Realtek SD Express Solution
COMPUTEX TAIPEI 2023
About Realtek Card Readers

- Realtek is a world leading fabless IC design company that provides a variety of IC products
- The Realtek Card Reader product line focuses on high-speed connectivity technology
  - PCIe/USB SD card reader/USB HUB/USB Type-C/Power Delivery
- Realtek SD card readers are widely adopted by ODM/OEM
  - Tight partnership with SD card and host chipset vendors
  - Offer a wide choice of SD card readers

<table>
<thead>
<tr>
<th>SD/Host Interface</th>
<th>USB</th>
<th>PCIe</th>
</tr>
</thead>
<tbody>
<tr>
<td>UHS-I</td>
<td>RTS5176E/RTS5306E/RTS5350</td>
<td>RTS5227S/RTS5228</td>
</tr>
<tr>
<td>UHS-II</td>
<td>RTS5329</td>
<td>RTS5250S</td>
</tr>
<tr>
<td>SD Express</td>
<td>RTL9211DS RTL9220DP</td>
<td>RTS5261 RTS5264</td>
</tr>
<tr>
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<td>NEW NEW</td>
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</tbody>
</table>
What is SD Express?

- Leverage the benefits of SD card and PCIe NVMe SSD

**SD Card**
- Most widely used removable media
- Supported by most host devices
- Tiny form factor

**PCle NVMe SSD**
- High speed & Low latency
- PCIe is a widely used high-speed interface standard

**SD Express Card**
- Extreme high speed (up to 3938MB/s)
- Backward compatible with old SD hosts
- Tiny form factor
The Secret of SD Express

- How does SD Express achieve high speed and backward compatibility?

SD Card

SD Memory Card

SD7.1 SD Express Card

PCIe Interface
1 lane

SD Interface
For backward compatibility

SD8.0 SD Express Card

PCIe Interface
2 lane

SD Interface
For high speed

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SD Express Reader

- Why do I need an SD Express reader?
  - An SD Express card reader can unlock the true speed of SD Express cards
  - The SD Express card can also run in backward compatible mode, however the speed might be limited to UHS-I SDR104 (104MB/s)
Consider your end-product type and choose the optimal design

The table below shows combinations of reader and card

<table>
<thead>
<tr>
<th>Host/Card</th>
<th>SD7.x Card PCIe Gen3x1 (G3L1)</th>
<th>SD8.0 Card PCIe Gen3x2 (G3L2)</th>
<th>SD8.0 Card PCIe Gen4x1 (G4L1)</th>
<th>SD8.0 Card PCIe Gen4x2 (G4L2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD7.1 Reader supports up to PCIe Gen3x1 (G3L1)</td>
<td>985MB/s</td>
<td>985MB/s</td>
<td>985MB/s</td>
<td>985MB/s</td>
</tr>
<tr>
<td>SD8.0 Reader supports up to PCIe Gen3x2 (G3L2)</td>
<td>985MB/s</td>
<td>1969MB/s</td>
<td>985MB/s</td>
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<td>1969MB/s</td>
<td>1969MB/s</td>
<td>3938MB/s</td>
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Implement SD Express Reader

- Select an SD Express reader according to your product type and host interface
  - Reader for built-in host system: Suggest using PCIe interface RTS5264/RTS5261
    - Example use: Laptop, Tablet, Gaming console
  - Reader in a detachable device: Suggest using USB interface RTL9220DP/RTL9211DS
    - Example use: Docking station, Dongle, USB card reader

- Special notes for PCIe interface implementation
  - Host chipset should support PCIe hot plug
  - Vendor driver needs to be installed in the host system
  - If the above requirements cannot be met, use a USB interface.
# RTS5261

SD Express Reader Controller

<table>
<thead>
<tr>
<th>Interface</th>
<th>PCIe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>QFN32 4x4</td>
</tr>
<tr>
<td>Power</td>
<td>3.3V</td>
</tr>
</tbody>
</table>
**RTS5261**

**SD Express Reader Controller**

- The world’s 1st mass-produced PCIe SD Express reader controller
- Widely adopted by laptop makers in gaming, creator, and workstation laptops
- Integrates all power sources for SD/SD Express cards. Reduces BOM cost and design effort
- Co-layout with Realtek UHS-I RTS5227S/RTS5228, UHS-II RTS5250S, SD Ex RTS5264 solution
- Design kit available for SD7.1 or SD8.0 design
RTS5264

SD Express Reader Controller

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</table>
RTS5264
SD Express Reader Controller

