



Choosing the Right Technology for Signature Capture Products

By: Gary L. Barret, Chief Technical Officer

As a result of a market research survey done in 2002 that provided detailed information on the signature capture market; our engineering team developed Digital Ink. While we believe that Digital Ink is the ideal technology for the signature capture space as it solves many of the issues that signature capture manufacturers are experiencing today, this whitepaper also looks at other ecommerce touch screen technologies that are being used. The document is intended to help you with the initial phase of the product evaluation process.

Overview

Current Market Status: There are four viable types of transparent ecommerce signature capture products on the market today. There are also a series of opaque solutions made by a number of other manufacturers. This document will only look the transparent touch technologies.

1. **4/5-Wire Analog Resistive Touch Screen with a Protective Overlay:** Companies such as HHP, Hypercom, IBM and others offer this type of technical solution. It is the least expensive option, however, it is also the option with the least durability and lowest sunlight readability. There are units where pen and "hard push" finger input is possible, but most often, the user will "sign and poke" using the stylus as the actuation force is too great for comfortable finger input.
2. **Pen-Only Glass Digitizer:** Digitizers do not support the finger input capability that is required by the personal identification number (PIN) process. Given that this solution is based on resistive touch screen technology, the electronics remain inexpensive, and the glass digitizer resolves the polyester scratch problem associated with standard 4-wire resistive touch screen technology, but the digitizer solution has other inherent durability problems.
3. **Electrostatic/Capacitive Digitizer:** Ingenico is using an electrostatic digitizer that has enhanced the electronics to support signature capture on glass, and large button finger actuation using capacitive coupling techniques. Market data suggests that the sensor, controller, and active stylus are considered cost prohibitive.
4. **Projective Capacitive:** Digital Ink is a projected capacitive solution that enables touches to be sensed through a protective layer in front of a display. It is the thinnest and only form fitting, unbreakable, wear resistant touch screen capable of stylus, finger, and gloved-hand input with palm rejection. While slightly more expensive than the transparent 4-wire solution, it supports multiple forms of input devices such as finger or passive pen, has good optical clarity, a rugged writing surface, and is priced considerably less than Electrostatic technology.

Based on the poor transmission and life-cycle results of 4-wire resistive touch screens with a protective overlay on one side of the spectrum, and the high cost of the current electrostatic/capacitive offering on the other side of the spectrum, Digital Ink offers the most durable pen signature surface with touch capabilities at a price point that is very attractive to the market.

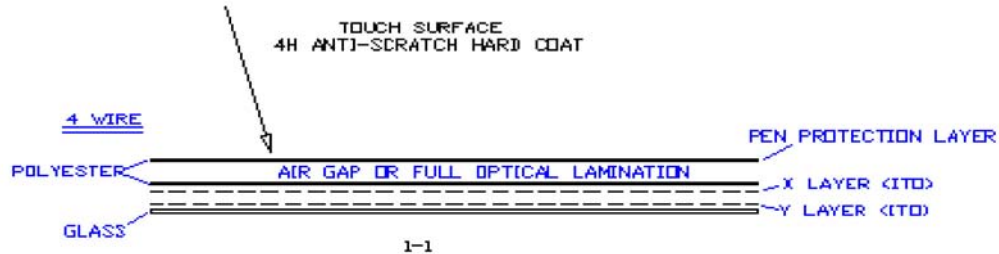
Key Technical Issues within the Signature Capture Market

As the various transparent technology solutions are compared in the next section of this paper, there are really three key technical issues that need to be taken into consideration when making your technology choice:

1. Scratch resistance problems
2. Transmission and optical clarity issues
3. Cost concerns.

Technology Overview

Baseline 4-Wire Protective Overlay Product Offering:



Advantages:

- Works with inactive “dumb” stylus and finger input. (Depending on palm rejection requirements, finger input may require uncomfortable, harder activation force.)
- Low sensor costs.
- Inexpensive electronics.
- Multiple suppliers.

