Physical Layer Interface Standards (PSTN)

- **EIA RS-232-C/D**
  - The most commonly found interface
  - Intended to join Terminal and computer to modem
  - Also used to join terminal to computer and computer to computer
  - Terminal = Data Terminal Equipment (DTE)
  - Computer = DTE
  - Modem = Data Circuit-terminating Equipment (DCE)

- Voltage +3 \(\rightarrow\) +15V logic 0
- Voltage -3 \(\rightarrow\) -15V logic 1
- Unbalanced system
- < 20kbps
- < 15m
## Line designation

<table>
<thead>
<tr>
<th>CCITT circuit</th>
<th>Pin</th>
<th>Signal Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>125 RI</td>
<td>22</td>
<td>Ring Indication RI</td>
</tr>
<tr>
<td>108 DTR</td>
<td>20</td>
<td>Data Terminal Ready DTR</td>
</tr>
<tr>
<td>111 TxClk</td>
<td>16</td>
<td>Transmit Data Timing DTE Source</td>
</tr>
<tr>
<td>114 TxClk</td>
<td>15</td>
<td>Transmit Data Timing DCE Source</td>
</tr>
<tr>
<td>115 RxClk</td>
<td>17</td>
<td>Receive Data Timing</td>
</tr>
<tr>
<td>109 CD</td>
<td>8</td>
<td>Carrier Detect CD</td>
</tr>
<tr>
<td>102 SIG</td>
<td>7</td>
<td>Signal Ground SIG</td>
</tr>
<tr>
<td>107 DSR</td>
<td>6</td>
<td>Data Set Ready DSR</td>
</tr>
<tr>
<td>106 CTS</td>
<td>5</td>
<td>Clear To Send CTS</td>
</tr>
<tr>
<td>105 RTS</td>
<td>4</td>
<td>Request To Send RTS</td>
</tr>
<tr>
<td>104 RxD</td>
<td>3</td>
<td>Receive Data RxD</td>
</tr>
<tr>
<td>103 TxD</td>
<td>2</td>
<td>Transmit Data TxD</td>
</tr>
<tr>
<td>101 SHG</td>
<td>1</td>
<td>Shield Ground SHG</td>
</tr>
</tbody>
</table>

◊ **RS-232-D (1987) defines extra signals for loopback testing**
Under RS-232-C a number of connector may be used the most common being the DB25 (ISO 2110)
RS-232-D specifies this connector only
• V.24
  ◊ Defined by CCITT
  ◊ RS-232 basically compatible with V.24
  ◊ Most apparent difference is pin or circuit identifiers
  ◊ Use CCITT circuit numbers

• V.28
  ◊ Same as RS-232C except has faster rise and fall times

In summary the RS-232D standard is
  Electrical    CCITT V.28
  Functional    CCITT V.24
  Mechanical    ISO 2110
  Procedural    CCITT V.24
- The Null modem
  - Often wish to connect two DTE's together directly
  - Terminal -> computer
  - Computer -> printer etc
  - V.24 or RS-232 data circuits must be reversed
  - Control circuits must be fooled

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<th>CD</th>
<th>SIG</th>
<th>DSR</th>
<th>CTS</th>
<th>RTS</th>
<th>RxD</th>
<th>TxD</th>
<th>SHG</th>
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<td>RxD</td>
<td>TxD</td>
<td>SHG</td>
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</tbody>
</table>
• RS-423-A
  ◊ An electrical standard
  ◊ Unbalanced line
  ◊ NRZ L
  ◊ 0 = +2 to +6 volts
  ◊ 1 = -2 to -6 volts
  ◊ 3kbps @ 1000m
  ◊ 300kbps @ 10m
  ◊ Compatible with V.10, X26

• RS-422-A
  ◊ Balanced line
  ◊ NRZ L
  ◊ 0 = +2 to +6 volts
  ◊ 1 = -2 to -6 volts
  ◊ 100kbps @ 1200m
  ◊ 10Mbps @ 12m
  ◊ Compatible with X.27, V.11
  ◊ Multidrop as RS-485
• RS-449
  ◊ Intended to replace RS-232
  ◊ Uses RS-422 and RS-423 electrical standards
  ◊ Specified up to 2Mbps
  ◊ 37 circuits (large footprint)
  ◊ ISO 4902 connector
  ◊ Not popular
• **EIA-530**
  ◊ Uses RS-422 and RS-423
  ◊ 20kbps to 2Mbps
  ◊ 25 circuits almost identical to RS-232-D
  ◊ DB-25 connector (ISO 2110)
  ◊ 422 for signalling
  ◊ 423 for loopback and test signals

• **V.35**
  ◊ Intended for high speed connection between high speed wideband modems and a DTE
  ◊ 34 pin connector
  ◊ 48 - 168 kbps
  ◊ Signalling circuits RS-422
  ◊ Control circuits RS-232
  ◊ Can run over long distance when only using signal lines
  ◊ Normally associated with V.35 modem (48000 bps)

These are a few of the interfaces used to access PSTN lines via modems. Many more specialised interfaces exist. See some later.
USB (Universal Serial Bus)

USB Specification Rev 2

USB2 480, 12 and 1.5 Mb/s
See maxwell for full specification
Overview

ITU - T V series

Telephone
V.24/EIA-232D
- 2/4 wire leased
  - V.23 600 or 1200 bps
  - V.26 1200 or 2400 bps
  - V.27 2400 or 4800 bps
  - V.29 4800 or 9600 bps
  - V.33 14400 bps
- 2 wire switched
  - V.21 300/300 bps duplex
  - V.22 1200/1200 bps duplex
  - V.22 bis 2400/2400 bps duplex
  - V.23A 75/1200 bps duplex
  - V.29 4800/9600 bps duplex
  - V.32 4800/9600 bps duplex
  - V.32 bis 14400 bps
  - V.34 28800 bps

Wideband
V.35/EIA-530
- point to point
  - V.36 48 kbps
  - V.37 72-168 kbps