eMagin Corporation

MICRODISPLAY INTEGRATION & HANDLING GUIDELINES

Revision -

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-	001313	07-28-2022	Initial Release – Supersedes and obsoletes Doc # D01-500727-01(Files in Arena)

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1. INTRODUCTION

This document provides guidelines and recommendation for integrating eMagin Corporation's OLED microdisplays into a viewing subsystem.

2. MOUNTING LOCATIONS

The microdisplay assembly has been designed to provide a minimalist mechanical envelope. As a result, it is devoid of mounting holes.

In a typical installation, the microdisplay is mounted in a frame whose opening is slightly less than the area provided by the cover glass. No adhesive should be used between the cover glass and the frame in order to avoid any seepage extending over the display active area.

The display assembly is typically attached to the frame from the rear side (component side of the circuit board assembly) using either a retaining mechanism or, as in most applications, an adhesive.

Contacting the printed circuit board is acceptable
Contacting the edges of the silicon die is acceptable. However, the bulk of the silicon die is a ground potential. If a metal housing is being considered, precautions must be taken to avoid a potential short or low electrical resistance contact to the silicon die edges.

3. KEEP-OUT AREAS

The microdisplay has defined areas that should **not** be brought in contact with a mounting frame or any other hardware. They are defined by the exposed surface of the silicon as shown below in Figure

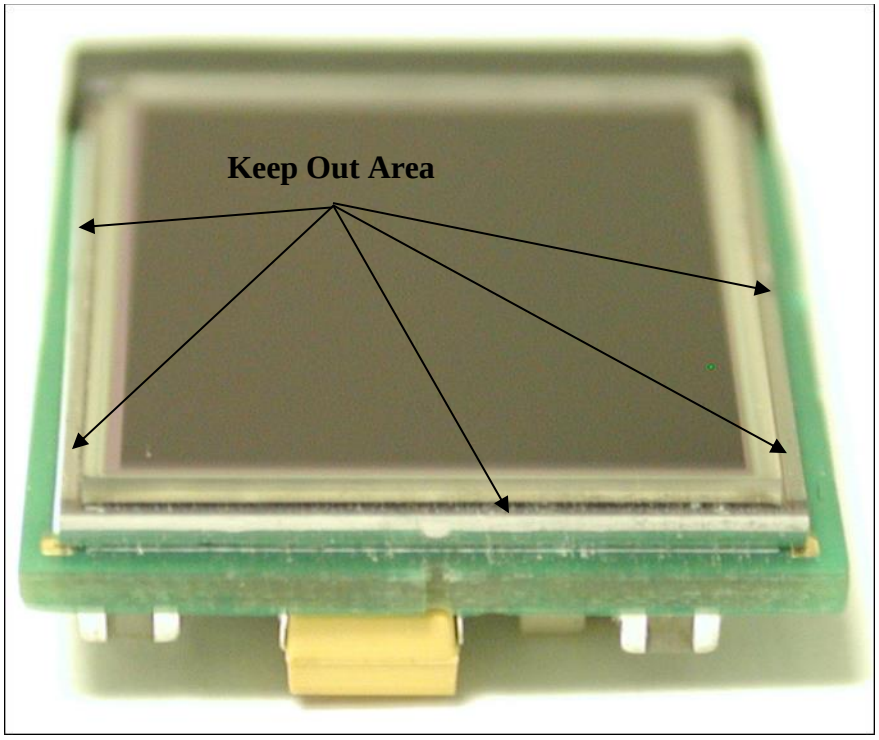

Figure 1: Keep-out Areas

4. ADHESIVES

A variety of adhesives can be used to attach the microdisplay assembly to a supporting frame.

4.1 UV-Cured adhesives

In general, UV-cured adhesives are to be avoided if the curing light will shine on the display cover glass. A "Blue Light" adhesive or similar (wavelength >400 nm) may be used on the rear side of the display assembly as shown in Figure 2 below (eMagin SVGA+ Display on the eMagin WF05 lens bracket)

