Choosing the Right Embedded Display & Touch Solution
Choosing the Right Embedded Display & Touch Solution

Speakers:

Michael Melvang – Managing Director EDT Europe

Søren Mikkelsen – Account manager – ST Microelectronics - TouchGFX
- GoToWebinar
- Different polls during the webinar
- Q&A & Chat during and after webinar
Personal Introduction

- Michael Melvang, B.Sc. E.E.
- Part of EDT Europe team since Feb. 2012
- 20+ years of commercial experience with industrial electronics
- Specialized in displays & touch solutions since 1998
What’s in it for you?

• Shared experience
• Short cut to your market
• Design with reliability & confidence
• Enabling you to make a good choice
What’s on our agenda?

• Our value proposition in short

• Embedded display project considerations:
  • Longevity & Lifecycle
  • Display (technologies, viewing angle, resolution, interface etc.)
  • Touch Technologies
  • Cover Lens and Integration
  • Environmental Challenges

• Q&A session after the seminar
About EDT and why we are here?

Emerging Display Technologies Corp. Ltd.

Taiwan based manufacturer of integrated Smart Embedded displays & touch solutions

- Established in September 1994
- Headquarter in Kaohsiung, Taiwan
- Listed on the Taiwan Stock Exchange (3038) since 2001
- Approximately 1200 employees worldwide
# Smart Embedded Evaluation Kits

<table>
<thead>
<tr>
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<td>8MB</td>
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<td>16MB</td>
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<td><strong>Other memory config. possible</strong></td>
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<th><strong>Power Supply</strong></th>
<th>12Volt option for Power supply input only</th>
<th>7-36V</th>
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Other Sizes / resolution, Full- and Semi-Custom modules can be built to Customers requirements.
Embedded Display
Initial Key Questions

Product Application?
- Who will be using your device?
- What functionality do they need?
- Which environment shall the device operate in?

When and how long?
- When will you go to the market?
- How long will your product stay in the market?
- What is your product life cycle support plan?

Technical & Commercial Requirements?
- Optical/Cosmetic/Look&Feel?
- Electrical Interface & Power Restraints?
- Mechanical Structure & Robustness?
- Volume qty. & Logistic setup?
Embedded Display (EDT In-house Core Competences)
Main Display Questions

- Viewing Direction
- Brightness Intensity
- Resolution & Color Depth
- Interface
Display Technologies

- Active LCD (Liquid Crystal Display, transistor driven)
  - TFT display is based on LCD technology
  - Hence LCD TV is made with a TFT panel

- Generally two main categories of TFT available:
  - TFT based on TN-panel
  - TFT based IPS/MVA or TN+SWV film

- This presentation focus on TFT
Display Technologies

- Passive LCD (Liquid Crystal Display, voltage driven)
  - Monochrome (Generic terms: TN/STN/FSTN)
  - Character/Graphic/Matrix
  - Reflective/Transflective/Transmissive
  - Advantage: Long term available

- Other Display Technologies
  - ePaper/eInk
  - Single or multi-color OLED
  - RGB OLED
  - Availability?

Source: Samsung
Viewing Position vs Viewing Angle

9 o’clock  center  3 o’clock

12 o’clock  6 o’clock
Grey Scale Inversion Angle

- Mostly a concern for TFT TN-panels
  - Often confused with Viewing Angle
Display Resolution

- Graphical Displays: Number of pixels per row x pixels per column
- Acronyms: VGA, SVGA, WSVGA
- Ratio: 4:3, 16:9, 5:3 (15:9)

Display Resolution

- Consider your needs!
  - Simple GUI – or Video?
  - Allowed time to transfer display-data?
  - Available Buffer-size?
  - Color Depth? 16-bit/18-bit/24-bit

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<tr>
<th>Application</th>
<th>Size</th>
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<th>Colors</th>
<th>Buffer size (KBytes)</th>
</tr>
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<tbody>
<tr>
<td>&quot;Handheld&quot;</td>
<td>2.4”</td>
<td>240x320</td>
<td>16-bit</td>
<td>150</td>
</tr>
<tr>
<td>&quot;Meter&quot;</td>
<td>4.3”</td>
<td>480x272</td>
<td>24-bit</td>
<td>382</td>
</tr>
<tr>
<td>&quot;Tablet&quot;</td>
<td>7.0”</td>
<td>800x480</td>
<td>24-bit</td>
<td>1125</td>
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</table>
• LED-backlight is the de-facto standard in LCD/TFT Displays
  • Brightness is measured in cd/m² (Candela/m²) or nits
  • Current-driven
  • Life-Time definition: Time until Nominal Intensity has decreased 50% @25°C
  • Most power-consuming part of LCD/TFT display

