Touch Panel Technologies and Integration

Tommy Miwa, Sr. Manager
Renesas Electronics America America

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Tommy Miwa

Regional Engineer and District sales Sr. Manager
- FAE support for Northwest and Southwest regions
- Liaison between REA and NLT Japan for new products and marketing

Additional Work Experience
- 19 years LCD experience with NLT/NEC and Renesas
  - Business Plan and Cost down at Purchasing Engineering div.
  - Product manager at Module Design division – primarily for design of medium size LCDs
  - Mechanical engineer at Module Design div
Renesas Technology & Solution Portfolio
Display Module Solutions
Sophisticated solutions  Sustainable support

LED Backlight LCDs
- Low power consumption
- Long life LEDs
- Thin profile and light weight design
- Replaceable LED light source unit

Enhanced View TFT (EVT)
- Suited for a variety of ambient-light environments
- Proprietary transflective LCD technologies
  - Reflective-Enhanced View TFT (R-EVT)
  - Transmissive-Enhanced View TFT (T-EVT)

Wide Format LCDs
- More data on a single screen
- 16:9 aspect ratio

Super-Fine TFT (SFT)
- High luminance and wide color gamut
- Superior image quality
- Ultra-wide viewing angles

Industrial Mobile Displays
- Robust feature sets
- Long-term product support
- Amorphous silicon (A-Si) displays
- Low-temperature polysilicon (LTPS) displays

Emerging Technologies
- 2D/3D displays
- On-cell touch
- PCAP touch
Agenda

- General
  - Touch panel market trends
  - Touch panel technologies

- Renesas/NLT solutions
  - What is the benefit to the customer
  - Options
  - Line up of projective capacitive (PCAP) solutions
General
Touch Panel Market Trend

Leading by Mobile phone and Tablet PCA
CAGR 16.5% (2010-2017)

Source: DisplaySearch
Touch Panel Market Trend – by Type

Market Trend Leader is PCAP (Projective Capacitive).

Source: DisplaySearch

<table>
<thead>
<tr>
<th>Year</th>
<th>Others</th>
<th>Resistive</th>
<th>PCAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.1</td>
<td>0.4</td>
<td>0.5</td>
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<tr>
<td>2011</td>
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<td>0.5</td>
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<td>2016</td>
<td>0.7</td>
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<td>2017</td>
<td>0.8</td>
<td>0.03</td>
<td>0.2</td>
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</table>
Touch Panel Technologies

- Resistive
  - Analog
  - Digital
- Capacitive
  - Projected Capacitive
  - Surface Capacitive
- Infrared
- Acoustic Wave
  - Surface Acoustic Wave
  - Bending Wave
- Digitizer
Resistive Touch

Touch panel cross-section image

When PET film is pushed by stylus pen or finger, ITO films contact each other. The touch position is determined by measuring the electric resistance between the electrodes.
Resistive Touch

Analog

Ex. 4wire type

Digital

Matrix type
Resistive Touch

4-wire version

Electric conduction occurs by pushing

Membrane resistance (transparent ITO)
Resistive Touch

5-wire version

Electric conduction occurs by pushing

Transparent conductive film (ITO)

Membrane resistance (transparent ITO)

Electrode
Resistive Touch

8-wire version
- Similar structure to the 4-wire

Electric conduction occurs by pushing

Reference voltage

Membrane resistance
Electrode

Reference voltage
Infrared and Acoustic Wave Touch

**Infrared**

- Touch position is determined where the photoreceptor was hidden.

**Acoustic Wave**

- Touch position is determined by the sound waves picked up each transducer.
Surface Capacitive Touch

Electrode

Membrane resistance (transparent ITO)

Cover

Glass

Touch position is determined by the intensity of the electric current from each electrode.

Electrostatic capacity between finger and each electrodes.
Projected Capacitive Touch

Touch position is determined by the measurement of electrostatic capacity.

Electrostatic capacity between finger and each electrodes.

