



## TE0720 Test Board

Revision v.54

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Online version of this document:

<https://wiki.trenz-electronic.de/display/PD/TE0720+Test+Board>

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## 4 Overview

Zynq PS Design with Linux Example and PHY status LED on Vivado HW-Manager.

Refer to <http://trenz.org/te0720-info> for the current online version of this manual and other available documentation.

### 4.1 Key Features

- Vitis/Vivado 2021.2
- PetaLinux
- SD
- ETH (use EEPROM MAC)
- USB
- I2C
- RTC
- VIO PHY LED
- FSBL for EEPROM MAC and CPLD access / petalinux patch
- Special FSBL for QSPI Programming

### 4.2 Revision History

<b>Date</b>	<b>Vivado</b>	<b>Project Built</b>	<b>Authors</b>	<b>Description</b>
2022-02-02	2021.2 1.2	TE0720-test_board-vivado_2021.2-build_11_20220202131818.zip TE0720-test_board_noprebuilt-vivado_2021.2-build_11_20220202131838.zip	Manuela Strücker	<ul style="list-style-type: none"> <li>• bugfix "os" folder</li> <li>• updated Petalinux config               <ul style="list-style-type: none"> <li>• added QSPI Partition for bootscr file</li> </ul> </li> </ul>
2022-01-25	2021.2 1.2	TE0720-test_board-vivado_2021.2-build_10_20220125090947.zip TE0720-test_board_noprebuilt-vivado_2021.2-build_10_20220125090947.zip	Manuela Strücker	<ul style="list-style-type: none"> <li>• 2021.2 update</li> </ul>
2021-11-02	2020.2	TE0720-test_board-vivado_2020.2-build_9_20211215123235.zip TE0720-test_board-	Manuela	<ul style="list-style-type: none"> <li>• new Assembly variants</li> </ul>

<b>Date</b>	<b>Vivado</b>	<b>Project Built</b>	<b>Authors</b>	<b>Description</b>
2-15	0.2	vivado_2020.2-build_9_20211215123235_production.zip	Strücker	
2021-11-29	2.0.2	TE0720-test_board-vivado_2020.2-build_9_20211129062154.zip TE0720-test_board_noprebuilt-vivado_2020.2-build_9_20211129062716.zip	Manuela Strücker	<ul style="list-style-type: none"> <li>new Assembly variants</li> </ul>
2021-07-19	2.0.2	TE0720-test_board_noprebuilt-vivado_2020.2-build_6_20210719131800.zip TE0720-test_board-vivado_2020.2-build_6_20210719131744.zip	Manuela Strücker	<ul style="list-style-type: none"> <li>boot.scr file updated for 256 MB QSPI flash size variants</li> </ul>
2021-04-30	2.0.2	TE0720-test_board_noprebuilt-vivado_2020.2-build_5_20210430085624.zip TE0720-test_board-vivado_2020.2-build_5_20210430085609.zip	Manuela Strücker	<ul style="list-style-type: none"> <li>update board files</li> <li>update boot.scr file</li> </ul>
2021-04-01	2.0.2	TE0720-test_board_noprebuilt-vivado_2020.2-build_4_20210401140444.zip TE0720-test_board-vivado_2020.2-build_4_20210401140432.zip	John Hartfiel	<ul style="list-style-type: none"> <li>bugfix missing binaries+ boot.scr file(supports now QSPI and SD boot with image.ub on SD)</li> </ul>
2021-02-07	2.0.2	TE0720-test_board_noprebuilt-vivado_2020.2-build_2_20210217064925.zip TE0720-test_board-vivado_2020.2-build_2_20210217064913.zip	John Hartfiel	<ul style="list-style-type: none"> <li>2020.2 update</li> <li>add boot.scr file</li> <li>petalinux fsbl patch (beta-version)</li> </ul>



<b>Date</b>	<b>Vivado</b>	<b>Project Built</b>	<b>Authors</b>	<b>Description</b>
2020-03-25	2.0.1.9.2	TE0720-test_board_noprebuilt-vivado_2019.2-build_8_20200325075220.zip TE0720-test_board-vivado_2019.2-build_8_20200325075301.zip	John Hartfield	<ul style="list-style-type: none"> <li>script update</li> </ul>
2020-01-22	2.0.1.9.2	TE0720-test_board-vivado_2019.2-build_3_20200122154933.zip TE0720-test_board_noprebuilt-vivado_2019.2-build_3_20200122154951.zip	John Hartfield	<ul style="list-style-type: none"> <li>script update for linux user</li> </ul>
2020-01-14	2.0.1.9.2	TE0720-test_board-vivado_2019.2-build_3_20200114090828.zip TE0720-test_board_noprebuilt-vivado_2019.2-build_3_20200114090837.zip	John Hartfield	<ul style="list-style-type: none"> <li>Vitis script updates (include linux domain and prebuilt linux files for vitis)</li> <li>prebuilt binary export on selection guide</li> </ul>
2019-12-18	2.0.1.9.2	TE0720-test_board-vivado_2019.2-build_1_20191218151902.zip TE0720-test_board_noprebuilt-vivado_2019.2-build_1_20191218152732.zip	John Hartfield	<ul style="list-style-type: none"> <li>2019.2 update</li> <li>Vitis support</li> </ul>
2019-03-04	2.0.1.8.3	TE0720-test_board-vivado_2018.3-build_01_20190304100745.zip TE0720-test_board_noprebuilt-vivado_2018.3-build_01_20190304100755.zip	John Hartfield	<ul style="list-style-type: none"> <li>update for -1CR version only (256MB DDR3)</li> </ul>
2019-09-01	2.0.1	TE0720-test_board-vivado_2018.3-build_01_20190221125123.zip	John Hartfield	<ul style="list-style-type: none"> <li>TE Script update</li> <li>rework of the FSBLs</li> <li>some additional Linux features</li> </ul>

<b>Date</b>	<b>Version</b>	<b>Project Built</b>	<b>Authors</b>	<b>Description</b>
2-21	8.3	TE0720-test_board_noprebuilt-vivado_2018.3-build_01_20190221125133.zip		
2018-08-23	20 8.2 1 8.2	te0720-test_board-vivado_2018.2-build_03_20180823185142.zip te0720-test_board_noprebuilt-vivado_2018.2-build_03_20180823185158.zip	John Hartfiel	<ul style="list-style-type: none"> <li>• DDR setup bugfix for l1if only</li> </ul>
2018-08-13	20 8.0 1 8.2	te0720-test_board-vivado_2018.2-build_02_20180810162024.zip te0720-test_board_noprebuilt-vivado_2018.2-build_02_20180810162040.zip	John Hartfiel	<ul style="list-style-type: none"> <li>• 2018.2 update</li> <li>• Board Part Files rework</li> </ul>
2018-04-26	20 8.0 1 7.4	te0720-test_board-vivado_2017.4-build_07_20180426144351.zip te0720-test_board_noprebuilt-vivado_2017.4-build_07_20180426144405.zip	John Hartfiel	<ul style="list-style-type: none"> <li>• new assembly variant</li> </ul>
2018-03-12	20 8.0 1 7.4	te0720-test_board_noprebuilt-vivado_2017.4-build_06_20180312152408.zip te0720-test_board-vivado_2017.4-build_06_20180312152419.zip	John Hartfiel	<ul style="list-style-type: none"> <li>• add assembly variant</li> <li>• script update</li> </ul>
2018-01-09	20 8.0 1 7.4	te0720-test_board_noprebuilt-vivado_2017.4-build_02_20180109121313.zip te0720-test_board-vivado_2017.4-build_02_20180109121300.zip	John Hartfiel	<ul style="list-style-type: none"> <li>• no design changes</li> <li>• set EEPROM MAC with FSBL+u-boot</li> <li>• FSBL for QSPI Programming</li> </ul>