- Realtek 2nd Gen SD Express Reader. Evolved from Realtek market proven design RTS5261
- Supports UHS-II and SD8.0 SD Express in the same SD slot
- Integrates all power sources for SD/SD Express cards. Reduces BOM cost and design effort
- Co-layout with Realtek UHS-I RTS5227S/RTS5228, UHS-II RTS5250S, SD Ex RTS5261 solution
- Design kit available for SD7.1 or SD8.0 design
RTS5264

SD Express Reader Controller

- Performance reference result

**Performance Reference Result**

<table>
<thead>
<tr>
<th>Model</th>
<th>Read (MB/s)</th>
<th>Write (MB/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTS5264</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UHS-II HD312</td>
<td>283.18</td>
<td>248.64</td>
</tr>
<tr>
<td>QGT1</td>
<td>283.42</td>
<td>259.45</td>
</tr>
<tr>
<td>QG1T1</td>
<td>11.15</td>
<td>3.60</td>
</tr>
<tr>
<td>RND4K G32T1</td>
<td>10.77</td>
<td>3.56</td>
</tr>
<tr>
<td>SDR104</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kingston CANVAS React 64G</td>
<td>98.43</td>
<td>82.33</td>
</tr>
<tr>
<td>UHS-I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SD Express ADATA SD7.0 256G</td>
<td>892.01</td>
<td>762.64</td>
</tr>
<tr>
<td></td>
<td>860.55</td>
<td>729.18</td>
</tr>
<tr>
<td></td>
<td>373.17</td>
<td>264.26</td>
</tr>
<tr>
<td></td>
<td>39.45</td>
<td>94.17</td>
</tr>
</tbody>
</table>
Co-Layout for Faster Product Design

- It is common to use one PCB design for different segments in Notebooks.
  - Realtek’s PCIe readers can co-layout and use the same QFN32 4x4 footprint
  - Realtek’s PCIe card readers make different segment designs easy

<table>
<thead>
<tr>
<th>Premium</th>
<th>Mainstream</th>
<th>Basic</th>
</tr>
</thead>
<tbody>
<tr>
<td>SoC+ GPU+</td>
<td>SoC GPU</td>
<td>SoC</td>
</tr>
<tr>
<td>RTS5264</td>
<td>RTS5261</td>
<td>RTS5228</td>
</tr>
<tr>
<td>RTS5264 supports SD Express &amp; UHS-II</td>
<td>RTS5261 supports SD Express</td>
<td>RTS5228 supports UHS-I</td>
</tr>
</tbody>
</table>

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RTL9211DS
SD Express Reader Controller

- Interface: USB3.2 Gen2
- Package: QFN68 8x8
- Power: 5V
RTL9211DS

SD Express Reader Controller

- The world’s 1st mass-produced USB SD Express reader controller
- Supports USB3.2 Gen2 10Gbps
- Widely adopted by dongle makers
- Design kit available for SD7.1 or SD8.0 design

<table>
<thead>
<tr>
<th></th>
<th>Super Speed Plus (UASP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Read</td>
</tr>
<tr>
<td><strong>Seq 1M Q8T1</strong></td>
<td>971</td>
</tr>
<tr>
<td><strong>Seq 128K Q32T1</strong></td>
<td>924</td>
</tr>
<tr>
<td><strong>RND4K Q32T16</strong></td>
<td>252</td>
</tr>
<tr>
<td><strong>RND4K Q1T1</strong></td>
<td>27</td>
</tr>
</tbody>
</table>

SD Express SD8.0 Gen3 x2
RTL9220(DP)
SD Express
Reader Controller

Interface: USB3.2 Gen2x2
Package: QFN88 10x10
Power: 5V
RTL9220(DP)

SD Express Reader Controller

- The world’s 1st mass-produced USB SD Express reader controller is able to support 1 LUN/port and dual LUN/port applications
- Supports USB3.2 Gen2x2 20Gbps
- Widely adopted by dongle makers
- Design kit available for SD7.1 or SD8.0 design

SD Express SD8.0 Gen3 x2
Dual LUN, Double Productivity

- Dual LUN means a card reader can support dual SD slots
  - Two SD slots can operate at the same time
  - A classic design is one standard SD slot and one micro SD slot
    - No requirement for dedicated micro SD adapter
New Applications for SD Express

- **Beyond Removable Storage**
  - SD Express can provide SSD-like speed; it can be a removable bootable device
  - Whole PC onto one card becomes a possibility

SD Express

Boot to Windows 11 in a very short time.