Front glass
Sensor grid
Back glass
Projected Capacitive Touch

Projected Capacitive

Glass Base
- Single Glass
- 2Glass
- Film/Glass

Film Base
- Single Film
- 2Film

Sensor layer by ITO and metal wire

*ITO: Indium Tin Oxide
## Comparison of Touch Panel Technologies

<table>
<thead>
<tr>
<th>Type of Touch Technology</th>
<th>Benefits</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected Capacitive</td>
<td>✓High durability</td>
<td>✓Mainly finger touch</td>
</tr>
<tr>
<td></td>
<td>✓Multi touch</td>
<td>✓Exclusive IC</td>
</tr>
<tr>
<td></td>
<td>✓Works on curved surface</td>
<td></td>
</tr>
<tr>
<td>Resistive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4wire</td>
<td>✓Simple structure</td>
<td>✓Needs calibration</td>
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<tr>
<td></td>
<td>✓Simple Controller IC</td>
<td>✓Mainly Single Touch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓Optical performance</td>
</tr>
<tr>
<td>5wire</td>
<td>✓Longest life of resistive</td>
<td>✓Large footprint</td>
</tr>
<tr>
<td></td>
<td>technologies</td>
<td>✓Needs calibration</td>
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<tr>
<td></td>
<td></td>
<td>✓Optical performance</td>
</tr>
<tr>
<td>8wire</td>
<td>✓No calibration</td>
<td>✓Large footprint</td>
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<tr>
<td></td>
<td></td>
<td>✓Exclusive IC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓Optical performance</td>
</tr>
<tr>
<td>Surface Capacitive</td>
<td>✓High transmittance</td>
<td>✓Exclusive IC</td>
</tr>
<tr>
<td>Infrared</td>
<td>✓High transmittance</td>
<td>✓Resolution</td>
</tr>
<tr>
<td></td>
<td>✓Reliability, Long life</td>
<td>✓Exclusive IC</td>
</tr>
<tr>
<td></td>
<td>✓Large size (100inch)</td>
<td>✓Sensitive to ambient light</td>
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<tr>
<td>Acoustic Wave</td>
<td>✓Any touch-object</td>
<td>✓Exclusive IC</td>
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<tr>
<td></td>
<td>✓High Durability</td>
<td>✓Soft touch</td>
</tr>
<tr>
<td>Digitizer</td>
<td>✓High resolution</td>
<td>✓Original pen only</td>
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</table>
Renesas / NLT Touch Solutions
What is the benefit for the customer?

- **Same NLT Industrial Product Support & TCO Policies**
  - Same Long Term product life as LCD module
  - Stable and consistent support through product life
  - Same EOL and phase out policy as LCD module

- **More Efficient & Cost Effective Material Management**
  - Single supplier source for orders, quality, support, etc.
  - Design, Production and Assembly of PCAP 100% NLT
  - Customer Service by NLT/REA

- **Customization and Flexibility**
  - Ability to support a customized solution at NLT factory level
    
    (i.e. sensor design, glass size, flex design, cover glass, etc.)

- **Ability to Support Variety of Volume Levels**
  - As low as 1.2 K pc EAU

*TCO : Total Cost of Ownership*
Simple Design Process

【Before】

Step1 Select LCD
Step2 Design of Touch Screen
Step3 Matching/Assembling LCD and Touch Screen

Product

【NLT solution】

Step1 Providing LCD with Touch Screen

Product

- Same TCO
- Same Support
- Same Quality
- Single Supplier
- Single Order
Benefits for mechanical design

- Narrow frame
  NLT has the know-how for “fine” ITO process.

- Single glass design
  General PCAP using and combining 2 pieces of glass for sensor.

*NLT provides flexible design for customers*
PCAP Options
Options

- Clear(AFP) Film
- AG (AFP) Film
- Bonding
- Cover Panel & Decorated Panel

AFP: Anti Finger Print
Standard

Thickness: LCD + approx. less than 1mm

Note: PCAP is added to the front of the display. For ruggedization, NLT suggests customers add a cover panel.
Options

Cover panel style

Thickness: approx. LCD +2mm to 4mm

- Cover Panel design
  - Glass: approx. less than 3mm
  - Resin/PC: approx. less than 1.2mm