<b>Date</b>	<b>Vivado</b>	<b>Project Built</b>	<b>Authors</b>	<b>Description</b>
2017-11-27	2017.2-1.7.2	te0720-test_board_noprebuilt-vivado_2017.2-build_05_20171127153028.zip te0720-test_board-vivado_2017.2-build_05_20171127153006.zip	John Hartfield	<ul style="list-style-type: none"> <li>remove duplicated content</li> </ul>
2017-11-20	2017.2-1.7.2	te0720-test_board_noprebuilt-vivado_2017.2-build_05_20171122074701.zip te0720-test_board-vivado_2017.2-build_05_20171122074646.zip	John Hartfield	<ul style="list-style-type: none"> <li>initial release</li> </ul>

**Table 1: Design Revision History**

### 4.3 Release Notes and Known Issues

<b>Issues</b>	<b>Description</b>	<b>Workaround</b>	<b>To be fixed version</b>
QSPI Flash	Programming QSPI fails with Vivado 2021.2	use Vivado 2020.2 or 2019.2 for programming	
TE0720-test_board_noprebuilt-vivado_2020.2-build_2_20210217064925.zip TE0720-test_board-vivado_2020.2-build_2_20210217064913.zip	Linux binaries are missing boot.scr are only prepared for SD Boot	create and modify by yourself or use 2019.2 design	solved with 2020-04-01 update

Issues	Description	Workaround	To be fixed version
Variant with 256MB DDR only(TE0720-03-1CR)	wrong netboot offset	recreate u-boot on petalinux with reduced netboot offset only	solved with 2019-03-04 update

**Table 2: Known Issues**

## 4.4 Requirements

### 4.4.1 Software

Software	Version	Note
Vitis	2021.2	needed, Vivado is included into Vitis installation
PetaLinux	2021.2	needed

**Table 3: Software**

### 4.4.2 Hardware

Basic description of TE Board Part Files is available on [TE Board Part Files](#).<sup>1</sup>  
 Complete List is available on "<project folder>\board\_files\\*\_board\_files.csv"

Design supports following modules:

Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EM MC	Others	Notes
TE0720-03-2IF	2if_1gb	REV03 REV02	1GB	32MB	4GB	NA	NA

<sup>1</sup> <https://wiki.trenz-electronic.de/display/PD/TE+Board+Part+Files>

Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EM MC	Others	Notes
TE0720-03-2IFC3	2if_1gb	REV03 REV02	1GB	32MB	4GB	2.5 mm connectors	low profile
TE0720-03-2IFC8	2if_1gb	REV03 REV02	1GB	32MB	32GB	NA	NA
TE0720-03-1QF	1qf_1gb	REV03 REV02	1GB	32MB	4GB	NA	NA
TE0720-03-1CF*	1cf_1gb	REV03 REV02	1GB	32MB	4GB	NA	NA
TE0720-03-1CFA	1cf_1gb	REV03 REV02	1GB	32MB	8GB	NA	NA
TE0720-03-1CR	1cr_256mb	REV03 REV02	256MB	32MB	NA	NA	NA
TE0720-03-L1IF	l1if_512mb	REV03 REV02	512MB	32MB	4GB	NA	LP DDR3
TE0720-03-14S-1C	14s_1gb	REV03 REV02	1GB	32MB	4GB	NA	NA
TE0720-03-1QFA	1qf_1gb	REV03 REV02	1GB	32MB	4GB	NA	NA
TE0720-03-2IFA	2if_1gb	REV03 REV02	1GB	32MB	4GB	NA	NA
TE0720-03-1QFL	1qf_1gb	REV03 REV02	1GB	32MB	4GB	2.5 mm connectors	low profile
TE0720-03-31C33FA	14s_1gb	REV03	1GB	32MB	8GB	NA	NA

Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EM MC	Others	Notes
TE0720-03-61C33FA	1cf_1gb	REV03	1GB	32MB	8GB	NA	NA
TE0720-03-61C530A	1cr_256mb	REV03	256MB	32MB	NA	NA	NA
TE0720-03-61Q33FA	1qf_1gb	REV03	1GB	32MB	8GB	NA	NA
TE0720-03-61Q33FL	1qf_1gb	REV03	1GB	32MB	8GB	2.5 mm connectors	low profile
TE0720-03-61Q42GA	1qf_256mb	REV03	256MB	32MB	32GB	NA	NA
TE0720-03-61Q43FA	1qf_256mb	REV03	256MB	32MB	8GB	NA	NA
TE0720-03-61Q43GA	1qf_256mb	REV03	256MB	32MB	32GB	NA	NA
TE0720-03-61Q86KL	1qf_1gb	REV03	1GB	32MB	8GB	NA	Automotive DDR and QSPI
TE0720-03-62I33GA	2if_1gb	REV03	1GB	32MB	32GB	NA	NA
TE0720-03-62I12GA	2if_1gb	REV03	1GB	32MB	32GB	NA	NA

Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EM MC	Others	Notes
TE0720-03-62I320M	2if_1gb	REV03	1GB	32MB	NA	NA	CAO: no Eth USB RTC VBAT CryptoKey
TE0720-03-62I330M	2if_1gb	REV03	1GB	32MB	NA	NA	CAO: no Eth USB RTC VBAT CryptoKey
TE0720-03-62I33FA	2if_1gb	REV03	1GB	32MB	8GB	NA	NA
TE0720-03-62I33FL	2if_1gb	REV03	1GB	32MB	8GB	2.5 mm connectors	low profile
TE0720-03-64I63FA	l1if_512mb	REV03	512MB	32MB	8GB	NA	LP DDR3
TE0720-03-1QFY	1qf_1gb	REV03	1GB	32MB	4GB	NA	no RTC
TE0720-03-31C33MA	14s_1gb	REV03	1GB	32MB	8GB	NA	NA
TE0720-03-61C33MAS	1cf_1gb	REV03	1GB	32MB	8GB	NA	NA
TE0720-03-61Q33MA	1qf_1gb	REV03	1GB	32MB	8GB	NA	NA
TE0720-03-61Q33MAY	1qf_1gb	REV03	1GB	32MB	8GB	NA	no RTC

Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EM MC	Others	Notes
TE0720-03-61Q33ML	1qf_1gb	REV03	1GB	32MB	8GB	2.5 mm connectors	low profile
TE0720-03-61Q42GAY	1qf_256mb	REV03	256 MB	32MB	32 GB	NA	no RTC
TE0720-03-61Q43MA	1qf_256mb	REV03	256 MB	32MB	8GB	NA	automotive Zynq mit IME1G16D3E EBG-15:EI
TE0720-03-62I33MA	2if_1gb	REV03	1GB	32MB	8GB	NA	NA
TE0720-03-62I33MAN	2if_1gb	REV03	1GB	32MB	8GB	NA	industrieller Temperaturbereich; coated
TE0720-03-62I33MAY	2if_1gb	REV03	1GB	32MB	8GB	NA	no RTC
TE0720-03-62I33ML	2if_1gb	REV03	1GB	32MB	8GB	2.5 mm connectors	low profile
TE0720-03-62I33NA	2if_1gb	REV03	1GB	32MB	32 GB	NA	NA
TE0720-03-S006C1	1qf_1gb	REV03	1GB	32MB	8GB	NA	custom variant
TE0720-03-S007C1	1qf_1gb	REV03	1GB	32MB	8GB	NA	custom variant



Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EM MC	Others	Notes
TE0720-03-S011	2if_1gb	REV03	1GB	32MB	8GB	NA	custom variant, no ETH
TE0720-03-S012	2if_1gb	REV03	1GB	32MB	8GB	NA	custom variant
TE0720-03-S014	2if_1gb	REV03	1GB	32MB	8GB	NA	custom variant
TE0720-03-S016	1cr_256mb	REV03	256 MB	32MB	NA	NA	custom variant, no RTC
TE0720-03-S017	2if_1gb	REV03	1GB	32MB	8GB	NA	custom variant, no RTC
TE0720-03-61C33MA	1cf_1gb	REV03	1GB	32MB	8GB	NA	NA
TE0720-03-61C33MAY	1cf_1gb	REV03	1GB	32MB	8GB	NA	no RTC
TE0720-03-62I33-V1	2if_1gb	REV03	1GB	32MB	NA	NA	NA
TE0720-03-S013	1cf_1gb	REV03	1GB	32MB	8GB	NA	custom variant

**Table 4: Hardware Modules**

\*used as reference

Design supports following carriers:

Carrier Model	Notes
TE0701	<ul style="list-style-type: none"> <li>See restrictions on usage with 7 Series Carriers: <a href="#">4 x 5 SoM Carriers</a><sup>2</sup></li> </ul>
TE0703	<ul style="list-style-type: none"> <li>See restrictions on usage with 7 Series Carriers: <a href="#">4 x 5 SoM Carriers</a><sup>3</sup></li> <li>Used as reference carrier.</li> </ul>
TE0705	<ul style="list-style-type: none"> <li>See restrictions on usage with 7 Series Carriers: <a href="#">4 x 5 SoM Carriers</a><sup>4</sup></li> </ul>
TE0706*	<ul style="list-style-type: none"> <li>See restrictions on usage with 7 Series Carriers: <a href="#">4 x 5 SoM Carriers</a><sup>5</sup></li> </ul>
TEBA0841	<ul style="list-style-type: none"> <li>See restrictions on usage with 7 Series Carriers: <a href="#">4 x 5 SoM Carriers</a><sup>6</sup></li> <li>No SD Slot available, pins goes to Pin Header</li> <li>For TEBA0841 REV01, please contact TE support</li> </ul>

**Table 5: Hardware Carrier**

\* used as reference

Additional HW Requirements:

Additional Hardware	Notes
USB Cable for JTAG/UART	Check Carrier Board and Programmer for correct type
XMOD Programmer	Carrier Board dependent, only if carrier has no own FTDI

**Table 6: Additional Hardware**

## 4.5 Content

For general structure and usage of the reference design, see [Project Delivery - Xilinx devices](#)<sup>7</sup>

<sup>2</sup> <https://wiki.trenz-electronic.de/display/PD/4+x+5+SoM+Carriers>

<sup>3</sup> <https://wiki.trenz-electronic.de/display/PD/4+x+5+SoM+Carriers>

<sup>4</sup> <https://wiki.trenz-electronic.de/display/PD/4+x+5+SoM+Carriers>

<sup>5</sup> <https://wiki.trenz-electronic.de/display/PD/4+x+5+SoM+Carriers>

<sup>6</sup> <https://wiki.trenz-electronic.de/display/PD/4+x+5+SoM+Carriers>

<sup>7</sup> <https://wiki.trenz-electronic.de/display/PD/Project+Delivery+-+Xilinx+devices>

### 4.5.1 Design Sources

Type	Location	Notes
Vivado	<project folder>\block_design <project folder>\constraints <project folder>\ip_lib <project folder>\board_files	Vivado Project will be generated by TE Scripts
Vitis	<project folder>\sw_lib	Additional Software Template for Vitis and apps_list.csv with settings automatically for Vitis app generation
PetaLinux	<project folder>\os\petalinux	PetaLinux template with current configuration

**Table 7: Design sources**

### 4.5.2 Additional Sources

Type	Location	Notes
init.sh	<project folder>\misc\sd\	Additional Initialization Script for Linux

**Table 8: Additional design sources**

### 4.5.3 Prebuilt

File	File-Extension	Description
BIF-File	*.bif	File with description to generate Bin-File

File	File-Extension	Description
BIN-File	*.bin	Flash Configuration File with Boot-Image (Zynq-FPGAs)
BIT-File	*.bit	FPGA (PL Part) Configuration File
Boot Script-File	*.scr	Distro Boot Script file
DebugProbes-File	*.ltx	Definition File for Vivado/Vivado Labtools Debugging Interface
Diverse Reports	---	Report files in different formats
Device Tree	*.dts	Device tree (2 possible, one for u-boot and one for linux)
Hardware-Platform-Description-File	*.xsa	Exported Vivado <a href="#">hardware description file</a> for Vitis and PetaLinux
LabTools Project-File	*.lpr	Vivado Labtools Project File
OS-Image	*.ub	Image with Linux Kernel (On Petalinux optional with Devicetree and RAM-Disk)
Software-Application-File	*.elf	Software Application for Zynq or MicroBlaze Processor Systems

**Table 9: Prebuilt files (only on ZIP with prebuilt content)**

#### 4.5.4 Download

Reference Design is only usable with the specified Vivado/Vitis/PetaLinux version. Do never use different Versions of Xilinx Software for the same Project.

