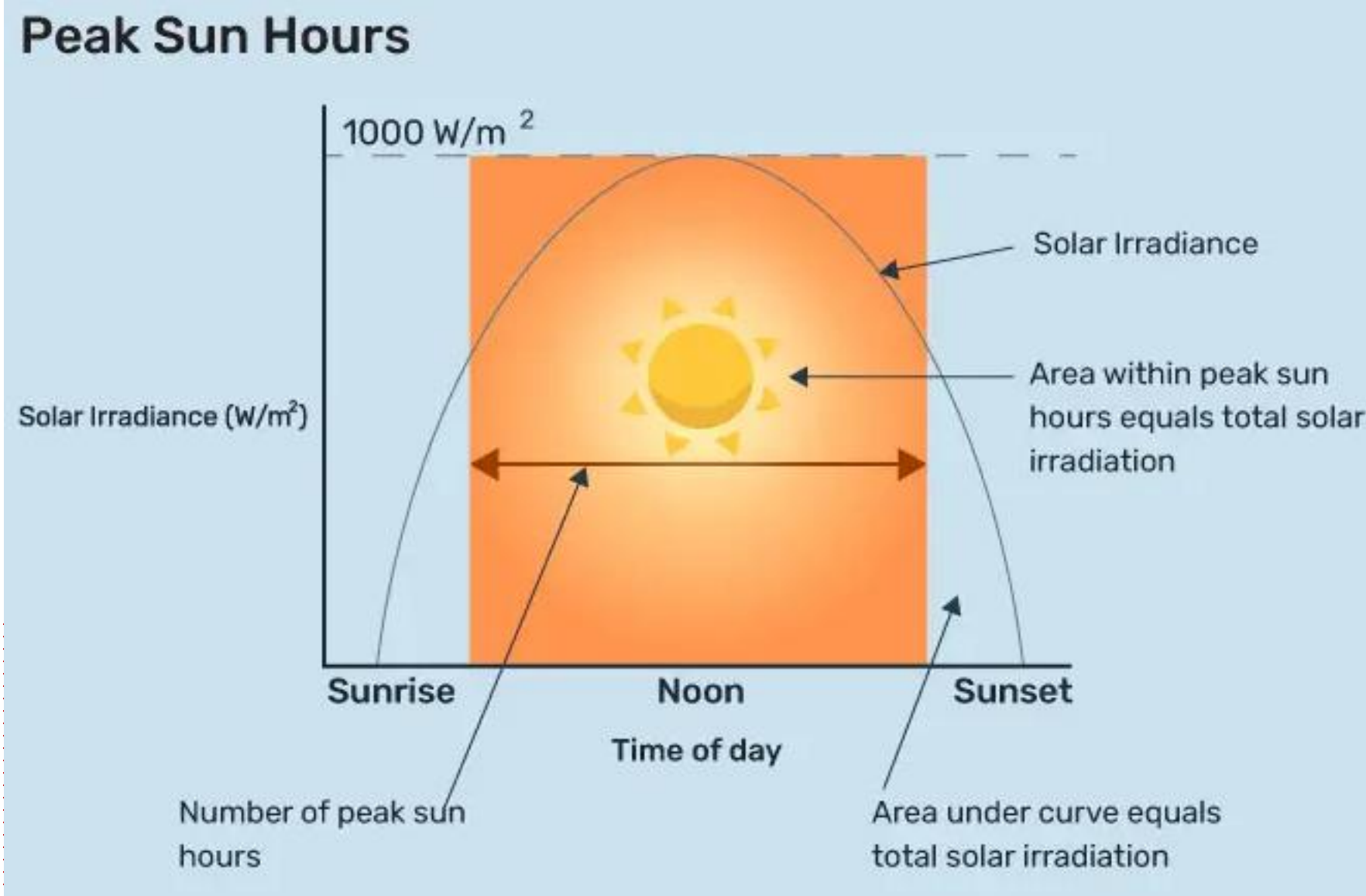


# Outdoor Basics

- 1. Basics/Physics – Light**
- 2. Basics/Physics – Casing**
- 3. Solutions Semi-outdoor**
- 4. Solutions Full-outdoor**

# Basics/Physics – Sunlight



Solar radiation theoretical max.	<b>1368 <math>W/m^2</math></b>
Peak radiation values (summer)	<b>1000 <math>W/m^2</math></b>
Peak radiation values (winter)	<b>500 <math>W/m^2</math></b>
New Mexico, USA	<b>Up to 9 <math>kW/m^2</math> per day (summer)</b>
New York, USA	<b>Up to 4 <math>kW/m^2</math> per day (summer)</b>

$W/m^2$  = Watt per square meter  
 $kW/m^2$  = Kilowatt per square meter

# Basics/Physics – Brightness

Parts that are exposed to direct sunlight, heat up significantly, as anyone who has ever burned their fingers on a metal part lying in the sun surely knows!

