# Important features for Medical Grade All-in-One PCs

For use in the patient environment

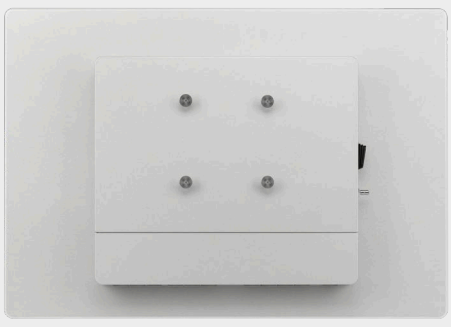
# 1
## Fully enclosed housing without ventilation openings

The devices can be regularly disinfected in hygienically critical areas. To prevent bacteria and liquids from penetrating the device during disinfection, a fully enclosed design without ventilation openings is strongly recommended.

# 2
## Fanless design

Cooling with fans only makes sense if large volumes of air can be moved from the inside to the outside, as air itself has a poor thermal conductivity coefficient.
In this respect, the absence of ventilation openings in the housing also makes the use of internal fans virtually ineffective.

However, from the perspective of noise reduction when in close proximity to patients and caregivers, ease of maintenance and increased longevity of the device, it is strongly recommended to have no internal rotating fans. Internal fans increase noise, reduce longevity, and can interfere with germreducing laminar flow ceilings.



# 3
## Aluminum enclosure

Points 1. and 2. inevitably lead to the exclusive use of metal enclosures. Among the metals, aluminum offers the best price/weight/thermal conductivity ratio and is therefore widely used for such applications in industry. Inexpensive plastic enclosures are unsuitable for physical reasons, as the thermal conductivity of these materials makes them more suitable for use as thermal insulators.

Due to the law of conservation of energy, the use of plastic housings inevitably leads to significantly higher internal temperatures and to significantly higher device failure rates.  In addition, plastics can become discolored and brittle with heat exposure and the use of chemical disinfectants.

| Metal | Thermal conductivity λ W/ (m · K) |
|---|---|
| Silver | 429 |
| Copper, pure | 401 |
| Copper, commodity | 240...380 |
| Copper alloys (Sn, Zn, Ni, Pb) | 30...110 |
| Gold, pure | 314 |
| Aluminum (99,5 %) | 236 |
| Aluminum alloys | 75...235 |

| Plastics | Thermal conductivity λ W/ (m · K) |
|---|---|
| Polyethylene terephthalate (PET) | 0,24 |
| Polyurethane compact (PUR) | 0,245 |
| Polyimide (PI) | 0,37...0,52 |
| Polyetherimide (PEI) | 0,24 |
| Polytetrafluorethylene (PTFE) | 0,25 |
| Polyvinyl chloride (PVC) | 0,17 |

# 4
## Weight

The use of all metal enclosures can add weight to the device. It is advisable to set an upper weight limit, as mounting solutions are designed for maximum loads. Overloading mounting solutions can lead to signs of fatigue and increase risk of a failure point of the mounting hardware. Many mounting systems are designed for a maximum of 12 kg. As, in addition to the weight of the device, any keyboard solutions or the support of the operator on the device must also be taken into account, it is advisable to limit the weight of the terminal itself to a maximum of 8-9.5 kg. In most cases, the permissible weight of the mounting solution on the mounting plate is also specified, so that any leverage effects that may occur must be taken into account.

# 5
## Protective glass pane made of aluminumsilicate glass

The DIN EN 60601-1 standard requires high impact resistance for the entire device, which is why the sensitive TFT modules must be protected from external influences by glass panels. The use of modern aluminum silicate glass, which is five times more impact and scratch resistant than normal soda-lime glass (float glass), is recommended here. These glasses were specially developed for touchscreen applications and have better electrical conductivity values due to a different chemical composition, making them more suitable for touch systems in particular. Thanks to the more modern manufacturing process, the glass is extremely flat and distortion-free. This further improves touch performance.

Corning Gorilla Glass is an example of a well-known brand name for this type of modern glass, which is widely used in cell phones and tablet PCs.

The weight reduction made possible by the thinner design of the protective pane with simultaneously improved properties (1.5 mm instead of 3.5 mm) promises additional advantages.

