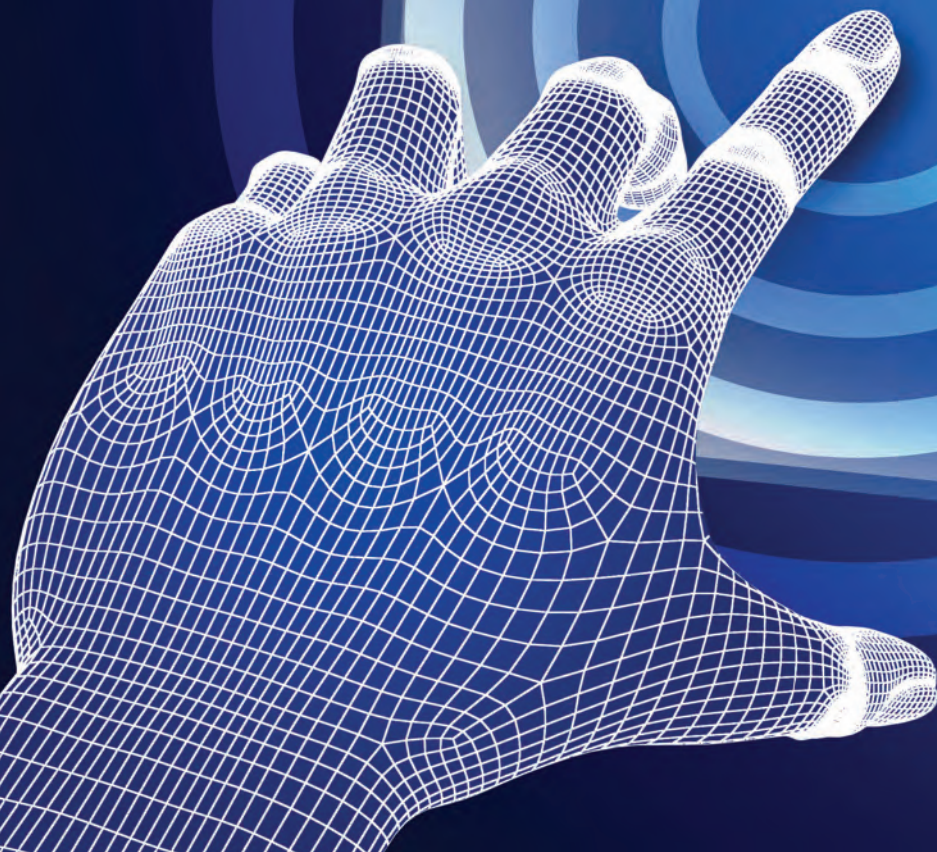




DISPLAY TECHNOLOGY
A FORTEC GROUP MEMBER

VACUBOND FAQ'S

EMPOWERING DISPLAY TECHNOLOGY





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VacuBond Optical Bonding FAQ's



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VacuBond Optical Bonding FAQ's



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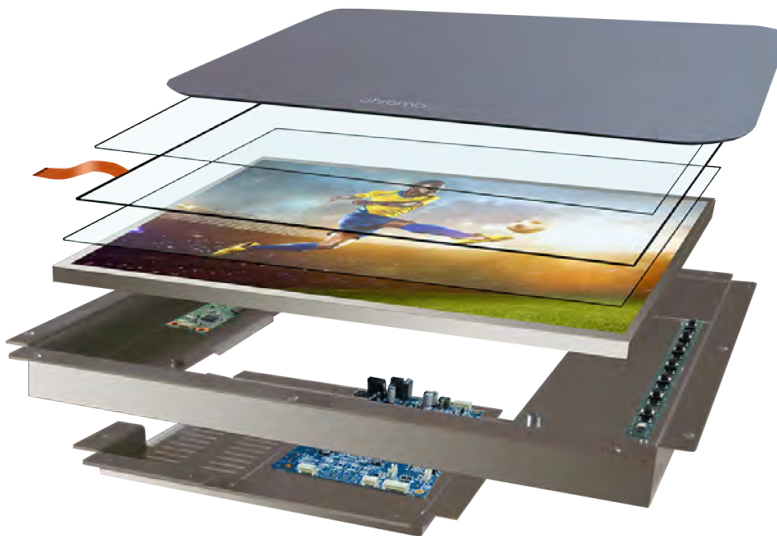
1. What is optical bonding?

Optical Bonding involves bonding a cover glass or touch screen to an LCD cell. An adhesive, such as silicone gel, epoxy or urethane, is used to eliminate air gaps by inserting it between the cover glass and the LCD. Although different adhesives can be used within the optical bonding process, we here at Display Technology use a high-performance silicone Opto a-Gel to achieve the best results.