To have electronic devices readable under direct sunlight, high brightness is needed. In an indoor environment (e.g. office), with solely artificial light, around 150 cd/m<sup>2</sup> brightness gives good readability.

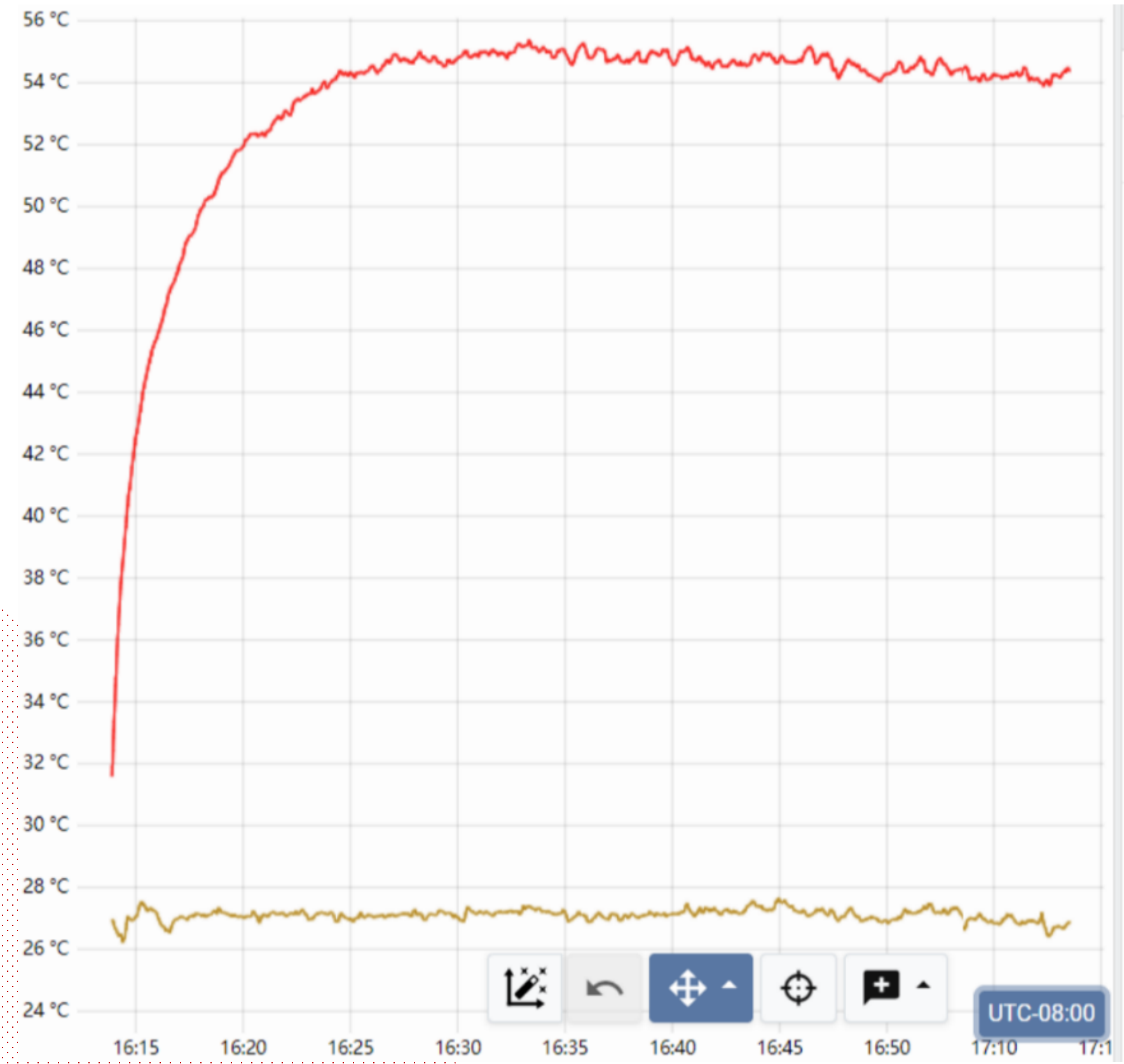
However, to have electronic devices readable under direct sunlight, high brightness is needed. **Direct sunlight** can reach over **10,000 cd/m<sup>2</sup>**.

