



TE0818 StarterKit

Revision v.17

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Online version of this document:

<https://wiki.trenz-electronic.de/display/PD/TE0818+StarterKit>

1 Table of Contents

1	Table of Contents	2
2	Table of Figures	4
3	Table of Tables	5
4	Overview	7
4.1	Key Features	7
4.2	Revision History	7
4.3	Release Notes and Know Issues	9
4.4	Requirements	10
4.4.1	Software	10
4.4.2	Hardware	10
4.5	Content	13
4.5.1	Design Sources	13
4.5.2	Additional Sources	14
4.5.3	Prebuilt	14
4.5.4	Download	15
5	Design Flow	16
6	Launch	18
6.1	Programming	18
6.1.1	Get prebuilt boot binaries	18
6.1.2	QSPI-Boot mode	18
6.1.3	SD-Boot mode	18
6.1.4	JTAG	19
6.2	Usage	19
6.2.1	Linux	19
6.2.2	Vivado HW Manager	20
7	System Design - Vivado	22
7.1	Block Design	22
7.1.1	PS Interfaces	22
7.2	Constraints	23
7.2.1	Basic module constraints	23
7.2.2	Design specific constraints	23
8	Software Design - Vitis	26
8.1	Application	26
8.1.1	zynqmp_fsbl	26
8.1.2	zynqmp_pmufw	26
8.1.3	hello_te0818	26
8.1.4	u-boot	26
9	Software Design - PetaLinux	27
9.1	Config	27
9.2	U-Boot	27

9.3	Device Tree	28
9.4	Kernel.....	31
9.5	Rootfs.....	32
9.6	FSBL patch (alternative for vitis fsbl trenz patch)	32
9.7	Applications.....	32
9.7.1	startup	32
9.7.2	webfwu	32
10	Additional Software	33
10.1	SI5345	33
11	App. A: Change History and Legal Notices	34
11.1	Document Change History.....	34
11.2	Legal Notices	35
11.3	Data Privacy.....	35
11.4	Document Warranty	35
11.5	Limitation of Liability	35
11.6	Copyright Notice	35
11.7	Technology Licenses.....	35
11.8	Environmental Protection	35
11.9	REACH, RoHS and WEEE	36

2 Table of Figures

Figure 1: Block Design	22
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3 Table of Tables

Table 1: Design Revision History	7
Table 2: Known Issues.....	9
Table 3: Software	10
Table 4: Hardware Modules.....	10
Table 5: Hardware Carrier.....	12
Table 6: Additional Hardware.....	12
Table 7: Design sources	13
Table 8: Additional design sources	14
Table 9: Prebuilt files (only on ZIP with prebuilt content).....	14
Table 10: Vivado Hardware Manager	21
Table 11: PS Interfaces.....	22
Table 12: Document change history.	34

4 Overview

Refer to <http://trenz.org/te0818-info> for the current online version of this manual and other available documentation.

4.1 Key Features

- Vitis/Vivado 2022.2
- TEBF0818
- Linux
- USB
- ETH
- MAC from EEPROM
- PCIe
- SATA
- SD
- I2C
- RGPIO
- Display Port (DP)
- user LED access
- Modified FSBL for Si5345 programming

4.2 Revision History

Expand List

Date	Vivado	Project Built	Authors	Description
2023-08-15	2022.2	TE0818-StarterKit-vivado_2022.2-build_6_20230815120540.zip TE0818-StarterKit_noprebuilt-vivado_2022.2-build_6_20230815120540.zip	Manuela Strücker	<ul style="list-style-type: none">• new assembly variants
2023-06-14	2022.2	TE0818-StarterKit-vivado_2022.2-build_2_20230619104156.zip TE0818-StarterKit_noprebuilt-vivado_2022.2-	Manuela Strücker	<ul style="list-style-type: none">• 2022.2 release• new assembly variants

Date	Vivado	Project Built	Authors	Description
		build_2_20230619104156.zip		
2023-02-14	2021.2.1	TE0818-StarterKit_noprebuilt-vivado_2021.2-build_20_20230214112518.zip TE0818-StarterKit-vivado_2021.2-build_20_20230214112518.zip	Manuela Strücker	<ul style="list-style-type: none"> new assembly variants
2022-09-12	2021.2.1	TE0818-StarterKit_noprebuilt-vivado_2021.2-build_15_20220912092618.zip TE0818-StarterKit-vivado_2021.2-build_15_20220912092618.zip	Manuela Strücker	<ul style="list-style-type: none"> update board part files compatible to Vivado 2021.2.1
2022-05-12	2021.2	TE0818-StarterKit_noprebuilt-vivado_2021.2-build_14_20220512120454.zip TE0818-StarterKit-vivado_2021.2-build_14_20220512120454.zip	Manuela Strücker	<ul style="list-style-type: none"> new assembly variant
2022-02-24	2021.2	TE0818-StarterKit_noprebuilt-vivado_2021.2-build_11_20220224094436.zip TE0818-StarterKit-vivado_2021.2-build_11_20220224094436.zip	Manuela Strücker	<ul style="list-style-type: none"> bugfix (read MAC from EEPROM)

