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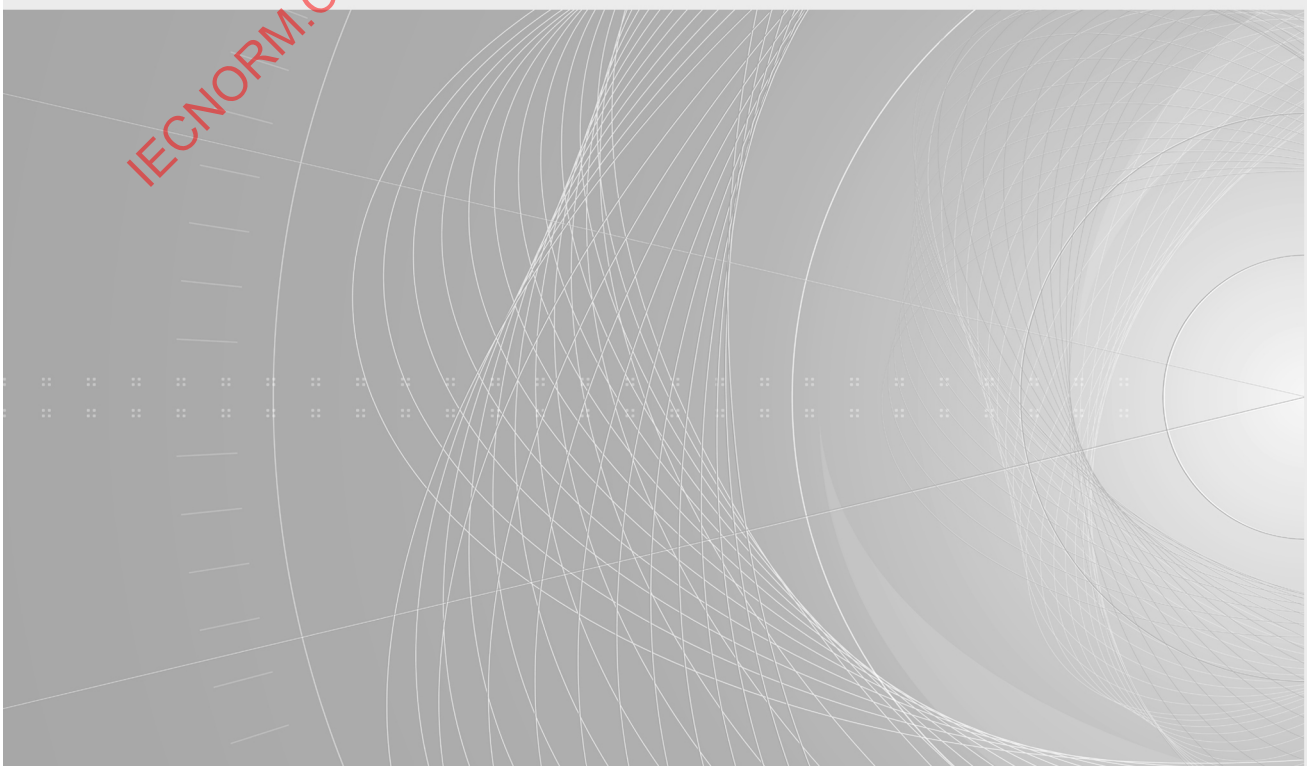
Edition 1.0 2021-07

TECHNICAL REPORT

Touch and interactive displays –
Part 1-3: Generic – General introduction to pen touch technology



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colour inside

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FOREWORD

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IEC TR 62908-1-3 has been prepared by IEC technical committee 110: Electronic displays. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
110/1311/DTR	110/1331/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 62908 series, published under the general title *Touch and interactive displays*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

With the spread of smartphones in recent years, finger touch technology has become widespread throughout the world. The field of popularization has started from smartphones, and has spread from information terminals such as notebook (laptop) PCs and tablets to kiosks, ATMs, sales equipment in the field of social infrastructure, medical equipment for professional use, and construction-related items.

Finger touch has several challenges, such as malfunction due to usage environment, such as wearing of gloves or water droplets, in addition to the difficulty of fine drawing with finger touch, signature input, and so on.

Initially, for the pen touch, the operating system and application software supported only the same function as finger touch, but recently a new concept of digital ink has enabled to use not only the data of the entered trajectory, but also the progressing data such as writing pressure, pen angle and drawing, being digitized and saved together with the trajectory data. This means that a new technique with pen input has been developed, which goes beyond the conventional technology of finger touch input.

Based on the above situation, this document aims to focus on the issues related to future standardization by summarizing the sensing methods of pen touch, the types of touch pens and the corresponding technologies, and the market trends of pen touch technology.

TOUCH AND INTERACTIVE DISPLAYS –

Part 1-3: Generic – General introduction to pen touch technology

1 Scope

This part of IEC 62908, which is a technical report, provides general information on pen touch technology with the aim toward standardization. This document includes an overview of the pen touch technology, critical performance characteristics, issues of characteristics measurements, and other information.