2. What are the different methods of optical bonding?

Traditionally LOCA (Liquid Optically Clear Adhesive), or 'wet bonding' pioneered the process, but there are downside to this method, as the only chance for rework is prior to the curing the process, curing is a lengthy period often taking days and the process is labour intensive due to the requirement to create a 'dam' for the wet silicone.

The second process is Dry Bonding. To meet the high volume, high consistency requirements of tablet and smart phone bonding, the process of dry bonding was developed. This process is the vacuum application of a silicone sheet between the layers. This allows for multiple displays to be bonded quickly and simultaneously via a multi cavity Jig, and eliminates the downsides seen when wet bonding.



Branded as our VacuBond service, the dry bonding method is used at Display Technology Ltd.



3. Why choose Display Technology Ltd for Optical Bonding?

It is important to choose the right company to complete your Optical Bonding process, to ensure that your individual requirements are met with perfection. There are many reasons to choose Display Technology, including our wealth of experience and expertise with applying Optical Bonding to devices in-house. We operate in fantastic facilities and clean environments to ensure that the process is completed to the highest possible standard and we are also able to provide a sample of the finished product so you can see the quality for yourself. With more than 15 years of experience within the industry, we are perfectly placed to provide a fantastic service to you and to meet all of your Optical Bonding and display requirements.

4. Where does VacuBond Optical Bonding take place?

We currently have production facilities in both Germany and America, and due to such high demand for the excellent bonding service that we provide, we are set to open further facilities in the Czech Republic and Ronkonkoma, New York. All our optical bonding takes place in a clean room environment to ensure quality.

5. What types of display can be bonded?

The majority of displays can be bonded, but it is critical that both front surface of the LCD and rear surface of the filter is flat. Display Technology Ltd also undertakes a test which determines the adhesion angle of each material layer.

6. Which touch sensor technologies can be Optically Bonded to LCDs? Can I bond any other kind of glass?

All different touch technologies can be used with Optical Bonding including resistive and projective capacitive types. Our expertise integrating touch screens optimises sensitivity and performance, even in demanding assemblies. All kinds of glass can be optically bonded, as well as a wide range of chemically stable plastics.



7. What's the minimum/maximum sized display which can be optically bonded?

The VacuBond process can bond the smallest displays (currently our smallest LCD offering is 2.2") up to 32" diagonal.

8. Is Free Air Exclusion Bonding/Void Exclusion Bonding possible for Explosion Protected Areas?

With VacuBond free air exclusion bonding it is possible to fill air spaces within the display itself. The benefits of this are Explosion Protection, Prevents the ignition of explosive atmospheres (IEC60079) and the limitation of explosion effects (Constructional Explosion Protection – to $<10\text{cm}^3$ for highest ATEX certifications).

9. Which industries is optical bonding most suited to?

Typically in applications where a higher performing display is required. These include displays which are used in high reliability environments where a rugged display is required and applications where displays need to be viewable in high ambient light conditions. The process of optical bonding is particularly suited, and much more effective, when applied to devices that may operate outdoors or in heavily lighted conditions.

Although not limiting, main markets sectors that bonding is popular with include military, marine, kiosk, transportation and medical.





10. What are the benefits of Optical Bonding?

- a) Optical clarity is increased – Optical Bonding eliminates the internal reflection created by a cover glass, creating a single index of refraction instead. Eliminating the internal reflection means that the brightness can be improved and the image can be crisp and detailed, with increased contrast and a reduction in glare.
- b) Reduction of parallax issues – Optical Bonding helps to reduce parallax issues, where any gap between the LCD display and the cover glass would create the effect that, depending on your position, pixels shift position. This means that the touch alignment is much more precise in interactive systems and the display can also be viewed from many different angles.
- c) Zero contamination of moisture and dust – Optical Bonding protects the display screen from moisture and dust, particularly when in humid environments, due to the fact that condensation isn't able to form between the display and the cover glass.
- d) Scratch and damage resistance – Optically bonding cover glass to the LCD display provides a protective layer and improves the durability of the display. This process helps to protect against scratches and dirt on the screen, allowing for high usage in public environments and minimising the need for extra protective accessories. Using optical bonding as an alternative to other methods of adding a cover glass means that there is no added depth to the display, which allows for easy integration and installation.

11. How does Optical Bonding compare to using a brighter LCD?

Optical bonding works by removing the optical effects that reduce visibility, such as ambient light reflection, image refraction and display fogging. This means that the original display quality is maintained in all conditions. Increasing the backlight power on the other hand will improve the display brightness but will also affect the visible colour range and the image contrast. High bright displays also use more electricity and generate more heat.