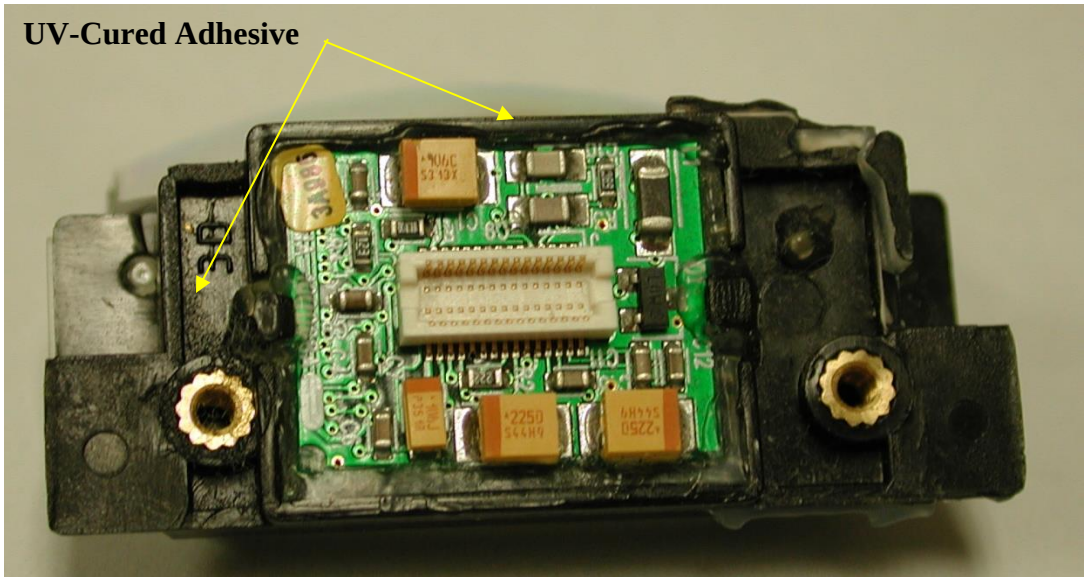

Figure 2: SVGA+ and WF05 Bracket

4.2 Thermally cured adhesives

Any thermally cured adhesive is acceptable so long as its curing temperature remains no higher than 100°C
When selecting a thermally cured adhesive, attention must be paid to the coefficients of thermal expansion of all materials that will come into contact:

- printed circuit board (Fiberglass FR-4 material)
- Bracket (plastic or metal)
- Adhesive itself

Depending on the operating temperature range, some materials may not be suitable. This is application dependent and no specific recommendation can be made in this document.

As a rule, the adhesive connecting the printed circuit card to the frame should have no contact with the silicon die.

4.3 Room Temperature Cured Adhesives

Adhesives such as cyano-acrylates (also commonly known as “crazy glue”) are acceptable but their very short curing time does not provide much margin for alignment (might not be suitable for extreme humidity environments).
Caution must be taken with the “Blooming effect” of cyano-acrylate adhesives. Blooming effect (white cloudy spots” could manifest itself in places where finger contact is made or in the presence of moisture

Urethane based materials are an acceptable choice.

4.4 Silicone-based Adhesives

RTV materials are a suitable choice for attaching a display assembly to a frame. Care must be taken to select materials with low outgassing properties or ensure that the adhesive will remain outside any optical cavity.

4.5 Mounting Frame / Bracket

The display mounting frame can be either plastic or metal. eMagin Corporation recommends the use of plastic (Ultem or polycarbonate for example) over metal in order to reduce the risk of damaging the display.

The frame will typically be used as a mechanical alignment reference and limits the lateral movements of the display at the silicon die level (3 sides for most eMagin Corporation products).

