

# TE0722 Test Board

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## Overview

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Zyng PS Design with Revison History

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Refer to <http://trac4.egi.fr/2012/info> for the current online version of this manual and other available documentation.

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## Key Features

- Vivado 2023.2
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- UART
- Design Flow
- I2C
- SD
  - 3.1 [Programming](#)
- Modified FSB1 for DDR, less Zynq + small app with LED+Sensor and SD Card access
- Special FSB1 for QSPI programming

- Special FSBL for QSPI programming

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- ## Revision History

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- ### 3.2.2 Vivado HW Manager

- |   |               |        |           |
|---|---------------|--------|-----------|
| 4 | System Design | Vivado | Project R |
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## Revision History

Date	System Design - Vivado	Project Built	Authors	Description
2024-03-25	<ul style="list-style-type: none"> <li>3.2.2 Vivado HW Manager</li> <li>4.1 Block Design                             <ul style="list-style-type: none"> <li>4.1.1 PS Interfacing                                     <ul style="list-style-type: none"> <li>4.1.1.1 PS Interfacing</li> </ul> </li> </ul> </li> </ul>	TE0722-test_board-noprebuild_20_20230214143311.zip TE0722-test_board-vivado_2023.2-build_05_20190522113216.zip	Waldemar Handemann	2023.2 update
2023-02-13	<ul style="list-style-type: none"> <li>4.1 Block Design                             <ul style="list-style-type: none"> <li>4.1.1 PS Interfacing                                     <ul style="list-style-type: none"> <li>4.1.1.1 PS Interfacing</li> </ul> </li> </ul> </li> <li>4.2 Constraints                             <ul style="list-style-type: none"> <li>4.2.1 Basic module constraints</li> <li>4.2.2 Design specific constraints</li> </ul> </li> <li>5 Software Design - Vitis                             <ul style="list-style-type: none"> <li>5.1 Application                                     <ul style="list-style-type: none"> <li>5.1.1 zynq_fsbl</li> <li>5.1.2 zynq_fsbl_app</li> <li>5.1.3 zynq_fsbl_flash</li> </ul> </li> </ul> </li> </ul>	TE0722-test_board-noprebuild_20_20230214143311.zip TE0722-test_board-vivado_2023.2-build_05_20190522113216.zip	Waldemar Handemann	2021.2 update
2020-04-16	<ul style="list-style-type: none"> <li>6 Additional Software</li> <li>7 Appx. A: Change History and Legal Notices                             <ul style="list-style-type: none"> <li>7.1 Document Change History</li> <li>7.2 Legal Notices</li> <li>7.3 Data Privacy</li> <li>7.4 Document Warranty</li> <li>7.5 Limitation of Liability</li> <li>7.6 Copyright Notice</li> <li>7.7 Technology Licenses</li> <li>7.8 Environmental Protection</li> <li>7.9 REACH, RoHS and WEEE</li> </ul> </li> </ul>	TE0722-test_board-noprebuild_10_20200416064916.zip TE0722-test_board-vivado_2019.2-build_10_20200416064756.zip	John Hartfiel	<ul style="list-style-type: none"> <li>2019.2 update</li> </ul>
2019-05-22	<ul style="list-style-type: none"> <li>8 Table of contents</li> </ul>	TE0722-test_board-noprebuild_05_20190522113216.zip TE0722-test_board-noprebuild_10_20200416064916.zip	John Hartfiel	<ul style="list-style-type: none"> <li>split FSBL into 2 templates, one with and one without Sensor +LED access example app</li> </ul>

2019-05-14	2018.3	TE0722-test_board-vivado_2018.3-build_05_20190510163659.zip TE0722-test_board_noprebuild-vivado_2018.3-build_05_20190510163900.zip	John Hartfiel	<ul style="list-style-type: none"> <li>TE Script update</li> <li>rework of the FSBLs <ul style="list-style-type: none"> <li>DDR LESS, Device ID, Sensor+LED access</li> </ul> </li> <li>VIO for RGB access</li> </ul>
2018-08-14	2018.2	TE0722-test_board-vivado_2018.2-build_02_20180815123557.zip TE0722-test_board_noprebuild-vivado_2018.2-build_02_20180815123610.zip	John Hartfiel	<ul style="list-style-type: none"> <li>initial release</li> </ul>