The purpose of this documents is to provide an overview of the different products available in pen touch technology.

NOTE The companies and products named in this document do not constitute an endorsement by IEC of these products.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 62908-1-2, *Touch and interactive displays – Part 1-2: Generic – Terminology and letter symbols*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60068-1 and IEC 62908-1-2 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Abbreviated terms

AES Active electrostatic
AP Apple pencil
API Application program(ing) interface
AR/VR Augmented reality / virtual reality
ATM Automated [automatic] teller machine
DSC Digital Stationery Consortium
EMI Electromagnetic induction

EMR Electromagnetic resonance
ES Electrostatics
IC Integrated circuit
MPP Microsoft Pen Protocol
OS Operating system
PCAP Projected capacitive touch panel
SDK Software developer's kit
SNR Signal to noise ratio
USI Universal Stylus Initiative
WA Wacom AES
WE Wacom EMR

4 Generic information on pen touch technology

4.1 General

In Clause 4, the classification of pen types, the corresponding sensing technology, and the touch panel structure and principle are described.

4.2 Classification

To clarify the performance of the touch pens, a comparison is made between a finger touch, a pen touch, and a mouse as a pointing device, as shown in Table 1.

The first major difference is that the finger touch and pen touch specify the absolute position of the screen, but the mouse specifies the relative position of the screen, because it operates at a different place from the screen.

The next point is regarding the accuracy of the position. The pen touches directly a specific position of the screen, so the pen touches have the highest position accuracy. The second highest accuracy is the mouse, because the mouse can control the precise position, and the lowest accuracy is the finger touch, because the point area of a finger is larger than a certain area on the screen.

On the other hand, the finger touch is suitable for multi-point designation and intuitive gesture motion.

In addition, as a pen is a general writing tool, the pen touch is most suitable for drawing pictures and signs, and also most suitable for manual input letters without using a keyboard.

Table 1 – Comparison of pointing devices

	Finger	Pen	Mouse
Coordinates	Absolute coordinates	Absolute coordinates	Relative coordinates
Positional accuracy	Poor	Excellent	Fair
Multi points	Available	Available	N.A.
Gesture operation	Excellent	Fair	Poor
Drawing performance	Fair	Excellent	Poor
Conformance of the signature	Fair	Excellent	Poor
Compatibility with digital ink	N.A.	Available	N.A.

Next, the types of touch pens can be classified as shown in Table 2. In Table 2 the first category is whether the pen has an electrical circuit or not. The next category is about the method of detecting the pen touch. In the third category, there are two types, one-way communication (unidirectional) and two-way communication (bidirectional) with the pen and the detection panel or the system side.

Table 2 – Classification of touch pen

Circuits built-in or not	Pen touch sensing method	Pen type/ protocol[1]	Unidirectional or bidirectional
Passive pen (without circuits)	Resistive	General commercial pen	Unidirectional
	PCAP	General commercial pen	Unidirectional
Active pen (built-in circuits)	PCAP	Type MPP	Bidirectional
		Type WA	Bidirectional
		Type AP	Bidirectional
		Type USI	Bidirectional
		Universal pen	Bidirectional
	EMI	Old type	Bidirectional
		Type WE	Unidirectional
	Optical	Exclusive	Bidirectional

The active stylus pen which supports the PCAP touch panel is most in use for smartphones, tablets, and note PCs. Some companies have recently developed their own methods which compete with each other.

The optical pen is developed exclusively for a specific system, and there are many types, but in this document the detailed technology is omitted.

4.3 Sensing technology for touch pen

4.3.1 General

There are two types of panel structure for the sensing pen touch:

1) Use of the touch panel sensing method (resistive type, capacitive type, optical type, or ultrasonic type).
2) Use of the additional digitizer panel sensing method (EMI method).

Table 3 summarizes the relationship between the touch panel system and the touch pen.

In 4.3.2 to 4.3.6, the structure of each touch panel and the detection method are described.

[1] Microsoft Pen Protocol, Apple Pencil, Wacom AES and Wacom EMR are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of these products.

Table 3 – Correspondence between touch panel and touch pen

Type	Resistive panel	Capacitive panel	Optical panel	Ultrasonic panel	EMI panel
Passive stylus pen	Mainly used	Mainly used	Available	Available	N.A.
Active stylus pen	Available	Mainly Used	Available	N.A.	N.A.
EMI pen	Available	N.A.	N.A.	N.A.	Mainly used

NOTE 1 An electronic circuit is not included in the "passive stylus pen" (e.g., resonant circuits).

NOTE 2 Depending on the material of the passive stylus pen, detection can be by an optical method or an ultrasonic method.

NOTE 3 Active stylus pens are generally made for capacitive type panel.

NOTE 4 There are also special pens for specific products on the market.

4.3.2 Resistive type panel structure and sensing method

The resistive type touch panel, which is shown in Figure 1, is configured with two resistive films and a gap between these films.