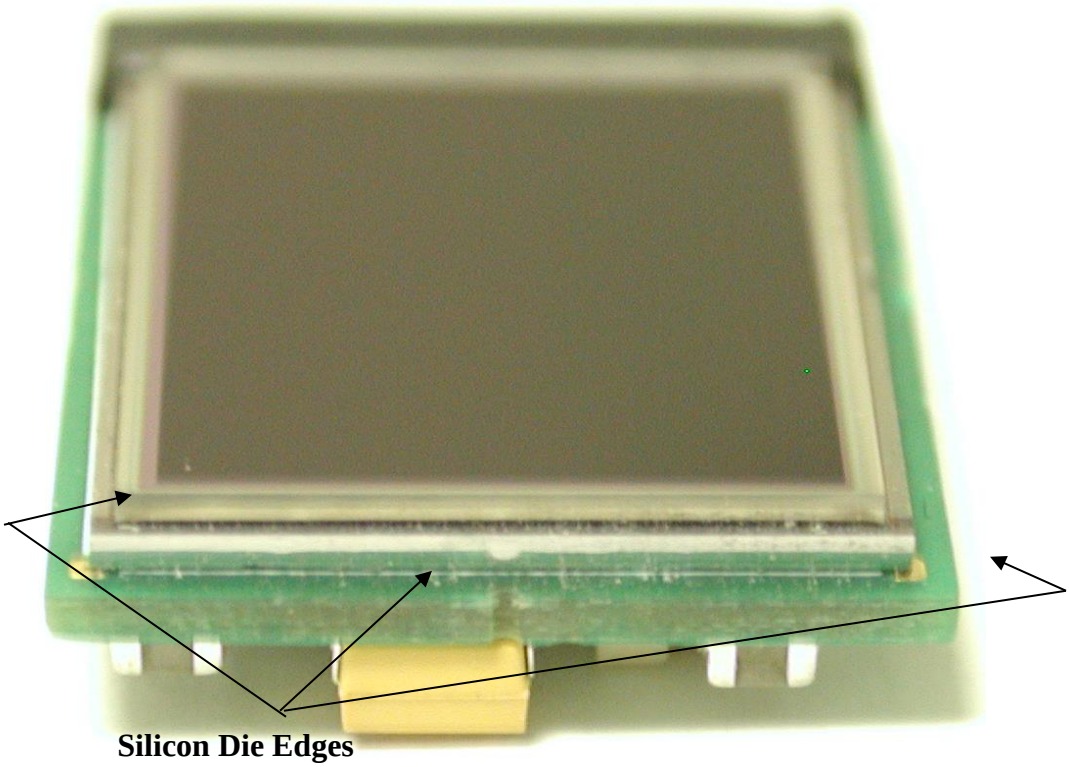

Figure 3 Lateral contact area for mounting frame

The frame should extend over the cover glass while staying outside the viewing area to provide a vertical assembly constraint.
eMagin Corporation recommends that only the top of the cover glass be used for this vertical (z-axis) mechanical reference. In other words, the top surface of the printed circuit board should not be used for the same purpose to avoid a possible interference or tolerance issue.
From an assembly standpoint, the design of the display frame and its attachment to the display assembly needs to take into consideration the differential stresses that can result. In particular, attention must be paid to avoid a situation that would result in bending the assembly. Whatever clamping approach is used, it needs to result in a uniform stress distribution between the cover glass and the rear side of the microdisplay assembly.

Furthermore, eMagin Corporation recommends that no pressure be applied to the wirebond encapsulant. By design, the top of the wirebond encapsulant lies below the plane defined by the top of the cover glass, thereby eliminating a potential risk.

Figure 4 shows a typical eMagin Corporation microdisplay assembly side view.