	43" (400 cd/m <sup>2</sup> )	43" (1,000 cd/m <sup>2</sup> )	43" (2,500 cd/m <sup>2</sup> )
Screen area size (m <sup>2</sup> )	0.41	0.41	0.41
Power consumption (W)	60	160	380
Heat (W/m <sup>2</sup> )	147	392	930

**Fun fact** – On sailing boats, only 10 cd/m<sup>2</sup> brightness seems incredibly bright during the night.

cd/m<sup>2</sup> = Nits = Candela per square meter

# Basics/Physics - Cover Glass under Direct Sunlight



- 通道和轴
- 环境温度  
A0113/446 | 4 | 类型 K
  - 1.8mm  
A0113/446 | 2 | 类型 K

## Cover Glass - 600 W/m<sup>2</sup> sunlight simulation:

In the graph on the left you can see that the cover glass surface temperature reaching 55°C within 15 minutes, while the environmental temperature is around 27°C.

**Skin damage** occurs in the following scenarios:

Temperature	Time before skin damage occurs
45°C - 51°C	Within minutes
51°C - 70°C	Within seconds
> 70°C	In fractions of a second

Countries require Caution/Warning labels for hot surfaces, starting from between 65°C and 75°C to warn people.

## Examples:

- In Germany - DIN EN 563
- In United States - ASTM C1055

## Basics/Physics - Blackening under Direct Sunlight

faytech's 11.6" semi-outdoor touch panel with 1000 cd/m<sup>2</sup> brightness used on EDEKA's EASY Shopper, in a test that simulated 800 W/m<sup>2</sup> sunlight:

