CLICK HMI TOUCH

Your HMI solution provider

Whitepaper:
Touch Sensing technologies

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ClickTouch technology

In order to control a machine, usually touch technology is used as an interface between human and machine. These Human Machine Interfaces (HMI) can work in very different ways. This paper gives an overview of the different kinds of touch technology and lists the advantages and disadvantages of these different technologies.

ClickTouch started in 1986 with the development and manufacturing of membrane switches based on a patented innovative 'ClickTouch' embossing technology. As a founder of 'capacitive touch technology' for industrial usage, ClickTouch has further grown in developing and producing custom-made innovative HMI technologies that offer an absolute reliable quality and added value for the customer. Both hardware and firmware are customised to meet the specific needs of the application. This development is done in-house by engineers at ClickTouch headquarters in Gavere - Belgium. Offering the combination of both software and hardware is a unique solution in the market and gives a strong competitive advantage. ClickTouch has its own production facilities in Europe and Asia.

In 2000, ClickTouch, together with the founder of Quantum (now Microchip), developed the very first capacitive touch for industrial applications. This collaboration was complemented in 2007 by industrial applications developed together. From the first project for Cypress in the industrial market, the cooperation grew into a Platinum Partnership. Now that Cypress has been acquired by Infineon, ClickTouch is, as of 2021, a preferred design house for Infineon. Thanks to this close collaboration, ClickTouch now has access to low level programming of the microcontrollers developed by Infineon.

This offers customers the great advantage that both the touch sensors and the microcontroller are perfectly matched. In addition, the control software is 100% adapted to the user requirements and environmental conditions. This cooperation allows ClickTouch to take customer service to the next level for high-end solutions where perfect tuning of the PCB with the touch solution is required. We dig deep in the libraries of the microprocessor and can solve nearly any question ourselves, without the time-consuming communication with the producer of the processor. This intense customer support is the company's most valued added value.

ClickTouch is a complete solution provider. Products are developed in partnership with the customer, from the initial idea up to the final result. ClickTouch is capable of customizing the necessary solution from scratch. We don't start from a standard solution if that doesn't meet your needs. We build accordingly to the required specs. Complete solutions with display, controller boards, PCB (printed circuit boards) and bonding solution are developed from A to Z.

ClickTouch's solutions are used in different applications for industries like:

- White goods
- POS systems
- Consumer goods
- Industrial applications
- Transport
- Medical & healthcare
- Agriculture
- Defence & military
- Home automation
- Sport & wellness

Sensor material

In order to make capacitive sensors, a transparent conductive material is needed. ITO (Indium Tin Oxide) is most commonly used for this purpose. This layer is applied by sputtering on various substrates such as transparent film or glass. A pattern is made by etching through laser or a chemical process. This technology offers a very good compromise between optical properties, resistance and cost.

In our plant in the Far East, ClickTouch etches the ITO on these different substrates. In the non-visible areas we print silver wires that connect the transparent layer to the electronics. We have the most up-to-date equipment to enable this through silk screen printing.

Other alternatives to apply conductive material are:

- Metal mesh for big screens larger than 40”
- Silver nano wires, which combine high electrical conductivity with low light absorption in the visible parts and which are used in a wide range of applications, but mostly for screens under 20”
- Carbon nano tubes
- Poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS), a conducting polymere.

The choice for one of these solutions is

determined by:

- The dimension of the touch solution
- The application
- The desired price level
- The environment in which the touch solution will be used (critical environments or not).

Most of ClickTouch’s solutions are based upon ITO, but depending on the customer’s needs, we apply the technology needed for an optimized solution.

Tuning

Each capacitive touch technology must be adapted to its specific installation and housing in order to function optimally according to the manufacturer’s requirements. Therefore, each high-end solution must be tuned to the applications needed: how do we want the screen to function when water gets on it? How fast should the touch give a reaction? Can the use of gloves or other elements disturb normal interaction?