# 6
## Anti-reflective coating

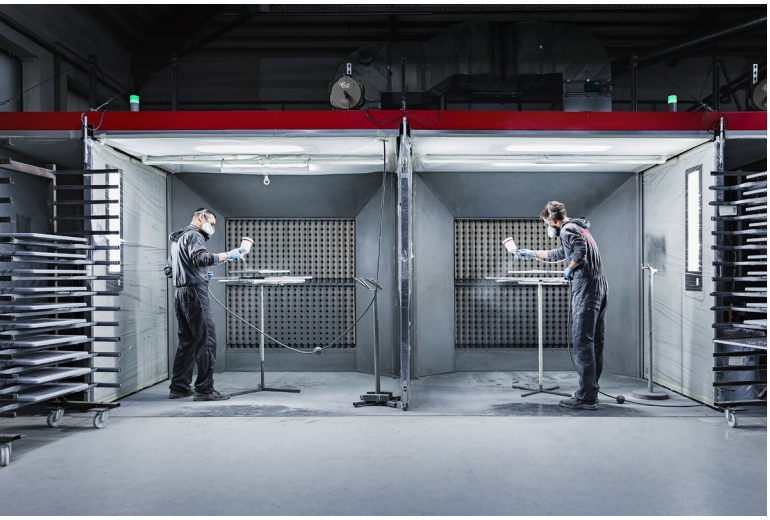
Very strong light sources are often used in operating theaters and intensive care units. An anti-reflective coating (AR) is therefore required for better readability. This must not only have good anti-reflective properties, but also be hard to be better scratch resistant and resistant to disinfection processes to ensure a long service life.
For touch applications, an oleophobic coating is also highly recommended, which has a strong water-repellent effect and effectively reduces fingerprints etc. on the glass. This coating is often referred to as an anti-fingerprint (AF) coating. For industrial applications, anti-glare (AG) surface treatments are also often used, which create a matt surface by etching, but this is accompanied by a reduction in display quality. Not recommended for displaying image and video material, but rather for operator terminals.

# 7
## Protective glass pane made of antibacterial glass

A genuine antibacterial glass (AntiMicrobial= AM) from the American manufacturer Corning is new on the market. Here, silver ions (Ag+) are introduced directly into the glass during the tempering process, which have been proven to have a strong antibacterial effect. In contrast to all previously known coatings, these are not applied retrospectively, but are permanently incorporated and are therefore a property of the glass itself. This means that there is no risk to the user from the disinfectant layer “peeling off” and becoming less effective. There is even FDA approval for this. Only available in conjunction with the AG coating up to size 32”.

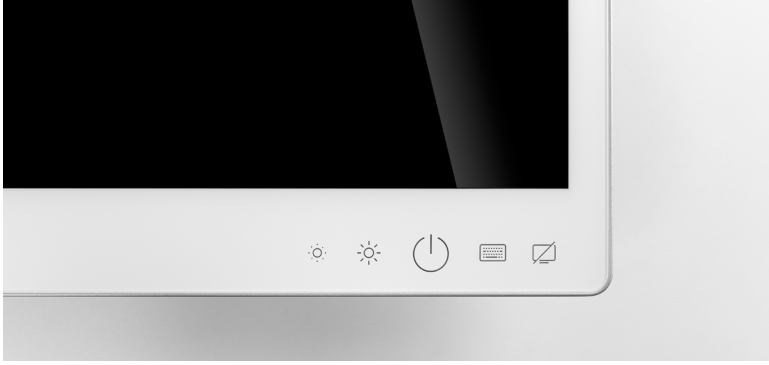
# 8
## Antibacterial coating and Full glass protective pane

To reduce the germ load, an antibacterial coating of the housing may also be required. In addition, antibacterial glass is also useful, as cross-contamination can pose a risk, especially when using touchscreens. Glass types that are antibacterial in the material itself are recommended, as coatings naturally rub off and lose their effect. The design of the entire front panel uses an all-glass front incorporating the antibacterial glass technology.



# 9
## IPS/PLS TFT panel with high brightness and all-round viewing angle

In the operating theater and at the ICU, special attention must be paid to optimal image display. On the one hand, users are often unable to position themselves optimally in relation to the screen, so that the requirement for an all-round viewing angle (horizontal 178° and vertical 178°) appears appropriate. In particular, the often high mounting on ceiling supply units requires an optimal display even when viewed from below. In addition to the actual viewing angle, the color shift often also plays a major role, as different shades of red can also signal disease states, for example, which is used in endoscopy. Here, only panels based on IPS (LG) and PLS technology (Samsung) achieve acceptable displays over a wide viewing angle. Panels with TN or MVA technology show clear weaknesses even with otherwise good viewing angles.