By "pressing" the top resistive film with a finger or a pen, the pressed position is electrically short-circuited. The driving and controlling IC detects this short-circuited position by measuring the resistance value of this resistive film.

The pen has sufficient rigidity to short the two layers of resistive film electrically.

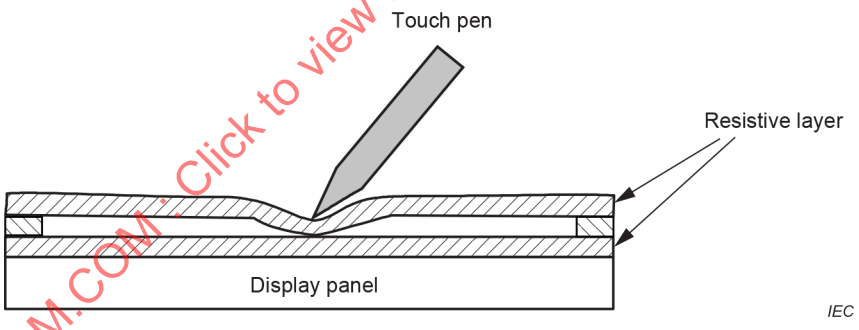


Figure 1 – Resistive type panel structure

4.3.3 Capacitive type panel structure and sensing method

The capacitive type panel, which is shown in Figure 2, has a structure in which two types of electrodes are arranged in a matrix.

Since the two types of the adjacent electrodes are capacitively coupled, and the capacitive component of the human body changes a parasitic capacitance of the point where a finger or a pen touches, then the drive circuit detects this point.

In the case of the passive stylus pen, this pen needs the conductivity in order to transfer the parasitic capacitance of the human body to the touch panel.

In the case of the active stylus pen, it has a built-in circuit to change the electric field generated by the touch panel at a similar level as that of the finger touch. This touch pen has a conductivity that can transmit a sufficient signal to the touch panel. In addition, there are

various structures forming the two types of adjacent electrodes on one substrate, for example electrodes are formed on two pieces of glass or film.

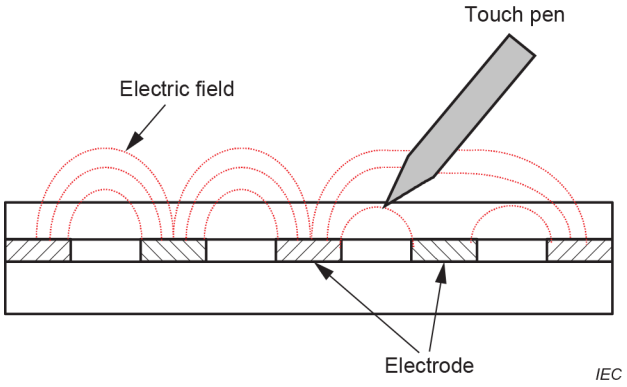


Figure 2 – Capacitive type panel structure

4.3.4 EMI type panel structure and sensing method

As shown in Figure 3, the EMI panel structure has a plurality of rectangular antenna coils arranged in parallel in a two-dimensional (X-axis, Y-axis) direction orthogonal to each other.

The detection method of the digitizer uses the electromagnetic induction between a plurality of antenna coils stretched around the digitizer panel and a touch pen.

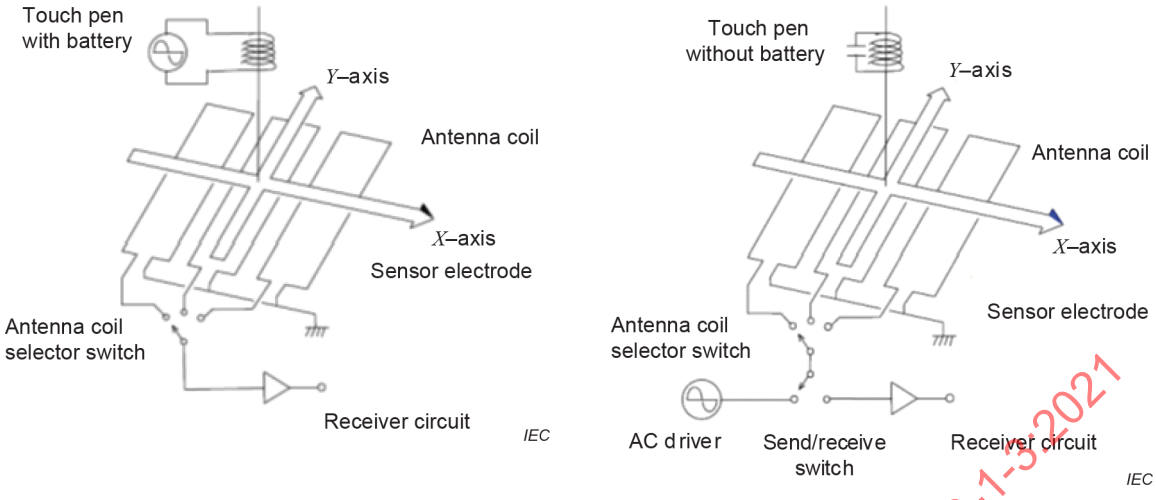
As shown in Figure 3 a), the initial touch pen has a transmitter coil, a power supply for continuously generating an alternating magnetic field from the coil, a driver circuit, and an oscillator circuit.