All these solutions, and many more, require extensive tuning for optimal use. Thanks to our relationship with Infineon & EETI, we can configure the necessary parameters and make the required adjustments ourselves, so that the customer is served very quickly and gets an optimised solution in the fastest possible way.

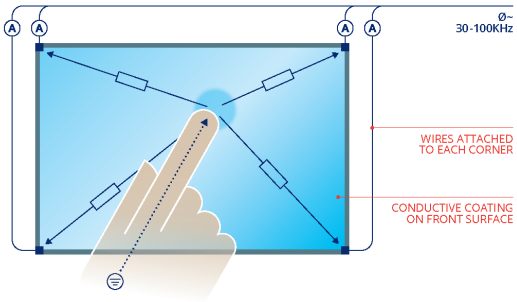
This service is the most valued added value of ClickTouch and makes sure that every touch solution you get is the solution you need.

Surface capacitive

What is it?

Surface capacitive touchscreens have a conductive coating on the front surface of the glass. Wires are attached to each corner, and a small AC-voltage is applied to each of the corners. When the screen is touched, a small current flows to the touch point, comparing the relative contribution of each corner to the total current, the touch position can be determined, allowing the sensor to pinpoint the exact touch point. Used for displays up to 32 inch.

How it works



Pros

- No visible pattern
- Very sensitive
- Low cost
- Resistant to contamination

Cons

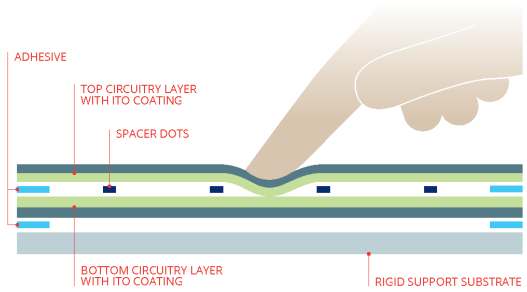
- No multi-touch capability
- Finger input only
- Calibration needed
- Difficult to integrate
- Fragile (only a thin coating is protecting the sensor)
- Unable to withstand heavy use

Resistive touch

What is it?

Resistive touch technology makes use of a touchsensitive display composed of two flexible sheets coated with a resistive material and separated by an air gap or microdots. If one sheet gets in touch with the other sheet, the voltage of the drive layer at the touch point is transferred to the sense layer and measured. This allows already positioning of 1 axis. In a second step the roles of sense and drive are switched and hence the other axis can be determined. The touch point is at the crossing of the axis. This technology is commonly used for displays up to 20 inch.

How it works



Pros

- Low cost
- Basic electronics, no tuning needed
- Resistant to contamination = no unwanted contacts

Cons

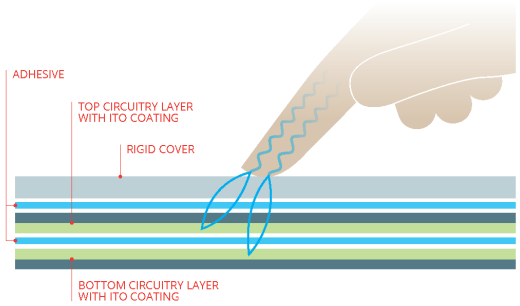
- Standard no multi-touch
- Durability (flexible top layer)
- Calibration needed
- Optical quality (2 ITO layers, spacer dots, air layer)
- Fragile (only protected by a film)

Projected capacitive

What is it?

