Intelligent Display Buffer with DSI Interface

Hiroshi Matsunaga
Renesas Electronics Corporation

Member-to-Member Presentations
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• Concept of Intelligent Buffer IC (iBIC)
• Tremolo Low power solution
• UNH-IOL MIPI Interoperability
• Tremolo Product
Concept of Intelligent Mobile Display

- Realize higher display quality & lower power for any mobile platform
- Intelligent display reduces traffic, and saves power in the system

Mobile Main System Platform

Intelligent Mobile Display

Renesas’ Intelligent Buffer IC

Intelligent Display Controller
- Display Buffering
- Back light Control
- Intelligent Function

Longer battery life by saving power
Less load and easy access to display

Higher resolution & Quality
Lower power Display
Intelligent Display functions
What’s “Tremolo” Solution

Total Solution for intelligent display with image quality & lower power

- DRAM
- DBB Appli Chip
- Power save

Buffer IC e-DRAM

Active

- Back Light Control
- Flexible Mobile I/F (MDDI, MIPI)
- Rotation, Flip, etc..
- Double Buffering
- Window Access (PIP)
- Super Resolution
- 3D Display & AMOLED
Display Power saving in still Image mode

“Tremolo” supports both Command mode and Video mode.

Still Image on Display
- No operation by DBB/Appli chip at power saving
- “Tremolo” keeps still image for display for lower power

Display Frame Rate Control
- Display frame rate can be changed from 30fps to 60 fps
Total Power Saving Concept

① No Backlight Control
② Still Image w/o Frame Buffer

CPU+BB
1.2W

② Still Image w/ Frame Buffer

System Power
2.4W

LCD Panel (LCD + Backlight)

① AGCPS for Power Saving

With Tremolo
① AGCPS for Power saving
② Still Image w/ Frame Buffer

CPU
0.2W

System Power

LCD Panel (LCD + Backlight)
1.45W

Tablet 1366x768 10”
Content-based Backlight Power Saving

(AGCPS = Auto Gamma Control and Power Saving)

Contribute Longer battery life!
Ambient Light-based Backlight Power Saving

Auto control for ambient light level (Backlight, Gamma, Contrast)

- Ambient Light Sensor+CPU
- Tremolo AGCPS-II
- Picture Quality Control
- Get Level of Ambient light
- Backlight control
- Gamma Contrast
- Backlight
- Backlight
- Backlight
- Backlight
- Backlight
- Gamma + Contrast Auto Control

- Down backlight for low power
- RGB Independent Gamma control
- Clear picture even Strong light from outside
- Low Power
- Picture Quality
Image Content-Based Backlight Control

WVGA LCD Panel

Power consumption comparison

Source Image

<Measurement Condition>
LCD Panel: 4.1 inch WVGA (260k color)
Frame rate: 60Hz
Voltage for LCD: 3.0V, Voltage for LED: 19.2V (6pcs x2)
Image Content-Based Backlight Control

WVGA LCD Panel

<Measurement Condition>
- LCD Panel: WVGA (800x480)
- Frame rate: 30Hz
- Voltage for LCD: 3.2V, Voltage for LED: 19V (Series connection)

Power consumption comparison

Source Image
**UNH-IOL MIPI interoperability**

http://www.iol.unh.edu/services/testing/mipi/integratorslist.php

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**MIPI Product Integrators List**

**Display Panels/Peripherals**

<table>
<thead>
<tr>
<th>Company</th>
<th>Product</th>
<th>Device Type</th>
<th>Test Selection</th>
<th>Feature Description</th>
<th>Date Listed</th>
<th>Test ID</th>
<th>Data Sheet</th>
<th>Contact Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renesas Electronics</td>
<td>Tremolo-S µPD60800</td>
<td>DSI to RGB Bridge With Frame Buffer</td>
<td>DISPLAY INTEROP WORKSHOP</td>
<td>2 Data Lanes 1024x600</td>
<td>12/13/2010</td>
<td></td>
<td>Further Info</td>
<td><a href="mailto:Juergen.Moeschen@renesas.com">Juergen.Moeschen@renesas.com</a>, <a href="mailto:ryuichi.hashishita.xr@renesas.com">ryuichi.hashishita.xr@renesas.com</a>, <a href="mailto:greg.kasprzak@renesas.com">greg.kasprzak@renesas.com</a></td>
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<tr>
<td>Renesas Electronics</td>
<td>Tremolo-M µPD60801</td>
<td>DSI to RGB Bridge with Frame Buffer</td>
<td>DISPLAY INTEROP WORKSHOP</td>
<td>2 Data Lanes 1280x768</td>
<td>01/04/2011</td>
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</tr>
</tbody>
</table>

## MIPI Interoperability Test Results

<table>
<thead>
<tr>
<th>Host Device</th>
<th>I/F</th>
<th>Device</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company A</td>
<td>MIPI DSI</td>
<td>Tremolo-S</td>
<td>PASS</td>
</tr>
<tr>
<td>Company B Product 1</td>
<td>MIPI DSI</td>
<td>Tremolo-S</td>
<td>PASS</td>
</tr>
<tr>
<td>Company B Product 2</td>
<td>MIPI DSI</td>
<td>Tremolo-M</td>
<td>PASS</td>
</tr>
<tr>
<td>Company C</td>
<td>MIPI DSI</td>
<td>Tremolo-S</td>
<td>PASS</td>
</tr>
<tr>
<td>Company D</td>
<td>MIPI DSI</td>
<td>Tremolo-M</td>
<td>PASS</td>
</tr>
<tr>
<td>Company E</td>
<td>MIPI DSI</td>
<td>Tremolo-M</td>
<td>PASS</td>
</tr>
<tr>
<td>Renesas SH-Mobile</td>
<td>MIPI DSI</td>
<td>Tremolo-M</td>
<td>PASS</td>
</tr>
</tbody>
</table>
Tremolo-M (uPD60801)

**Feature**

- Resolution: WXGA (Single buffer), up to WSVGA/qHD (Double buffer)
- Frame Buffer: 30Mb eDRAM (14.9Mb x2 e-DRAM configuration)
- Input Interface:
  - MIPI DSI 2 data lane
  - MDDI type 1
- Output Interface
  - MIPI DPI (RGB 24bit Interface)
- Input Clock: 32.768kHz or 19.2MHz or 26MHz (selectable)
- AGCPS (Auto Gamma Control & Power Saving) for power saving of LCD backlight
- Rotate, Flip, Upside-down image, Window Access available
- Tearing Effect pin to control host so as to handle a potential display tearing effect
- PKG: 144 pin CSP, 5.5mm x 5.5mm, 0.4mm BGA pitch

**Schedule**

- Sample: Now
- Production: Now
AGCPS: Auto Gamma Control and Power Saving, which includes both CABC (Content Adaptive Backlight Control) and Ambient-light based Backlight Control.
Tremolo-M Demo-Kit

AGCPS-II Content Base BL Power saving
AGCPS-II Contrast increase under strong light
Basic Function: Frame Buffer, PiP, Rotation, Double Buffer
Thank you !