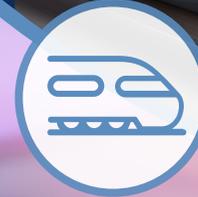


FORTEC
INTEGRATED



CLEAR. ROBUST. BRILLIANT.

VacuBond® - Displays and Touches visually in focus

STRONG IN THE FORTEC GROUP

WHY FORTEC INTEGRATED?

THE GROUP



Our particular strength lies in designing, developing, and producing exactly the solution you are looking for. Everything from a single source.



QUALITY

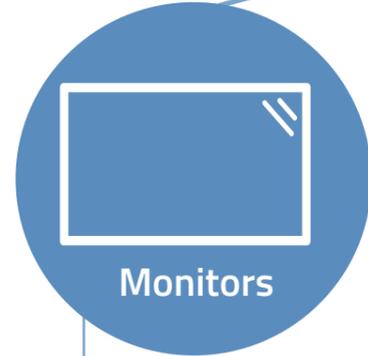
- Robust & hygienic:** Scratch-resistant glass surfaces, resistant to cleaning agents
- Suitable for industrial use:** Industrial components, vandalism and protective glass options for harsh environments
- Clear image:** Optical bonding - VacuBond (optional) reduces reflections and increases contrast

FLEXIBILITY

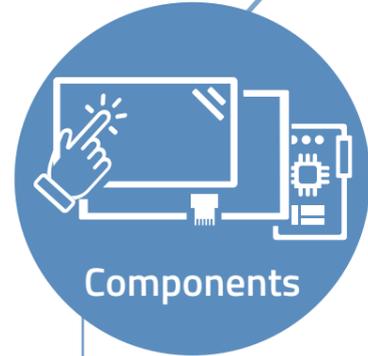
- Customized:** Mechanics, glass, printing, electronics - tailored precisely to your needs
- Design freedom:** TrueFlat, narrow frames, passe-partout printing, logos, and colors



VACUBOND®



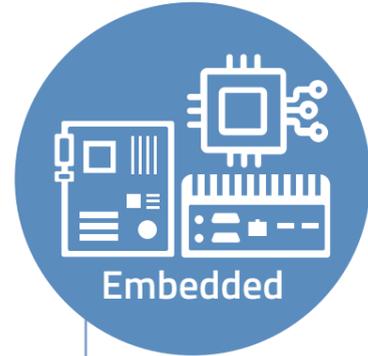
- Fire Protection | IoT
- Rugged | IP Protection
- High Bright | Touch
- Special formats | Braille



- Displays | Controller
- Touchscreens
- Kits | Accessories



- Customized Solutions
- Bonding | Glass
- Touches | Embedded
- Services



- Edge AI Systeme
- Box PCs | COM
- SBCs | Motherboards
- Single Cable Solutions

Designed,
developed and
made in Germany

full.custom

Do you have an idea? Do you need visualization or power supply solutions for YOUR product or your new challenge?

We are YOUR partner for the realization of your project. We develop monitors, visualization, and power supply solutions according to your requirements, accompany you through the implementation process until series production is ready, and manufacture the solution in our production facilities.

As an active market player, our range of services also includes our own manufacturing, development, and production facilities as well as modern logistics solutions.

semi.custom

Want to stand out from your competitors, but only have a limited budget? We can adapt products from our series to match your corporate design or modify them for you with additional features such as firmware adaptations, diagnostic modules, and more.



Mechanical Design



Project support



Certifications



Manufacturing

HIGHLIGHTS

THE REVOLUTIONARY TECHNOLOGY

OPTICAL BONDING - VACUBOND®

VacuBond® is FORTEC Integrated's proprietary technology for highly transparent bonding of TFT displays with touchscreens and/or protective glass using high-performance silicone gel.

Vacuum bonding (also known as direct dry optical bonding) achieves a particularly high-quality, virtually flawless bond and ensures long-term material stability without yellowing.

The fully automated bonding process also allows modern, slim TFT displays that do not have a stable frame to be bonded without any problems.

- Better readability with the same power consumption by eliminating reflections
- No contamination, condensation, or internal fogging by closing the air gap between the individual components

THE EFFECT OF



BONDING

OPTICAL VACUUM BONDING & VACUUM ASSEMBLY

In close strategic and technical co-operation with the Japanese Taica - Group we developed the latest generation of optical bonding and assembly technology. For supply security and for support of your risk management we installed the identical machines and processes in Germering/Munich, Germany, Ronkonkoma/NY, USA and Pilsen, Czech Republic.