The touch sensitive layer of the **projected capacitive** (pcap) sensor consists of typical 2 conductive layers with a patttern that are not visible on an active screen. Unlike the surface capacitive touch system, where the sensor is located on the surface of the touch panel, the projected capacitive touch system has the sensor located in the screen between the laminated glass. Not only does this technology provide a highly reliable, low-maintenance system, but it also offers unparalleled protection against a wide range of physical threats - a cost-effective solution for the most demanding (public) applications, for screens up to 80”

How it works



Pros

- Low cost
- Most used => a lot of benefits
- User friendly: quick, sensitive and accurate
- Reliable and durable
- Small screens can be single layer
- Combining self and mutual capacitance creates redundancy

Cons

- Unwanted activations (no force needed)
- Tuning needed (EMI, environment)
- Integration needs to be done carefully

Now there are two variants in this technology, that are often combined to result in the best of both worlds:

Self capacitance

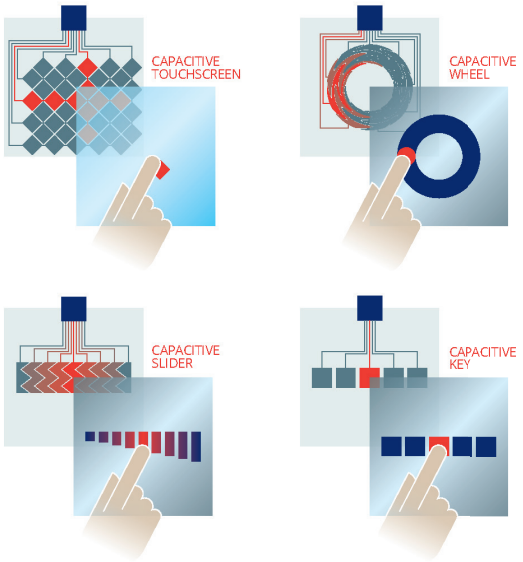
A single electrode is used for measuring each sensor. The human body increases capacitance and the sense layer detects the coordinates. Optimal for hover and proximity touch, touch through water or gloves...

Mutual capacitance

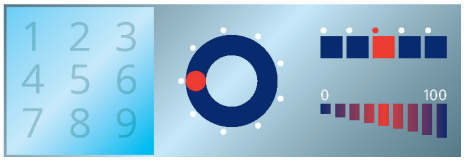
Both a drive electrode and a sense electrode are used and a touch decreases the current between them, where each intersection is measured seperately. Multitouch becomes possible.

This technology can be used in very different configurations, that offer extra customized functionalities:

- Touchscreen
- Wheel
- Slider
- Key



All configurations can be integrated in one control panel

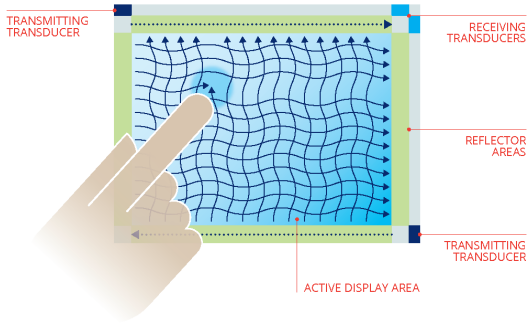


Surface acoustic wave

What is it?

Surface acoustic wave touch screen consists of one glass sheet with transmitting transducers, reflectors and receiving transducers. Transmitting transducers generate acoustic ultrasonic waves that travel over the panel surface. The waves are reflected by the reflectors and received by the receiving transducers.

How it works



Pros

- High optical performance
- Durable
- Gloves and soft stylus are possible

Cons

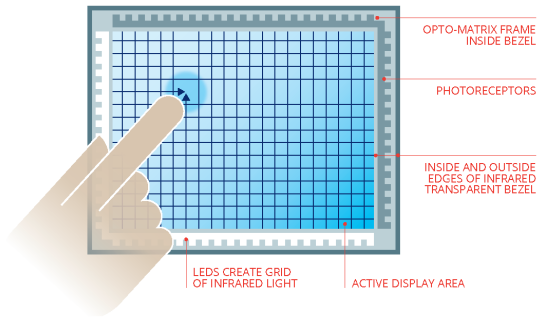
- Very sensitive to surface contamination (e.g. water)
- Some activation force needed (15-80 gram)
- Difficult integration (flexibility needed)
- Max. 2 fingers

Infrared

What is it?