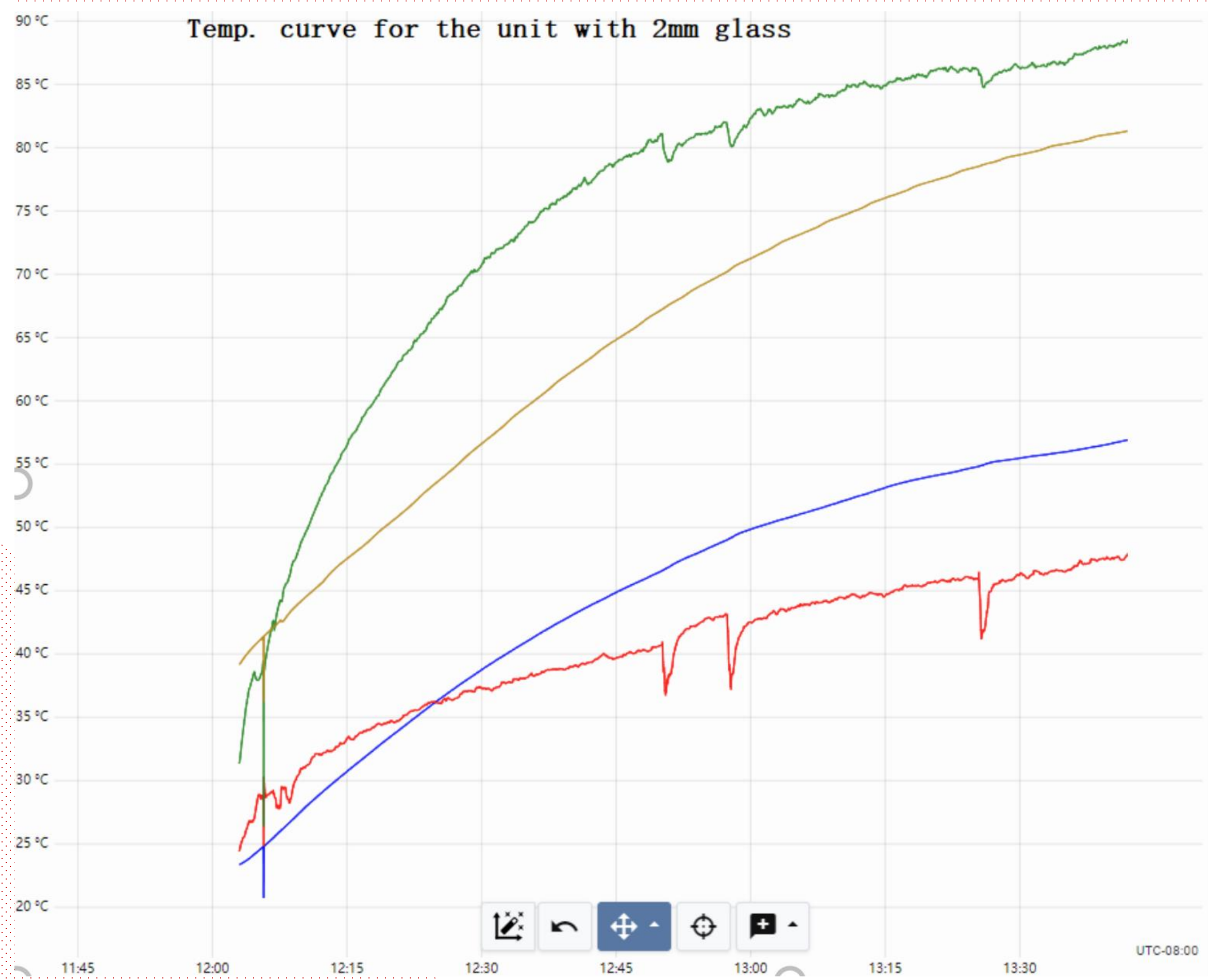
### 4.6. *Status after 50min*

Surface Temperature:	84.0°C
Display Picture:	60% area display blackening effect at more than 84.0°C
Touch Functionality:	No abnormal behavior



Reverse blackening is a process whereby within 10 minutes after the radiation stopped, the blackening disappears, with no long-term damage of the display.

# Basics/Physics - 11.6" Touch PC under Peak Sunshine



- Inner unit  
A0113/446 | 4 | 类型 K
- Test chamber  
A0113/446 | 2 | 类型 K
- TP  
A0113/446 | 7 | 类型 K
- Mainboard IC  
A0113/446 | 6 | 类型 K

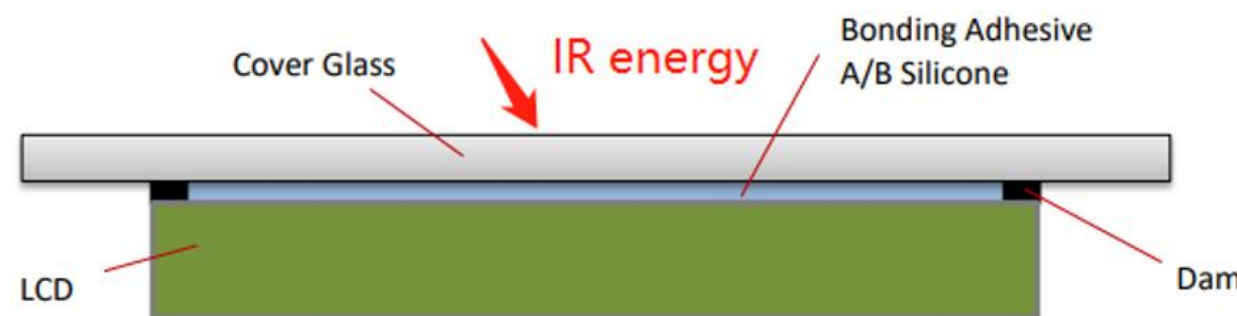
Temperature results after 90 minutes at 1100 W/m<sup>2</sup>.

The 11.6" semi-outdoor Touch PC with 1000+ cd/m<sup>2</sup> at 45°C environmental temperature:

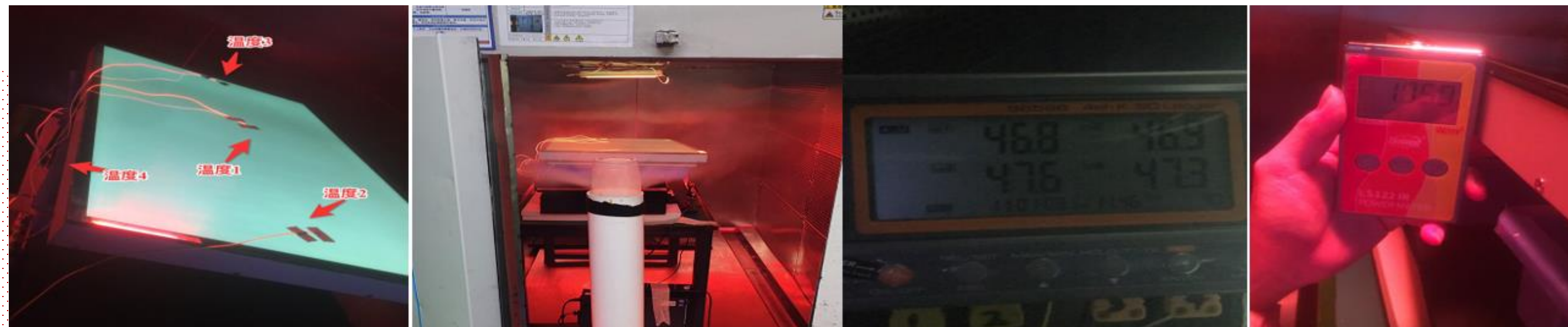
Parts	Temperature
Touch panel	88°C
Mainboard	82°C
Inner case	57°C
Test chamber	45°C

