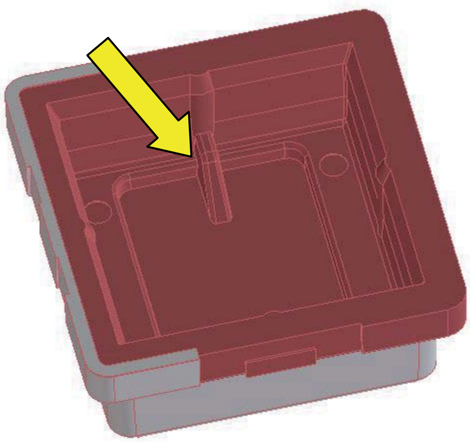
NOTE :- Process 3 Lens assembly process and Process 4 Top cover assembly process should be carried out at one station by one operator without interruption. The total process duration depends on inspection process and jigs used but the time should be kept as short as possible. This is to minimize contamination from entering the sensor, lens and top cover.

4.1. Top cover assembly should be done immediately after the lens is attached onto the sensor. This is to minimize the possibility of particle contamination to lens and sensor. Ensure that the top cover is cleaned with air blow to clear all dust particles.

4.2. Pick up the top cover by the sides using tweezers. Avoid touching the navigation window to minimize chances of scratching the navigation window.

4.3. Place and secure the top cover onto the lens to ensure the sensor and lens components are always interlocked to the correct vertical height.

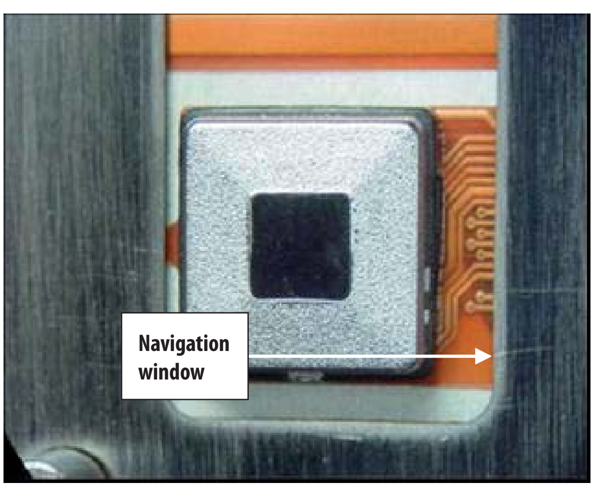
4.4. Recommended to have Poke yoke features for the top cover design to guide the top cover assembly onto lens. An example is shown below with non-symmetrical step within the top cover.



4.5. Recommended to use a fixture to clamp on the top cover to control the module z-height dimension.

4.6. Proceed to cure the assembled modules together with the clamp fixture.

4.7. Curing temperature will depend of type of epoxy used. In Avago ADBM-A3x0 module samples where Loctite 3118 is used, curing is done with 80±5°C for 30 minutes.



View after complete top cover attach

5. FPCB Singulation Process

5.1. Where applicable, singulate the modules into individual units from the FPCB panels using a cutter.

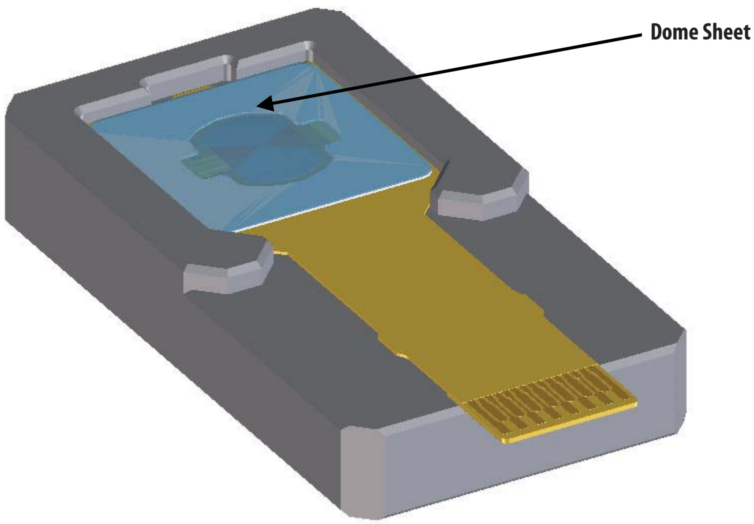
5.2. The cutting process and cutter design depends very much on the FPCB panel design.