Infrared touch technology (also known as IR) is widely used in commercial applications. Using IR technology means that no actual contact with the screen is required so less damage is incurred over time. It works by embedding LED lights and sensors into the bezel of a monitor above the glass. These LED's beam a signal across to the corresponding sensor on the other side forming an invisible grid. When the grid is broken by a finger, or other solid object, the sensors can detect the touch point. For screens up to 150"

How it works



Pros

- High optical performance (no ITO-layers or OCA)
- Durable
- Gloves and stylus are possible
- Multi-touch is possible

Cons

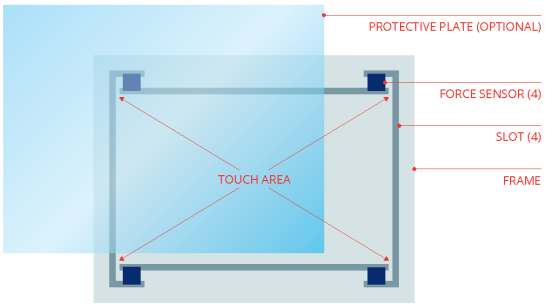
- Bezel on top, no sleek design
- External (sun)light can be an issue
- Low resolution
- High cost
- Power consumption

Force sensing

What is it?

A **force sensor** adds an extra layer of user intent information (based on the user finger pressure) to the capacitive touch technology. A soft touch can induce one action and a harder touch a second. For instance, in medical applications the movement of the finger registers a touch position and a harder touch initiates an action which leads to much better accuracy.

How it works



Pros

- High optical performance (no ITO-layers or OCA)
- Z-axis
- Gloves and stylus are possible
- Can be combined with PCAP for redundancy

Cons

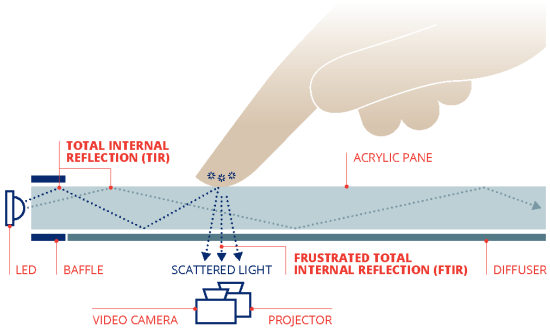
- Single touch
- Difficult to integrate
- Low resolution
- Vibration / temperature can cause false activations

Vision-based touch

What is it?

Vison-based touch systems employ one or more IR imaging cameras positioned so that an image of the entire screen can be captured. This usually means that the camera must be located a significant distance away from the screen, therefore most vision-based touch technologies are implemented with the detecting cameras behind a projection-screen surface. After capture, screen images are deciphered by imageanalysis software to determine the coordinates of touching object.

How it works



Pros

- Object recognition
- Unlimited multi-touch is possible
- Zero-force touch
- High optical performance
- High degree of scalability

Cons

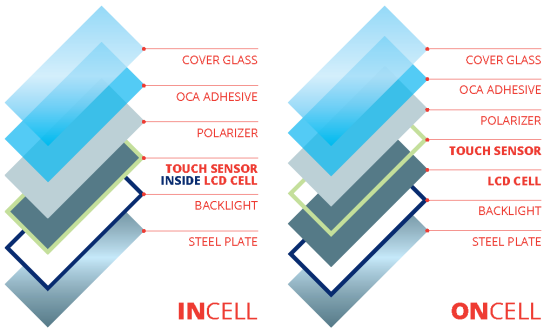
- Complex
- Needed space
- High cost

Embedded: In- /On cell

What is it?

With in-cell technology, the digitizer (which converts the analog touch signals into digital signals) or touch sensor is physically embedded inside the LCD cell or display layer. The touch sensing can be capacitive or lightsensing. With on-cell technology, the touch sensor is an extra layer between the LCD polarizer and the LCD.