* OCA: optical clear adhesive
Options

Cover panel style

Thickness: + approx. less than 0.2mm

Options
1. AFP* (Clear)
2. AFP* (AG)
3. AR

*AFP: Anti Finger Print
Options

Bonding

Thickness: LCD + approx. 1mm
Options

Tough style

Thickness: approx. LCD +2mm to 4mm

* OCA: optical clear adhesive
Line up of PCAP products
Line-up

- **Mass Production**
- **Under Development**
- **Under Planning**

---

**— PCAP Type —**

<table>
<thead>
<tr>
<th>Size</th>
<th>Description</th>
<th>Date</th>
<th>Base Code</th>
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<tbody>
<tr>
<td>6.5&quot;</td>
<td></td>
<td>Dec</td>
<td>NL10276BC13-01</td>
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<tr>
<td>10.4&quot;</td>
<td>Sample: Now</td>
<td></td>
<td>NL10276BC20-18D</td>
</tr>
<tr>
<td>10.6&quot; Wide</td>
<td>Sample: Now</td>
<td></td>
<td>NL12876AC18-03D etc.</td>
</tr>
<tr>
<td>12.1&quot;</td>
<td>Sample: Dec</td>
<td></td>
<td>NL10276BC24-21/21F etc.</td>
</tr>
<tr>
<td>12.1&quot; Wide</td>
<td>Sample: Now</td>
<td></td>
<td>NL12880BC20-05D etc.</td>
</tr>
<tr>
<td>15&quot;</td>
<td>Sample: Dec</td>
<td></td>
<td>NL10276BC30-34D etc.</td>
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</table>

**2012**

**2013**
Preliminary Spec. of 6.5” with PCAP

General Specifications

- Number of pixels: 1024 x 768 pixels (XGA)
- Display area: 132.096(H) x 99.072(V) mm
- Pixel pitch: 0.129(H) x 0.129(V) mm
- Luminance: (400) cd/m² typ.*1
- Contrast ratio: (500):1 typ.
- Viewing angle: R:80°, L:80°, U:80°, D:60°
- Color gamut: 36% typ. (to NTSC)
- Module size: 153.0(H) x 118.0(V) x (11.0) (D) mm typ.*1
- Response time: 25 msec typ. (Ton+Toff)
- Weight: TBD g typ.
- Display color: 16,777,216 / 262,144 colors
- Interface signals: LVDS 8bit/6bit
- Supply voltage: 3.3V
- Backlight type: Edge light type : LED
- Power cons.: 3.9W typ. (except for touch panel)
- Surface treatment: Clear (Touch panel surface)*1
- Operation temp: (-20) to (+70) °C
- Storage temp: (-30) to (+80) °C
- LED replacement: Available
- Recommend LED Driver Board: TBD
- Estimated luminance life time of LED itself: 13,000h at Ta=25°C (LED current=60mA)
- Mounting method: Side mount
- Touch Panel type: Projected Capacitive Touch Panel
- Number of Touch: up to 16 concurrent touches

*1 PCAP : at standard type

Touch Panel
(Projected Capacitive)

Touch Panel FPC

*1 LED replacement

(11) mm

153.0 mm

132.096 mm

118.0 mm

99.072 mm
Preliminary Spec. of 10.4” with PCAP

**General Specifications**

- **Number of pixels**: 1024 x 768 pixels (XGA)
- **Display area**: 210.432(H) x 157.824(V) mm
- **Pixel pitch**: 0.2055(H) x 0.2055(V) mm
- **Luminance**: (350) cd/m² typ.*1
- **Contrast ratio**: (800):1 typ.
- **Viewing angle**: R:80° ,L:80° ,U:80° ,D:80°
- **Color gamut**: 40% typ. (to NTSC)
- **Module size**: 228.0(H) x 178.5(V) x (9.5) (D)mm typ.
- **Response time**: 18 msec typ. (Ton+Toff)
- **Weight**: TBD g typ.
- **Display color**: 16,777,216 / 262,144 colors
- **Interface signals**: LVDS 8bit/6bit
- **Supply voltage**: 3.3V
- **Backlight type**: Edge light type : LED
- **Power cons.**: 4.8W typ. (except for touch panel)
  
  (at LED current = 60 mA and checkered flag pattern)
- **Surface treatment**: Clear (Touch panel surface) *1
- **Operation temp**: (-20) to (+70) °C
- **Storage temp**: (-30) to (+80) °C
- **LED replacement**: Available
- **Recommend LED Driver Board**: 104PW02F
- **Estimated luminance life time of LED itself**: 70,000h at Ta=25°C (LED current=60mA)
- **Mounting method**: Side mount
- **Touch Panel type**: Projected Capacitive Touch Panel
- **Number of Touch**: up to 16 concurrent touches