The digitizer's main body sequentially changes the switch of the antenna coil to scan the sensor panel surface. The position of the touch pen was calculated by using the signal level. Where the touch pen is closest to the panel, the strongest signal is detected from the antenna coil, and a relatively weak signal is from the coil adjacent to the pen.

Further, information such as the switch data of the touch pen and the writing pressure has been sent to the digitizer's main body by modulating the response signal from the touch pen side by changing the capacity inside the touch pen.

In recent years, the "penable technology type digitizer" (see Figure 3b) WE type) has been commercialized and occupies the market. In this method, the touch pen has no power source, and the position is detected by exchanging electromagnetic energy between the touch pen and the antenna coil of the digitizer body. [1][2]

2 Numbers in square brackets refer to the Bibliography.



a) Original type **b) WE type**

Figure 3 – EMI type panel structure

4.3.5 Optical type panel structure and sensing method

There are various types of optical touch panels, such as a scanning type, a projection type, and an image (camera) type. Among them, a scanning panel structure will be described as a typical example. This type panel has a structure in which a light emitting element array and a light receiving element array are arranged as a set on opposite sides, as shown in Figure 4.

As for the detection method, the optical touch panel detects the position by shading the light at the place where the pen hits.

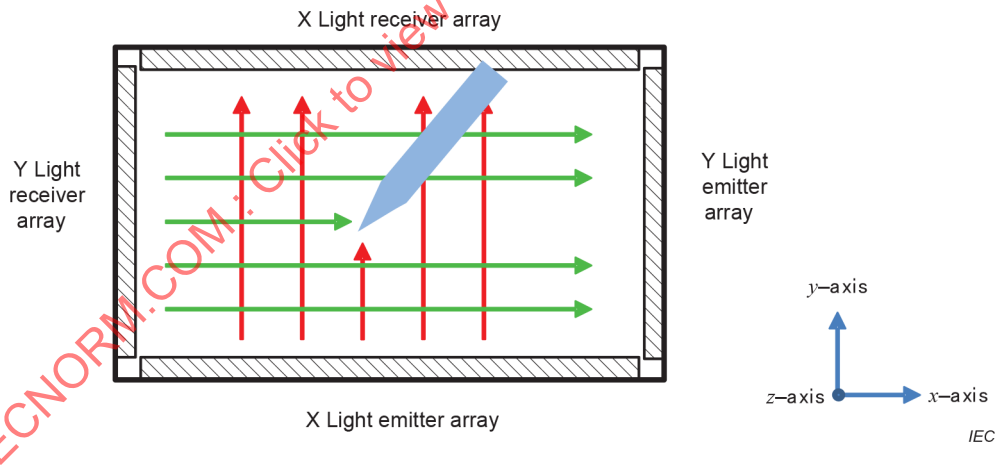


Figure 4 – Optical type panel structure

4.3.6 Ultrasonic type panel structure and sensing method

In the structure of the ultrasonic touch panel, as shown in Figure 5, ultrasonic transmitters and receivers are arranged on adjacent sides. The ultrasonic waves transmitted from each side are sequentially reflected by Reflector 1 at 90° from the side closer to the transmitter Y in Figure 5, and propagate to the panel. The ultrasonic wave received from the panel is reflected by Reflector 2 at 90° and propagates to the receiver in sequence.

In the vicinity of the Y transmitter, the ultrasonic wave will be immediately reflected by Reflector 1 at 90°, after being propagated to the panel; it will be again reflected at 90° by Reflector 2 near the Y receiver, and will be received by the Y receiver in a short time after transmission.

In an area far away from the Y transmitter, the propagation distance inside Reflector 1 and 2 becomes long, and the time until it will be received by the Y receiver becomes long. Therefore, ultrasonic waves propagate through the entire surface of the panel with a time difference.

The detection method attenuates the ultrasonic signal at the place where the pen touches, so the intensity of the ultrasonic wave at the time corresponding to this place is attenuated, and the position can be detected.

In this case, the necessary function of the pen is "coupled" with the substrate, such as glass, which propagates the ultrasonic waves.