Reference Design is available on:

- [TE0720 "Test Board" Reference Design](#)<sup>8</sup>

<sup>8</sup> [https://shop.trenz-electronic.de/Download/?path=Trenz\\_Electronic/Modules\\_and\\_Module\\_Carriers/4x5/TE0720/Reference\\_Design/2021.2/test\\_board](https://shop.trenz-electronic.de/Download/?path=Trenz_Electronic/Modules_and_Module_Carriers/4x5/TE0720/Reference_Design/2021.2/test_board)

## 5 Design Flow

**!** Reference Design is available with and without prebuilt files. It's recommended to use TE prebuilt files for first launch.

Trenz Electronic provides a tcl based built environment based on Xilinx Design Flow.

See also:

- [AMD Development Tools](#)<sup>9</sup>
- [Vivado Projects - TE Reference Design](#)<sup>10</sup>
- [Project Delivery](#).<sup>11</sup>

The Trenz Electronic FPGA Reference Designs are TCL-script based project. Command files for execution will be generated with "\_create\_win\_setup.cmd" on Windows OS and "\_create\_linux\_setup.sh" on Linux OS.

TE Scripts are only needed to generate the vivado project, all other additional steps are optional and can also be executed by Xilinx Vivado/Vitis GUI. For currently Scripts limitations on Win and Linux OS see: [Project Delivery Currently limitations of functionality](#)<sup>12</sup>

**!** **Caution!** Win OS has a 260 character limit for path lengths which can affect the Vivado tools. To avoid this issue, use Virtual Drive or the shortest possible names and directory locations for the reference design (for example "x:\<project folder>")

1. Run \_create\_win\_setup.cmd/\_create\_linux\_setup.sh and follow instructions on shell:

**\_create\_win\_setup.cmd/\_create\_linux\_setup.sh**

```
-----Set design paths-----
-- Run Design with: _create_win_setup
-- Use Design Path: <absolute project path>
-----
-----TE Reference Design-----
-----
-- (0)  Module selection guide, project creation...prebuilt export...
-- (1)  Create minimum setup of CMD-Files and exit Batch
-- (2)  Create maximum setup of CMD-Files and exit Batch
-- (3)  (internal only) Dev
-- (4)  (internal only) Prod
-- (c)  Go to CMD-File Generation (Manual setup)
-- (d)  Go to Documentation (Web Documentation)
-- (g)  Install Board Files from Xilinx Board Store (beta)
-- (a)  Start design with unsupported Vivado Version (beta)
-- (x)  Exit Batch (nothing is done!)
-----
Select (ex.: '0' for module selection guide):
```

2. Press 0 and enter to start "Module Selection Guide"
3. Create project and follow instructions of the product selection guide, settings file will be configured automatically during this process.


<sup>9</sup> <https://wiki.trenz-electronic.de/display/PD/AMD+Development+Tools#AMDDDevelopmentTools-XilinxSoftware-BasicUserGuides>

<sup>10</sup> <https://wiki.trenz-electronic.de/display/PD/Vivado+Projects+-+TE+Reference+Design>

<sup>11</sup> <https://wiki.trenz-electronic.de/display/PD/Project+Delivery+-+Xilinx+devices>

<sup>12</sup> <https://wiki.trenz-electronic.de/display/PD/Project+Delivery+-+Xilinx+devices#ProjectDeliveryXilinxdevices-Currentlylimitationsoffunctionality>


- optional for manual changes: Select correct device and Xilinx install path on "design\_basic\_settings.cmd" and create Vivado project with "vivado\_create\_project\_gui mode.cmd"

 Note: Select correct one, see also [Vivado Board Part Flow](#)<sup>13</sup>


4. Create hardware description file (.xsa file) for PetaLinux project and export to prebuilt folder

**run on Vivado TCL (Script generates design and export files into "\prebuilt\hardware\")**

```
\prebuilt\hardware\")">
TE::hw_build_design -export_prebuilt
```

 Using Vivado GUI is the same, except file export to prebuilt folder.


5. Create and configure your PetaLinux project with exported .xsa-file, see [PetaLinux KICKstart](#)<sup>14</sup>
  - use TE Template from "<project folder>\os\petalinux"
  - use exported .xsa file from "<project folder>\prebuilt\hardware<short name>". **Note:** HW Export from Vivado GUI creates another path as default workspace.
  - The build images are located in the "<plnx-proj-root>/images/linux" directory
6. Configure the **boot.scr** file as needed, see [Distro Boot with Boot.scr](#)<sup>15</sup>
7. Copy PetaLinux build image files to prebuilt folder
  - copy **u-boot.elf**, **u-boot.dtb**, **system.dtb**, **image.ub** and **boot.scr** from "<plnx-proj-root>/images/linux" to prebuilt folder

 "<project folder>\prebuilt\os\petalinux\<ddr size>" or "<project folder>\prebuilt\os\petalinux\<short name>"

8. Generate Programming Files with Vitis

**run on Vivado TCL (Script generates applications and bootable files, which are defined in "test\_board\sw\_lib\apps\_list.csv")**

```
TE::sw_run_vitis -all
TE::sw_run_vitis (optional; Start Vitis from Vivado GUI or start with TE
Scripts on Vivado TCL)
```

 TCL scripts generate also platform project, this must be done manually in case GUI is used. See [Vitis](#)<sup>16</sup>

<sup>13</sup> <https://wiki.trenz-electronic.de/display/PD/Vivado+Board+Part+Flow>


<sup>14</sup> <https://wiki.trenz-electronic.de/display/PD/PetaLinux+KICKstart>

<sup>15</sup> <https://wiki.trenz-electronic.de/display/PD/Distro+Boot+with+Boot.scr>

<sup>16</sup> <https://wiki.trenz-electronic.de/display/PD/Vitis>

## 6 Launch


### 6.1 Programming

 Check Module and Carrier TRMs for proper HW configuration before you try any design. Reference Design is also available with prebuilt files. It's recommended to use TE prebuilt files for first launch.

Xilinx documentation for programming and debugging: [Vivado/Vitis/SDSoC-Xilinx Software Programming and Debugging](#)<sup>17</sup>

#### 6.1.1 Get prebuilt boot binaries

1. Run `_create_win_setup.cmd/_create_linux_setup.sh` and follow instructions on shell
2. Press 0 and enter to start "Module Selection Guide"
  - a. Select assembly version
  - b. Validate selection
  - c. Select create and open delivery binary folder

 Note: Folder "<project folder>\\_binaries\_<Article Name>" with subfolder "boot\_<app name>" for different applications will be generated


#### 6.1.2 QSPI-Boot mode

Option for **Boot.bin** on QSPI Flash and **image.ub** and **boot.scr** on **SD** or **USB**.