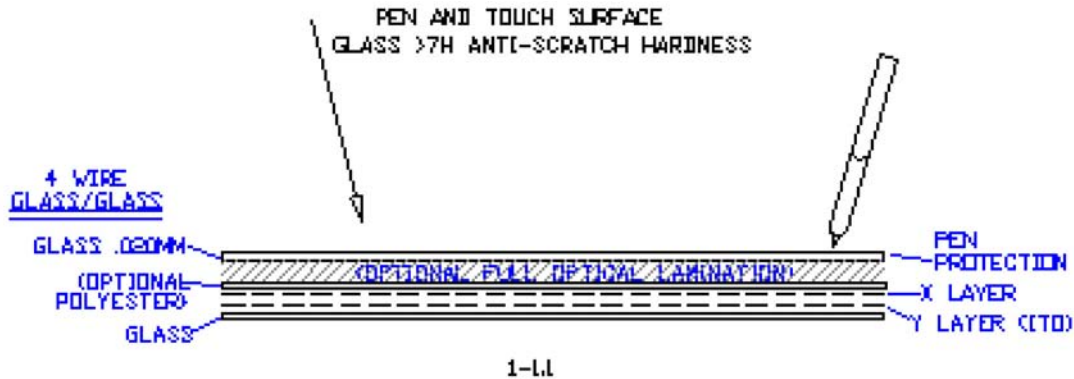
Disadvantages:

- Polyester hard coat scratch resistance not durable enough for multiple signatures in same zone.
- Optional “throw away” polyester protective overlay to extend sensor performance:
 - Requires field maintenance to replace when heavily scratched.
 - Reduces optical performance.
 - Makes finger activation more difficult.
- Short electrical and optical product lifecycles (1 year or less).
- Cannot have pen, palm rejection and light finger touch input.

Parameter	4-Wire Resistive
Transmissivity	83% +/-5
Transmissivity w/Touch Overlay	70% Minimum
Transparency	----
Anti-Glare	Haze 6 Typical
Durability - Electrical - Aesthetic	100k Strokes @ 250g 4H Pencil Hardness
Accuracy	+/-1.5%
ESD Susceptibility	20kv Punch through at Center
Pen and Finger	Yes
Gloved Finger	Yes
Non-Conductive Stylus	Yes
Force Required	80g typ. Pen-Input
Response Time	20ms
Pen Resolution	Analog (A/D Determined)
Finger Resolution	Analog (A/D Determined)
(For Budgetary Purposes) Unit Cost:	(Without/With Overlay)
10k/yr.	\$8.30/\$8.80
25k/yr.	\$8.10/\$8.60
50k/yr.	\$7.95/\$8.35
Electronics w/Chipset	Available Immediately
Development Cost	None
Development Lead-Time	None
Other Comments	None

Technology Overview

4-Wire Glass/Glass



Advantages:

- Works with in-active “dumb” stylus and finger input. (Depending on palm rejection requirements, finger input may require uncomfortable, harder activation force.)
- Glass top sheet increase aesthetic and scratch resistance performance over standard resistive w/polyester top sheet.
- Can use polyester lamination as safety bond and/or to improve optics (light transmission) with anti-reflection films.
- Uses standard inexpensive resistive technology electronics

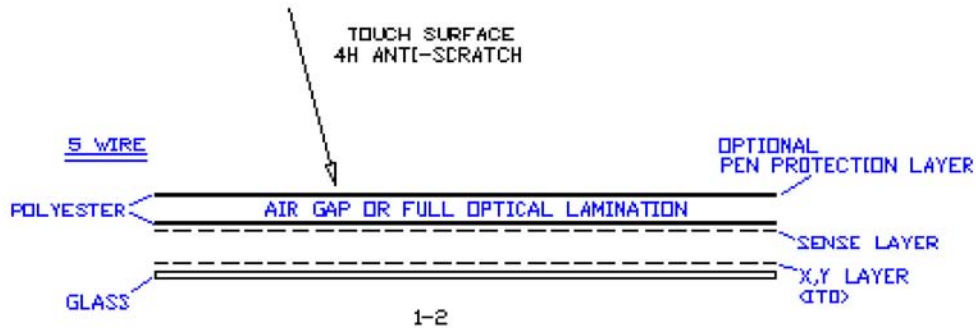
Disadvantages:

- Can be built using .020mm glass top sheet, but, in case of breakage, may require polyester lamination as glass containment layer.
- Laminated glass to X layer (see diagram) introduces manufacturing process problems.
- Glass first surface only available in polished finished.
- Cannot have pen, palm rejection and light finger touch input.