Vacuum Bonding doesn't need:

- Drying process / curing time
- Dam construction like wet bonding
- Comprehensive "optical defect specification"
- Stable mechanical structure of TFT

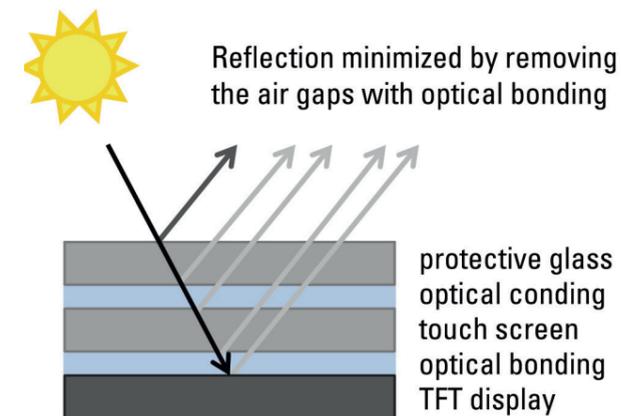
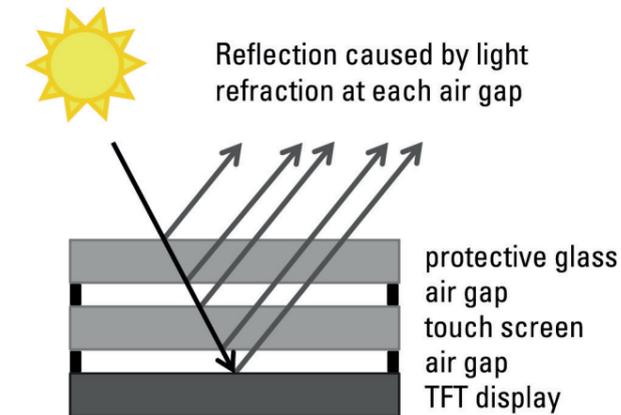


LOCATIONS

DIE DETAILS

OPTICAL BONDING - VACUBOND®

- Perfect contrast and readability in sunshine by eliminating the air gaps between TFT display and cover glass / touch
- No condensation / fogging in air-gap
- Reduced danger of splintering during glass breakage
- Improved shock absorption, more robust construction
- Improved heat transmission via front-glass (up to factor 8)
- Cost-efficient and reliable bonding of small and sensitive TFTs, e-Papers and OLEDs in the range of 2,4" to 7" and up to 32" in general
- "free air exclusion" bonding: we fill free space inside of the TFT by bonding (ex-protection)
- We can directly bond into your front-panel
- High precision in production due to production jig and automated process
- Our process is reversible, we can re-bond e.g. for repair
 - ▶ No loss of expensive material



DIE DETAILS

ASSEMBLY WITH VACUBOND®

- Easy assembly of the fragile new generation TFTdisplays without metal housings
- Zero anomalies production (opaque, translucent)makes a cosmetic specification superfluous
- Assembly of protective glass of any thickness forincreased ruggedness (drop ball tests, IEC60721-3-7as well as MIL STD 810F passed with VacuBond)
- Assembly of touch screens of all common technologies:resistive, glass/glass, AMR, projected capacitive
- Assembly at room temperature in contrast to assemblyin autoclaves, which may exceed the maximumspecified temperature of the touch screen.



Modern 3,2" TFT display assembled in VacuBond technology with a protective glass



Same 3,2" TFT display without protective glass: the very small bezel and the fragile mechanics do not allow for tape assembly or wet bonding

THE INDIVIDUAL CERTIFICATIONS

TESTED STANDARDS

VacuBond® products from FORTEC have achieved the following certifications in tests conducted in our customers' test laboratories:

- **Humidity test according to railway standard EN50155 / LESDB Damp heat test**
3 cycles per 24 hours. Storage at +55 °C and 95%-100% relative humidity, reduction to +25 °C in 3 hours at 90%-95% relative humidity
Function test after 24 hours
Vibration and shock
- **Vibration and shock test according to railway standard**
Requirements according to: IEC 60571
Tested according to: EN 61373, Category 1, Class B
- **Environmental test**
DIN 60068-2-1 From: -40 °C / 504 h, + 80 °C / 504 h
DIN 60068-2-14 Nb: -40 °C / 30 min...+ 80 °C / 30 min; 10 K/ min. temperature change, 100 cycles
DIN 60068-2-78 Ca: + 60 °C, 95 % relative humidity, 504 h

UNIT AND APPLICATION TESTS

The final assessment of the suitability of the bonded unit for its intended practical use is the responsibility of the customer.