# Basics/Physics - Active Cooling under Peak Sunshine

faytech's outdoor 43" panel with full backlight LED of 1,500 cd/m<sup>2</sup> brightness and active cooling, in a test that simulated 1,150W/m<sup>2</sup> sunlight for 240 hours:



Test Parameters / Duration (hours)	IR meter Energy W/m <sup>2</sup>	Touch Monitor Glass surface temperature (°C)	Display
0H	1,150	31.4	Normal, no blacking
After 72H	1,150	80.4	Normal, no blacking
After 96H	1,150	84.4	Normal, no blacking
After 120H	1,150	86.5	Normal, no blacking
After 144H	1,150	87.3	Normal, no blacking
After 168H	1,150	88.2	Normal, no blacking
After 192H	1,150	88.9	Normal, no blacking
After 216H	1,150	86.6	Normal, no blacking
After 240H	1,150	87.4	Normal, no blacking



# Basics/Physics – Summary "Sunlight"

On clear, sunny days, surface temperatures will increase to a level that makes touching uncomfortable.

In order to make displays readable under direct sunlight, a brightness level of at least 1,000 cd/m<sup>2</sup> brightness is required, whereas to achieve a bright and extremely clear image, around 2,500 cd/m<sup>2</sup> is needed. To reach such a display brightness, substantial additional heat is generated in the process.

Without active cooling, a clear readable display under direct sunlight is not possible.\*

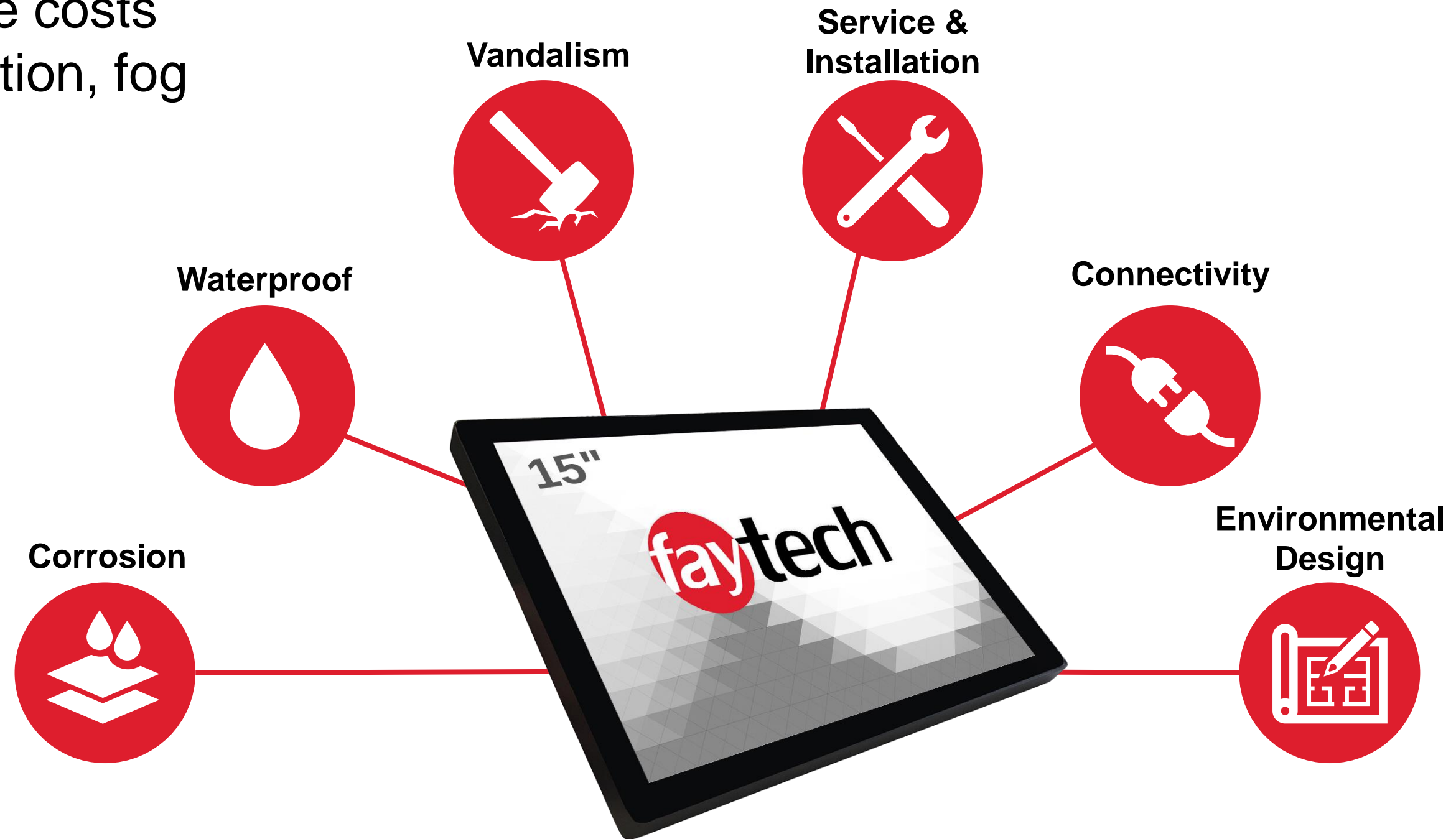
\* Transflective display technology would work but it is not available in mass production anymore