# 10
## Front-operated and illuminated keypad with shortcut keys

PCs are used continuously in intensive care units. The control panel must be visible and operable from the front even at night, but must not disturb the patient during sleep. A separate switch-off option for the backlight avoids disturbing the patient at night, extends the service life of the devices and protects the environment. A smooth, easy-to-clean surface and illuminated buttons reduce the risk of operating errors and thus ensure greater hygiene and fewer mistakes.

The following function keys should also be available

- Setting the screen brightness
- Calling up the on-screen keyboard as a hotkey
- Switch off the backlight in night mode (screen off button)
- Clean mode to switch off the touch function while the device is being cleaned
- On/off switch

# 11
## PCap-Multitouch which can be operated with gloves

PCap (projected capacitive) multitouch suitable for use with gloves are of great importance for medical panel PCs units, as they must function precisely even while wearing gloves. In operating theaters and intensive care units, staff must wear gloves for hygiene and safety reasons. PCAP technology ensures that medical staff can interact seamlessly with the system without having to remove their gloves. In addition, this touch technology enables precise and responsive input, which is essential for quick decision-making in high-pressure medical situations.



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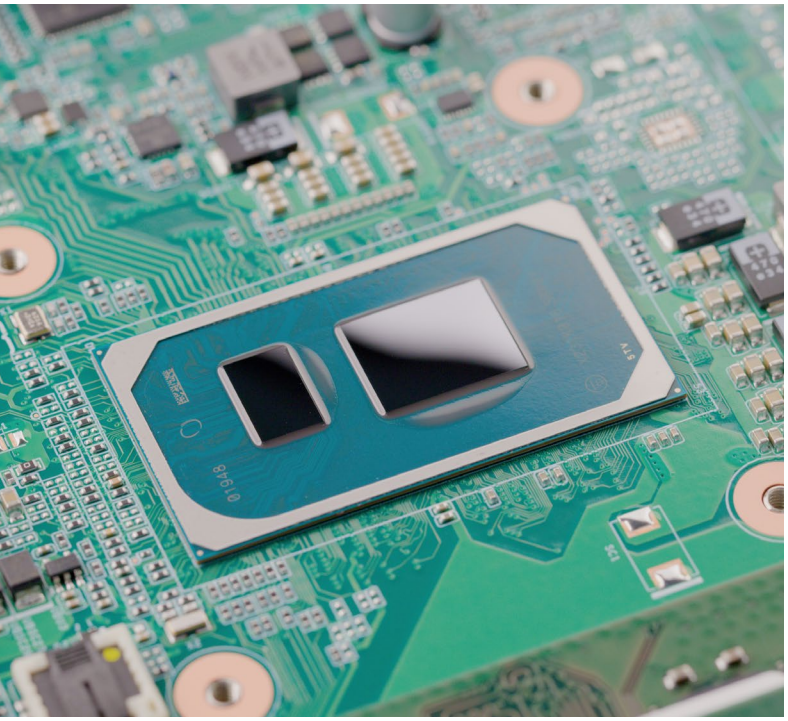
# 12
## Intel® ULV-processors

The fully enclosed design makes it necessary to keep the power consumption of the devices as low as possible in order to achieve a long service life. It is therefore strongly recommended to require low-power ULV processors, as the processor is the component with the highest power consumption.

Regardless of the manufacturer, a thermal design power (TDP) of <=15W should be required. The Core i5 mobile and desktop processors are more powerful, but have a TDP of at least 35W and are therefore unsuitable for completely enclosed devices. To ensure a long service life in 24/7 operation, a maximum internal temperature of <50°C (better <45°C) should be required in continuous operation under real device conditions. Internal temperatures above 60°C are not permitted. The power consumption of the device should be measured as part of the evaluation and included as an important criterion in the assessment. In addition to the lower consumption costs, this also has the advantage of a significantly longer service life with very good performance. The 13th generation of Intel Core i5/i7 processors is significantly more powerful than the Celeron processors with similarly low power consumption.