How it works



Pros

- Low weight and thin

Cons

- Standard product, no customization or tuning possible
- No support for small series
- IP protection
- The sensor is close to the LCD (noise source) and the distance to the touch area is higher because of an extra airgap/ layers
- Unwanted touches (on cell)

Bonding

An important part of the production of touch screens is the bonding of the different layers. Several methods are possible:

Sensor bonding

Optical clear adhesive lamination
This is a lamination process with optically clear adhesive (OCA). A lamination from soft to hard takes place, e.g. a film-based sensor (ITO / mesh) behind the cover lens. With the help of storage in an autoclave, the air bubbles are eliminated.

Liquid bonding
Here bonding of hard to hard is done, i.g. a glass-based PCAP sensor is bonded behind the front glass.

Display bonding

Air gap or edge bonding
In this process, the display is glued all around with an adhesive frame directly behind the sensor or on the printing of the cover lens in the clean room. An air gap between the display and the sensor / cover lens remains. Air bonding is a simple and cost-effective way to connect displays with cover lenses or touch sensors

Liquid optical clear adhesive (LOCA) bonding
The air gap between the display surface and the rear side of the sensor is filled with a UV liquid adhesive. The adhesive is silicone-free, non-aging and UV stable. The method is suitable for TFT displays with frames. This method is already a common bonding technology. The liquid adhesive is applied over the cover glass and then bonded to the touch panel or TFT panel. The adhesive is spread evenly and bubble-free between the two components. The adhesive is cured without heat using UV light.

Dry bonding
In the dry bonding process, the bonding material is cut to the size of the visible display surface. The assembly of the front glass with the touch and display is carried out under vacuum in the bonding machine. This method is not suitable for all displays.

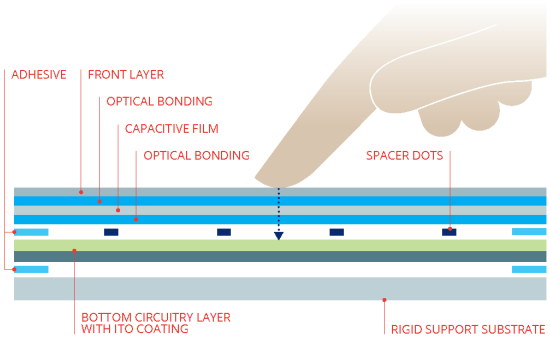
Gel bonding
This bonding method is essentially a technology between dry and liquid bonding. It has the optical and mechanical advantages of liquid bonding (improved shock resistance, stress mitigation, increased contrast, reduced parallax, less reflection and improved luminance) and the comparable production of dry bonding (better constant thickness, roller lamination, reverse lamination).

TwoTouch - Redundant touch screen technology

What is it?

TwoTouch Redundancy Technology sees a second, resistive screen installed underneath the first, capacitive contact screen. Through this, a touch is registered on each screen separately and verified on both screens combined. In this way, the user is certain that a touch is only registered when it is certain, desired and is meant to trigger an action.

How it works



Pros

TwoTouch Redundant Technology eliminates an important disadvantage for capacitive touchscreens in critical conditions: the touchscreen's involuntary activation through minimal unintentional pressure, strong fluctuations in temperature or the close proximity of conductive materials.

- Extremely high operational reliability
- Safety in critical applications
- High quality
- Long lifecycle
- Aesthetic design
- Stable operation in fluctuating temperatures
- Less significant impact of environmental conditions
- The possibility of having one operational screen when the other is broken (reliability)

Applications

TwoTouch Redundant Technology makes the followingapplications possible:

Maximum safety (redundancy)
Combining the signals of both technologies increases safety because both screens have to transmit the same touch coordinate before it is validated. No chance on false touches or accidental Touch. Think of medical procedures in which a drop of blood may not activate the screen, military and industrial situations in which a slight, unintentional touch can have big consequences.

Safety backup
Increased reliability because of the possibility to have one of the screens operational if the other is no longer operational (broken, defect, ...). For instance: resistive signal is the backup for the capacitive signal in case of water, blood or broken front.