- Vibration, broadband random vibration, and guidance – Test Fh IEC60068-2-64
- Mechanical environmental conditions IEC60721-3-7, Class 5M1, 5M2, 5M3
- Mechanical environmental conditions MIL STD 810F, MIL STD 810G, and MIL STD 461
- Aging of automotive components in sun simulation DIN 75220-Z-OUT (standard) and DIN 75220-Z-OUT-F (global stress)
- General rules for coating films for automotive parts JIS D 0202
- Test method for weather resistance of automotive parts JIS D 0205
- Environmental conditions and test methods for aviation equipment Avionics fire test DO-160E Section Fire, Flammability 26 – Test Category C

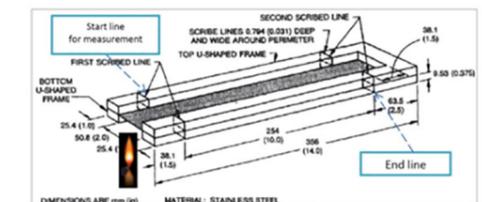
THE TEST AT TAICA GROUP

OPTαGEL corresponds to FMVSS (Federal Motor Vehicle Safety Standard) Nr. 302

- Sample: OPTαGEL K120E t0.8mm
- Test equipment: MVSS-2 (Suga Test Instrument Co.)
- Environmental conditions: 21°C, Luftfeuchte 47%

TEST RESULT

- Self-extinguishing test passed, i.e., the flame never reaches the starting line for measurement
Test conducted by CERI (Chemicals Evaluation Research Institute Japan)
Test method & equipment—see images below

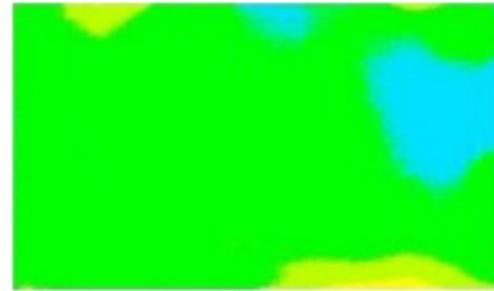


THE MURA-COMPARISON

WETBONDING VS OPTICAL BONDING - WITH *OPTαGEL*



0,3 mm Wetbonding



0,5 mm *OPTαGEL*

MURA = Uneven luminance (flashing effects | cloudiness)

Optical Bonding with *OPTαGEL* ► Excellent screen uniformity

Mura-Relation *OPTαGEL* vs wetbonding: only **46%** with Optical Bonding compared to wet bonding

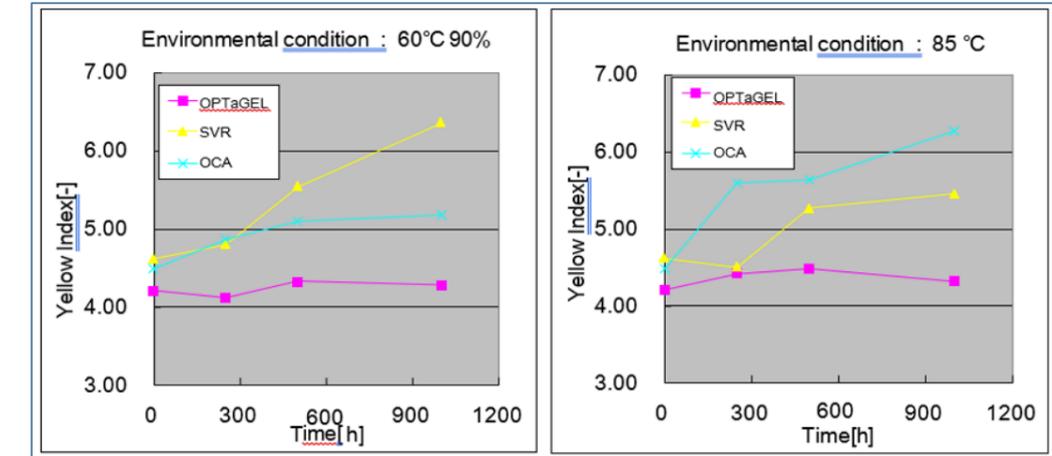
THE YELLOWING

WITH *OPTαGEL* PREVENT YELLOWING

The yellowing of urethane resin is mainly due to the oxidative decomposition of isocyanate, which is essential for the formation of the hard segment of urethane resin. Such oxidative decomposition produces a quinone-based segment, which is naturally yellow in color.