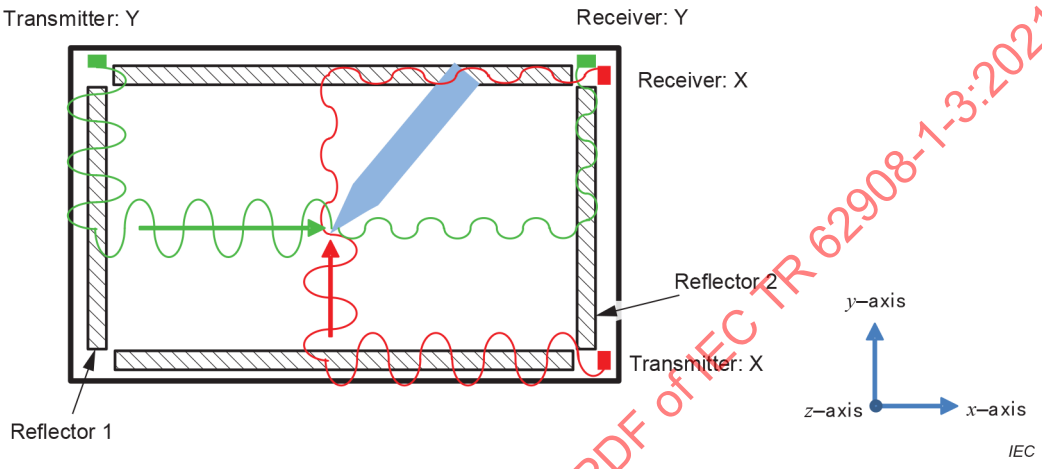


Figure 5 – Ultrasonic type panel structure

4.4 Touch pen architecture

4.4.1 General

Subclause 4.4 describes the structure and features of each type of touch pen more specifically according to Table 2.

4.4.2 Passive stylus pen

A passive stylus pen is a pen without an electrical circuit inside. The pen tips have different shapes corresponding to the respective detection methods.

The shape of the pen tip for the resistive type touch panel is generally a hard tip and often has a pointed shape.

The pen tip for a PCAP type touch panel has various tip (nib) shapes and materials, but each has a certain area or more to allow the touch panel to detect the capacity of the operating human.

In general, for general public terminals with optical or ultrasonic touch panels, such as ATMs and ticket vending machines, dedicated touch pens are not sold, but even passive stylus pens for PCAP can be used, if the SNR level is sufficient

This means that, when using a PCAP passive stylus pen for an optical touch panel, it can be used if the pen can sufficiently block the sensing light.

On the other hand, in the early days of personal products such as early mobile terminals and PDAs, resistive touch panels were mainly used, but recently smartphones, tablets, and note PCs have become popular, and along with these, the PCAP type has become the mainstream touch panel type.

Passive stylus pens for PCAP touch panels have now become mainstream, and a wide variety of those is now widely sold.

Examples of the material of the pen tip (nib) include silicone rubber, resin, fibre, transparent disk, among others. Figure 6 to Figure 8 are examples of different types of pens.

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Figure 6 – Example of conductive fibre tip

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Figure 7 – Example of transparent disk tip

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Figure 8 – Example of exclusive pen

4.4.3 Active stylus pen

4.4.3.1 General

An active stylus pen is a pen that has some kind of electronic circuit inside.

An active stylus pen sends out a signal to a dedicated touch sensing system so that the touch controller detects the signal and calculates the pen position. In order for an active stylus pen to send out the signal, a battery is generally required in the pen.

An active stylus pen system usually has a modulation capability to send information from the pen to the system such as the pen tip pressure, battery level, etc.

The active stylus pen is now widely used for smartphones, note PCs, and pen tablets with PCAP touch panels, and many kinds of active stylus pens have been developed and sold. Further, even for large-sized display products, such as electronic blackboards and projectors, which use an optical touch panel, a dedicated pen for each product has been developed and has become popular.

The active stylus pen systems are classified into the following two categories based on their communication channel.

a) Unidirectional: Only the pen sends a signal to the device.

b) Bidirectional: There is a downlink where the pen sends a signal to the device, and there is an uplink where the device sends a signal to the pen. The uplink is used for the timing synchronization between the device and the pen, or for sending commands from the device to the pen, among others.

An active stylus pen is roughly divided into two fields: an EMI pen for an EMI panel and an active pen for a PCAP panel.

The types of active stylus pens for PCAPs that are popular in the market are roughly classified into the following five types:

1) universal active stylus pen (4.4.3.3)
2) type MPP (Microsoft Pen Protocol) (4.4.3.4)
3) type AP (Apple Pencil) type (4.4.3.5)
4) type WA (Wacom AES) (4.4.3.6)
5) type USI (Universal Stylus Initiative) (4.4.3.7).

4.4.3.2 EMI pen

Regarding the EMI system, there was an active pen with a built-in battery in the past, but now the active pen without a built-in battery is becoming the mainstream.

Now that the Type WE has become mainstream, a number of EMI pens have been released, as shown in Figure 9.

Figure 9 – Example of EMI pens (Type WE)

The features of these EMI pens are as follows.

Because they do not have any batteries, these pens are small and lightweight with excellent operability and tracking performance. In addition, the built-in pen pressure sensor has 256 or more levels of pressure sensing, and it is possible to set up the same function of mouse switch for the pen tip and/or the side tail part of the pen via the OS. [2]

4.4.3.3 Universal active stylus pen

Although the principal operating details are not clear, this type of pen does not comply with a particular touch panel drive IC system. Not all PCAP type touch panels can be used, but there are also cases where even the touch panel of each company's dedicated protocol described below can be detected and used as a pen touch.