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<tr>
<th>Type</th>
<th>Life time [hours]</th>
<th>cd/m²</th>
<th>#LEDs</th>
<th>Power [W]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Line 7”</td>
<td>&gt;20K</td>
<td>Typ. 300</td>
<td>7x3series</td>
<td>1.344</td>
</tr>
<tr>
<td>Main Line 7” IPS</td>
<td>&gt;50K</td>
<td>Typ. 1000</td>
<td>4x6series</td>
<td>2.64</td>
</tr>
<tr>
<td>High Line 7”</td>
<td>&gt;70K</td>
<td>Typ. 600</td>
<td>3x5series</td>
<td>3.0</td>
</tr>
</tbody>
</table>
• Single-Ended TTL for short cable length and low display resolution
  - SPI
  - MCU
  - RGB

• Differential for long cable length and high display resolution
  - LVDS (RGB)
  - MIPI DSI (RGB)
SPI Interface

- SPI (Serial Peripheral Interface)
  - Ideal for small-scale Application
  - Less IO-lines required
  - Lower resolutions typ. 240x320 pixels

- NOT suitable for high frame-rate applications
  - 240x320 pixels x 16bit color = 1,228,800 data bit per frame
  - 10MHz / 1,228,800 ≈ 8.1 frame/sec

- Consider MCU or RGB!
MCU Interface

• MCU (Parallel Interface)
  • Originally i8080 and M6800 Buses
    • Databus, Addressbus and control-signals
  • Display mostly implement only Databus and control-signals
    • Addressing is done by Index-register
    • Clocks 8-bit/9-bit/16-bit or 18-bit Data per clock-pulse
    • Better choice for small-scale application with demand for frame-rate
  • Mostly found on smaller displays (<=3.2”) w/ built-in controller
• RGB (Parallel Interface)
  • Clocks Color-Data to Display pixel-by-pixel
  • Continuously sending color data from GPU to Display
  • SYNC- or Data Enable/DE-Mode
  • Typical Resolutions max. 800 x 480 pixels
    • @60Hz Framerate clock-frequency approx. 30MHz
    • Crosstalk may appear with long cables
    • EMI/Radiated Emission
    • Higher resolutions/Longer cables: Use LVDS/MIPI
LVDS/MIPI Interface

- LVDS (Low-voltage differential signaling Bus)
  - Serialized Data-transmission
  - Differential/Balanced transmission lines (twisted pair)
  - 3 Data lines: 18bit per color, 4 Data lines: 24-bit per color

- Advantages:
  - Longer Distance btw Application and Display
  - Higher Display Resolution (typ. 1024x600+)
  - Better EMI-capabilities

- MIPI = Mobile Industry Processor Interface
Resistive Touch Technology

- Resistive Touch Panel (RTP)
  - Simple technology
  - PE-Glass Laminate
  - Activated by mechanical pressure
  - 4/5/6/7 or 8-wire interface
  - Only requires ADC – or simple touch controller

Capacitive Touch Technology

- Consider your needs
  - Single Finger or Multi-Finger touch function?
  - Swipe, slide, zoom, rotate?
  - Glove? (What kind of glove?)
  - Humidity/hot/wet environment?
  - Public Applications?
    - Cover Lens in General
    - Improvements for Outdoor Readability
    - Improvements for Vandal-proofing
Resistive Touch Technology

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  - Only requires ADC – or simple touch controller

Source: Internet
Resistive Touch +-

**RTP Pros**
- Simple Technology
- Low price
- Tactile feedback
- Requires mechanical activation: Finger/Stylus/Card can be used
- Easy to adapt: Dedicated controller or ADC in customers MCU
- Software generally available

**RTP Cons**
- Optically not on-par to Glass!
- Requires mechanical activation force
- Wear and Tear to the top PET-layer
  - Scratches to Surface
  - Micro-cracks in PET ITO-layer causes bad linearity over time
- Calibration required at Production time
- Integration Restraints
- No Vandal-proofing
- No Sunlight Readability
Capacitive Touch Technology

- Consider your needs
  - Single Finger or Multi-Finger touch function?
  - Swipe, slide, zoom, rotate?
  - Glove? (what kind of glove?)
  - Humid/moist/wet environment?
  - Public Application?
    - Cover Lens in General
    - Improvements for Outdoor Readability
    - Improvements for Vandal-proofing
Capacitive Sensing Technologies