Parameter	4-Wire Glass/Glass
Transmissivity	84% +/-5 (Improve w/AR)
Transmissivity w/Touch Overlay	----
Transparency	Neutral
Anti-Glare	Not Available
Durability - Electrical - Aesthetic	TBD (Expected Very High) 7H Pencil Hardness
Accuracy	+/-1.5%
ESD Susceptibility	TBD KV Punch through at Center
Pen and Finger	Yes
Gloved Finger	Yes
Non-Conductive Stylus	Yes
Force Required	<100g typ.
Response Time	20ms
Pen Resolution	Analog (A/D Determined)
Finger Resolution	Analog (A/D Determined)
(For Budgetary Purposes) Unit Cost:	Std. (with Optional PET Layer)
10k/yr.	\$20.00/\$22.55
25k/yr.	\$18.90/\$21.00
50k/yr.	\$17.85/\$19.80
Electronics w/Chipset	Available Immediately
Development Cost	\$15,000.00
Development Lead-Time	90 Days
Other Comments	Mfg. yields may require 5-wire glass/glass due to steps needed in 4-wire top sheet processing.

Technology Overview

5-Wire Protective Overlay Product Offering:



Advantages:

Same as 4-wire plus the following:

- Longer sensor electrical lifecycle accuracy due to touch coordinate on glass instead of sensor top sheet.

Disadvantages:

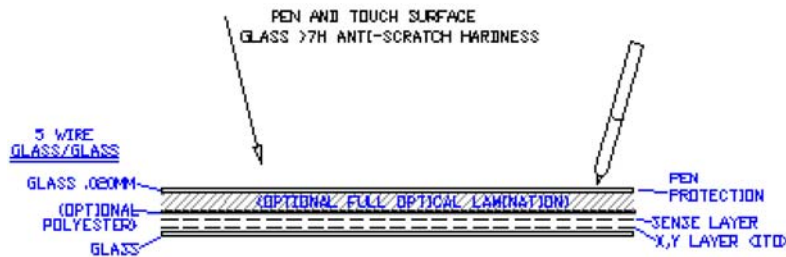
Same as 4-wire

- Weakest component is scratch-resistance hard coat.
- More expensive than 4-wire initially (but lower cost over product lifecycle assuming only protective overlay is replaced with scratched due to field use.
- Cannot have pen, palm rejection and light finger touch input.

Parameter	5-Wire Resistive
Transmissivity	83% +/-5
Transmissivity w/Touch Overlay	70% Minimum
Transparency	----
Anti-Glare	Haze 6 Typical
Durability - Electrical - Aesthetic	500k Strokes @ 250g 4H Pencil Hardness
Accuracy	+/-1.5%
ESD Susceptibility	20kv Punch though at Center
Pen and Finger	Yes
Gloved Finger	Yes
Non-Conductive Stylus	Yes
Force Required	80g typ. Pen-Input
Response Time	20ms
Pen Resolution	Analog (A/D Determined)
Finger Resolution	Analog (A/D Determined)
(For Budgetary Purposes) Unit Cost:	(Without/With Overlay)
10k/yr.	\$13.45/\$13.95
25k/yr.	\$13.10/\$13.55
50k/yr.	\$12.85/\$13.25
Electronics w/Chipset	Available Immediately
Development Cost	None
Development Lead-Time	None
Other Comments	None

Technology Overview

5-Wire Glass/Glass



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Advantages:

- Works with inactive “dumb” stylus and finger input. (Depending on palm rejection requirements, finger input may require uncomfortable, harder activation force.)
- Glass top sheet increase aesthetic and scratch resistance performance over standard resistive w/polyester top sheet.
- Can use polyester lamination as safety bond and/or to improve optics (light transmission) with anti-reflection films.
- Incorporated more durable 5-wire touch screen coordinate theory of operation. (i.e. longer life)
- Uses standard inexpensive resistive technology electronics.
- No issue with the manufacturing process since lamination is to the top sheet.