6. Dome Switch Attach Process

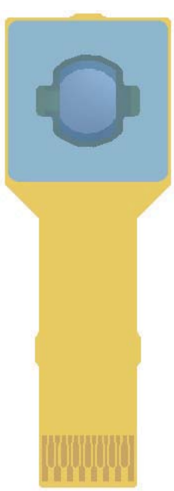
6.1. Peel a dome switch sheet from its panel with a pair of tweezers.

6.2. Place the sticky side of the sheet onto the bottom side of FPCB, directly below the top cover/ lens/sensor assembly.

6.3. When attaching the dome switch, match the mylar outline to the FPCB outline.
Recommended to use a fixture to guide the outline of the FPCB during metal dome sheet attach as shown below.



6.4. As a general guideline, maximum offset of dome switch to actuator to be 0.3mm. Actual alignment depends upon the metal dome manufacturer and recommendations from manufacturers should be followed.



View after complete Dome Switch attach

7. Electrical Test

7.1. For module level test, FPCB pinout to sensor connectivity test is recommended.

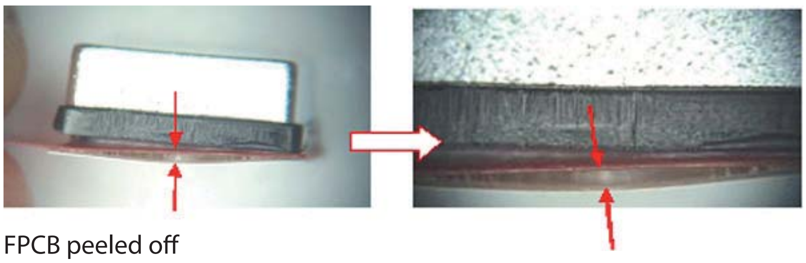
8. Final Visual Inspection Process

8.1. Perform final visual inspection on individual modules under 10x magnification microscope.

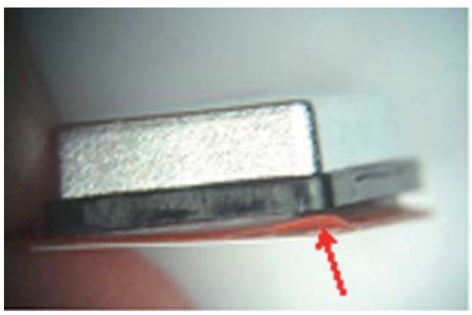
8.2. Measure or use "go/no go" jig to make sure critical outline dimensions are within specifications. Module Z-height is typically a critical outline dimension.