1. Connect **JTAG** and power on carrier with module
2. Open Vivado Project with "vivado\_open\_existing\_project\_guimode.cmd" or if not created, create with "vivado\_create\_project\_guimode.cmd"

##### run on Vivado TCL (Script programs **BOOT.bin** on QSPI flash)

```
TE::pr_program_flash -swapp u-boot
TE::pr_program_flash -swapp hello_te0720 (optional)
```

 To program with Vitis/Vivado GUI, use special FSBL (fsbl\_flash) on setup

3. Copy **image.ub** and **boot.scr** on **SD** or **USB**
  - use files from "<project folder>\\_binaries\_<Article Name>\boot\_linux" from generated binary folder, see: [Get prebuilt boot binaries](#) (see page 23)
  - or use prebuilt file location, see "<project folder>\prebuilt\file\_location.txt"
4. Set Boot Mode to **QSPI-Boot** and insert **SD** or **USB**.
  - Depends on Carrier, see carrier TRM.

<sup>17</sup> <https://wiki.trenz-electronic.de/display/PD/AMD+Development+Tools#AMDDDevelopmentTools-XilinxSoftwareProgrammingandDebugging>

### 6.1.3 SD-Boot mode

---

1. Copy **image.ub**, **boot.src** and **Boot.bin** on **SD**
  - use files from "<project folder>\\_binaries\_<Article Name>\boot\_linux" from generated binary folder, see: [Get prebuilt boot binaries](#)(see page 23)
  - or use prebuilt file location, see "<project folder>\prebuilt\file\_location.txt"
2. Set Boot Mode to SD-Boot.
  - Depends on Carrier, see carrier TRM.
3. Insert SD-Card in SD-Slot.

### 6.1.4 JTAG


---


Not used on this Example.

## 6.2 Usage

---

1. Prepare HW like described on section [Programming](#)(see page 23)
2. Connect UART USB (most cases same as JTAG)
3. Select SD Card as Boot Mode (or QSPI - depending on step 1)

 Note: See TRM of the Carrier, which is used.

 Starting with Petalinux version 2020.1, the industry standard "Distro-Boot" boot flow for U-Boot was introduced, which significantly expands the possibilities of the boot process and has the primary goal of making booting much more standardised and predictable. The boot options described above describe the common boot processes for this hardware; other boot options are possible. For more information see [Distro Boot with Boot.scr](#)<sup>18</sup>

4. Power On PCB  
**boot process**
  1. Zynq Boot ROM loads FSBL from SD/QSPI into OCM,
  2. FSBL init PS, programs PL using the bitstream and loads U-boot from SD into DDR,
  3. U-boot loads Linux (**image.ub**) from SD/QSPI/... into DDR

### 6.2.1 Linux

---

1. Open Serial Console (e.g. putty)
  - Speed: 115200
  - select COM Port

 Win OS, see device manager, Linux OS see dmesg |grep tty (UART is \*USB1)

2. Linux Console:

---

<sup>18</sup> <https://wiki.trenz-electronic.de/display/PD/Distro+Boot+with+Boot.scr>



```
petalinux login: root
Password: root
```

**Note:** Wait until Linux boot finished

3. You can use Linux shell now.

```
i2cdetect -y -r 0    (check I2C 0 Bus)
i2cdetect -y -r 1    (check I2C 1 Bus)
dmesg | grep rtc     (RTC check)
udhcpc              (ETH0 check)
lsusb               (USB check)
```

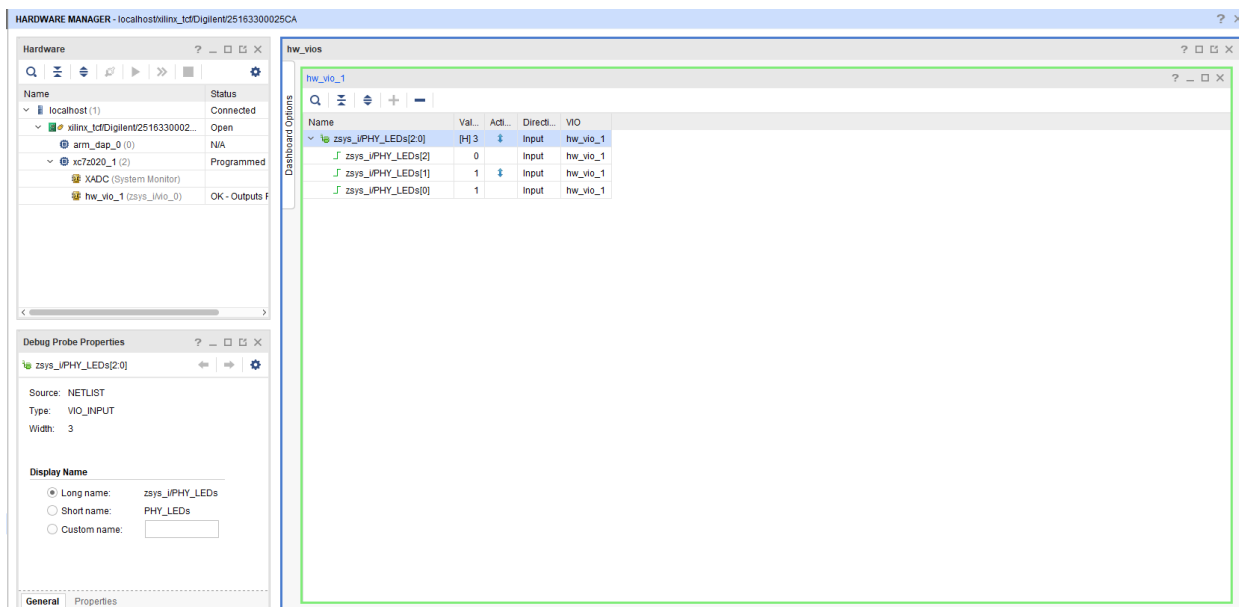
4. Option Features

- Webserver to get access to Zynq
  - insert IP on web browser to start web interface
- init.sh scripts
  - add init.sh script on SD, content will be load automatically on startup (template is included in "<project folder>\misc\SD")

## 6.2.2 Vivado HW Manager

Open Vivado HW-Manager and add VIO signal to dashboard (\*.ltx located on prebuilt folder)