Date	Vivado	Project Built	Authors	Description
2022-02-03	2021.2	TE0818-StarterKit_noprebuilt-vivado_2021.2-build_11_20220203074431.zip TE0818-StarterKit-vivado_2021.2-build_11_20220203074431.zip	John Hartfiel	<ul style="list-style-type: none"> initial release

Table 1: Design Revision History

4.3 Release Notes and Know Issues

Issues	Description	Workaround	To be fixed version
Xilinx Software	Incompatibility of board files for ZynqMP with eMMC activated between 2021.2 and 2021.2.1 patch, see Xilinx Forum Request¹	use corresponding board files for the Vivado versions	--
MAC from EEPROM	The MAC address stored in the EEPROM is not read out and initialised correctly during start-up. This is caused by two I2C expanders each switched to the same EEPROM with the same address i2cswitch@73 --> i2c@5 --> reg = <0x50> and i2cswitch@77 --> i2c@4 --> reg = <0x50>	Switching the second I2C expander (i2cswitch@77) to another channel in the fsbl solves the error during the start-up procedure.	Solved with 20220224 update

Table 2: Known Issues

¹ https://support.xilinx.com/s/feed/0D54U00005Wbon6SAB?language=en_US

4.4 Requirements

4.4.1 Software

Software	Version	Note
Vitis	2022.2	needed, Vivado is included into Vitis installation
PetaLinux	2022.2	needed
SI ClockBuilder Pro	---	optional

Table 3: Software

4.4.2 Hardware

Basic description of TE Board Part Files is available on [TE Board Part Files](#).²

Complete List is available on "<project folder>\board_files*_board_files.csv"

Design supports following modules:

Expand List

Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EM MC	Others	Notes
TE0818-01-9GI21-A*	9eg_2i_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-9BE21-A	9eg_1e_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-S001	6eg_1e_4gb	REV01	4GB	128MB	NA	NA	without PLL

² <https://wiki.trenz-electronic.de/display/PD/TE+Board+Part+Files>

Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EMMC	Others	Notes
TE0818-01-S002	9eg_2i_4gb_B	REV01	4GB	128MB	NA	NA	NA
TE0818-01-S003	9eg_2i_4gb_B	REV01	4GB	128MB	NA	NA	NA
TE0818-01-9BE21-AZ	9eg_1e_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-9GI21-AK	9eg_2i_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-BBE21-A	15eg_1e_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-BBE21-AZ	15eg_1e_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-9BI41-X	9eg_1i_8gb_D	REV01	8GB	128MB	NA	NA	NA
TE0818-01-T001K	15eg_1e_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-T002K	9eg_2i_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-9GI81-A	9eg_2i_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-BBE81-A	15eg_1e_4gb_D	REV01	4GB	128MB	NA	NA	NA
TE0818-01-9GI81-AK	9eg_2i_4gb_D	REV01	4GB	128MB	NA	NA	NA

Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EMMC	Others	Notes
TE0818-01-BBE81-AK	15eg_1e_4gb_D	REV01	4GB	128MB	NA	NA	NA

Table 4: Hardware Modules

*used as reference

Note: Design contains also Board Part Files for TE0818 only configuration, this board part files are not used for this reference design.

Design supports following carriers:

Carrier Model	Notes
TEBF0818	Used as reference carrier.

Table 5: Hardware Carrier

*used as reference

Additional HW Requirements:

Additional Hardware	Notes
Display Port Monitor	Optional HW Not all monitors are supported, also Adapter to other Standard can make trouble. Design was tested with DELL U2412M
USB Keyboard	Optional HW Can be used to get access to console which is show on Display Port
USB Stick	Optional HW USB was tested with USB memory stick
SATA Disk	Optional HW
PCIe Card	Optional HW

Additional Hardware	Notes
ETH cable	Optional HW Ethernet works with DHCP, but can be setup also manually
SD card	with fat32 partition

Table 6: Additional Hardware

* used as reference

4.5 Content

For general structure and usage of the reference design, see [Project Delivery - AMD devices](#)³

