Project Delivery - Xilinx devices

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4 Quick Start

The most Trenz Electronic FPGA Reference Designs are TCL-script based project.

There are several options to create the Vivado project from the project delivery. These options are described in Vivado Projects - TE Reference Design[1].

Since 2018.3 special "Module Selection Guide" is included into "_create_win_setup.cmd" and "_create_linux_setup.sh"

- **Execute** "_create_win_setup.cmd" or "_create_linux_setup.sh"
- **Select** "Module Selection Guide" (press "0" and Enter)
- **Follow instructions**

For manual configuration or addition command files for execution will be generated with "_create_win_setup.cmd" on Windows OS and "_create_linux_setup.sh" on Linux OS. If you use our prepared batch files for project creation do the following steps:

1. open "design_basic_settings.cmd/.sh" with text editor and set correct vivado path and board part number (this will be also done automatically with the "Module Selection Guide"). **How select the correct board part number is described on** TE Board Part Files[2]
2. run "vivado_create_project_guimode.cmd/.sh"

See Reference Design: Getting Started[3] for more details.

If you need our Board Part files only, see Board Part Installation[4].

⚠ For Problems, please check Checklist / Troubleshoot[5] at first.

1 https://wiki.trenz-electronic.de/display/PD/Vivado+Projects+-+TE+Reference+Design
2 https://wiki.trenz-electronic.de/display/PD/TE+Board+Part+Files
3 https://wiki.trenz-electronic.de/display/PD/Project+Delivery#ProjectDelivery-Reference-Design:GettingStarted
4 https://wiki.trenz-electronic.de/display/PD/Installation
5 https://wiki.trenz-electronic.de/display/PD/Project+Delivery#ProjectDelivery-Checklist/Troubleshoot

5 Zip Project Delivery

5.1 Zip Name Description

Description	PCB Name		Project Name+(opt. Variant)		supported VIVADO Version		Build Version and Date	
Example:	te0720	-	-test_board(_noprebuilt)	-	vivado_2020.2	-	build_1_20210118145407	.zip

5.2 Last supported Release

Type or File	Version	Note
Vivado Design Suite	2020.2	
Trenz Project Scripts	2020.2.2	
Trenz <board_series>_board_files.csv	1.4	
Trenz apps_list.csv	2.3	
Trenz zip_ignore_list.csv	1.0	
Trenz mod_bd.csv	1.1	internal usage only
Trenz prod_cfg_list.csv	1.0	internal usage only

5.2.1 Currently limitations of functionality

- Important Note: QSPI Programming need special FSBL on 2017.4 or higher for all Zynq/ZynqMP. Special programming FSBL will be provided on all newer reference designs
- Linux OS only: Vivado project generation fails:
  - Reason: Vivado need "en_US.UTF-8"
  - Workaround:Check language in ":$ locale" and change language in "/etc/default/locale"
- Linux OS only: HLS generated IPs creates : [IP_Flow 19-4318 IP] ACT warning
  - Reason: Missing Libs
  - Workaround: Install Libraries like GCC, clib6-dev....
- Linux OS only: VITIS software generation failed.
  - Reason: start "gmake" failed, alias is not set on Ubuntu

    - Workaround: "sudo ln -s /usr/bin/make /usr/bin/gmake" to generate alias or use SDK GUI to generate applications and boot files.
- Linux OS only: Function, which used external programs.
    - Reason: Currently only set correctly for Win OS.
    - Workaround: Change TCL scripts program path manually.
- Linux OS (Ubuntu 18.04) only: Project generation fails, in case language is not English
    - Workaround:Set LC_NUMERIC=en_US.UTF-8 for bash