Point and shoot
Ability to perform double confirmation. Increased ease of by combining two functions in one movement. The first screen can be used to navigate until the desired position has been reached after which the second screen makes the activation possible through an intentional push. Just think of a medical application in which a surgeon navigates a laser-pointer to the correct position and pushes the screen to activate the laser. The first screen is used to make the intention clear or for aiming, the second provides confirmation.

Application areas

- Medical applications
- Military applications
- Industrial applications
- Transportation industry
- Safety equipment
- Payment terminals
- ...

UnicTouch

What is it?

UniCTouch® or Universal Capacitive Touch stands for capacitive operation (keys, slider, wheel functions and touchpad) through every conceivable type of overlay and toplayer: metal, stainless steel, wood, cork, gold, glass, ...!

The name Universal Capacitive Touch indicates that the customer has design freedom to bring a highly innovative product to the market!

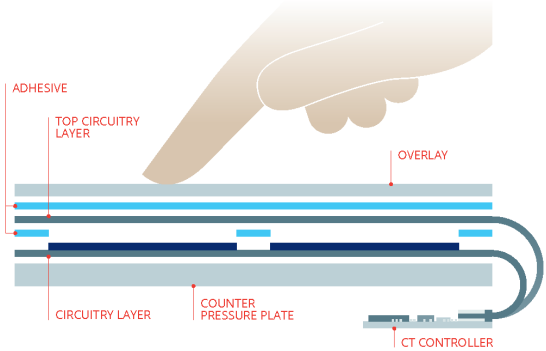
The UniCTouch® principle

A capacitive system detects the movement of the overlay as the distance between the two electrodes becomes shorter. This results in an increase in capacity. We can change the actuation force by playing with the mechanical design and software.

Stylich apperance

Metal and stainless steel are already widely used in your products. We now offer you the option to extend your metal surface to your control interface. You can have different input types: keys, sliders, wheel and touchpad. The design possibilities are endless!

How it works



Pros

Compared to other technologies, UniCTouch® has no limitations and offers more possibilities:

- Capacitive sensor for any type of material
- Cost effective
- Innovative design and detection
- Possibility of curved overlays
- Vandalproof
- Easy mounting & electronics
- Possibility of backlighting
- Sealed user interface
- Reliable & durable
- EMI / EMC protection

The future of Touch

There are also new touch technologies, that may have a function in specific areas:

Hover touch or 3D touch
A touch is discovered as far as 5 cm from the touch screen. This can be combined with functionalities in the Z-axis, where you get more possibilities as you move closer to the screen.

Haptic touch
A feedback (e.g. a vibration or noise signal) is given
when a touch is received, in order to assure the user
of receiving the touch. Harder to implement with big
dimensions

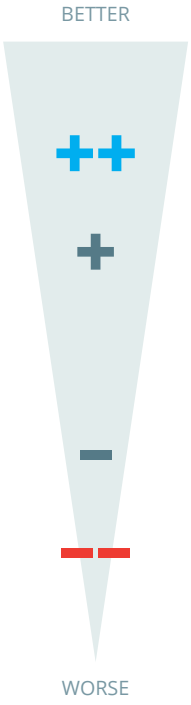
Frameless touch
Normally, silver wires are applied around the entire touch surface. With frameless touch, only one side is wired for connection to the electronics. The rest of the sides are free. This saves space and provides aesthetic possibilities, for example when placing a small touch surface on a large glass without a small frame.

Proximity touch
Used for energy saving purposes. A touch display turns off when you go away or turns on as soon as you come close to the touch surface.