# Basics/Physics – Casing

For outdoor cases, the main issues are as follows:

- Vandalism/stability
- Installation and service costs
- Waterproof, condensation, fog
- Connectivity
- Corrosion
- Environmental design
  - Noise
  - ESD/EMI



# Basics/Physics – Casing – Suggestions

Discuss the main situation of the installation and feedback to engineers. The main task is to understand how rugged the design must be.

## "Sales points" / "Easy to integrate"

- Optical bonding improves picture quality, ruggedness, stops fog
- Define how the system receives power, network, etc. (e.g. through socket or wall?)
- How to service? Can the device be easily changed? Make the display-kit changeable, how to, ...
- In loud environments you need strong loudspeaker and professional MIC to hear/communicate

**Guidance** – for most installation situations faytech will most likely have done a similar installation before which can be used as a reference.

**Just collect/provide proper information!**

## Solution 1 – Semi-outdoor

Based on "physics", it is impossible to have a non-cooled device under direct sunlight, especially when it is required to support touch functionality.

**The solution is to define a semi-outdoor scenario, which means:**

- A location with no direct sunlight or a sun-shadow is installed on top of the device
- A typical brightness of 1000 cd/m<sup>2</sup>, which gives good readability under bright light
- No need for direct cooling
- Standard design is still to be rugged and waterproof

**faytech** has 'off-the-shelves' standard solutions with integrated waterproofing, as well as many semi-outdoor kiosks, wall-mounts, etc. which have been provided in customized projects before.

# Solution 1 – Semi-outdoor Portfolio

## faytech's key technologies for semi-outdoor:

- Edge backlight with 1000 cd/m<sup>2</sup> brightness
- Automotive long-lifetime LEDs with 100K hours lifetime
- Optical bonding;
  - Improved picture quality, stability, brightness, no dust, no fog
- Available options:
  - As open frame solution for easy integration
  - As free-standing solution
  - As kiosk solution

## [Open Frame Touch Screen Monitors | faytech AG](#)

Customized solutions from 7" to 86" available



7" Open Frame Capacitive Touch Monitor



11.6" Open Frame Capacitive Touch Monitor



15" Open Frame Capacitive Touch Monitor



15.6" Open Frame Capacitive Touch Monitor



21.5" Open Frame Capacitive Touch Monitor



32" Open Frame Capacitive Touch Monitor



43" Open Frame Capacitive Touch Monitor



55" Open Frame Capacitive Touch Monitor (4K)

# Solution 1 - Semi-outdoor Technology "spotlight" Edge Backlight

## Edge backlight "sandwich" design:

DITO-Glass-Touch-Sensor  
(highest quality)