The yellowing of urethane resin is essentially unavoidable, as various aromatic isocyanates are widely used in industry to control the chemical reaction rate in the production of urethane resins.

OPTαGEL is a silicone gel that has shown significantly better results than urethane resin and acrylic in tests conducted by our partner Taica Cooperation. The bonding energies of silicone are strong enough to be free of UV/light-induced bond splitting.



COMPARISON TECHNOLOGY



	OCA optically clear adhesive	OCR LOCA Optically clear resin Liquid OCA	OPTαGEL
Material	Acrylic	Acrylic-Silicone	Silicone
Bonding Method (Equipment)	Adhesive Tape Type (Autoclave)	Liquid Type (UV-Curing Gap filling)	Adhesive Sheet Type (Vacuum-Lamination)
Thickness [mm]	0.025 ~ 0.250	< 0.400	0.3 0.5 1.0 1.8 ¹
Resistance to Weather Durability Yellowing	Good	Good	Excellent
Impact Absorption Stress Relaxation	Restricted	Restricted	Premium (viscoelastic)
Reworkability	Restricted	Restricted	Outstanding ²
Remarks	Gap filling process is complex.	Thin sheet type products	Various thicknesses up to 1.8 mm possible

1 - Project-oriented, other strengths also possible | 2 - Possible depending on the adhesion of the single components, surface activation, and inaccessibility of the joint.



SERVICE



	COVER GLASS Glass Display	TOUCH Touch Sensor Glass Touchpanel Display	MISCELLANEOUS
PROFESSIONAL	<ul style="list-style-type: none"> High-quality safety glass such as Schott Xensation™ Corning Gorilla Glass™ Dragontrail™ Reinforced safety glass Ceramic or organic screen printing PMMA Plexiglas® pane 	<ul style="list-style-type: none"> Projective capacitive touch Resistive touch glass/ glass Infrared (IR) touch 	<ul style="list-style-type: none"> Bonding behind the LCD for cavity-free displays, application of an LED logo diffuser film
ECONOMY	<ul style="list-style-type: none"> Safety glass Economy 	<ul style="list-style-type: none"> Resistive touch on glass or as a film Resistive analog matrix multi-touch 	
ENVIRONMENTALLY FRIENDLY	GLASS DISPLAY	TOUCHPANEL DISPLAY	<p>Standard: Non-structural bonding¹, without surface activation (high reworkability)</p> <p>Advanced: Structural bonding^{2 3} with surface activation (limited reworkability)</p>

Explanations for footnotes 1, 2, and 3 on the following page

IN DETAIL

Contact angle measurement

We can perform contact angle measurements to assess the surface energy and wettability of the surface.³

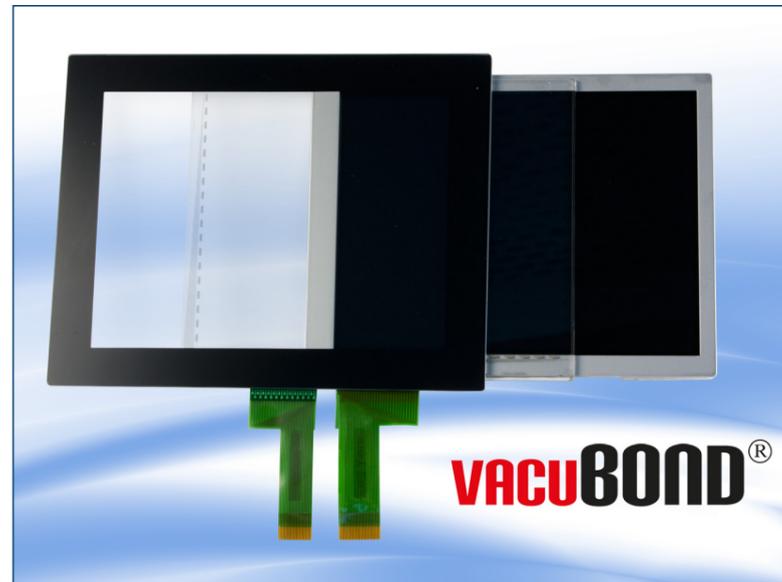
Surface activation

We can perform surface activation using low-pressure plasma and atmospheric plasma.