• **Self Capacitance Technology**
  - Not able to detect Multiple Touchpoints
  - Works with mist/water on the glass

  ![Self Capacitance Diagram](Source: Internet)

• **Mutual Capacitance Technology**
  - Can detect multiple individual Touchpoints
  - Challenged if water occur

  ![Mutual Capacitance Diagram](Source: Internet)
Capacitive Touch Sensor

- Overview
- ITO Pads are transparent
- Many Patents Apply!
• General Purpose is Protection and Branding
  • Material, Thickness
  • Scratch Resistance, Impact Strength
  • Surface Treatments: AG, AR, AF, AB
  • Printing: Logo, Design, Company Face to the public
  • Milling and Drilling: Cut-outs, Chamfering, Corners, Holes

• Bonding and Integration is vital for protection level
Overcoming Environmental Challenges

**Vandal Proof**
- How to obtain it
  - Thicker Glass Cover Lens
  - CS-Glass or Tempered Glass
  - Gorilla Glass™
  - Plastic - PMMA
  - Consider material constants

**Outdoor & Sunlight Challenge**
- Outdoor Readability
  - How to obtain it?
  - Boost backlight intensity by 300%?
  - User wearing polarized sunglasses?
- Optical Bonding
  - Improves contrast, brightness and viewing angle experience by removing reflections
  - Reduces crosstalk between display and touch sensor
  - Non-dust particles or inserts can enter visible area
  - Improves mechanical stress resistance by its laminated structure

**Surface Treatments**
- Caution:
  - UV
  - Heat
  - Reflective

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*TouchGFX*
Vandal Proof – how to obtain it

- Thicker Glass Cover Lens
- CS-Glass or Tempered Glass
- Gorilla Glass™
- Plastics – PMMA?
  - Consider Material Constant e
Solid Bonding Structure

- Bonding Structure 1 (no air gap)
• Bonding Structure 2 (with air gap)
Outdoor & Sunlight Challenge

• Outdoor Readability
  • How to Obtain it?
  • Boost Backlight intensity by 500%?
  • User wearing polarized sunglasses?

• Optical Bonding
  • Improves contrast, brightness and viewing angle experience by removing reflections!
  • Removes condensation between display and touch sensor
  • No dust particles or insects can enter visible area
  • Improves mechanical stress resistance by it’s laminated structure

Caution:
• UV!
• Heat!
• Reflections!
Understanding Reflections

- Reflections is the problem
  - Air-to Glass and Glass-to-Air Transition
  - Each Transition adds 4% to Total reflection
  - Air gap adds twice!
Reducing Reflections

- Reducing the reflections
  - Surface coated with AR-coating reduces 4% to 0.5%
  - Air Gap filled with OCA or OCR reduces to 0.1% (best case)
  - Further improvement by increasing BL-Intensity by 100%
    - With respect to dissipated Heat, lifetime and ambient temperature
Benefits by Optical Bonding

- Advantages
  - Enhanced Outdoor Readability
  - Increased Impact Strength -> Higher IK class
  - Higher Shock and Vibration Resistance
  - Very Low Reflection
  - Improved viewing angles
  - No Air Gap -> No Particles
  - No Air Gap -> No Condensation
Optical Bonding - OCA

• OCA – Optically clear Adhesive
  • Solid Glue-material
  • Applied by mechanical pressure
  • Unwanted Bubbles may be removed in Vacuum Autoclave
  • Final Curing by UV-light
Optical Bonding - OCR

- OCR – Optically Clear Resin
  - Liquid Glue-material
  - Dispensed by Machine
  - Final Curing by UV-light
Surface Treatments

Anti Glare
- AG – Anti Glare
  - Sured Glass Surface, durable
  - Spray Coating (diffused particles), low cost solution

Anti Reflection
- AR – Anti Reflection
  - One Spray layer filters one wavelength
  - Da cameral diff. Spray layers (pco Coating)
  - AR-coating vulnerable to Fingerspots → Add AF-coating

Anti Fingerprints
- AF/AS – Anti Fingerprint/ Anti Smudges
  - Hydrophobic – Repel Water and Oil
  - Nano-Water Material
  - Qualify measured by angle of Water-drop
  - Protects AR coating, OK 50 Rettungs

Anti Bacterial
- AB – Anti Bacterial
  - Multi-bio-microorganisms Inhibit
  - Typically Ag or Polymer
  - Medical, Office, Industry, Gyms