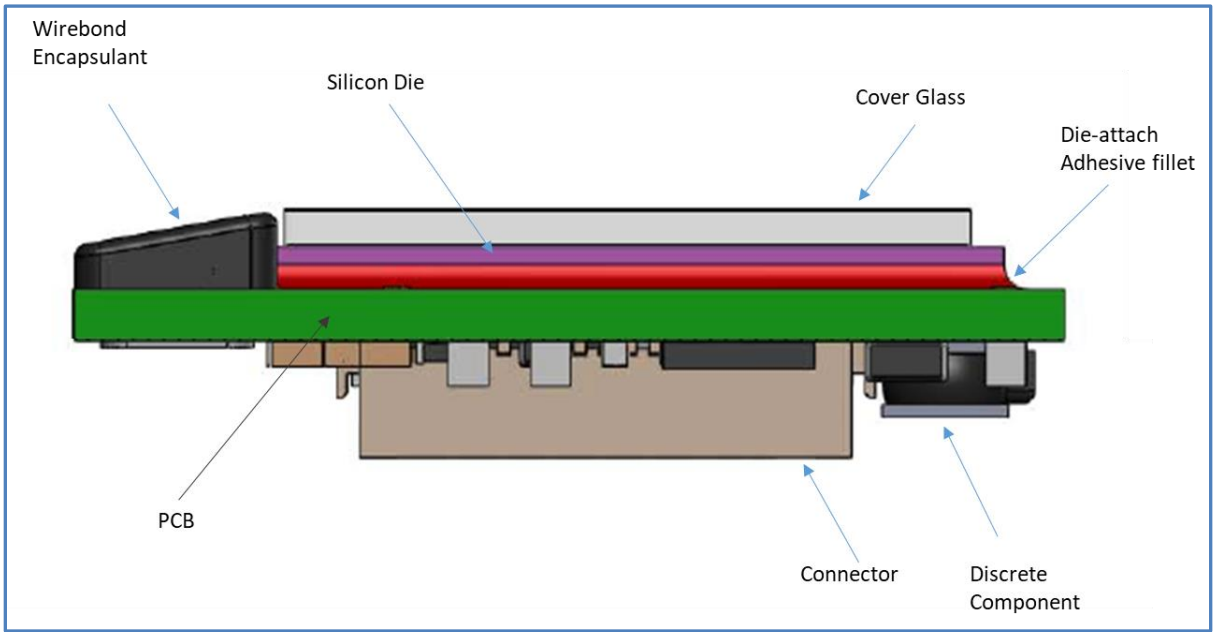

Figure 4: Microdisplay Side View

Figure 2 shows a typical housing implementation with an eMagin Corporation VGA microdisplay. This is a simplified configuration aimed at providing perspective, eMagin Corporation typically does not design/manufacture housings for microdisplays because they are very application specific.

In this example, the housing outside shape is circular and intended for eyepiece integration.

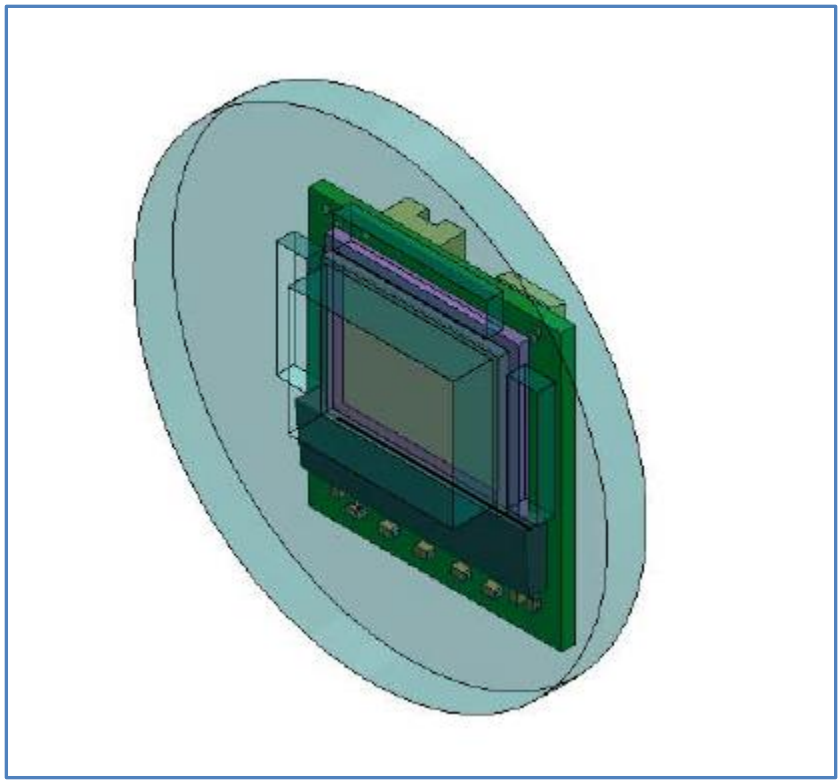

Figure 5: Example VGA Microdisplay Housing

Figure 6 shows side views highlighting the edge and vertical stops built into the plastic housing. The open window exposing the display active area is narrower than the display cover glass and rests on it, providing a precise vertical reference (± 10 µm) to the image plane.

The edge stops allow the housing to use the vertical edges of the silicon die to position the microdisplay in the x/y plane. The tolerance from the edge of the die to the pixel array is on the order of 10 µm.

The microdisplay is then potted in place using, for example, an RTV type adhesive.