8.3. Some examples of visual inspection reject criteria:

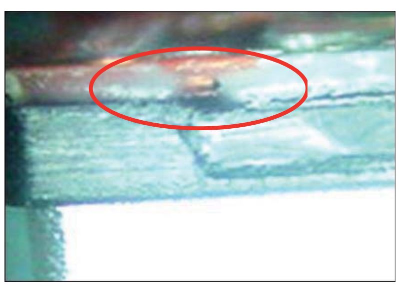
8.3.1. Dome Switch peeled off



8.3.2. FPCB peeled off

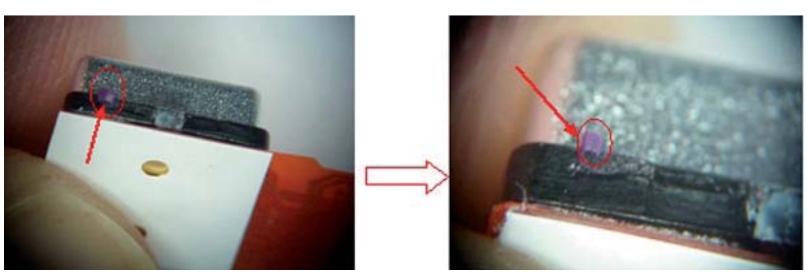


8.3.3. Epoxy void with see through air hole



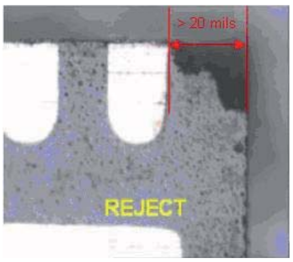
8.3.4. Top cover tilt

8.3.5. Serious scratches on top cover package and navigation window.

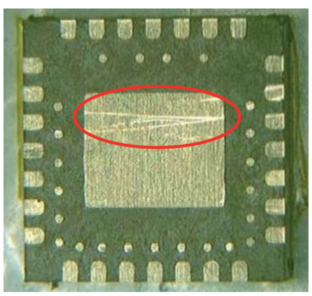


Appendix C – Sensor Inspection Guides

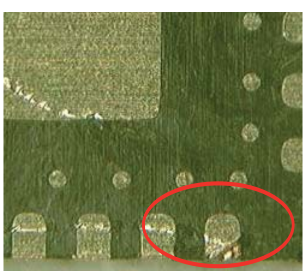
1. Sensor inspection can be done on a sampling basis as an incoming check. Finger cot & ESD wrist strap should be worn. Pick up the sensors with tweezers by the sizes and inspect under 10x magnification microscope.
2. Examples of sensor inspection criteria are shown next.
3. Reject any chip out on the package surface that exposes die, wire, base material or reject any package chip > 20 mils or having exposed lead surface.



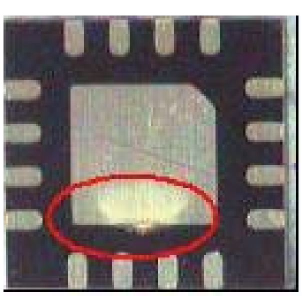
4. Reject any scratch with exposed copper on lead or if exposed copper L > 30 mils, W > 30 mils on Pad.



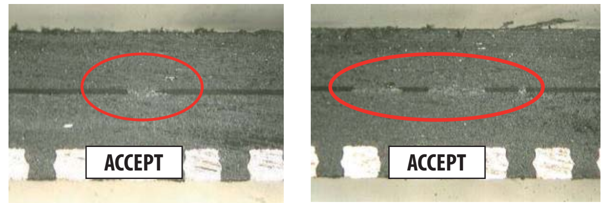
5. Reject any broken / missing lead or any sign of cracking on leads.



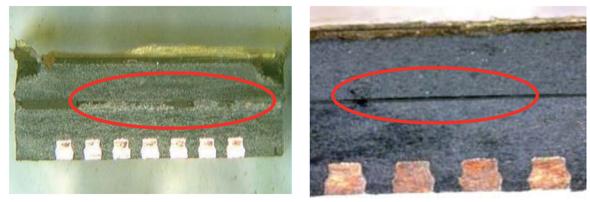
6. Reject any contamination or foreign material on lead or on pad > 40 sq.mils



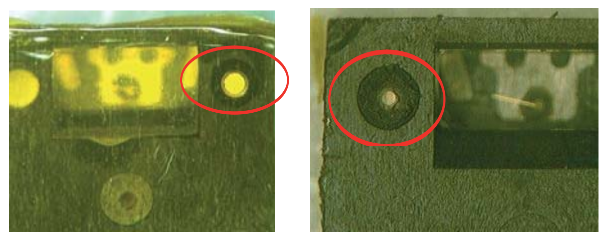
7. Accept multiple epoxy void (surface only, non-see through) L < 2.0 mm (1/3 of package length)



8. Reject any epoxy separation between leadframe and lid attach.

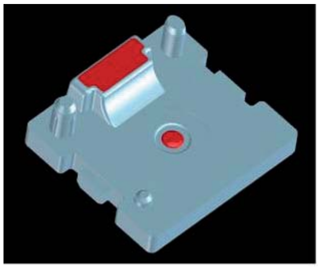


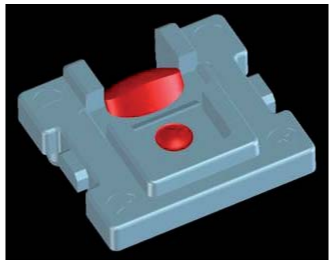
9. Reject Any Epoxy bleeding on the hole of lid cover.



Appendix D – Lens Inspection Guides

1. Inspect lens under 10x magnification microscope
2. No non-removable particle and no visible scratches are allowable on the optical surfaces shaded red below.





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AV02-2654EN - September 27, 2010