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

³ <https://wiki.trenz-electronic.de/display/PD/Project+Delivery+-+AMD+devices>

4.5.2 Additional Sources

Type	Location	Notes
SI5345	<project folder>\misc\PLL\	SI5345 Project with current PLL Configuration
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
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 hardware description file for Vitis and PetaLinux
LabTools Project-File	*.lpr	Vivado Labtools Project File

File	File-Extension	Description
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:

- [TE0818 "Starterkit" Reference Design⁴](#)

⁴ https://shop.trenz-electronic.de/Download/?path=Trenz_Electronic/Modules_and_Module_Carriers/5.2x7.6/TE0818/Reference_Design/2022.2/StarterKit

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](#)⁵
- [Vivado Projects - TE Reference Design](#)⁶
- [Project Delivery](#).⁷

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](#)⁸

! **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.


⁵ <https://wiki.trenz-electronic.de/display/PD/AMD+Development+Tools#AMDDDevelopmentTools-XilinxSoftware-BasicUserGuides>

⁶ <https://wiki.trenz-electronic.de/display/PD/Vivado+Projects+-+TE+Reference+Design>

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

⁸ <https://wiki.trenz-electronic.de/display/PD/Project+Delivery+-+AMD+devices#ProjectDeliveryAMDdevices-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](#)⁹
Important: Use Board Part Files, which ends with *_tebf0818


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](#)¹⁰
 - 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](#)¹¹
7. Generate Programming Files with Vitis
 - a. Copy PetaLinux build image files to prebuilt folder
 - copy **u-boot.elf**, **system.dtb**, **bl31.elf**, **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>"

- b. Generate Programming Files

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](#)¹²

Generate Programming Files with Petalinux (alternative), see [PetaLinux KICKstart](#)¹³

⁹ <https://wiki.trenz-electronic.de/display/PD/Vivado+Board+Part+Flow>

¹⁰ <https://wiki.trenz-electronic.de/display/PD/PetaLinux+KICKstart>

¹¹ <https://wiki.trenz-electronic.de/display/PD/Distro+Boot+with+Boot.scr>


¹² <https://wiki.trenz-electronic.de/display/PD/Vitis>

¹³ <https://wiki.trenz-electronic.de/display/PD/PetaLinux+KICKstart>

6 Launch

For basic board setup, LEDs... see: [TEBF0818 Getting Started](#)¹⁴


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](#)¹⁵

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

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 hello_te0818
```

3. Set Boot Mode to **QSPI-Boot**.
 - Depends on Carrier, see carrier TRM.
 - TEBF0818 change automatically the Boot Mode to SD, if SD is inserted, optional CPLD Firmware without Boot Mode changing for microSD Slot is available on the download area

6.1.3 SD-Boot mode

1. Copy **image.ub**, **boot.src** and **Boot.bin** on **SD**

¹⁴ <https://wiki.trenz-electronic.de/display/PD/TEBF0818+Getting+Started>

¹⁵ <https://wiki.trenz-electronic.de/display/PD/AMD+Development+Tools#AMDDDevelopmentTools-XilinxSoftwareProgrammingandDebugging>


- use files from "<project folder>_binaries_<Article Name>\boot_linux" from generated binary folder, see: [Get prebuilt boot binaries \(see page 18\)](#)
 - 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 \(see page 18\)](#)
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](#)¹⁶

4. (Optional with TEBF0818) Insert PCIe Card (detection depends on Linux driver. Only some basic drivers are installed)
5. (Optional with TEBF0818) Connect SATA Disc
6. (Optional with TEBF0818) Connect Display Port Monitor (List of usable Monitors: <https://www.xilinx.com/support/answers/68671.html>)
7. (Optional with TEBF0818) Connect Network Cable
8. Power On PCB

boot process

1. ZynqMP Boot ROM loads FSBL from SD/QSPI into OCM,
2. FSBL init the PS, programs the PL using the bitstream and loads PMU, ATF and U-boot from SD/QSPI 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

¹⁶ <https://wiki.trenz-electronic.de/display/PD/Distro+Boot+with+Boot.scr>

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

2. Linux Console:

```
# password disabled
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, replace 0 with other bus number is
also possible)
dmesg | grep rtc     (RTC check)
udhcpc              (ETH0 check)
lsusb               (USB check)
lspci               (PCIe check)
```

4. Option Features

- Webserver to get access to ZynqMP
 - 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 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)

- RGPIO Interface (**Important:** CPLD Firmware REV07 or newer is needed) for Control and Monitoring:
 - Set Enable to send Write date over RGPIO interface.
 - **CPLD Description:** [TEBF0818 CPLD](https://wiki.trenz-electronic.de/display/PD/TEBF0818+CPLD)¹⁷
 - Buttons, LEDs, Status...
- Control:
 - LEDs: XMOD 2 (without green dot) and HD LED are accessible.
 - CAN_S

¹⁷ <https://wiki.trenz-electronic.de/display/PD/TEBF0818+CPLD>

hw_vios					
hw_vio_3 hw_vio_1 × hw_vio_2					
<div>Dashboard Options</div> <div> <div>Q</div> <div>≡</div> <div>⬇</div> <div>+</div> <div>−</div> </div>					
Name	Value	Acti...	Directi...	VIO	
> zsys_iRGPIOIo_rgpio_m_7dt8_unused[1:0]	[H] 0	▼	Output	hw_vio_1	
> zsys_iRGPIOIo_rgpio_m_11dt8_muxsel[3:0]	[H] 0	▼	Output	hw_vio_1	
> zsys_iRGPIOIo_rgpio_m_23dt12_unused[11:0]	[H] 000	▼	Output	hw_vio_1	
> zsys_iRGPIOIo_rgpio_m_11dt8_MUX[3:0]	[H] 0		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_12_CAN_FAULT	[B] 0		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_17_S5_3_USER	[B] 1		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_18_S5_4_FMCVADJ	[B] 1		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_20_SD_WP	[B] 0		Input	hw_vio_1	
> zsys_iRGPIOIo_rgpio_m_7dt0_data[7:0]	[H] 00		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_21_FMC_CLKDIR	[B] 0		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_s_0_S5_1_bootmode	[B] 0		Input	hw_vio_1	
> zsys_iRGPIOIo_rgpio_m_5dt0_leds[5:0]	[H] 00	▼	Output	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_enable	[B] 0	▼	Output	hw_vio_1	
> zsys_iRGPIOIo_rgpio_m_15dt13_PHY_LEDS[2:0]	[H] 2	⚡	Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_16_XMOD2BUTTON	[B] 1		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_19_reserved	[B] 0		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_22_PJTAG_TRST	[B] 1		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_m_23_PJTAG_SRST	[B] 1		Input	hw_vio_1	
zsys_iRGPIOIo_rgpio_s_1_S5_2_bootmode	[B] 0		Input	hw_vio_1	

hw_vios					
hw_vio_3 hw_vio_1 hw_vio_2 ×					
<div>Dashboard Options</div> <div> <div>Q</div> <div>≡</div> <div>⬇</div> <div>+</div> <div>−</div> </div>					
Name	Value	Acti...	Directi...	VIO	
> zsys_iMGT_128_CLK0_Si5345_out6[31:0]	[U] 78799999	⚡	Input	hw_vio_2	
> zsys_iMGT_229_CLK1_Si5345_out2[31:0]	[U] 99999999	⚡	Input	hw_vio_2	
> zsys_iMGT_230_CLK0_Si5345_out1[31:0]	[U] 124999999	⚡	Input	hw_vio_2	
> zsys_iMGT_230_CLK1_TEBF_Si5345_out7[31:0]	[U] 156249999	⚡	Input	hw_vio_2	
> zsys_iMGT_128_CLK1_floating[31:0]	[U] 715825	⚡	Input	hw_vio_2	
> zsys_iMGT_228_CLK0_TEBF0818_FMC[31:0]	[U] 156249441	⚡	Input	hw_vio_2	
> zsys_iMGT_228_CLK1_Si5345_out3[31:0]	[U] 2931815	⚡	Input	hw_vio_2	
> zsys_iMGT_229_CLK0_TEBF0818_FMC[31:0]	[U] 156249441	⚡	Input	hw_vio_2	

hw_vios					
hw_vio_3 × hw_vio_1 hw_vio_2					
<div>Dashboard Options</div> <div> <div>Q</div> <div>≡</div> <div>⬇</div> <div>+</div> <div>−</div> </div>					
Name	Value	Activity	Directi...	VIO	
zsys_iIo_CAN_0_S	[B] 0	▼	Output	hw_vio_3	
zsys_iIo_LED_HD	[B] 0	▼	Output	hw_vio_3	
zsys_iIo_LED_XMOD2	[B] 0	▼	Output	hw_vio_3	

Table 10: Vivado Hardware Manager

Type	Note
UART0	MIO
GPIO0	MIO
SWDT0..1	
TTC0..3	
GEM3	MIO
USB0	MIO/GTP
PCIe	MIO/GTP
SATA	GTP
Display Port	EMIO/GTP

Table 11: PS Interfaces

7.2 Constraints

7.2.1 Basic module constraints

_i_bitgen.xdc