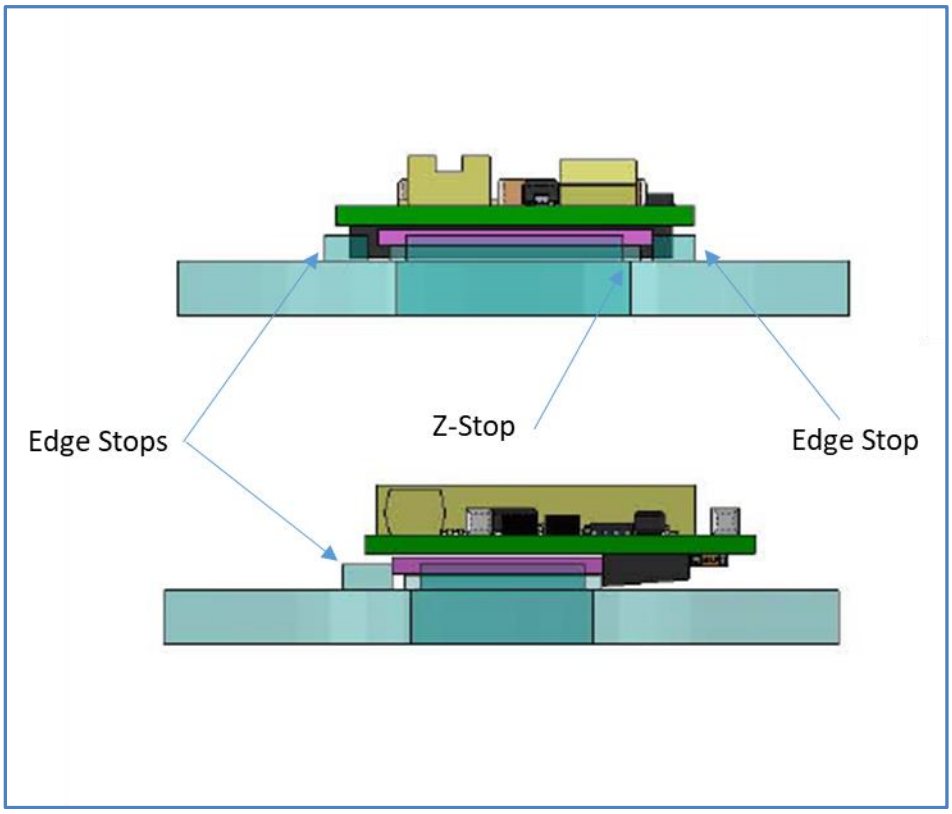

Figure 6 Housing edge and vertical stops

4.6 Mechanical References

There are several possibilities to reference the display active area with respect to the mounting frame: silicon edge, circuit board edge, display assembly connector.

As a rule, eMagin Corporation strongly recommends to avoid using the cover glass edges as a mechanical reference. Primarily because of the risk to have contact with the top side of the silicon die (which is to be avoided).

From a precision standpoint, the best reference is the silicon die edge. The typical tolerance on the active area to die edge distance is 10 microns.

Referencing the circuit board is far less accurate in that the printed circuit board size tolerance is typically ±0.2 to ±0.3 mm

Using the connector as a mechanical reference is not recommended because the component assembly process has a large placement tolerance (no better than ±0.3 mm) in either axis.

4.7 Thermal Management

A few of eMagin Corporation microdisplay products have been designed with thermal pickup tabs on the top side of the display assembly carrier board (SXGA096, WUXGA, and 2K x 2K). The pads are gold plated traces that are connected to a large copper bad onto which the silicon die is mounted. The pads are at electrical ground, and devoid of solder mask to facilitate heat transfer.

For applications where thermal management is required, a thermally conductive housing design can take advantage of these thermal pads to provide passive (or active) cooling to the microdisplay silicon die.

Figure 7 shows where the thermal pickup areas of the eMagin Corporation WUXGA microdisplay are.