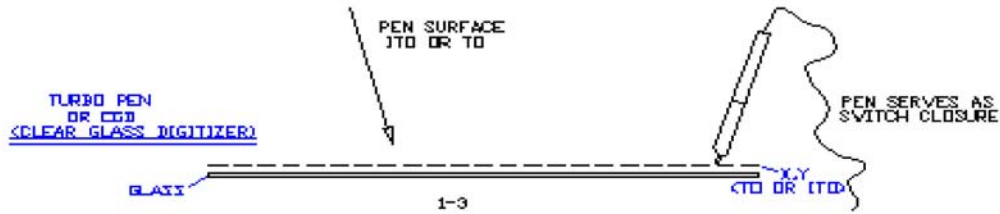
Disadvantages:

- Can be built using .020mm and .030 mm glass top sheet, but, in case of breakage, may require polyester lamination as glass containment layer.
- Glass first surface only available in polished finished.
- Cannot have pen, palm rejection and light finger touch input.

Parameter	5-Wire Glass/Glass
Transmissivity	84% +/-5 (Improve w/AR)
Transmissivity w/Touch Overlay	----
Transparency	Neutral
Anti-Glare	Not Available
Durability - Electrical - Aesthetic	TBD (Expected Very High) 7H Pencil Hardness
Accuracy	+/-1.5%
ESD Susceptibility	TBD KV Punch through at Center
Pen and Finger	Yes
Gloved Finger	Yes
Non-Conductive Stylus	Yes
Force Required	<100g typ.
Response Time	20ms
Pen Resolution	Analog (A/D Determined)
Finger Resolution	Analog (A/D Determined)
(For Budgetary Purposes) Unit Cost: 10k/yr. 25k/yr. 50k/yr.	Std. (with Optional PET Layer) \$21.40/\$23.95 \$20.20/\$22.50 \$18.95/\$21.00
Electronics w/Chipset	Available Immediately
Development Cost	\$15,000.00
Development Lead-Time	90 Days
Other Comments	Mfg. yields may require 5-wire glass/glass only offering. (not 4-wire glass/glass)

Technology Overview

CGD: (Clear Glass Digitizer)



Advantages:

- All glass solution.
- More durable glass versus polyester touch surface.
- Better optics.
- Lowest price for all glass technologies.
- Lowest price solution when compared to competing all-glass touch screen technology.
- Uses low cost T6 (5-wire) resistive electronics.

Disadvantages:

- Pen/palm rejection only.
- Pen comes in contact with thin film on touch surface. (Less durable than electrostatic or capacitive coupled sensors.)
- Electrical coating damages easily in some high contaminant environments. (i.e. Home Depot “dust”)
- More expensive than 4-wire initially. (But lower cost over product lifecycle.)
- In field tests, the thin film has failed.

Optional Development/Enhancement

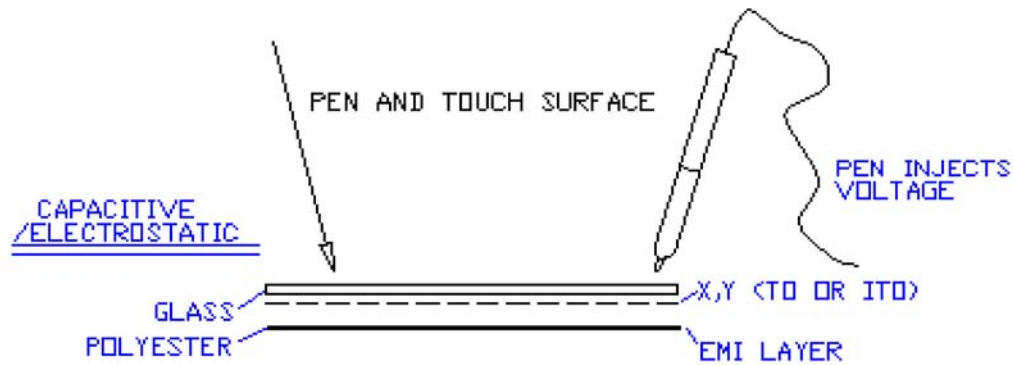
CGD with TO thin film on polished or etched glass is a more durable coating, but would need development efforts.