The following rule of thumb can be used as a guideline for the service life of electronic components as a function of temperature: For every 10 K increase in temperature, the expected service life is halved.



# 13
## Industrial grade DDR5-RAM

DDR5 offers a significantly higher bandwidth and clock frequency compared to DDR4. DDR5 standard modules can transfer around 50 percent more data than DDR4 modules, which is noticeable in shorter loading times and smoother execution of individual programs. The memory clock should be at least 5200 MHz.

# 14
## m.2 NVME SSD

m.2 NVMe SSDs use the PCIe interface and offer significantly higher data transfer rates compared to SATA or mSATA SSDs. This enables shorter boot times, faster loading of applications and seamless processing of large medical data sets such as high-resolution image files or electronic patient records. The compact, wireless design of the M.2 SSDs eliminates the need for vulnerable cable connections, reducing potential sources of error. Compared to their predecessors, M.2 NVMe SSDs consume less power, resulting in less heat generation. The lower latency of NVMe SSDs ensures faster data access, which is crucial for real-time applications such as patient monitoring or diagnostic imaging. The small form factor of M.2 SSDs frees up space in the medical PC and enables better thermal management or the integration of additional components such as GPU accelerators for AI-driven diagnostics.

# 15
## Intel vPro® and dTPM

Technologies such as Intel vPro® and dTPM provide security, connectivity and remote management of hardware. This allows the IT team to avoid hardware-related on-site visits, helping to reduce costs and improve IT productivity. In addition, hardware issues can be resolved faster with Intel vPro®-based devices. The Discrete Trusted Platform Module (dTPM) is a specialized microcontroller designed to secure hardware. It integrates cryptographic keys into devices and is used for secure cryptographic processes and secure storage of critical data.

# 16
## RS232/422/485– interfaces

The RS232/422/485 serial interfaces ensure compatibility with legacy devices, which is important to fully utilize the hospital infrastructure, support device integration and extend the life of older devices.

# 17
## RJ45 with 2.5 Gb LAN

The 2.5-Gb-LAN enables fast and reliable data transmission for real-time imaging and all clinical decision support tasks. Due to the large amounts of data flowing through the clinical workflow, speed is critical to avoid bottlenecks.

# 18
## Real 4kV decoupling of the RJ-45 and RS232 interfaces

The 4 kV decoupling ensures the safety of users and operating personnel even in the event of high-voltage faults in the vicinity of the devices. This is important for devices that are connected to patients and where electrical safety is of crucial importance. It also protects sensitive internal components from voltage fluctuations or faults, reducing the risk of failure. True 4kV decoupling is distinct from simple 1.5kV decoupling and is necessary for the patient environment.

# 19
## USB 3.2 and USB-C

Large files such as image data or patient files are often processed in medical applications. USB 3.2 offers data transfer rates of up to 20 Gbit/s, enabling faster and more efficient workflows. This reduces downtime and ensures that important data is available when needed.

The USB-C port is a standard that supports a wide range of devices, making it ideal for various medical devices. Its reversible design ensures quick and easy connections and minimizes errors in emergency situations. It supports higher output power, allowing peripherals such as medical sensors, wearable devices or even other systems to be charged or powered directly.

This optimizes space requirements as fewer additional chargers are needed. The design is built for durability and long-term use, meeting the expectations of a long life cycle in healthcare.

# 20
## Wi-Fi 6 and Bluetooth 5.2

Wi-Fi 6 and Bluetooth 5.2 ensure speed and reliability and support seamless communication with IoT-enabled medical devices. Wireless integration allows for faster setup, elimination of cable clutter (important in the operating room) and quick integration of numerous end devices.

# 21
## RFID/NFC–Reader

RFID/NFC technologies enable secure, contactless authentication and thus simplify the work processes of medical staff. This not only saves valuable time that would normally be spent on manual registration, but also increases security as the object or user is clearly identified and typing errors are avoided. Work processes such as dispensing medication are accelerated and made safer by scanning and identifying the object within seconds.


# 22
## Internal power supply unit

An internal medical power supply unit with a wide range input (AC/DC or on request DC/DC) is required, as external power supply units require additional mounting solutions and cables and can decrease the effectiveness of disinfection efforts.