```
set_property BITSTREAM.GENERAL.COMPRESS TRUE [current_design]
set_property BITSTREAM.CONFIG.UNUSEDPIN PULLNONE [current_design]
```

7.2.2 Design specific constraints

_i_io.xdc

```
#System Controller IP
#LED_HD SC0 J3:C13
#LED_XMOD SC17 J3:B19
#CAN RX SC19 J3:B23
#CAN TX SC18 J3:B22
```

```
#CAN S SC16 J3:B18
```

```
#HDIO_SC0 J14
set_property PACKAGE_PIN J14 [get_ports BASE_sc0]
#HDIO_SC5 G13
set_property PACKAGE_PIN G13 [get_ports BASE_sc5]
#HDIO_SC6 J15
set_property PACKAGE_PIN J15 [get_ports BASE_sc6]
#HDIO_SC7 K15
set_property PACKAGE_PIN K15 [get_ports BASE_sc7]
#HDIO_SC10 A15
set_property PACKAGE_PIN A15 [get_ports BASE_sc10_io]
#HDIO_SC11 B15
set_property PACKAGE_PIN B15 [get_ports BASE_sc11]
#HDIO_SC12 C13
set_property PACKAGE_PIN C13 [get_ports BASE_sc12]
#HDIO_SC13 C14
set_property PACKAGE_PIN C14 [get_ports BASE_sc13]
#HDIO_SC14 E13
set_property PACKAGE_PIN E13 [get_ports BASE_sc14]
#HDIO_SC15 E14
set_property PACKAGE_PIN E14 [get_ports BASE_sc15]
#HDIO_SC16 A13
set_property PACKAGE_PIN A13 [get_ports BASE_sc16]
#HDIO_SC17 B13
set_property PACKAGE_PIN B13 [get_ports BASE_sc17]
#HDIO_SC18 A14
set_property PACKAGE_PIN A14 [get_ports BASE_sc18]
#HDIO_SC19 B14
set_property PACKAGE_PIN B14 [get_ports BASE_sc19]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc0]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc5]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc6]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc7]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc10_io]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc11]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc12]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc13]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc14]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc15]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc16]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc17]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc18]
set_property IOSTANDARD LVCMOS18 [get_ports BASE_sc19]
```

```
# Audio Codec
```

```
#LRCLK J3:49 B47_L9_N
#BCLK J3:51 B47_L9_P
#DAC_SDATA J3:53 B47_L7_N
#ADC_SDATA J3:55 B47_L7_P
```

```
#LRCLK G14
set_property PACKAGE_PIN G14 [get_ports I2S_lrclk ]
#BCLK G15
```



```

set_property PACKAGE_PIN G15 [get_ports I2S_bclk ]
#DAC_SDATA E15
set_property PACKAGE_PIN E15 [get_ports I2S_sdin ]
#ADC_SDATA F15
set_property PACKAGE_PIN F15 [get_ports I2S_sdout ]
set_property IOSTANDARD LVCMOS18 [get_ports I2S_lrclk ]
set_property IOSTANDARD LVCMOS18 [get_ports I2S_bclk ]
set_property IOSTANDARD LVCMOS18 [get_ports I2S_sdin ]
set_property IOSTANDARD LVCMOS18 [get_ports I2S_sdout ]

# MGTs
# F25 MGT_128_CLK0_P -> U5,45 -> Si5345 -> out6
# F26 MGT_128_CLK0_N -> U5,44 -> Si5345 -> out6
# D25 MGT_128_CLK1_P -> B2B,J2-A7 -> floating
# D26 MGT_128_CLK1_N -> B2B,J2-A6 -> floating

# R8 MGT_228_CLK0_P -> B2B,J3-B27 -> TEBF0818-01_FMC_J5E-D5
# R7 MGT_228_CLK0_N -> B2B,J3-B26 -> TEBF0818-01_FMC_J5E-D4
# N8 MGT_228_CLK1_P -> U5,35 -> Si5345 -> out3
# N7 MGT_228_CLK1_N -> U5,34 -> Si5345 -> out3

# L8 MGT_229_CLK0_P -> B2B,J3-C26 -> TEBF0818-01_FMC_J5E-B21
# L7 MGT_229_CLK0_N -> B2B,J3-C25 -> TEBF0818-01_FMC_J5E-B20
# J8 MGT_229_CLK1_P -> U5,31 -> Si5345 -> out2
# J7 MGT_229_CLK1_N -> U5,30 -> Si5345 -> out2