Parameter	Turbo ¹
Transmissivity	83% - 88% (90%)
Transmissivity w/Touch Overlay	N/A
Transparency	----
Anti-Glare	Not Available
Durability - Electrical - Aesthetic	300k Strokes @ 250g 7H (9H) Pencil Hardness
Accuracy	+/-1.5%
ESD Susceptibility	Some
Pen and Finger	No
Gloved Finger	No
Non-Conductive Stylus	No
Force Required	Hardware Adjustable
Response Time	20ms
Pen Resolution	Analog (A/D Determined)
Finger Resolution	N/A
(For Budgetary Purposes) Unit Cost:	(Sensor Only)
10k/yr.	\$14.40
25k/yr.	\$13.85
50k/yr.	\$12.90
Electronics w/Chipset	Available Immediately
Development Cost	None (\$4,500.00)
Development Lead-Time	None (90 Days)
Other Comments	None

¹When Spec. Difference, to Spec. in ().

Technology Overview

Capacitive/Electrostatic Technology: (Ingenico Solution)



Advantages:

- No wear to touch surface.
- Established pen digitizer technology.
- No environmental susceptibility.
- Long lasting.

Disadvantages:

- High Cost.
- Active, expensive pen required.

Parameter	Capacitive & Electrostatic
Transmissivity	80% Minimum
Transmissivity w/Touch Overlay	N/A
Transparency	----
Anti-Glare	Available
Durability - Electrical - Aesthetic	TBD (Expected Very High)
Accuracy	+/-1.5% on pen; TBD on Capacitive Coupling
ESD Susceptibility	None
Pen and Finger	Yes
Gloved Finger	TBD (Expected Yes)
Non-Conductive Stylus	Active Pen Required
Force Required	Hardware Adjustable
Response Time	TBD
Pen Resolution	1024x1024
Finger Resolution	TBD
(For Budgetary Purposes) Unit Cost:	(Sensor Budgetary Quote)
10k/yr.	\$19.50
25k/yr.	\$18.25
50k/yr.	\$17.10
Electronics w/Chipset	TBD (See Other Comments)
Development Cost	\$25,00 - \$50,000
Development Lead-Time	180+
Other Comments	Analog Capacitive Controller currently modified to include CGD/pen application.

Technology Overview

Digital Ink:

Advantages:

- No wear to touch surface.
- Unbreakable substrate options.
- Capable of stylus, finger and gloved hand input with palm rejection.
- Sensor thickness - .36mm ~ 50.8mm (.014" ~ 2")
- Scratch resistant up to 9H, depending on customer's specification.
- Chemically resistant to household cleaners, industrial corrosives and acidic beverages.
- Anti-Electrostatic.
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Disadvantages:

- The stylus must be tethered as is typical in signature capture product applications.
- Maximum scale up to 5.7 diagonal currently. (Roadmap calls for larger sizes in 2004)

Parameter	Digital Ink
Transmissivity	85% +*
Transmissivity w/Touch Overlay	N/A
Transparency	Neutral
Anti-Glare	Available
Durability - Electrical - Aesthetic	300M, 250M*
Accuracy	+/-1%
ESD Susceptibility	50KV
Pen and Finger	Yes
Gloved Finger	Yes
Non-Conductive Stylus	Yes
Force Required	>1gm (75gms Typical)
Response Time	10ms
Pen Resolution	4000x4000
Finger Resolution	4000x4000
(For Budgetary Purposes) Unit Cost:	(Sensor*)
10k/yr.	\$19.50
25k/yr.	\$17.00
50k/yr.	\$15.70
Electronics w/Chipset	Available
Development Cost	\$15,000 - \$25,000
Development Lead-Time	90 Days
Other Comments	None