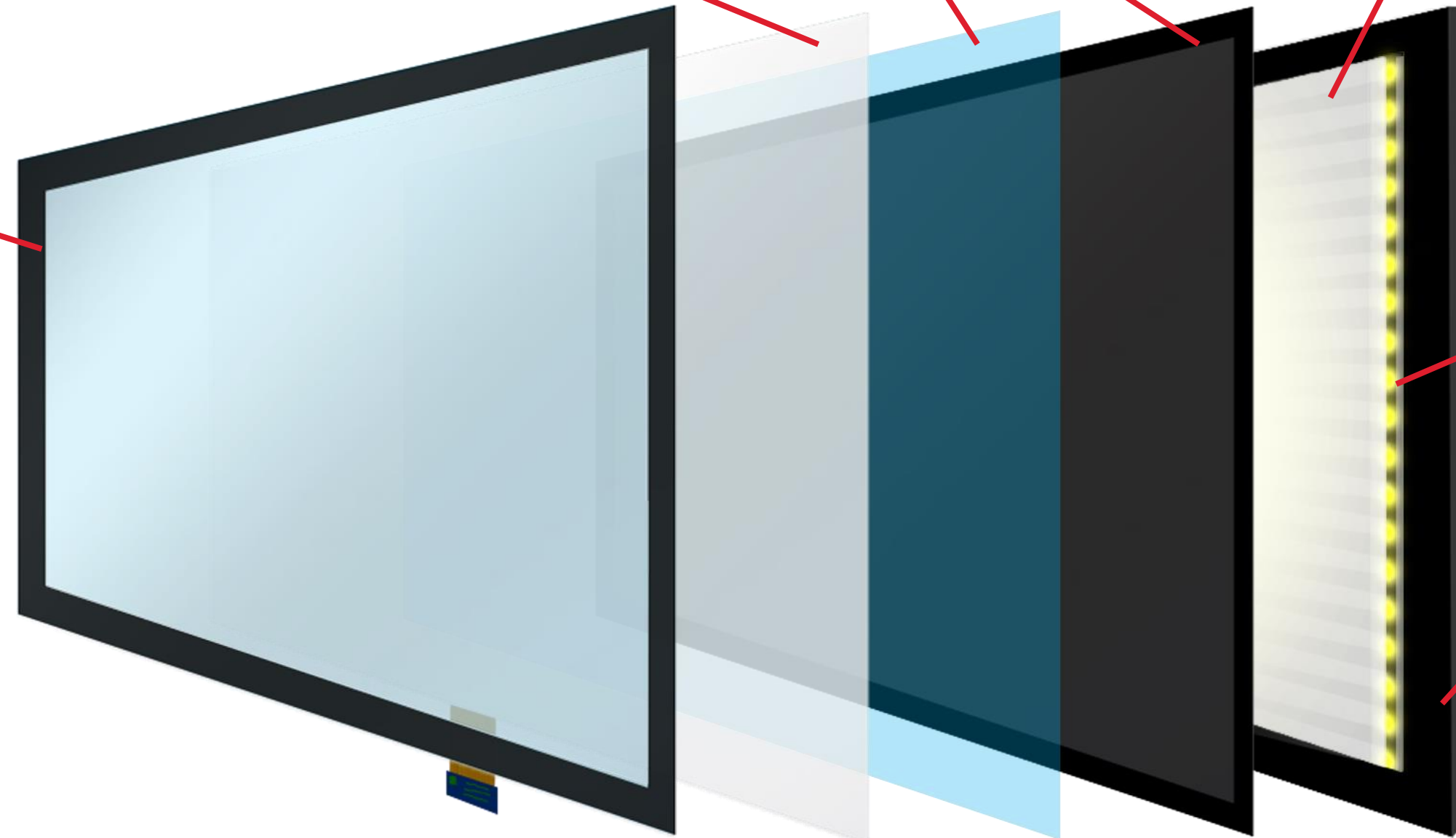
Optically bonded to Cell  
No yellowing secured for all parts

Light guide plate (LGP) to  
evenly distribute the backlight

Customizable Cover Glass

Customizable edge backlight  
(500 cd/m<sup>2</sup> to 1500 cd/m<sup>2</sup>)

Customizable  
case/enclosure



faytech solutions easily connects to monitors, embedded, PC-boards or for direct machine integration

# Solution 1 – Full-outdoor

Active cooling is required to offer direct sunlight-support, also a very high brightness of 2500+ cd/m<sup>2</sup> suggested

## The full-outdoor scenario means:

- Design must guarantee no blackening under direct sunlight
  - Commercial standard: 8 hours 800 W/m<sup>2</sup>
  - Automotive/Military: 240 hours 1,200 W/m<sup>2</sup>
- Extra high brightness required
- Complete waterproof and rugged design
- Active cooling included

# Solution 1 – Full-outdoor Portfolio

Full outdoor kits are customized projects. **faytech** has many projects in the size of 7" to 65", whereas the main quantity is for 43" and 55".