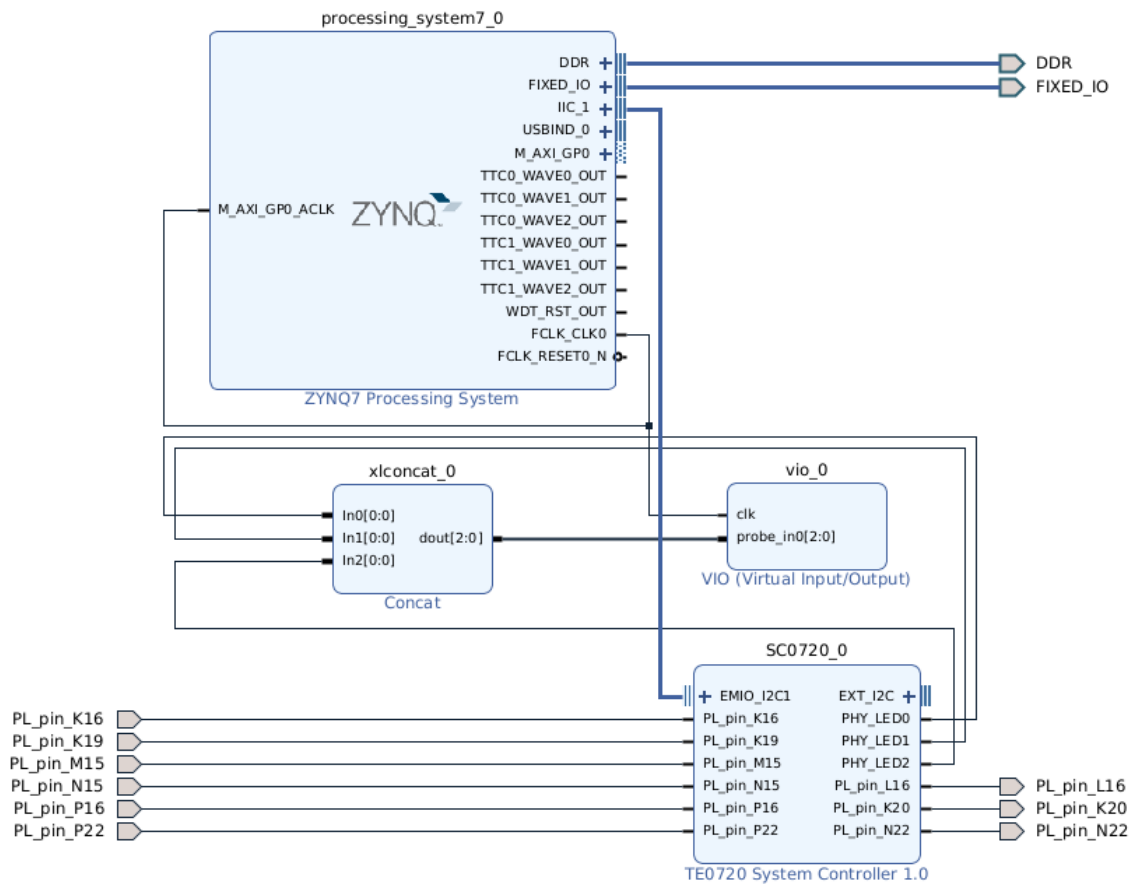
- Monitoring: PHY LED



**Figure 1: Vivado Hardware Manager**

## 7 System Design - Vivado

### 7.1 Block Design



**Figure 2: Block Design**

#### 7.1.1 PS Interfaces

Activated interfaces:

Type	Note
DDR	---
QSPI	MIO
SD0	MIO
SD1	MIO

Type	Note
I2C0	MIO
I2C1	EMIO
UART0	MIO
UART1	MIO
GPIO	MIO
SWDT	EMIO
TTC0..1	EMIO
ETH0	MIO
USB0	MIO

**Table 10: PS Interfaces**

## 7.2 Constrains

### 7.2.1 Basic module constrains

#### **\_i\_bitgen\_common.xdc**

```
#
# Common BITGEN related settings for TE0720 SoM
#
set_property BITSTREAM.GENERAL.COMPRESS TRUE [current_design]
set_property CONFIG_VOLTAGE 3.3 [current_design]
set_property CFBVS VCC0 [current_design]
```

#### **\_i\_common.xdc**

```
#
set_property BITSTREAM.CONFIG.UNUSEDPIN PULLUP [current_design]
```

## 7.2.2 Design specific constrain

### **\_i\_TE0720-SC.xdc**

```
#
# Constraints for System controller support logic
#
set_property PACKAGE_PIN K16 [get_ports PL_pin_K16]
set_property PACKAGE_PIN K19 [get_ports PL_pin_K19]
set_property PACKAGE_PIN K20 [get_ports PL_pin_K20]
set_property PACKAGE_PIN L16 [get_ports PL_pin_L16]
set_property PACKAGE_PIN M15 [get_ports PL_pin_M15]
set_property PACKAGE_PIN N15 [get_ports PL_pin_N15]
set_property PACKAGE_PIN N22 [get_ports PL_pin_N22]
set_property PACKAGE_PIN P16 [get_ports PL_pin_P16]
set_property PACKAGE_PIN P22 [get_ports PL_pin_P22]

#
# If Bank 34 is not 3.3V Powered need change the IOSTANDARD
#
set_property IOSTANDARD LVCMOS33 [get_ports PL_pin_P22]
set_property IOSTANDARD LVCMOS33 [get_ports PL_pin_P16]
set_property IOSTANDARD LVCMOS33 [get_ports PL_pin_N22]
set_property IOSTANDARD LVCMOS33 [get_ports PL_pin_N15]
set_property IOSTANDARD LVCMOS33 [get_ports PL_pin_M15]
set_property IOSTANDARD LVCMOS33 [get_ports PL_pin_L16]
set_property IOSTANDARD LVCMOS33 [get_ports PL_pin_K20]
set_property IOSTANDARD LVCMOS33 [get_ports PL_pin_K19]
set_property IOSTANDARD LVCMOS33 [get_ports PL_pin_K16]
```

## 8 Software Design - Vitis

---

For Vitis project creation, follow instructions from:

Vitis<sup>19</sup>

### 8.1 Application

---

Template location: "<project folder>\sw\_lib\sw\_apps\"

#### 8.1.1 fsbl

---

TE modified 2021.2 FSBL

General:

- Modified Files: main.c, fsbl\_hooks.h/.c (search for 'TE Mod' on source code)
- Add Files: te\_fsbl\_hooks.h/.c (for hooks and board)
- General Changes:
  - Display FSBL Banner and Device ID

Module Specific:

- Add Files: all TE Files start with te\_
  - READ MAC from EEPROM and make Address accessible by UBOOT (need copy defines on uboot platform-top.h)
  - CPLD access
  - Read CPLD Firmware and SoC Type
  - Configure Marvell PHY
  - USB PHY Reset
  - Configure LED usage

#### 8.1.2 fsbl\_flash

---

TE modified 2021.2 FSBL

General:

- Modified Files: main.c
- General Changes:
  - Display FSBL Banner
  - Set FSBL Boot Mode to JTAG
  - Disable Memory initialisation

#### 8.1.3 hello\_te0720

---

Hello World App in Endless loop.

#### 8.1.4 u-boot

---

U-Boot.elf is generated with PetaLinux. Vitis is used to generate Boot.bin.