The final assessment of the application and its suitability for actual use must be carried out by the customer.

Notes for subject "SERVICE" about VacuBond®

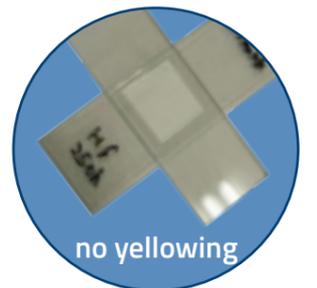
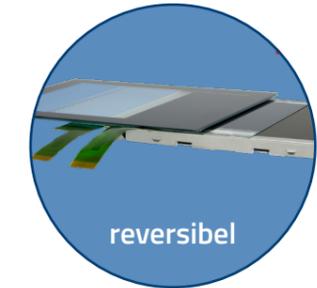
1. Optical bonding is generally a non-structural bond and is not mechanically stable.
2. Depending on the components used, the application, and the mechanical stress, structural bonding is possible.
3. A contact angle measurement can be performed according to the OWRK method with two-fluid measurement.



IN DETAIL

- Bonding of all sizes up to 32 inches
- Bonding of touchscreens of all technologies
- Bonding of safety glass and touch panels
- Bonding of pure frameless TFT panels possible
- Perfect material stability over time (e.g., no yellowing)
- Fast sample availability

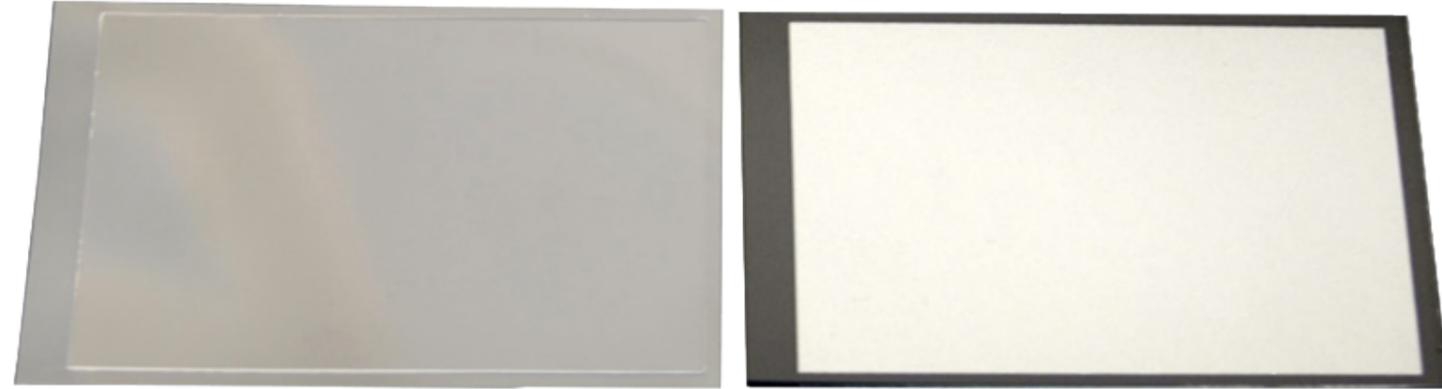
Designed,
developed and
made in Germany



HIGHLIGHTS

SAMPLES

SAMPLE 1: Bonding of a small, highly sensitive TFT display with protective glass



OPTALGEL on carrier foil

Protective glass



Highly sensitive TFT display



Protective glass with *OPTALGEL*

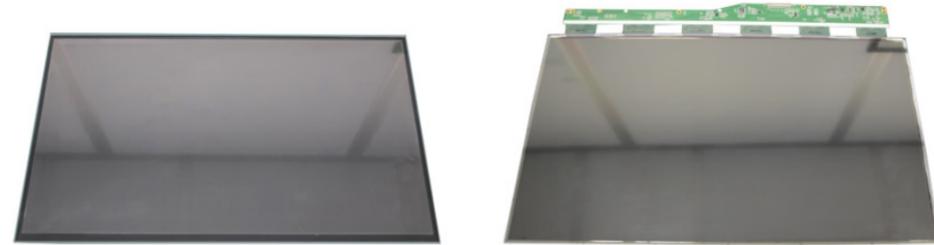


Complete unit: TFT display with protective glass, optically connected to **VACUBOND®**



