Electrical testing of the Ethernet port on Raspberry Pi devices.

Raspberry Pi Ltd

2023-12-05: githash: eddfe24-clean
Colophon

2020-2023 Raspberry Pi Ltd (formerly Raspberry Pi (Trading) Ltd.)

This documentation is licensed under a Creative Commons Attribution-NoDerivatives 4.0 International (CC BY-ND) licence.

build-date: 2023-12-05
build-version: githash: eddfe24-clean

Legal Disclaimer Notice

TECHNICAL AND RELIABILITY DATA FOR RASPBERRY PI PRODUCTS (INCLUDING DATASHEETS) AS MODIFIED FROM TIME TO TIME (“RESOURCES”) ARE PROVIDED BY RASPBERRY PI LTD (“RPL”) ‘AS IS’ AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW IN NO EVENT SHALL RPL BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THE RESOURCES, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

RPL reserves the right to make any enhancements, improvements, corrections or any other modifications to the RESOURCES or any products described in them at any time and without further notice.

The RESOURCES are intended for skilled users with suitable levels of design knowledge. Users are solely responsible for their selection and use of the RESOURCES and any application of the products described in them. User agrees to indemnify and hold RPL harmless against all liabilities, costs, damages or other losses arising out of their use of the RESOURCES.

RPL grants users permission to use the RESOURCES solely in conjunction with the Raspberry Pi products. All other use of the RESOURCES is prohibited. No licence is granted to any other RPL or other third party intellectual property right.

HIGH RISK ACTIVITIES. Raspberry Pi products are not designed, manufactured or intended for use in hazardous environments requiring fail safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, weapons systems or safety-critical applications (including life support systems and other medical devices), in which the failure of the products could lead directly to death, personal injury or severe physical or environmental damage (“High Risk Activities”). RPL specifically disclaims any express or implied warranty of fitness for High Risk Activities and accepts no liability for use or inclusions of Raspberry Pi products in High Risk Activities.

Raspberry Pi products are provided subject to RPL’s Standard Terms. RPL’s provision of the RESOURCES does not expand or otherwise modify RPL’s Standard Terms including but not limited to the disclaimers and warranties expressed in them.
Document version history

NOTE

This is a draft document, and is not yet finalised. It is intended to be technically complete, but it has not yet been edited. If you notice any issues, please let us know by email to applications@raspberrypi.com so that we can improve it for you and other customers.

<table>
<thead>
<tr>
<th>Release</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>1 Jul 2023</td>
<td>• Initial release</td>
</tr>
</tbody>
</table>

Scope of document

This document applies to the following Raspberry Pi products:

<table>
<thead>
<tr>
<th>Pi Zero</th>
<th>Pi 1</th>
<th>Pi 2</th>
<th>Pi 3</th>
<th>Pi 4</th>
<th>Pi 5</th>
<th>Pi 400</th>
<th>CM1</th>
<th>CM3</th>
<th>CM4</th>
<th>Pico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero</td>
<td>W</td>
<td>H</td>
<td>A</td>
<td>B</td>
<td>A+</td>
<td>B+</td>
<td>A</td>
<td>B</td>
<td>A+</td>
<td>B+</td>
</tr>
<tr>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE

Although the instructions presented here work on all the devices specified, they will usually only be required for Compute Module devices, where electrical testing of the physical Ethernet connection is required. This testing has already been done on those Raspberry Pi products that are sold with Ethernet jacks already installed.
**Introduction**

This white paper describes how to install and run software that allows electrical testing of the Ethernet wiring on devices based on the Raspberry Pi Ltd range of single-board computers (SBCs) and Compute Modules.

This white paper assumes that the Raspberry Pi is running Raspberry Pi OS, and is fully up to date with the latest firmware and kernels.
Software installation

Boot the Raspberry Pi device and bring up a terminal window/console.

In a terminal, install and build a copy of `mdio-tool`. The build system uses `cmake`, so you may need to install this first.

```
sudo apt install cmake
git clone https://github.com/PieVo/mdio-tool.git
cd mdio-tool
mkdir build
cd build
cmake ..
make
sudo make install
```
Running the test

The following command will force the Ethernet device to output a 100Mbit waveform:

```
sudo ./mdio-tool w eth0 0x0 0x2100
```

The following command will force the Ethernet device to output a 1000Mbit waveform:

```
sudo ./mdio-tool w eth0 0x0 0x0140
```

You can then start any of the following tests:

Test mode 1 — transmitter droop test mode:

```
sudo ./mdio-tool w eth0 0x9 0x3f00
```

Test mode 2 — transmit jitter test in master mode:

```
sudo ./mdio-tool w eth0 0x9 0x5f00
```

Test mode 3 — transmit jitter test in secondary/slave mode:

```
sudo ./mdio-tool w eth0 0x9 0x7f00
```

Test mode 4 — transmitter distortion test:

```
sudo ./mdio-tool w eth0 0x9 0x9f00
```

Test mode 5 — normal operation at full power:

```
sudo ./mdio-tool w eth0 0x9 0xbf00
```

To end any test modes, use the following command:

```
sudo ./mdio-tool w eth0 0x0 0x1140
```