*1 PCAP : at standard type
**General Specifications**

- **Number of pixels**: 1280 x 768 pixels (WXGA)
- **Display area**: 230.4 (H) x 138.24 (V) mm
- **Pixel pitch**: 0.18 (H) x 0.18 (V) mm
- **Luminance**: (250) cd/m² typ. *1
- **Contrast ratio**: (1000:1) typ.
- **Viewing angle**: R:88°, L:88°, U:88°, D:88°
- **Color gamut**: 40% typ. (to NTSC)
- **Module size**: 248.8 (H) x 155.8 (V) x (7.3) (D)mm typ. *1
- **Response time**: (25) msec typ. (Ton+Toff)
- **Weight**: TBD g typ.
- **Display color**: 16,777,216 / 262,144 colors
- **Interface signals**: LVDS 8bit/6bit
- **Supply voltage**: 3.3V (LCD Panel), 5.0V to 12.0V (LED Backlight)
- **Backlight type**: Edge light type : LED
- **Power cons.**: (3.2) W typ. (except for touch panel)
- **Surface treatment**: Clear (Touch panel surface) *1
- **Operation temp**: (-20) to (+70) °C
- **Storage temp**: (-30) to (+80) °C
- **Estimated luminance life time of LED itself**: 30,000h at Ta=25°C
- **LED replacement**: Available
- **LED Driver Circuit**: Built-in
- **Mounting method**: Side mount
- **Touch Panel type**: Projected Capacitive Touch Panel
- **Number of Touch**: up to 16 concurrent touches

*1 PCAP : at standard type
Preliminary Spec. of 12” with PCAP

General Specifications

- Number of pixels: 1024 x 768 pixels (XGA)
- Display area: 245.76 (H) x 184.32 (V) mm
- Pixel pitch: 0.24 (H) x 0.24 (V) mm
- Luminance: (720) cd/m² typ.*1
- Contrast ratio: (900:1) typ.
- Viewing angle: R:80°, L:80°, U:80°, D:80°
- Color gamut: 40% typ. (to NTSC)
- Module size: 260.5 (H) x 203.0 (V) x (10.7) (D)mm typ.*1
- Response time: 18 msec typ. (Ton+Toff)
- Weight: TBD g typ.
- Display color: 16,777,216 colors
- Interface signals: LVDS 8bit
- Supply voltage: 3.3V (LCD Panel)
- Backlight type: Edge light type : LED
- Power cons.: 7.5 W typ. (except for touch panel)
  (at LED current = 50 mA and checkered flag pattern)
- Surface treatment: Clear (Touch panel surface) *1
- Operation temp: -30 to +70 °C
- Storage temp: -30 to +80 °C
- Estimated luminance
  life time of LED itself: 70,000h at Ta=25°C (LED current=50mA)
- LED replacement: Available
- Recommend LED Driver Board: 104PW03F
- Mounting method: Side mount
- Touch Panel type: Projected Capacitive Touch Panel
- Number of Touch: up to 16 concurrent touches

*1 PCAP : at standard type
### General Specifications

- **Number of pixels**: 1024 x 768 pixels (XGA)
- **Display area**: 245.76 (H) x 184.32 (V) mm
- **Pixel pitch**: 0.24 (H) x 0.24 (V) mm
- **Luminance**: (400) cd/m² typ.*1
- **Contrast ratio**: (900:1) typ.
- **Viewing angle**: R:80°, L:80°, U:80°, D:80°
- **Color gamut**: 40% typ. (to NTSC)
- **Module size**: 260.5 (H) x 203.0 (V) x (10.7) (D)mm typ.*1
- **Response time**: 18 msec typ. (Ton+Toff)
- **Weight**: TBD g typ.
- **Display color**: 16,777,216 colors
- **Interface signals**: LVDS 8bit
- **Supply voltage**: 3.3V (LCD Panel)
- **Backlight type**: Edge light type : LED
- **Power cons.**: 5.2W typ. (except for touch panel)
  - (at LED current = 50 mA and checkered flag pattern)
- **Surface treatment**: Clear (Touch panel surface) *1
- **Operation temp**: -30 to +70 °C
- **Storage temp**: -30 to +80 °C
- **Estimated luminance life time of LED itself**: 70,000h at Ta=25°C (LED current=50mA)
- **LED replacement**: Available
- **Recommend LED Driver Board**: 104PW03F
- **Mounting method**: Side mount
- **Touch Panel type**: Projected Capacitive Touch Panel
- **Number of Touch**: up to 16 concurrent touches