* Stack-Up Material Dependent

Parameter	4-Wire Protective Overlay Resistive	4-Wire Resistive Glass/Glass	5-Wire Protective Overlay Resistive	5-Wire Resistive Glass/Glass
Transmissivity	83% +/-5	84% +/-5 (Improve w/AR)	83% +/-5	84% +/-5 (Improve w/AR)
Transmissivity w/Touch Overlay	70% Minimum	----	70% Minimum	----
Transparency	----	Neutral	----	Neutral
Anti-Glare	Haze 6 Typical	Not Available	Haze 6 Typical	Not Available
Durability, Electrical, & Aesthetic	100k Strokes @ 250g 4H Pencil Hardness	TBD (Expected Very High) 7H Pencil Hardness	500k Strokes @ 250g 4H Pencil Hardness	TBD (Expected Very High) 7H Pencil Hardness
Accuracy	+/-1.5%	+/-1.5%	+/-1.5%	+/-1.5%
ESD Susceptibility	20kv Punch through at Center	TBD KV Punch through at Center	20kv Punch though at Center	TBD KV Punch through at Center
Pen and Finger	Yes	Yes	Yes	Yes
Gloved Finger	Yes	Yes	Yes	Yes
Non-Conductive Stylus	Yes	Yes	Yes	Yes
Force Required	80g typ. Pen-Input	<100g typ.	80g typ. Pen-Input	<100g typ.
Response Time	20ms	20ms	20ms	20ms
Pen Resolution	Analog (A/D Determined)	Analog (A/D Determined)	Analog (A/D Determined)	Analog (A/D Determined)
Finger Resolution	Analog (A/D Determined)	Analog (A/D Determined)	Analog (A/D Determined)	Analog (A/D Determined)
(For Budgetary Purposes) Unit Cost: 10k/yr. 25k/yr. 50k/yr.	(Without/With Overlay) \$8.30/\$8.80 \$8.10/\$8.60 \$7.95/\$8.35	Std. (with Optional PET Layer) \$20.00/\$22.55 \$18.90/\$21.00 \$17.85/\$19.80	(Without/With Overlay) \$13.45/\$13.95 \$13.10/\$13.55 \$12.85/\$13.25	Std. (with Optional PET Layer) \$21.40/\$23.95 \$20.20/\$22.50 \$18.95/\$21.00
Electronics w/Chipset	Available Immediately	Available Immediately	Available Immediately	Available Immediately
Development Cost	None	\$15,000.00	None	\$15,000.00
Development Lead-Time	None	90 Days	None	90 Days
Other Comments	None	Mfg. yields 5-wire glass/glass may require due to steps needed in 4-wire top sheet processing.	None	Mfg. yields may require 5-wire glass/glass only offering. (not 4-wire glass/glass)

Parameter	Turbo ¹	Capacitive & Electrostatic	Digital Ink
Transmissivity	83% - 88% (90%)	80% Minimum	85% +*
Transmissivity w/Touch Overlay	N/A	N/A	N/A
Transparency	----	----	Neutral
Anti-Glare	Not Available	Available	Available
Durability, Electrical, & Aesthetic	300k Strokes @ 250g 7H (9H) Pencil Hardness	TBD (Expected Very High)	300M, 250M*
Accuracy	+/-1.5%	+/-1.5% on pen; TBD on Capacitive Coupling	+/-1%
ESD Susceptibility	Some	None	50KV
Pen and Finger	No	Yes	Yes
Gloved Finger	No	TBD (Expected Yes)	Yes
Non-Conductive Stylus	No	Active Pen Required	Yes
Force Required	Hardware Adjustable	Hardware Adjustable	>1gm (75gms Typical)
Response Time	20ms	TBD	10ms
Pen Resolution	Analog (A/D Determined)	1024x1024	4000x4000
Finger Resolution	N/A	TBD	4000x4000
(For Budgetary Purposes) Unit Cost: 10k/yr. 25k/yr. 50k/yr.	(Sensor Only) \$14.40 \$13.85 \$12.90	(Sensor Budgetary Quote) \$19.50 \$18.25 \$17.10	(Sensor*) \$19.50 \$17.00 \$15.70
Electronics w/Chipset	Available Immediately	TBD (See Other Comments)	Available
Development Cost	None (\$4,500.00)	\$25,00 - \$50,000	\$15,000 - \$25,000
Development Lead-Time	None (90 Days)	180+	90 Days
Other Comments	None	Analog Capacitive Controller currently modified to include CGD/pen application.	None

¹When Spec. Difference, to Spec. in ().

*Stack-Up Material Dependent