12. Will the Optical Bonding process have an impact on the operating temperature range of a display?

The operating temperature range of the display will not be changed as the bonding does not affect the components of the display, only the surface. Our head office, based in Munich, has specialist industrial heating cabinets, meaning that we can undertake experiments based on the temperature requirements that you may have.

13. How does Optical Bonding affect the heat management of my Display?

LCDs emit a large amount of heat from the display surface to maintain their operating temperature by air convection and direct radiation. Mounting a cover glass reflects the heat back onto the display and traps the increasingly hot air, quickly causing overheating. Optical Bonding the display eliminates the insulating airgap, reduces reflected heat and conducts heat away from the LCD to the glass surface.

14. Is there a cosmetic spec for particle contamination within the bonded layer?

Many optical bonding suppliers work on cosmetic spec which would allow for a certain number of particles, of a certain size for a bonded unit to pass quality control. At DTL we work on zero visible particle contamination. This is zero when held at arm's length and checked in normal office lighting conditions.

15. Will the displays become yellow after being exposed to UV light?

As we use silicone for our Optical Bonding process here at Display Technology, the displays will not turn yellow after exposure to UV light.



16. Does optical bonding help to IP rate a unit?

In theory the IP rating is based on the seal from the housing to the cover glass / touch so has no direct impact on IP approval compared to standard strip bonding, however removing the void from between the cover glass and LCD will improve anti-fogging.

17. Is the process reversible?

The process is absolutely reversible with dry bonding and unlike traditional wet bonding this process can be reversed throughout the life of the product as there is no curing requirement for the VacuBond process.

18. How much does it cost?

The price for our Optical Bonding service is dependent upon the size of the display, the number of displays being bonded and other aspects of the service.

19. Is there an MOQ?

Subject to component parts being available, we are able to bond samples without an MOQ. As we control production we are generally able to supply samples within 2 weeks of order. After prototype/sample approval, we usually look at an MOQ of 20 pieces to make the production setup cost effective, but will consider other options depending on the customer.

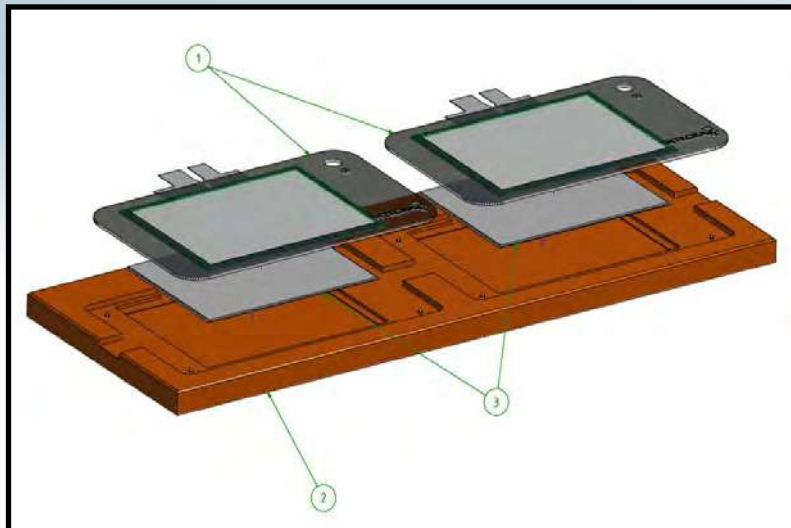
20. Can you bond our own free issue parts?

Yes, ideally we like to supply all the parts, but appreciate that sometimes the customer may have sourced parts which Display technology Ltd do not support. In these situations we would set a purchasing agreement dealing with yield, nature of supply etc.



21. What is a professional Jig?

Part of the DTL design/supply philosophy is to offer the quality and continuity of supply. During a bonding project there are two stages. The first stage is sampling and very small production runs using a 'hand built' jig. Due to the nature of this jig, there may be slight tolerances in the bonding process. The second stage is a mass production 'professional' Jig. This is a highly engineered CNC machines Jig will produce a consistent and accurate bond time after time, month after month, year after year. Subject to the size of the bonded display, this can also be multi cavity, thus speeding up the process and reducing cost.





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ABOUT US

Established in 2001, UK based Display Technology is part of the Fortec AG group of companies. Display Technology develops and supplies highly innovative display solutions for industrial, consumer, medical, in-vehicle and professional applications. Supporting all project phases from initial concept, design and development, procurement and production, Display Technology will supply fully bespoke designs incorporating TFT LCD modules, touchscreen integration, optical bonding, embedded electronics and mechanical housings.

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