# G8 MGT_230_CLK0_P -> U5,28 -> Si5345 -> out1
# G7 MGT_230_CLK0_N -> U5,27 -> Si5345 -> out1
# E8 MGT_230_CLK1_P -> B2B,J3-D27 -> TEBF0818-01_CLK7_P -> B2B,J2-D5 -> U5,51
-> Si5345 -> out7
# E7 MGT_230_CLK1_N -> B2B,J3-D26 -> TEBF0818-01_CLK7_N -> B2B,J2-D6 -> U5,50
-> Si5345 -> out7

set_property PACKAGE_PIN F25 [get_ports {MGT_CLK_IN_clk_p[0]}]
set_property PACKAGE_PIN D25 [get_ports {MGT_CLK_IN_clk_p[1]}]
set_property PACKAGE_PIN R8 [get_ports {MGT_CLK_IN_clk_p[2]}]
set_property PACKAGE_PIN N8 [get_ports {MGT_CLK_IN_clk_p[3]}]
set_property PACKAGE_PIN L8 [get_ports {MGT_CLK_IN_clk_p[4]}]
set_property PACKAGE_PIN J8 [get_ports {MGT_CLK_IN_clk_p[5]}]
set_property PACKAGE_PIN G8 [get_ports {MGT_CLK_IN_clk_p[6]}]
set_property PACKAGE_PIN E8 [get_ports {MGT_CLK_IN_clk_p[7]}]

```

8 Software Design - Vitis

For Vitis project creation, follow instructions from:

[Vitis](#)¹⁸

8.1 Application

Template location: "<project folder>\sw_lib\sw_apps\"

8.1.1 zynqmp_fsbl

TE modified 2022.2 FSBL

General:

- Modified Files: xfsbl_main.c, xfsbl_hooks.h/.c, xfsbl_board.h/.c (search for 'TE Mod' on source code)
- Add Files: te_xfsbl_hooks.h/.c (for hooks and board)
- General Changes:
 - Display FSBL Banner and Device Name

Module Specific:

- Add Files: all TE Files start with te_ *
 - Si5345 Configuration
 - OTG+PCIe Reset over MIO
 - I2C MUX for EEPROM MAC

8.1.2 zynqmp_pmufw

Xilinx default PMU firmware.

8.1.3 hello_te0818

Hello TE0818 is a Xilinx Hello World example as endless loop instead of one console output.

8.1.4 u-boot

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

¹⁸ <https://wiki.trenz-electronic.de/display/PD/Vitis>

9 Software Design - PetaLinux

For PetaLinux installation and project creation, follow instructions from:

- [PetaLinux KICKstart](#)¹⁹

9.1 Config

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

Changes:

- select SD default instead of eMMC:
 - CONFIG_SUBSYSTEM_PRIMARY_SD_PSU_SD_1_SELECT=y
- add new flash partition for bootscr and sizing
 - CONFIG_SUBSYSTEM_FLASH_PSU_QSPI_0_BANKLESS_PART0_SIZE=0xA00000
 - CONFIG_SUBSYSTEM_FLASH_PSU_QSPI_0_BANKLESS_PART1_SIZE=0x2000000
 - CONFIG_SUBSYSTEM_FLASH_PSU_QSPI_0_BANKLESS_PART2_SIZE=0x40000
 - CONFIG_SUBSYSTEM_FLASH_PSU_QSPI_0_BANKLESS_PART3_NAME="bootscr"
 - CONFIG_SUBSYSTEM_FLASH_PSU_QSPI_0_BANKLESS_PART3_SIZE=0x80000
- Identification
 - CONFIG_SUBSYSTEM_HOSTNAME="Trenz"
 - CONFIG_SUBSYSTEM_PRODUCT="TE0818"

9.2 U-Boot

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

Changes:

- MAC from eeprom together with uboot and device tree settings:
 - CONFIG_ENV_OVERWRITE=y
 - CONFIG_ZYNQ_MAC_IN_EEPROM is not set
 - CONFIG_NET_RANDOM_ETHADDR is not set
- Boot Modes:
 - CONFIG_QSPI_BOOT=y
 - CONFIG_SD_BOOT=y
 - CONFIG_ENV_IS_IN_FAT is not set
 - CONFIG_ENV_IS_IN_NAND is not set
 - CONFIG_ENV_IS_IN_SPI_FLASH is not set
 - CONFIG_SYS_REDUNDAND_ENVIRONMENT is not set
 - CONFIG_BOOT_SCRIPT_OFFSET=0x2A40000
- Identification
 - CONFIG_IDENT_STRING=" TE0818"

Change platform-top.h:

```
#include <configs/xilinx_zynqmp.h>
#no changes
```

¹⁹ <https://wiki.trenz-electronic.de/display/PD/PetaLinux+KICKstart>

9.3 Device Tree

project-spec\meta-user\recipes-bsp\device-tree\files\system-user.dtsi

```
/include/ "system-conf.dtsi"

/*----- gtr -----*/

//https://xilinx-wiki.atlassian.net/wiki/spaces/A/pages/18841716/
//Zynq+Ultrascale+MPSOC+Linux+SI0U+driver

/ {
    refclk3:psgtr_dp_clock {
        compatible = "fixed-clock";
        #clock-cells = <0x00>;
        clock-frequency = <27000000>;
    };

    refclk2:psgtr_pcie_usb_clock {
        compatible = "fixed-clock";
        #clock-cells = <0x00>;
        clock-frequency = <100000000>;
    };

    refclk1:psgtr_sata_clock {
        compatible = "fixed-clock";
        #clock-cells = <0x00>;
        clock-frequency = <150000000>;
    };

    //refclk0:psgtr_unused_clock {
    //    compatible = "fixed-clock";
    //    #clock-cells = <0x00>;
    //    clock-frequency = <100000000>;
    //};
};

&psgtr {
    clocks = <&refclk1 &refclk2 &refclk3>;
    /* ref clk instances used per lane */
    clock-names = "ref1\0ref2\0ref3";
};

/*----- SD -----*/

&sdhci0 {
    // disable-wp;
    no-1-8-v;
};
```

```

&sdhci1 {
    // disable-wp;
    no-1-8-v;
};

/*----- USB -----*/
&dwc3_0 {
    status = "okay";
    dr_mode = "host";
    snps,usb3_lpm_capable;
    snps,dis_u3_susphy_quirk;
    snps,dis_u2_susphy_quirk;
    phy-names = "usb2-phy","usb3-phy";
    maximum-speed = "super-speed";
};

/*----- ETH PHY -----*/
&gem3 {
    /delete-property/ local-mac-address;
    phy-handle = <&phy0>;

    nvmem-cells = <&eth0_addr>;
    nvmem-cell-names = "mac-address";

    phy0: phy0@1 {
        device_type = "ethernet-phy";
        reg = <1>;
    };
};

/*----- SATA PHY -----*/
&sata {

    ceva,p0-burst-params = <0x13084a06>;
    ceva,p0-cominit-params = <0x18401828>;
    ceva,p0-comwake-params = <0x614080e>;
    ceva,p0-retry-params = <0x96a43ffc>;
    ceva,p1-burst-params = <0x13084a06>;
    ceva,p1-cominit-params = <0x18401828>;
    ceva,p1-comwake-params = <0x614080e>;
    ceva,p1-retry-params = <0x96a43ffc>;

};

/*----- QSPI -----*/
&qspi {
    #address-cells = <1>;
    #size-cells = <0>;
    status = "okay";
    flash0: flash@0 {

```

```

compatible = "jedec,spi-nor";
reg = <0x0>;
#address-cells = <1>;
#size-cells = <1>;
};
};

/*----- I2C -----*/
&i2c0 {
    i2cswitch@73 { // u
        compatible = "nxp,pca9548";
        #address-cells = <1>;
        #size-cells = <0>;
        reg = <0x73>;
        i2c-mux-idle-disconnect;
        i2c@0 { // MCLK TEBF0808 SI5338A, 570FBB000290DG_unassembled
            reg = <0>;
        };
        i2c@1 { // SFP TEBF0808 PCF8574DWR
            reg = <1>;
        };
        i2c@2 { // PCIE
            reg = <2>;
        };
        i2c@3 { // SFP1 TEBF0808
            reg = <3>;
        };
        i2c@4 { // SFP2 TEBF0808
            reg = <4>;
        };
        i2c@5 { // TEBF0808 EEPROM
            reg = <5>;
            eeprom: eeprom@50 {
                compatible = "microchip,24aa025", "atmel,24c02";
                reg = <0x50>;

                #address-cells = <1>;
                #size-cells = <1>;
                eth0_addr: eth-mac-addr@FA {
                    reg = <0xFA 0x06>;
                };
            };
        };
        i2c@6 { // TEBF0808 FMC
            reg = <6>;
        };
        i2c@7 { // TEBF0808 USB HUB
            reg = <7>;
        };
    };
    i2cswitch@77 { // u
        compatible = "nxp,pca9548";
        reg = <0x77>;
        i2c-mux-idle-disconnect;
        i2c@0 { // TEBF0808 PMOD P1

```

