Let’s Get Serial!
History and current state of everyone’s favourite interface

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About the Speaker

- IT Consultant for FourEnergy GmbH, Berlin
- Background in IIoT
- Upbringing in close proximity to an IBM PC/XT
Introducing: RS-232!
Agenda

- Technical Specifications
- Historical Uses
- Current Situation
- Outlook
General

- point-to-point
- binary
- asynchronous
- half- or full-duplex
Standardisation

- First published in May 1960 as ‘Interface Between Data Terminal Equipment & Data’
- RS-232C in August 1969
- Last amended in 2012 as TIA-232-F
Some Terminology

- **DTE**: Data Terminal Equipment
- **DCE**: Data Communications¹ Equipment

¹Alternatively: ‘circuit-terminating’
Electrical Specs

- Voltage levels: ±15V
- (usually) ten connections:
  - GND
  - PG
  - RX(D)
  - TX(D)
  - RI
  - DCD
  - CTS
  - RTR
  - RTS
  - DSR
  - DTR
# Connections

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Name</th>
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<tbody>
<tr>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>PG</td>
<td>Protective Ground</td>
</tr>
<tr>
<td>RXD</td>
<td>Receive Data</td>
</tr>
<tr>
<td>TXD</td>
<td>Send Data</td>
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<tr>
<td>RI</td>
<td>Ring Indicator</td>
</tr>
<tr>
<td>DCD</td>
<td>Data Carrier Detect</td>
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<tr>
<td>CTS</td>
<td>Clear to Send</td>
</tr>
<tr>
<td>RTR</td>
<td>Ready to Receive</td>
</tr>
<tr>
<td>RTS</td>
<td>Request to Send</td>
</tr>
<tr>
<td>DSR</td>
<td>Data Set Ready</td>
</tr>
<tr>
<td>DTR</td>
<td>Data Terminal Ready</td>
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</tbody>
</table>
DB-25

- ‘D-subminiature’
- 25 pin connector
- Enough room for two serial connections
9 pin connector
not exclusive to RS-232!
Modified Modular Jack

- Not unsimilar to RJ11/RJ12
- 6P6C
- 8P8C
- Incompatible with Ethernet on RJ45
- Commonly found on dedicated network equipment
Bare Headers

- Alternatively: Just soldering pads somewhere on a PCB
- Usually\(^2\) not voltage-compatible
- Regular sight on SoCs, and SBCs

\(^2\)read: almost certainly
<table>
<thead>
<tr>
<th>Data Rates [bps]</th>
<th>Technical Specifications</th>
<th>Historical Use</th>
<th>Current Situation</th>
<th>Conclusion</th>
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</table>
On-Wire Format

- Start Bit
- Vector
- Parity Bit
- Stop Bit(s)
Historical Use

- Mostly for peripherals (DCE-to-DTE)
- Also System-to-System (DTE-to-DTE)
Limitations of RS-232

- Limited wire length
- At most two comm. partners involved
- Bitrates unfit for many contemporary applications
On the other hand, though . . .

- Low adoption cost
- High availability in both, hard- and software
- Easy to debug
Industrial Applications

- Still relevant in niches
- Largely dispelled by RS-485 (or ‘proper’ fieldbusses)
Ouright: no.\textsuperscript{3}

\textsuperscript{3}Well, except ...
Embedded, SoCs, SBCs, etc

- Hidden almost everywhere
- Often used for:
  - Debugging
  - In-System Programming
  - Flashing firmware
  - Controlling UEFI, bootloader
Network Equipment

Very present. For when all else fails.
Virtual Machines, Containers

- `virsh console` ... is emulating a serial console
- Docker and systemd-machined are pulling tricks
Alternatives (?)

- rlogin\(^4\)
- telnet
- ssh
- netconsole

\(^4\)yes, really
Outlook

- w/o proper successor in some areas
- Left out of automation efforts
Conclusion

- Still standing strong in 2022!
- Moved quite a bit from its original purpose
- Surprisingly high rate of interoperability
Thank you for your attention!
Colophon

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