Surface Treatment Combinations
- Treatment Combinations
  - AF on Front or Both sides of GL
  - AF + AF
  - AF + AB + AF
  - AF + AB + AF + UNIVERS
  - AG + AB + AF
  - AF can be done during GL validation AF+
Anti Glare

- AG – Anti Glare
  - Etched Glass Surface, durable
  - Spray Coating (diffused particles), low cost solution

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<thead>
<tr>
<th>ITEM</th>
<th>Haze %</th>
<th>Gloss % (Glossmeter 60°)</th>
<th>Transmittance</th>
<th>Pencil Hardness (Loading=500g)</th>
<th>Abrasion Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4±2%</td>
<td>100±10</td>
<td>&gt;90</td>
<td>5H</td>
<td>Cotton(ISO 105 F09) Loading : 300g Times : 30000 Cycles Test area : 25mmx25mm Speed : 60rpm ▲Gloss&lt;10</td>
</tr>
<tr>
<td>B</td>
<td>7±2%</td>
<td>80±10</td>
<td>&gt;89</td>
<td>5H</td>
<td>Cotton(ISO 105 F09) Loading : 300g Times : 30000 Cycles Test area : 25mmx25mm Speed : 60rpm ▲Gloss&lt;10</td>
</tr>
<tr>
<td>C</td>
<td>9±2%</td>
<td>60±10</td>
<td>&gt;88</td>
<td>5H</td>
<td>Cotton(ISO 105 F09) Loading : 300g Times : 30000 Cycles Test area : 25mmx25mm Speed : 60rpm ▲Gloss&lt;10</td>
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</table>
• AR – Anti Reflection
  • One Spray-layer filters one wavelength
  • Do several diff. Spray-layers per Coating
  • AR-coating vulnerable to Fingerprints -> Add AF-coating
Anti Reflection

• AR – Anti Reflection
  • Principle of Light Reflection
  • Different Technologies available

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<th>Reflection</th>
<th>Transmittance</th>
<th>Pencil Hardness (Loading=500g)</th>
</tr>
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<tr>
<td>LR (EDT In-house)</td>
<td>Spray</td>
<td>&lt;7%</td>
<td>&gt;92.5%</td>
<td>6H</td>
</tr>
<tr>
<td>AR (EDT Outsourcing)</td>
<td>Deposition</td>
<td>&lt;4%</td>
<td>&gt;95.5%</td>
<td>6H</td>
</tr>
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</table>
Anti Fingerprint

- **AF/AS** – Anti Fingerprint/Anti Smudge
- Hydrophobic – Repels Water and Oil
- Nano-scale Material
- Quality measured by angle of Water-droplets
- Protects AR-coating: 2K-5K Rubbings

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<tr>
<td>EDT In-house</td>
<td>Spray</td>
<td>Water Contact Angel</td>
<td>2000 Cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thickness</td>
<td>Pencil Hardness</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Loading 500g)</td>
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<tr>
<td>EDT Outsourcing</td>
<td>Spray</td>
<td>≥110°</td>
<td>5~20 nm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test area</td>
<td>Steel Wool(#0000)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loading : 1000g</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Test area : 20mmx20mm</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Speed : 60 rpm</td>
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• AB – Anti Bacterial
  • Inhibits Micro-organisms to grow
  • Typically Ag+ or Polymer
  • Medical, Clinics, Industry, Gyms
Surface Treatment Combinations

- Treatment Combinations
  - AR on Front or Both sides of CL
  - AR + AF
  - AR + AB + AF
  - AR + AB + AF + UV/IR
  - AG + AB = ABG
  - AB can be done during CS via adding Ag+
• Shared experience
• Short cut to your market
• Design with reliability & confidence
• Enabling you to make a good choice
# Smart Embedded Module Solutions

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Where can I get support?

- Find your local contact points at our website

edt
the clear choice
WWW.EDTC.COM
Smart Embedded in TouchGFX Designer
• Q&A after the webinar

• Upcoming webinars – link in the chat
  • UX Responsiveness & Animations – Making your Application Come Alive
    • Wednesday, September 26th at 08:30 AM CET & 05:30 PM CET
  • Enhancing User Experience with TouchGFX – Advanced Graphics on the STM32
    • October 4th, 2018 12 PM CT / 07:00 PM CEST
  • Advanced Graphics on STM32 and TouchGFX - Hands-on seminar.
  • EDT’s Smart Embedded Display Modules
  • Embedded UI/UX Webinar
  • The New TouchGFX 4.10
Contact information:

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info@edt-Europe.com

Or visit:

www.TouchGFX.com

www.edt.com
Thank you for attending and let’s get in Touch!