#### Design Revision History

## Release Notes and Know Issues

Issues	Description	Workaround	To be fixed version
QSPI Flash Programming failed with 19.2	Depending on Flash content Flash programming failed with provided fsbl_flash (Xilinx <a href="#">AR# 70548</a> ) 2019.2 version	<ul style="list-style-type: none"> <li>Option1: <ul style="list-style-type: none"> <li>In case Flash is empty, use fsbl_flash on programming GUI</li> <li>In case Flash is programmed use normal fsbl on programming GUI</li> </ul> </li> <li>Option2: use in both case fsbl_flash on programming GUI and Vivado LabTools 2018.3</li> <li>see also <a href="#">AR#00002</a> and <a href="#">TE0722-Recovery</a></li> </ul>	

#### Known Issues

## Requirements

### Software

Software	Version	Note
Vitis	2023.2	needed, Vivado is included in Vitis installation

#### Software

## Hardware

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

Complete List is available on <design name>/board\_files/\*\_board\_files.csv

Design supports following modules:

Module Model	Board Part Short Name	PCB Revision Support	DDR	QSPI Flash	EMMC	Others	Notes
TE0722-01	10	REV01	0GB	16MB	NA	NA	NA
TE0722-02	10	REV02	0GB	16MB	NA	NA	NA
TE0722-02I	10_i	REV02	0GB	16MB	NA	NA	NA
TE0722-02IC7	10_i_c7	REV02	0GB	16MB	NA	"without SD"	NA
TE0722-02-07S-1C	7s	REV02	0GB	16MB	NA	NA	NA
TE0722-04-41C-4-A	10	REV04	0GB	16MB	NA	NA	NA
TE0722-04-41I-4-A*	10_i	REV04	0GB	16MB	NA	NA	NA

\*used as reference

Additional HW Requirements:

Additional Hardware	Notes
TE0790(for AMD) or other JTAG programmer	for JTAG, UART
external 3.3V power supply	

## Content

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

## 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

## Additional Sources

Type	Location	Notes
--	--	--

## 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
DebugProbes-File	*.ltx	Definition File for Vivado/Vivado Labtools Debugging Interface
Diverse Reports	---	Report files in different formats
Hardware-Platform-Specification-Files	*.xsa	Exported Vivado Hardware Specification for Vitis and PetaLinux
LabTools Project-File	*.lpr	Vivado Labtools Project File
Software-Application-File	*.elf	Software Application for Zynq or MicroBlaze Processor Systems

## Download

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

- [TE0722 "Test Board" Reference Design](#)

## Design Flow



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

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

See also:

- [AMD Development Tools#XilinxSoftware-BasicUserGuides](#)
- [Vivado Projects - TE Reference Design](#)
- [Project Delivery.](#)

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](#)



**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. (optional Win OS) Generate Virtual Drive or use short directory for the reference design (for example x:\<design name>)
4. Create project and follow instructions of the product selection guide, settings file will be configured automatically during this process.
  - a. optional for manual changes: Select correct device and Xilinx install path on "design\_basic\_settings.cmd" and create Vivado project with "vivado\_create\_project\_guimode.cmd"



Note: Select correct one, see also [Vivado Board Part Flow](#)

5. 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 "<project folder>\prebuilt\hardware\<short name>")**

```
TE::hw_build_design -export_prebuilt
```



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

## 6. Generate Programming Files with Vitis

### a. Run on Vivado TCL:

**run on Vivado TCL (Script generates design and export files into "<project folder>\prebuilt\hardware\<short name>")**

```
TE::sw_run_vitis -all
```

Note: Scripts generate applications and bootable files, which are defined in "sw\_lib\apps\_list.csv"

### b. (alternative) Start Vitis with Vivado GUI or start with TE Scripts on Vivado TCL: TE::sw\_run\_vitis

Note: TCL scripts generate also platform project, this must be done manually in case GUI is used. See [Vitis](#)

Projects contains 3 FSBL template: zynq\_fsbl (FSBL modified for DDR Less application use for Boot.bin), zynq\_fsbl\_app (FSBL modified for DDR Less application and with demo app included create Boot with this FSBL and Bitstream only), zynq\_fsbl\_flash(FSBL modified for Flash programming FSBL which must be selected separately to program Flash)



TE0722 is without DDR, so special FSBL (sources on reference designs) is needed, see also: [DDR less ZYNQ Design](#)

## Launch

Basic Information, see [TE0722 Getting Started](#)

## 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](#)

## 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

## QSPI-Boot mode

Set Board to JTAG Bootmode. Short pins of J4.