```

        reg = <0>;
    };
    i2c@1 { // i2c Audio Codec
        reg = <1>;
        /*
        adau1761: adau1761@38 {
            compatible = "adi,adau1761";
            reg = <0x38>;
        };
        */
    };
    i2c@2 { // TEBF0808 Firefly A
        reg = <2>;
    };
    i2c@3 { // TEBF0808 Firefly B
        reg = <3>;
    };
    i2c@4 { //Module PLL Si5338 or SI5345
        reg = <4>;
    };
    i2c@5 { //TEBF0808 CPLD
        reg = <5>;
    };
    i2c@6 { //TEBF0808 Firefly PCF8574DWR
        reg = <6>;
    };
    i2c@7 { // TEBF0808 PMOD P3
        reg = <7>;
    };
};
};
};

```

9.4 Kernel

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

Changes:

- Only needed to fix JTAG Debug issue:
 - # CONFIG_CPU_FREQ is not set
- Support PCIe memory card
 - CONFIG_NVME_CORE=y
 - CONFIG_BLK_DEV_NVME=y
 - # CONFIG_NVME_MULTIPATH is not set
 - # CONFIG_NVME_HWMON is not set
 - # CONFIG_NVME_TCP is not set
 - CONFIG_NVME_TARGET=y
 - # CONFIG_NVME_TARGET_PASSTHRU is not set
 - # CONFIG_NVME_TARGET_LOOP is not set
 - # CONFIG_NVME_TARGET_FC is not set
 - # CONFIG_NVME_TARGET_TCP is not set
 - CONFIG_SATA_AHCI=y
 - CONFIG_SATA_MOBILE_LPM_POLICY=0

9.5 Rootfs


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

Changes:

- For web server app:
 - CONFIG_busybox-httpd=y
- For additional test tools only:
 - CONFIG_i2c-tools=y
 - CONFIG_packagegroup-petalinux-utils=y (util-linux,cpufrequtils,bridge-utils,mtd-utils,usbutils,pciutils,canutils,i2c-tools,smartmontools,e2fsprogs)
- For auto login:
 - CONFIG_auto-login=y
 - CONFIG_ADD_EXTRA_USERS="root:root;petalinux::"

9.6 FSBL patch (alternative for vitis fsbl trenz patch)

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

 te_* files are identical to files in "<project folder>\sw_lib\sw_apps\zynqmp_fsbl\src" except for the PLL files (SI5345) which depend on PLL revision. The PLL files may have to be copied again manually into the appropriate petalinux folder "<project folder>\os\petalinux\project-spec\meta-user\recipes-bsp\embeddedsw\fsbl-firmware\git\lib\sw_apps\zynqmp_fsbl\src"

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 ZynqMP access. Need busybox-httpd

10 Additional Software

10.1 SI5345

File location "<project folder>\misc\PLL\Si5345_D\Si5345-*.slabtimeproj"

General documentation how you work with this project will be available on [Si5345](#)²⁰

²⁰ <https://wiki.trenz-electronic.de/display/PD/Si5345>

11 App. A: Change History and Legal Notices

11.1 Document Change History

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


Date	Document Revision	Authors	Description
 2023-08-15	v.17 (see page 6)	Manuela Strücker ²¹	<ul style="list-style-type: none"> new assembly variants
2023-06-21	v.16	Manuela Strücker	<ul style="list-style-type: none"> 2022.2 release new assembly variants
2023-04-13	v.14	Manuela Strücker	<ul style="list-style-type: none"> new assembly variants
2022-11-21	v.11	Manuela Strücker	<ul style="list-style-type: none"> update board part files compatible to Vivado 2021.2.1
2022-09-06	v.9	Manuela Strücker	<ul style="list-style-type: none"> new assembly variant
2022-03-10	v.6	Manuela Strücker	<ul style="list-style-type: none"> update chapter QSPI-Boot mode update chapter Usage update SI5345
2022-02-24	v.3	Manuela Strücker	<ul style="list-style-type: none"> bugfix (read MAC from EEPROM)
2022-02-03	v.2	John Hartfiel	<ul style="list-style-type: none"> initial release
--	all	John Hartfiel ²² , Manuela Strücker ²³	--

Table 12: Document change history.

²¹ <https://wiki.trenz-electronic.de/display/~m.struecker>

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

²³ <https://wiki.trenz-electronic.de/display/~m.struecker>

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 2019-06-07

²⁴ <http://guidance.echa.europa.eu/>

²⁵ <https://echa.europa.eu/candidate-list-table>

²⁶ <http://www.echa.europa.eu/>