4.4.3.4 Type MPP active stylus pen

In 2015, the type MPP started licensing its technology. This protocol is used widely in note PCs. In addition, this protocol supports palm rejection with both hands, as well as the hovering function.

4.4.3.5 Type AP active stylus pen

Officially this type AP has been on the market since 2015.

It seems that this touch panel technology as well as the sensing technology for the active stylus pen are original, and details are unknown.

4.4.3.6 Type WA active stylus pen

Type WA has been developed as an original type active pen technology for capacitive panels, and details are unknown.

4.4.3.7 Type USI active stylus pen

This type USI is supported by a standardization organization since April 2015 with the purpose of enabling the same active stylus pen to be shared by multiple models. The founding members include manufacturers with stylus technology, and hardware manufacturers.

The type USI stylus pen has recently been released.

The hardware defines the digitizer IC and pen on the main unit. The current standard defines the PCAP type method. The resolution is 10 bits (most digitizer pens currently are 8 bits), the interaction between the pen and the digitizer is bidirectional, the writing pressure is detected in 4 096 steps, and the pen tilt angle is detected. [3]

The following Table 4 is a comparison of the functions of the PCAP-type and EMI-type touch pens currently used in the most popular smartphones or tablets.

To explain the characteristics of the passive pen in Table 4, the pen pressure and the tilt angle can be detected in principle even with the passive pen. This is because if the pen tip of the passive pen is made of a soft resin, the contact area changes depending on the writing pressure and the contact shape changes depending on the angle, and thus the writing pressure and the tilt angle can be detected.

As for the EMI pen, there is an example of a product in which a plurality of pens can be used because an ID is given to the pen.

Table 4 – Performance comparison of touch pens for PCAP/EMI

Panel type	PACP panel						EMI panel
Active/passive stylus pen	Passive	Active					
Protocol type/name	Universal	Universal	Type MPP	Type AP	Type WA	Type USI	Electro-magnetic induction
With/without battery and circuits	Without battery No circuits	With Battery, with circuits					Without battery With circuits
Multi-pen touch	Available	Available	Available	Unknown	Available	Available	Available
Pen pressure detection	Possible	Possible	Available	Available	Available	Available	Available
Pen tilt angle detection	Possible	Possible	Available	Available	Available	Available	Available
Palm rejection	Available	Possible	Available	Available	Available	Available	Not necessary[a]
Mutual communication	N.A.	Possible	Available	Available	Available	Available	Possible
Hover sensing	N.A.	Available	Available	Available	Available	Available	Available
Note	•Cheep •Multifarious shape	•Multifarious shape	•Windows®10[3] supported	•iOS supported	•Widely used in pen tablet	•Started in 2015	•Now mainstream is type WE

NOTE 1 Available: This means that it is technically possible and already commercialized.

NOTE 2 Possible: This means that although it is technically possible, it is not currently commercialized.

a Not necessary: As an EMI panel has no sensitivity for finger and/or palm touch, palm rejection is therefore not relevant.

4.4.3.8 Exclusive pen

An example of an exclusive pen is the dedicated pen for an interactive projector.

The exclusive pen can communicate with the projector side by an infrared signal when the tip of the pen contacts a screen. The button of the pen also has the same function as the right button on a mouse. The pointing position of the pen is recognized by the camera on the projector side. In addition, the finger touch position is recognized not by the camera but by an infrared area sensor.

5 Pen touch characteristics

5.1 General

The pen touch characteristics are characteristics required for drawing, inputting characters and operating the screen by a touch pen. These characteristics can be classified into two categories. the first one is the same as the finger touch characteristic. The second one is the unique characteristic of the pen touch only.

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[3] Windows®10 is the trade name of a product supplied by Microsoft. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

5.2 Basic characteristics of pen touch

The pen touch has the same characteristics as the finger touch (see Table 5). See IEC 62908-12-10 [9] for details.

Table 5 – Basic pen touch characteristics

No.	Items	Contents	unit	IEC 62908-12-10:2017 [9] subclause
1	Accuracy	1) Closeness of the reported position to the target position（1 point) 2) Closeness of the reported position to the target position （matrix)	mm	5.2
2	Repeatability	Specify by repeatedly moving up and down at 1 point	mm	5.3
3	Jitter	In the matrix, deviation when maintaining a fixed position	mm	5.3
4	Linearity	1) Repeatability Deviation of each point when specified in a straight line 2) Jitter Deviation average when drawing straight lines at regular intervals	mm	5.4
5	Reproducibility	Deviation from the centre when 30 points are specified on the circumference	%	5.5
6	Latency	The response time between the actual and reported touch	s	5.8
7	Perpendicular touch /hover distance	Vertical sensitivity Height that cannot be recognized as touch	mm	5.13

5.3 Unique and important characteristics of touch pen

5.3.1 General

Table 6 lists the characteristics specific to the touch pen. These characteristics are mainly related to how to use the pen. The position parallax (No. 3) is not a problem with finger touch, due to the finger size being bigger than the pen tip.