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\_gui mode.cmd" or if not created, create with "vivado\_create\_project\_gui mode.cmd"
3. Type on Vivado TCL Console:

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

```
TE::pr_program_flash -swapp zynq_fsbl_app
```

## SD-Boot mode

Xilinx Zynq devices in CLG225 package do not support SD Card boot directly from ROM bootloader. Use QSPI for primary boot and SD for secondary boot only. See also [Xilinx AR#66846](#)

## JTAG

The JTAG Bootmode can be set on the newer pcb revisions, REV04+ (short both pins of J4)

## Usage

1. Prepare HW like described on section [Programming](#)
2. Connect UART USB (most cases same as JTAG)
3. Power On PCB
  1. Zynq Boot ROM loads FSBL from SD/QSPI into OCM,
  2. FSBL init PS, programs PL using the bitstream
  3. FSBL starts application (included into the FSBL Code)

## Standalone Application

Note: UART over J2 is used, this is only available, if PL part is configured with correct UART connection.

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



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

2. Output:

- a. Default output appears only a few seconds. Reboot device: force ResN pin to GND for short time, location see: [TE0722 Getting Started](#)  
SD card FAT32 Format should be inserted for SD access.

```
Device IDCODE: 13722093
Device Name: 7z010 (2)
Device Revision: 1
-----
TE0722 TE_FabHookBeforeHandoff_Custom
-----

RGB LED ON for 2 sec
RGB LED OFF

-----
SD write binary testfile success
SD read binary testfile success
-----

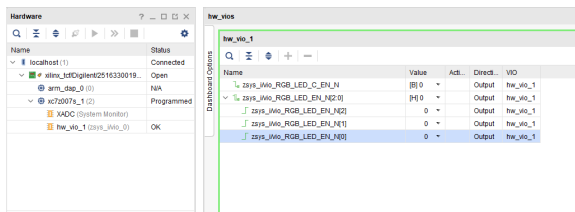
Read LIGHT SENSOR ID:
!only possible on PCB revision < REV03 which are populated with this sensor
Unknown PARTID 0x93 Revision: 93 Sequencer Revision: Unknown ID 0x93
LED D4 off (Remaining Loops 0x2)

Read LIGHT SENSOR ID:
!only possible on PCB revision < REV03 which are populated with this sensor
Unknown PARTID 0x93 Revision: 93 Sequencer Revision: Unknown ID 0x93
LED D4 off (Remaining Loops 0x1)
Loop finished...
-----
```

## Vivado HW Manager

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

- Control:
  - Enable/Disable RGB LED Counter (default on)
  - Enable/Disable different colors (default all off) - set to '1' to enable RGB LED