## Example:

- 55" 4K resolution (3840 x 2160)
- IP68 water- and dust-proof
- Strong, vandalism protected loudspeaker
- 2500+ cd/m<sup>2</sup>
- Optically bonded



# Solution 2 - Full-outdoor Technology "spotlight" Full-array Backlight

Full-array backlight "sandwich" design:

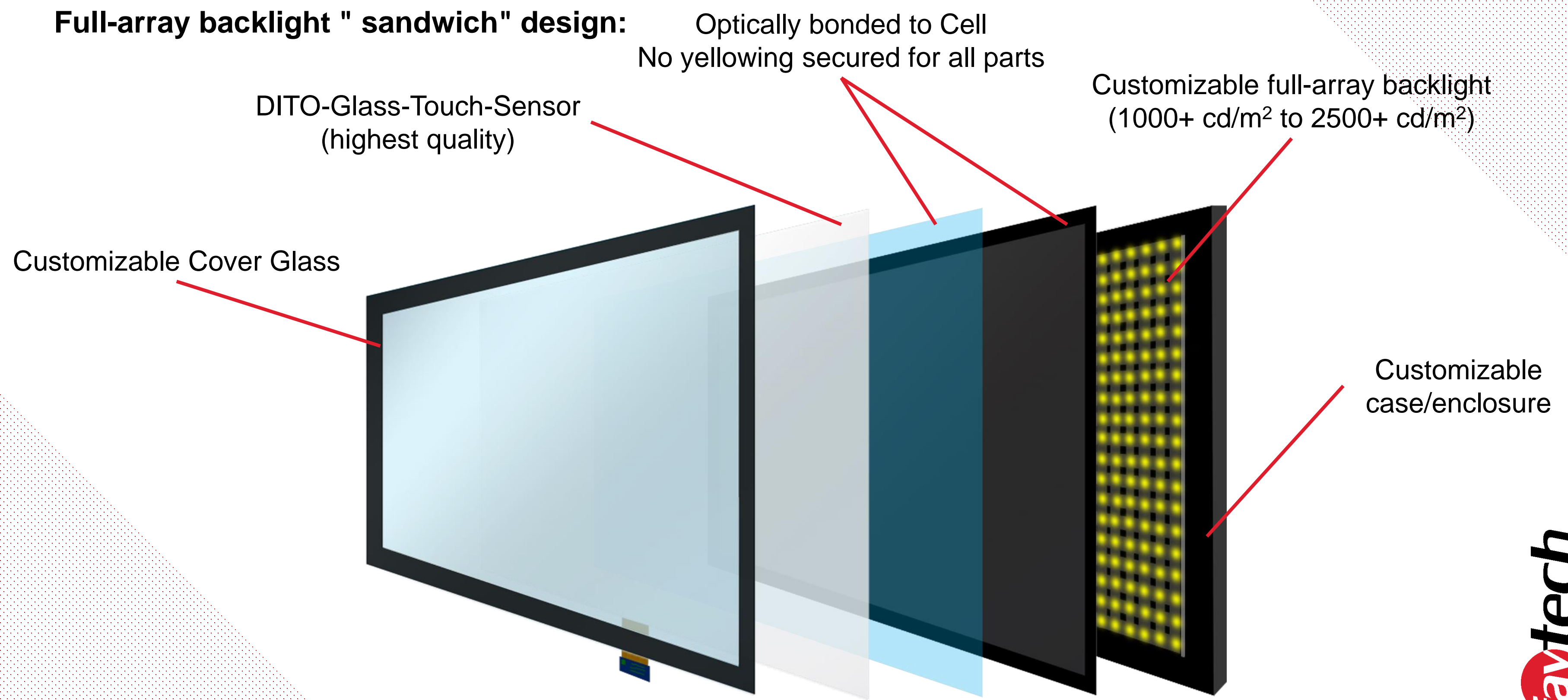
Optically bonded to Cell  
No yellowing secured for all parts

DITO-Glass-Touch-Sensor  
(highest quality)

Customizable full-array backlight  
(1000+ cd/m<sup>2</sup> to 2500+ cd/m<sup>2</sup>)

Customizable Cover Glass

Customizable case/enclosure



faytech solutions easily connects to monitors, embedded, PC-boards or for direct machine integration



**THANK YOU**  
*faytech*