SAMPLES

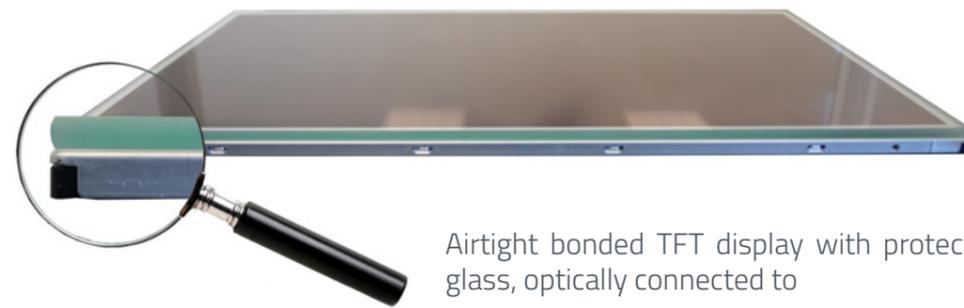
SAMPLE 2: Airtight bonding for a large TFT display with protective glass



Protective glass with **OPTAGEL** Frameless TFT panel



TFT back cover, open areas filled with **OPTAGEL**

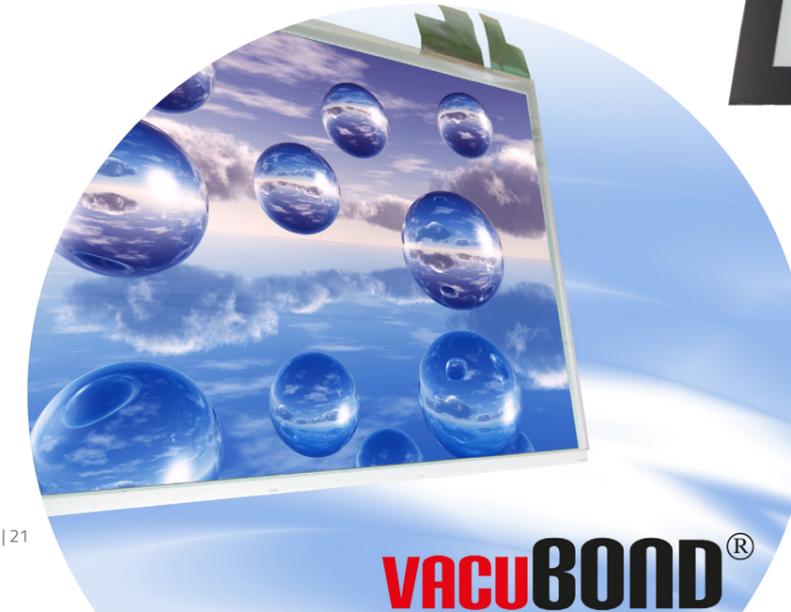
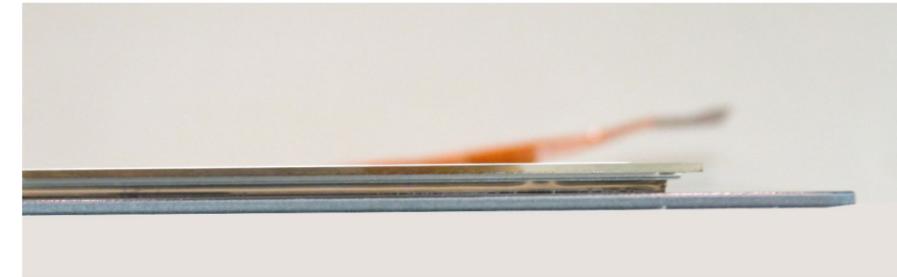


Airtight bonded TFT display with protective glass, optically connected to

VACUBOND®

SAMPLES

SAMPLE 3: 32" E-Paper display, optically bonded with protective glass



VACUBOND®



Unser Unternehmensnetzwerk unterstützt Sie weltweit mit Niederlassungen in Deutschland, Österreich, der Schweiz, Großbritannien; den Niederlanden, Tschechien, Ägypten und den USA. Für weitere Informationen kontaktieren Sie bitte:

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