---

<sup>19</sup> <https://wiki.trenz-electronic.de/display/PD/Vitis>

## 9 Software Design - PetaLinux

---

For PetaLinux installation and project creation, follow instructions from:

- [PetaLinux KICKstart](#)<sup>20</sup>

### 9.1 Config

---

Start with **petalinux-config** or **petalinux-config --get-hw-description**

Changes:

- CONFIG\_SUBSYSTEM\_SERIAL\_PS7\_UART\_0\_SELECT=y
- CONFIG\_SUBSYSTEM\_SERIAL\_IP\_NAME="ps7\_uart\_0"
- CONFIG\_SUBSYSTEM\_FSBL\_SERIAL\_PS7\_UART\_0\_SELECT=y
- # CONFIG\_SUBSYSTEM\_FSBL\_SERIAL\_PS7\_UART\_1\_SELECT is not set
- CONFIG\_SUBSYSTEM\_SERIAL\_FSBL\_IP\_NAME="ps7\_uart\_0"
- CONFIG\_SUBSYSTEM\_MEMORY\_PS7\_DDR\_0\_BANKLESS\_U\_\_BOOT\_TEXTBASE\_OFFSET=0x100000
- CONFIG\_SUBSYSTEM\_UBOOT\_EXT\_DTB=y
- CONFIG\_UBOOT\_EXT\_DTB\_FROM\_DTS=""
- CONFIG\_UBOOT\_DTB\_PACKAGE\_NAME="u-boot.dtb"
- CONFIG\_SUBSYSTEM\_FLASH\_PS7\_QSPI\_0\_BANKLESS\_PART2\_SIZE=0x01400000
- CONFIG\_SUBSYSTEM\_FLASH\_PS7\_QSPI\_0\_BANKLESS\_PART3\_NAME="bootscr"
- CONFIG\_SUBSYSTEM\_FLASH\_PS7\_QSPI\_0\_BANKLESS\_PART3\_SIZE=0x40000
- CONFIG\_SUBSYSTEM\_FLASH\_PS7\_QSPI\_0\_BANKLESS\_PART4\_NAME="spare"

Note: for variants with 256MB DDR only, change NET Boot Address to 0x8000000 on **boot.src** file

### 9.2 U-Boot

---

Start with **petalinux-config -c u-boot**

Changes:

- CONFIG\_QSPI\_BOOT=y
- CONFIG\_SD\_BOOT=y
- CONFIG\_ENV\_IS\_NOWHERE=y
- CONFIG\_ENV\_OVERWRITE=y (used to overwrite default mac address and use from EEPROM)
- CONFIG\_ENV\_IS\_IN\_FAT=y (needed to boot from SD card)
- CONFIG\_ENV\_IS\_IN\_SPI\_FLASH=y (needed to boot from QSPI flash)
- # CONFIG\_ENV\_IS\_IN\_NAND is not set
- CONFIG\_BOOT\_SCRIPT\_OFFSET=0x1920000 (Calculate the start address of partition 3 "bootscr" in the QSPI flash. To do this, add the sizes of partitions 0, 1 and 2 together)
- CONFIG\_PREBOOT=echo U-BOOT for petalinux;echo importing env from FSBL shared area at 0xFFFFFC00; if itest \*0xFFFFFC00 == 0xCAFEBABE; then echo Found valid magic; env import -t 0xFFFFFC04; fi;setenv preboot; echo;

### 9.3 Device Tree

---



---

<sup>20</sup> <https://wiki.trenz-electronic.de/display/PD/PetaLinux+KICKstart>

**Device Tree (system-user.dtsi in device-tree and uboot-device-tree)**

```

/include/ "system-conf.dtsi"
/ {
};

/* bugfix */
/* Uncomment on usage with single core variant only */
/*
&amba {
    ptm@f889d000 {
        cpu = <&cpu0>;
    };
};
*/

/* default */

/*----- QSPI PHY -----*/
&qspi {
    #address-cells = <1>;
    #size-cells = <0>;
    status = "okay";
    flash0: flash@0 {
        compatible = "jedec,spi-nor";
        reg = <0x0>;
        #address-cells = <1>;
        #size-cells = <1>;
    };
};

/*----- ETH PHY -----*/
&gem0 {
    phy-handle = <&phy0>;
    mdio {
        #address-cells = <1>;
        #size-cells = <0>;
        phy0: phy@0 {
            compatible = "marvell,88e1510";
            device_type = "ethernet-phy";
            reg = <0>;
        };
    };
};

/*----- USB PHY -----*/
/{
    usb_phy0: usb_phy@0 {
        compatible = "ulpi-phy";
        //compatible = "usb-nop-xceiv";
    };
};

```

```

        #phy-cells = <0>;
        reg = <0xe0002000 0x1000>;
        view-port = <0x0170>;
        drv-vbus;
    };
};

&usb0 {
    dr_mode = "host";
    //dr_mode = "peripheral";
    usb-phy = <&usb_phy0>;
};

/* I2C need I2C1 connected to te0720 system controller ip */
&i2c1 {

    iexp@20 {          // GPIO in CPLD
        #gpio-cells = <2>;
        compatible = "ti,pcf8574";
        reg = <0x20>;
        gpio-controller;
    };

    iexp@21 {          // GPIO in CPLD
        #gpio-cells = <2>;
        compatible = "ti,pcf8574";
        reg = <0x21>;
        gpio-controller;
    };

    /* Commend out if no RTC is fitted */
    rtc@6F {           // Real Time Clock
        compatible = "isl12022";
        reg = <0x6F>;
    };
};
};

```

## 9.4 FSBL patch

Must be add manually, see template

## 9.5 Kernel

Start with **petalinux-config -c kernel**

Changes:

- CONFIG\_RTC\_DRV\_ISL12022=y

## 9.6 Rootfs

Start with **petalinux-config -c rootfs**



Changes:

- CONFIG\_i2c-tools=y
- CONFIG\_busybox-httpd=y (for web server app)
- CONFIG\_packagegroup-petalinux-utils=y (util-linux,cpufrequtils,bridge-utils,mtd-utils,usbutils,pciutils,canutils,i2c-tools,smartmontools,e2fsprogs)
- CONFIG\_util-linux-umount=y
- CONFIG\_util-linux-mount=y
- CONFIG\_ethtool=y (for usage of phytool)
- # CONFIG\_auto-login is not set

Add in <project folder>\os\petalinux\project-spec\meta-user\conf\petalinuxbsp.conf:

```
IMAGE_INSTALL_append += "\  
phytool \  
"
```

## 9.7 Applications

---

See "<project folder>\os\petalinux\project-spec\meta-user\recipes-apps\"

### 9.7.1 startup

---

Script App to load init.sh from SD Card if available.

### 9.7.2 webfwu

---

Webserver application suitable for Zynq access. Need busybox-httpd

## 10 Additional Software




---

No additional software is needed.

## 11 Appx. A: Change History and Legal Notices

### 11.1 Document Change History

To get content of older revision got to "Change History" of this page and select older document revision number.