*1 PCAP : at standard type
**Preliminary Spec. of 12.1” Wide with PCAP**

### General Specifications

- **Number of pixels**: 1280 x 800 pixels (WXGA)
- **Display area**: 261.12 (H) x 163.2 (V) mm
- **Pixel pitch**: 0.204 (H) x 0.204 (V) mm
- **Luminance**: (400) cd/m² typ.*1
- **Contrast ratio**: (1000:1) typ.
- **Viewing angle**: R:88°, L:88°, U:88°, D:88°
- **Color gamut**: 40% typ. (to NTSC)
- **Module size**: 277.7 (H) x 180.6 (V) x (9.5) (D)mm typ.*1
- **Response time**: 25 msec typ. (Ton+Toff)
- **Weight**: TBD g typ.
- **Display color**: 16,777,216 / 262,144 colors
- **Interface signals**: LVDS 8bit/6bit
- **Supply voltage**: 3.3V (LCD Panel)
- **Backlight type**: Edge light type : LED
- **Power cons.** *(at LED current = 50 mA and checkered flag pattern)*: 6.45W typ. (except for touch panel)
- **Surface treatment**: Clear (Touch panel surface)*1
- **Operation temp**: -20 to +70 °C
- **Storage temp**: -30 to +80 °C
- **Estimated luminance life time of LED itself**: 70,000h at Ta=25°C (LED current=50mA)
- **LED replacement**: Available
- **Recommend LED Driver Board**: 104PW03F
- **Mounting method**: Side mount
- **Touch Panel type**: Projected Capacitive Touch Panel
- **Number of Touch**: up to 16 concurrent touches

*1 PCAP : at standard type
Preliminary Spec. of 15” with PCAP

**General Specifications**

- **Number of pixels**: 1024 x 768 pixels (XGA)
- **Display area**: 304.128 (H) x 228.096 (V) mm
- **Pixel pitch**: 0.297 (H) x 0.297 (V) mm
- **Luminance**: (300) cd/m² typ.
- **Contrast ratio**: (600:1) typ.
- **Viewing angle**: R:80°, L:80°, U:80°, D:80°
- **Color gamut**: 50% typ. (to NTSC)
- **Module size**: 326.5 (H) x 253.5 (V) x (14.5) (D)mm typ.
- **Response time**: 18 msec typ. (Ton+Toff)
- **Weight**: TBD g typ.
- **Display color**: 16,777,216 colors
- **Interface signals**: LVDS 8bit
- **Supply voltage**: 3.3V (LCD Panel)
- **Backlight type**: Edge light type : LED
- **Power cons.**: 9.8W typ. (except for touch panel)
  
  (at LED current = 50 mA and checkered flag pattern)
- **Surface treatment**: Clear (Touch panel surface)
- **Operation temp**: -20 to +70 °C
- **Storage temp**: -20 to +80 °C
- **Estimated luminance life time of LED itself**: 70,000h at Ta=25°C (LED current=50mA)
- **LED replacement**: Available
- **Recommend LED Driver Board**: 150PW02F
- **Mounting method**: Side mount
- **Touch Panel type**: Projected Capacitive Touch Panel
- **Number of Touch**: up to 4 concurrent touches
PCAP Controller board

General Specifications

- Outline: (80.0) (H) x (28.0) (V) typ.
- Operation temp: (-20 to +70) °C
- Storage temp: (-30 to +80) °C
- Supply voltage: 5.0V (USB Bus power)
- Power cons.: TBD
- Interface: USB 2.0 Full speed
- Connector: USB mini-B
- Supported OS:
  - Windows 7 (HID Digitizer device)
  - Windows 8 (Planning)
  - Linux (Planning to disclose source code)

- Interface Pin Connections

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<tr>
<th>No.</th>
<th>Symbols</th>
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<tbody>
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<td>1</td>
<td>VBUS (+5V)</td>
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<tr>
<td>2</td>
<td>D-</td>
</tr>
<tr>
<td>3</td>
<td>D+</td>
</tr>
<tr>
<td>4</td>
<td>N.C.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
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</table>
FAQ

Q) Is it available for Multi touch?
A) It’s 10 fingers.
   *depending on the size.
   10.4”/10.6”W/12.1”W are available for 16 fingers

Q) Is it available for customization of FPC shape and position?
A) Yes, please ask FAE, however it needs NRE.

Q) Is it available for Windows8?
A) Yes. If the customer will use with stylus, please ask FAE.
The sensor of PCAP will need to change the sensor pitch due to definition of Windows 8.

Q) Is it available without Controller IC?
A) Yes, however there are no tuning service.
Summary

- Touch panel is the major HMI (Human Machine Interface), especially PCAP.

- As of today, there is no “best” touch solutions.
  - Best touch solution is determined by customer’s application, display conditions and preferences.

- Renesas/NLT solutions provide you more efficient & cost effective material management
  - Single supplier source for orders, quality, support, etc.
  - Design, Production and Assembly of PCAP 100% NLT
  - Customer Service by NLT/REA
Questions?
Please Provide Your Feedback...

- Please utilize the ‘Guidebook’ application to leave feedback

or

- Ask me for the paper feedback form for you to use...