Touchscreen technology comparison

	Surface capacitive	Resistive touch	Projected capacitive	SAW	Infrared
	Capacitive electric field on material surface	Mechanical	Capacitive electric field thru material(s)	Surface acoustic waves	Light interruption
Input method	Finger, conductive stylus.	++ Finger, gloved finger, stylus pen.	+ Finger, gloved finger, conductive pen.	+ Finger, gloved finger, soft tip stylus.	++ Finger, gloved finger, stylus pen.
Activation	+ Activation sensitivity is non-customizable. Activation pressure is consistent across substrate.	− Activation sensitivity is non-customizable. Activation pressure is inconsistent across substrate and over time.	++ Activation sensitivity can be customizable. Activation pressure is consistent across substrate.	+ Activation sensitivity is non-customizable. Activation pressure is consistent across substrate.	High degree of false-actuation due to zero pressure.
Surface hardness	−− There is only a thin protective coating.	− Hadcoated PET toplayer or thin glass.	++ High. More than 9H.	++ High. More than 9H.	++ High. More than 9H.
Durability/ longevity	−− Conductive layer is easy to scratch. Drift and aging can have an impact.	−− Low. Easily damaged by foreign objects and/or harsh cleaners. Highly subject to wear under heavy use.	++ High. Solid-state technology protected thru thin or thick rigid substrates: highly shock/impact resistant.	−− Low. Highly susceptible to stress or wear in mechanical construction over time.	−− Low. Highly susceptible to stress or wear in mechanical construction over time. The IR senders/receiv-ers are easily accessible.
Surface or environmental contaminants	+ Resistant to waterdrops and mild contamination.	++ Dirt or water has no influence on operation.	+ Combining self and mutual scanning offers good water operation. Salty water/blood remains difficut.	−− Very sensitive to contamination.	− Non-transparent contamination acts like a finger.
Sensor substrate types	+ Typically soda lime glass.	−− Typical polyester film or other plastic type construction is actual switch.	++ Thicker glass; some plastics possible with choices depending on use and interactions.	Glass only.	++ Any substrate.
Multitouch	−− No.	−− No.	++ Yes.	− 2 fingers.	+ Recent decoding techiques allow muli-touch.
Surface shape	++ Can be curved at all sides.	−− Flat only.	Flat or curved one direction only.	−− Flat only.	−− Flat only.
Transmissivity optics	+ Good > 92%.	− Distortion due to coatings < 82%.	+ Good > 92%.	++ Very good > 92%.	++ No distortion 100%.

Force sensing	Vision-based optical touch	Embedded	TwoTouch	UniCTouch®
++ Finger, gloved finger, stylus pen.	++ Finger, gloved finger, stylus pen.	+ Finger, gloved finger, stylus pen.	++ Finger, gloved finger, stylus pen.	++ Finger, gloved finger, stylus pen.
++ Force can in theory be adjusted on the fly.	+ Size of touch area can be related to force.	+ Customisation is difficult.	+ See PCAP en resistive.	++ Some force is needed. Threshold can be set in software on the fly.
++ High. More than 9H.	++ High. More than 9H.	++ High. More than 9H.	+ Thin glass layers on top.	++ High. More than 9H.
-- Low. Highly susceptible to stress or wear in mechanical construction over time.	+ The vision system must be protected.	++ High. Solid-state technology protected thru thin or thick rigid substrates: highly shock/impact resistant.	+ PCAP on top protects the resistive touch.	++ High. Solid-state technology protected thru thin or thick rigid substrates: highly shock/impact resistant.
+ Little effect.	Depends heavily on the used technology and setup.	+ Similar to projected cap.	++ Offers best of both worlds.	++ Dirt or water has no influence on operation.
++ Any substrate.	++ Any substrate.	+ Similar to projected but liess sensitive (noise).	+ Thin toplayer, carrier any substrate.	++ Any substrate.
-- No.	+ Yes.	++ Yes.	+ Yes for PCAP, not for RTS.	++ Yes.
+ Can be curved.	+ Can be curved.	Flat only.	Flat only.	+ Curved in 1 direction.
++ Very good > 92%.	++ Very good > 92%.	+ Good > 92%.	Moderate.	n/a



TECHNOLOGIES OFFERED BY CLICKTOUCH