These will be described below.

Table 6 – Unique and important characteristics of touch pen

No.	Items	Contents	Remarks
1	Tracking speed	Difference between pen touch and responsiveness (drawing speed, distance between touch and response draw, time delay)	Issue
2	Writing comfort	Writing like a pencil or ball point pen or other types of pens	Issue
3	Position parallax	Difference between the pen touch position and the screen display position	
4	Minimum pressure / minimum area	Detectable minimum pen pressure and size factor	
5	Pressure sensitivity	Linearity and/or resolution of sensitivity for pen pressure	Issue
6	Tilt angle	Linearity and/or resolution of sensitivity for pen tilt angle	Issue
NOTE “Issue” items need more time to establish the measuring method and condition.			

5.3.2 Tracking speed

The tracking speed is the delay time between the pen touch and the system side response. When the touch point is fixed, it is difficult to recognize, but when the touch point is moved, this difference in tracking speed becomes easy to recognize.

In an experiment conducted in 2012, a video shows the response when the finger touch is moved left and right under four conditions. In this video, there are four parameters for the response speed. [4]

In this video, an experimental system is constructed, and the response speed of the touch panel is adjusted to 100 ms, 50 ms, 10 ms, and 1 ms, respectively. According to this experiment, the delay time of a general touch system was about 100 ms in March 2012. A 1 ms delay time gives almost no perceived delay.

It is necessary to set the standard delay time, as shown in the demonstration video [4]. This standard delay time is the total delay time of the touch panel, control circuit, PC control system, drawing software, and other functions.

5.3.3 Writing comfort

Writing comfort is the feeling of a hand when writing a character or drawing a picture with a pen on the screen, and it is also how to write easily.

It is difficult to write if the surface of the panel is too slippery, and also if the surface resistance is too strong. For example, a good feeling of writing comfort is that there is a moderate amount of resistance similar to writing with a pencil on paper.

This writing comfort is specifically how the person feels when using the pen. It depends on the frictional resistance between the pen tips, the frequency characteristics of the elastic modulus of the touch panel surface, and complex elements such as the frequency of vibration during drawing. There are various types of target pens, such as pencils, ballpoint pens, fountain pens, and brushes, and pencils and brushes have various hardness and spring properties.

5.3.4 Position parallax

The position parallax is the deviation between the designated display position and the designated position with the touch pen. It depends on the viewing angle of the display.

As shown in the left side of Figure 10, when viewed from the vertical direction with respect to the panel, there is no position parallax between the designated display position and the designated position with the touch pen.

However, position parallax will occur when viewed from an angle other than vertical, for example, $\theta°$ from the panel. In Figure 10, V is the position of the target pattern (viewing position), and P is the pointing position of the pen (pen touch position). The position parallax, then, is the distance between V and P.

The position parallax x can be simply calculated by the following formula, where y is the total of the thickness of the touch panel and the cover lens above the display panel, and θ is the viewing angle between the panel and viewing positions.

$$x = \frac{y}{\tan\theta} \tag{1}$$

Therefore, the thicker the total thickness of the cover lens and touch panel, the bigger the position parallax x.

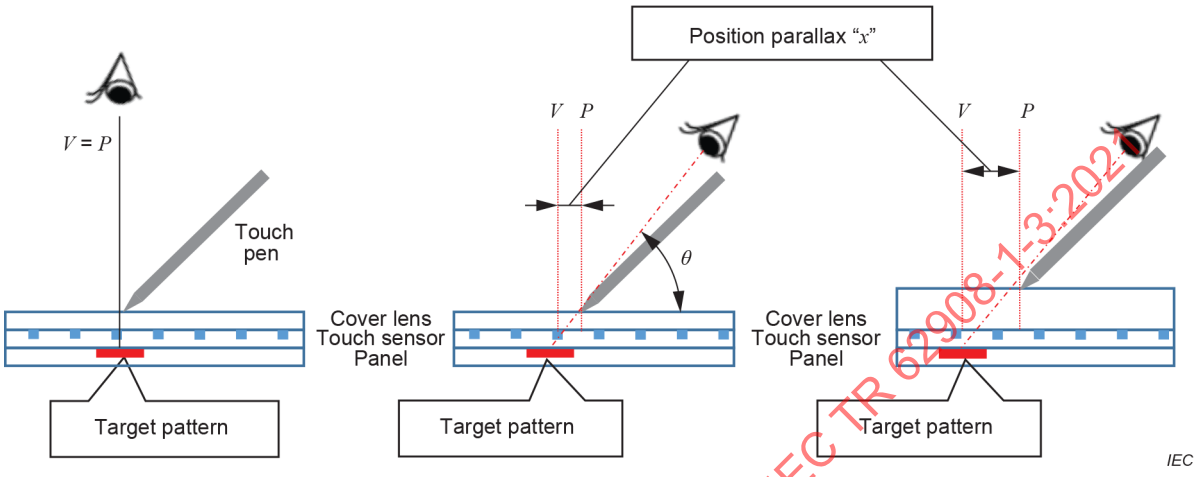

Figure 10 – Position parallax

5.3.5 Minimum area and minimum pressure

The resistive touch panel requires minimum pressure because a certain pressure or more is required to short-circuit the two layers of resistance films.