Date	Document Revision	Authors	Description
 2023-05-31	<a href="#">v.54</a> (see page 6)	 <sup>21</sup>	<ul style="list-style-type: none"> <li>• bugfix os folder</li> <li>• bugfix table of content</li> </ul>
2022-01-25	v.50	Manuela Strücker	<ul style="list-style-type: none"> <li>• 2021.2 release</li> </ul>
2021-12-16	v.49	Manuela Strücker	<ul style="list-style-type: none"> <li>• new assembly variants</li> </ul>
2021-11-29	v.46	John Hartfiel	<ul style="list-style-type: none"> <li>• new assembly variants</li> </ul>
2021-07-19	v.45	Manuela Strücker	<ul style="list-style-type: none"> <li>• boot.scr file updated for 256 MB QSPI flash size variants</li> </ul>
2021-05-25	v.44	Manuela Strücker	<ul style="list-style-type: none"> <li>• update board files</li> <li>• update boot.scr file</li> </ul>
2021-04-01	v.42		<ul style="list-style-type: none"> <li>• Design update</li> </ul>
2021-02-26	v.41	John Hartfiel	<ul style="list-style-type: none"> <li>• add issue notes</li> </ul>
2021-02-17	v.40	John Hartfiel	<ul style="list-style-type: none"> <li>• 2020.2 release</li> </ul>
2020-03-25	v.39	John Hartfiel	<ul style="list-style-type: none"> <li>• script update</li> </ul>
2020-01-22	v.38	John Hartfiel	<ul style="list-style-type: none"> <li>• script update for linux user</li> </ul>

<sup>21</sup> <https://wiki.trenz-electronic.de/display/~w.hanemann>

Date	Document Revision	Authors	Description
2020-01-14	v.37	John Hartfiel	<ul style="list-style-type: none"> <li>Vitis script updates (include linux domain and prebuilt linux files for vitis)</li> <li>prebuilt binary export on selection guide</li> </ul>
2019-12-19	v.36	John Hartfiel	<ul style="list-style-type: none"> <li>2019.2 release</li> </ul>
2019-12-03	v.34	John Hartfiel	<ul style="list-style-type: none"> <li>bugfix document link</li> </ul>
2019-10-28	v.33	John Hartfiel	<ul style="list-style-type: none"> <li>removed remove instructions that are no longer used</li> </ul>
2019-05-07	v.31	John Hartfiel	<ul style="list-style-type: none"> <li>Some FSBL notes</li> <li>wrong link</li> </ul>
2019-03-06	v.28	John Hartfiel	<ul style="list-style-type: none"> <li>Fixed prebuilt issue for TE0720-03-1CR</li> </ul>
2019-03-01	v.27	John Hartfiel	<ul style="list-style-type: none"> <li>Known issue for TE0720-03-1CR linux design</li> </ul>
2019-02-21	v.26	John Hartfiel	<ul style="list-style-type: none"> <li>2018.3 release finished (include design reworks)</li> </ul>
2018-08-30	v.25	John Hartfiel	<ul style="list-style-type: none"> <li>update documentation PS configuration</li> </ul>
2018-08-23	v.24	John Hartfiel	<ul style="list-style-type: none"> <li>update l1if board parts</li> </ul>
2018-08-13	v.23	John Hartfiel	<ul style="list-style-type: none"> <li>2018.4 release</li> </ul>
2018-04-26	v.22	John Hartfiel	<ul style="list-style-type: none"> <li>add assembly variant</li> </ul>
2018-02-20	v.20	John Hartfiel	<ul style="list-style-type: none"> <li>small documentation update</li> </ul>
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Date	Document Revision	Authors	Description
2017-11-27	v.14	John Hartfiel	<ul style="list-style-type: none"> <li>• Typo correction</li> <li>• Design Files update</li> </ul>
2017-11-22	v.12	John Hartfiel	<ul style="list-style-type: none"> <li>• Update HW list</li> </ul>
2017-11-22	v.11	John Hartfiel	<ul style="list-style-type: none"> <li>• Release 2017.2</li> </ul>
2017-11-20	v.1	@ John Hartfiel <sup>22</sup>	<ul style="list-style-type: none"> <li>• Initial release</li> </ul>
--	All	@ Antonio Luppi <sup>23</sup> , John Hartfiel <sup>24</sup> , Manuela Strücker <sup>25</sup> , Thomas Dück <sup>26</sup> , Waldemar Hanemann <sup>27</sup>	--

**Table 11: Document change history.**

## 11.2 Legal Notices

## 11.3 Data Privacy

Please also note our data protection declaration at <https://www.trenz-electronic.de/en/Data-protection-Privacy>

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<sup>22</sup> <https://wiki.trenz-electronic.de/display/~j.hartfiel>

<sup>23</sup> <https://wiki.trenz-electronic.de/display/~a.luppi>

<sup>24</sup> <https://wiki.trenz-electronic.de/display/~j.hartfiel>

<sup>25</sup> <https://wiki.trenz-electronic.de/display/~m.struecker>

<sup>26</sup> <https://wiki.trenz-electronic.de/display/~t.dueck>

<sup>27</sup> <https://wiki.trenz-electronic.de/display/~w.hanemann>

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## 11.9 REACH, RoHS and WEEE

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### REACH

Trenz Electronic is a manufacturer and a distributor of electronic products. It is therefore a so called downstream user in the sense of [REACH](#)<sup>28</sup>. The products we supply to you are solely non-chemical products (goods). Moreover and under normal and reasonably foreseeable circumstances of application, the goods supplied to you shall not release any substance. For that, Trenz Electronic is obliged to neither register nor to provide safety data sheet. According to present knowledge and to best of our knowledge, no [SVHC \(Substances of Very High Concern\) on the Candidate List](#)<sup>29</sup> are contained in our products. Furthermore, we will immediately and unsolicited inform our customers in compliance with REACH - Article 33 if any substance present in our goods (above a concentration of 0,1 % weight by weight) will be classified as SVHC by the [European Chemicals Agency \(ECHA\)](#)<sup>30</sup>.

### RoHS

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<sup>28</sup> <http://guidance.echa.europa.eu/>

<sup>29</sup> <https://echa.europa.eu/candidate-list-table>

<sup>30</sup> <http://www.echa.europa.eu/>


Trenz Electronic GmbH herewith declares that all its products are developed, manufactured and distributed RoHS compliant.

**WEEE**

Information for users within the European Union in accordance with Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE).

Users of electrical and electronic equipment in private households are required not to dispose of waste electrical and electronic equipment as unsorted municipal waste and to collect such waste electrical and electronic equipment separately. By the 13 August 2005, Member States shall have ensured that systems are set up allowing final holders and distributors to return waste electrical and electronic equipment at least free of charge. Member States shall ensure the availability and accessibility of the necessary collection facilities. Separate collection is the precondition to ensure specific treatment and recycling of waste electrical and electronic equipment and is necessary to achieve the chosen level of protection of human health and the environment in the European Union. Consumers have to actively contribute to the success of such collection and the return of waste electrical and electronic equipment. Presence of hazardous substances in electrical and electronic equipment results in potential effects on the environment and human health. The symbol consisting of the crossed-out wheeled bin indicates separate collection for waste electrical and electronic equipment.

Trenz Electronic is registered under WEEE-Reg.-Nr. DE97922676.

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