# 23
## Potential equalization bolt

An equipotential connection that is freely accessible from the outside of the housing is necessary for equalizing electrical potentials and guarantees safety, reliability and conformity to standards in the medical environment.

# 24
## Components with long-term availability

Medical environments require highly reliable systems to ensure continuous operation. The devices are designed for a long service life, during which time additional purchases or repairs involving the replacement of components may be required. Industrial, long-term available components are specifically designed for longevity and stability to reduce the risk of failure. A 10-year replacement option ensures that the system remains functional and up to date for a longer period of time, which corresponds to the typical life cycle of medical devices. The availability of spare parts for a decade enables cost-effective maintenance. Instead of replacing the entire system, specific parts can be upgraded or replaced, significantly reducing long-term costs.

# 25
## Hygiene

Surfaces must be smooth and able to be cleaned with standard clinical cleaning agents without damaging the device. Avoiding openings prevents the ingress of dust, water and microbes and results in a sterile device that is easy to clean and maintain. This not only guarantees the longevity of the internal components, but also reduces the risk of system failure due to external factors and simplifies the disinfection process.

# 26
## Enclosure painting

A wet paint finish has better thermal conductivity than a powder coating, is harder and of higher quality. This is due to the fact that they can be applied in thinner and more even layers, which contributes to better heat dissipation.

Antimicrobial agents can be added to special wet paints during the formulation process to provide protection against bacteria, viruses and other pathogens. They ensure smoother and more even surfaces, which makes cleaning and disinfection easier.

# 27
## Warranty and support

A 3-year warranty must be offered as standard. Optional warranty extensions beyond several years reduce the financial uncertainty associated with possible repairs or replacement devices to zero and allow healthcare facilities to better plan their budgets. The global availability of services ensures that certified professionals can carry out repairs or support regardless of the location of the devices. This is particularly important for facilities in remote or underserved regions.
Extended warranties combined with worldwide service reduce risk, especially for medical grade PCs used in vital applications.

# 28
## Standardized VESA 100 mount

An integrated mounting interface in accordance with the VESA 100 standard simplifies installation and enables the use of standard accessories. Care should be taken to ensure that the devices can be mounted or dismounted quickly, without tools and by one person.

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# 29
## Safety in the patient environment

The protection of users and patients and the integrity of the working environment have the highest priority.  By complying with the global standards for electrical safety (IEC 60601-1, Edition 3.2) and electromagnetic compatibility (IEC 60601-1-2, Edition 4.1), medical PCs are certified for use in the patient environment by a notified body. Medical PCs certified according to these requirements are ideally suited as components of medical devices and can undergo the corresponding approval procedures. As the Medical PCs are supplied without software, they have no specific medical purpose and are therefore deliberately not declared as a medical device.

This decision enables maximum flexibility, simple administration without additional bureaucratic effort and rapid adaptation to new technologies.

# 30
## Production according to ISO 13485, 9001 and 14001

These standards ensure quality, reliability and sustainability, which are essential in the healthcare sector:

- ISO 13485 guarantees that Medical PCs meet stringent medical device regulations and safety standards, providing confidence and compliance for critical healthcare applications.
- ISO 9001 ensures consistent quality management and customer satisfaction, reflecting the reliability and durability of the PCs.
- ISO 14001 demonstrates environmental responsibility, supports hospital sustainability goals and is consistent with global environmentally conscious practices.

These certifications guarantee healthcare providers a safe, reliable and an environmentally friendly product.

# 31
## Made in Germany & service worldwide

German manufacturing is known worldwide for its commitment to high standards, precision engineering and attention to detail. German-made products are renowned for their durability and reliability, making them an excellent choice for medical applications where consistent performance is critical.

These products are maintenance-free and have extremely low RMA rates over a lifetime of more than 5 years, contributing to a lower total cost of ownership. Last but not least, the “Made in Germany” medical PCs are associated with environmentally friendly production methods and ethical working standards, which is of great importance for healthcare providers who want to achieve their social responsibility goals.

The service ranges from consultation, on-site inspection and measurement, installation to aftersales and support throughout the entire life cycle of the product, including return and disposal.

We would be happy to advise you through our sales and service team on site, by telephone or email. View our homepage for more information about the Medical Grade OR-PC® series.

We would be delighted to support you with your project.

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