Other types of touch panels have a minimum area. For example, in the PCAP touch and optical touch type methods, the parasitic capacitance and the light-shielding property are determined in proportion to the contact area, so it means the minimum area corresponding to the minimum signal that can be detected.

5.3.6 Pressure sensitivity

Writing pressure is the pressure applied to the display when using the pen.

Writing pressure can be detected with an active stylus pen and EMI pen.

In the active stylus pen, the data of the writing pressure sensor is generally transferred to the system side via a communication channel. The resolution of the writing pressure is determined by the resolution of the pressure sensor inside the pen and the resolution of the A/D converter that converts this analogue pressure signal into a digital signal.

In the case of an EMI pen, the EMI panel can detect the writing pressure by the changing of the resonance frequency, and by incorporating a capacitor that changes with the writing pressure of the pen. The resolution of the writing pressure of the EMI pen depends on the resolution of the detecting circuit capability of the detecting changes in the co-frequency.

There are two measurement items related to writing pressure: resolution and linearity.

Therefore, the pen pressure measurement is as follows. In the case of the active stylus pen, it will be the measurement of the performance of the pressure sensor inside the pen. In the case of the EMI pen, it will be the performance of the frequency detection circuit of the EMI panel.

5.3.7 Tilt angle

The tilt angle is the angle between the pen and the display panel.

These tilt angle characteristics are only for the active stylus pen.

Generally, an angle sensor or equivalent is built into the pen, and the data of this sensor is transferred to the system side via a communication channel.

In the case of an EMI pen, the detection position at the pen tip is compared with the position information from the second electrode on the pen side. If the two detection positions are the same, the pen is perpendicular to the panel, and if these two positions are different, the angle of the pen is detected by the difference between the two positions.

There are three measurement items related to tilt angle, resolution, measurement range, and linearity.

Since this measurement item also depends on the performance of the angle sensor inside the pen, the performance of this angle sensor is eventually measured as tilt angle performance.

6 Application example for each pen touch technology

6.1 General

Clause 6 describes the applications that are specific for touch pens after smartphones have been released.

6.2 Passive stylus pen

There is no application specifically for passive stylus pens. In general, there is no example of using the touch pen as an inevitable example for PCAP touch panel products, so the general application of passive stylus pen is outside the scope of the description.

6.3 Active stylus pen

6.3.1 General

Subclause 6.3 describes the applications for active stylus pens for EMI and PCAP touch panels, and the exclusive active stylus pens for optical touch panels.

6.3.2 EMI pen

6.3.2.1 General

Currently, these applications for EMI pens use the EMI panel technology called "pen-able technology" from Wacom. The main products are the pen tablet, which includes a liquid crystal display and an EMI panel, and the smartphone, which includes an OLED display, a PCAP touch panel, and an EMI panel.

6.3.2.2 Pen tablet

Pen tablets, which are used for creating animations and illustrations, are widely used in this field. An example photo is shown in Figure 11 [5].

Figure 11 – Pen tablet for animation/illustration

This type of product uses an EMI pen called "Pro Pen 2[4]", which has no battery. The pen pressure sensing level is 8 192 levels, the pen tilt angle range is ±60°, and two side switches are attached.

Alternatively, with a higher-level EMI pen called "Pro Pen 3D", a 3D drawing function is available, and the number of switches is increased from two to three. However, other functions are basically the same as for the "Pro Pen 2".

In addition, the EMI pen is used in educational tablets.

6.3.2.3 Smartphone

Certain types of smartphones have both an EMI panel and PCAP panel and are equipped with a battery-less type EMI pen. Recent models have been equipped with-battery type pens, but the basic function of the EMI pen remains the same. The writing pressure level is 4 096 levels.

6.3.3 Universal pen for PCAP type

In the case of the universal active stylus pen, the driving IC for the PCAP panel will detect the change of the alternating electric field excited by the circuit built into the pen. Basically, it seems that most of the PCAP touch panels can be used, but depending on the combination of the touch panel or touch panel controller and the pen, it may sometimes not be possible to use them.

6.3.4 Type MPP

The Type MPP is used in note PCs and tablets equipped with Windows® 10. This supports digital ink, and the number of applications will increase gradually. There are several types of pens, and the corresponding functions differ depending on the product group. Also, this Type MPP pen can only be used with products that support the Type MPP.

4 Pro Pen 2 and Pro Pen 3D are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of these products.