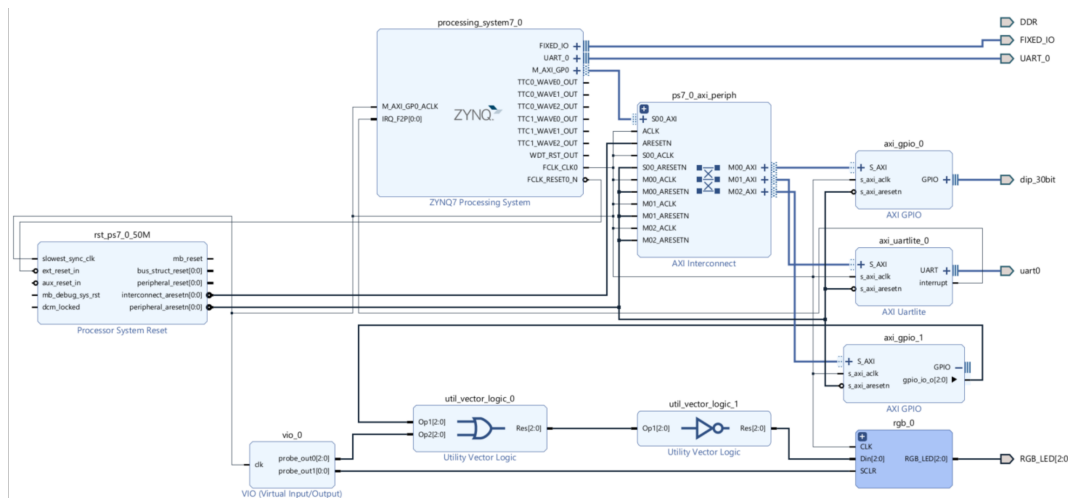


Vivado Hardware Manager

## System Design - Vivado

## Block Design





## PS Interfaces

Type	Note
DDR	Disabled!
QSPI	MIO
SD	MIO
UART0	EMIO
I2C1	MIO
GPIO	MIO
SWDT0	EMIO
TTC0..1	EMIO

### PS Interfaces

## Constraints

### Basic module constraints

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

```
#
# Common BITGEN related settings for TE0722
#
set_property BITSTREAM.GENERAL.COMPRESS TRUE [current_design]
set_property CONFIG_VOLTAGE 3.3 [current_design]
```

```
set_property CFGBVS VCC0 [current_design]

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

## Design specific constraints

### **\_i\_uart\_j2xmod.xdc**

```
set_property PACKAGE_PIN K15 [get_ports UART_0_txd]
set_property PACKAGE_PIN L13 [get_ports UART_0_rxd]

set_property IOSTANDARD LVCMOS33 [get_ports UART_0_*]
```

### **\_i\_io.xdc**

```
#RGB LED
#R
set_property PACKAGE_PIN J15 [get_ports {RGB_LED[0]}]
#G
set_property PACKAGE_PIN L14 [get_ports {RGB_LED[1]}]
#B
set_property PACKAGE_PIN K12 [get_ports {RGB_LED[2]}]
set_property IOSTANDARD LVCMOS33 [get_ports {RGB_LED[*]}]
```

## Software Design - Vitis

For Vitis project creation, follow instructions from:

[Vitis](#)

## Application

Source location: \sw\_lib\sw\_apps

### **zynq\_fsbl**

TE modified 2019.2 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)\n
- General Changes:
  - Display FSBL Banner and Device ID
  - **Disable Memory initialisation on main.c**

### **zynq\_fsbl\_app**

TE modified 2019.2 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)\n\
- General Changes:
  - Display FSBL Banner and Device ID
  - **Disable Memory initialisation on main.c**

Module Specific:

- Add Files: all TE Files start with te\_\*
  - Example app for LED access over MIO and sensor access (only pcb revisions 01 and 02) over I2C
  - RGB LED access via AXI GPIO
  - SD Card access rwrite/read file

## zynq\_fsbl\_flash

TE modified 2019.2 FSBL

General:

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

## Additional Software

No additional software is needed.

## Appx. A: Change History and Legal Notices

### 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
Error rendering macro 'page-info'	Error rendering macro 'page-info'	Error rendering macro 'page-info'	<ul style="list-style-type: none"><li>• 2023.2 release</li></ul>

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2023-02-14	v.9	Waldemar Hanemann	<ul style="list-style-type: none"> <li>2021.2 release</li> </ul>
2020-04-16	v.8	John Hartfiel	<ul style="list-style-type: none"> <li>2019.2 release</li> </ul>
2020-04-16	v.7	John Hartfiel	<ul style="list-style-type: none"> <li>separate template for FSBL with App included</li> </ul>
2019-05-14	v.6	John Hartfiel	<ul style="list-style-type: none"> <li>2018.3 release</li> </ul>
2018-08-15	v.5	John Hartfiel	<ul style="list-style-type: none"> <li>2018.2 release</li> </ul>
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Document change history.

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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.

#### **Error rendering macro 'page-info'**

Ambiguous method overloading for method jdk.

proxy241.\$Proxy3496#hasContentLevelPermission. Cannot resolve which method to invoke for [null, class java.lang.String, class com.atlassian.confluence.pages.Page] due to overlapping prototypes between: [interface com.atlassian.confluence.user.ConfluenceUser, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject] [interface com.atlassian.user.User, class java.lang.String, class com.atlassian.confluence.core.ContentEntityObject]