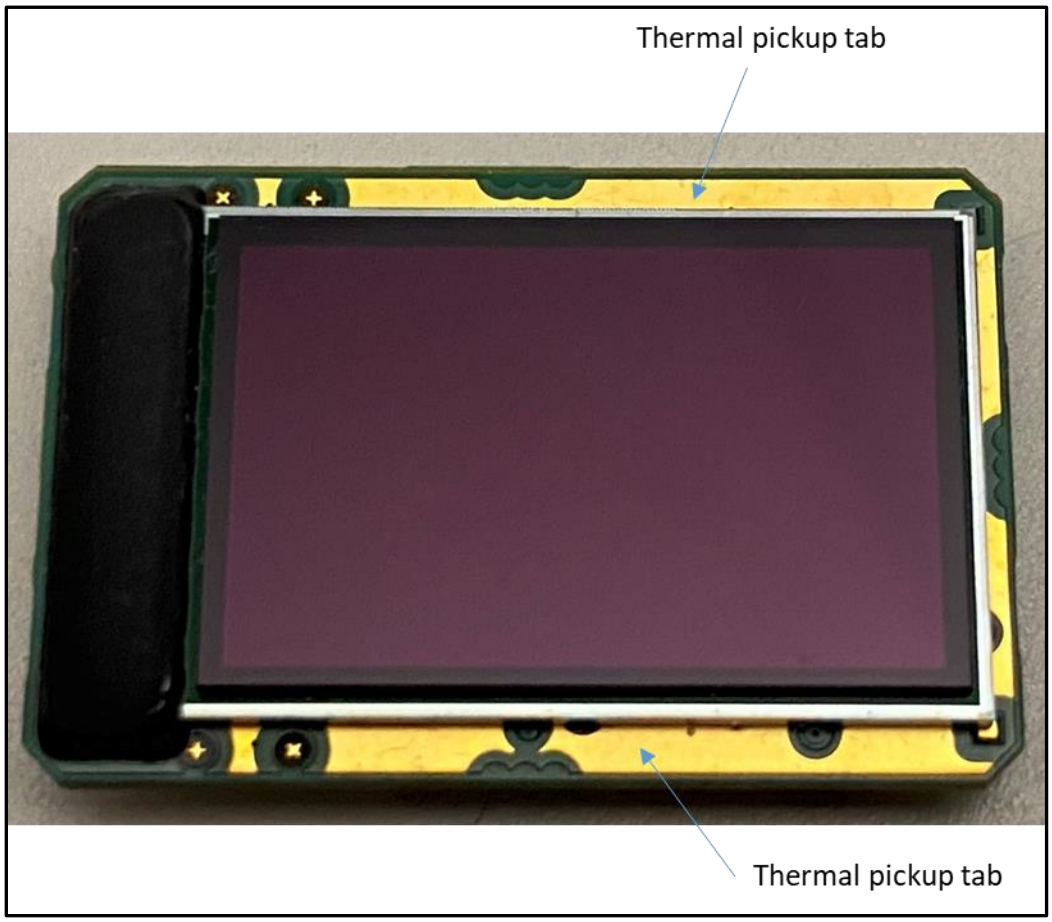

Figure 7: WUXGA Microdisplay thermal pickup areas

5. CLEANING, HANDLING AND STORAGE CONDITIONS

5.1 Cleaning

When cleaning the displays we recommend the use of TECH-SPEC lens cleaner, manufactured by Edmund Optics Inc. and Alpha wipes 1010

5.2 General handling considerations

• Do not expose the display to strong acids, bases, or solvents.
• Do not expose the display surface to UV or other strong ionizing radiation
• Temperatures in excess of the specified operating and storage range can cause irreversible damage to the display.
• Do not allow sharp objects to contact the exposed regions of the silicon display chip.
• Avoid immersion of the display in any liquid.
• The glass cover slip protects the display surface from most forms of damage and may be cleaned using techniques appropriate for fine lenses.
• Avoid applying force to the glass relative to the display chip in compressive, tensile, and sheer directions.

Fig. 3 Best method of handling the displays

Fig. 4 Avoid this method of display handling

5.3 Static Charge Prevention

The microdisplay is sensitive to electro-static discharge damage. The following measures are recommended to minimize ESD occurrences:
• When handling the microdisplay, operated under a flow of ionized air to discharge the panel
• Use a conductive wrist strap connected to earth ground via a 10 M-Ohm resistor.
• Wear non-chargeable clothes
• Keep stored displays away from charged materials

5.4 Protection from Dust and Dirt

It is also recommended that all display handling operations take place in a clean environment. The use of ionized nitrogen gas is the preferred method of removing particles from the surface.

5.5 Short Term Storage

For short term storage (one to two weeks or less), the displays should be kept in their original container at room ambient and the typical controlled office environment.

5.6 Long Term Storage

For displays that will be stored for a longer period (a few weeks and up), it is recommended to keep displays stored in a dry environment near or at room ambient (20ºC typically) whenever possible prior to installation into an optical subsystem.

There are several ways to achieve this:
- Dry storage cabinet
- Dry Nitrogen cabinet
- Nitrogen sealed bag
- Vacuum sealed bag with desiccant