5.3 Directory structure

File or Directory	Type	Description
<project folder>	base directory	Base directory with predefined batch files (*.cmd) to generate or open VIVADO-Project
<project folder>/block_design/	source	Script to generate Block Design in Vivado (*_bd.tcl). (optional) Some board part designs used subfolder <board_file_shortname> with Board Part specific Block Design (*_bd.tcl).
<project folder>/board_files/	source	Local board part files repository and a list of available board part files (<board_series>_board_files.csv)
<project folder>/board_files/carrier_extension	source	(Optional) Additional TCL-Scripts to extend Board Part PS-Preset with carrier board specific settings.
<project folder>/console	source	folder with different console command files. Use _create_win_setup.cmd or _create_linux_setup.sh to generate files on top folder.
<project folder>/constraints/	source	Project constrains (*.xdc). Some board part designs used subfolder <board_file_shortname> with additional constrains (*.xdc)
<project folder>/doc/	source	Documentation

File or Directory	Type	Description
<project folder>/hdl/	source	HDL-File and XCI-Files. Advanced usage only!
<project folder>/firmware/	source	ELF-File Location for MicroBlaze Firmware. Additional sub folder is used for MicroBlaze identification.
<project folder>/ip_lib/	source	Local Vivado IP repository
<project folder>/misc/	source	(Optional) Directory with additional sources
<project folder>/prebuilt/	prebuilt	Contains a readme with location information of different assembly variants
<project folder>/prebuilt/boot_images/	prebuilt	Directory with prebuilt boot images (*.bin) and configuration files (*.bif) for zynq and configured hardware files (*.bit and *.mcs) for micoblaze included in sub-folders: default or <board_file_shortname>/<app_name>
<project folder>/prebuilt/hardware/	prebuilt	Directory with prebuilt hardware sources (*.bit, *xsa, *.mcs) and reports included in subfolders: default or <board_file_shortname>
<project folder>/prebuilt/software/	prebuilt	(Optional) Directory with prebuilt software sources (*.elf) included in subfolders: default or <board_file_shortname>/<app_name>
<project folder>/prebuilt/os/	prebuilt	(Optional) Directory with predefined OS images included in subfolders "<os_name>/<board_file_shortname>" or "<os_name>/<ddr size>"
<project folder>/scripts/	source	TCL scripts to build a project

File or Directory	Type	Description
<project folder>/settings/	source	(Optional) Additional design settings: zip_ignore_list.csv, vivado project settings, SDSOC settings
<project folder>/software/	source	(Optional) Directory with additional software
<project folder>/os/	source	(Optional) Directory with additional os sources in in subfolders "<os_name>"
<project folder>/sw_lib/	source	(Optional) Directory with local Vitis software IP repository and a list of available software (apps_list.csv)
<project folder>/v_log/	generated	(Temporary) Directory with vivado log files (used only when Vivado is started with predefined command files (*.cmd) from base folder otherwise this logs will be written into the vivado working directory)
<project folder>/vivado/	work, generated	(Temporary) Working directory where Vivado project is created. Vivado project file is <project folder>.xpr
<project folder>/vivado_lab/	work, generated	(Optional/Temporary) Working directory where Vivado LabTools is created. LabTools project file is <project folder>.lpr
~~<project folder>/workspace/hsi~~	obsolete	(Optional/Temporary) Directory where hsi project is created
<project folder>/workspace/sdk	work, gene	(Optional) Directory where Vitis project is created

File or Directory	Type	Description
	rated	
<project folder>/tmp/	work, generated	(Optional) Directory for some tasks
<project folder>/_binaries_<articlenumber>	generated	export directory for binaries (run "_create_win_setup.cmd" and follow instructions)
~~<project folder>/.../SDSoC_PFM~~	obsolete	(Optional) Directory where SDSOC project is created
<project folder>/backup/	generated	(Optional) Directory for project backups

5.4 Command Files

Command files will be generated with "_create_win_setup.cmd" on Windows and "_create_linux_setup.sh" on Linux OS. Linux shell files are currently not available for this release.

5.4.1 Windows Command Files

File Name	Description
Design + Settings	
_create_win_setup.cmd	Use to create bash files. With 2018.3 and newer also "Module Selection Guide" is included and with 2020.2 prebuilt export for the selected variant

File Name	Description
_use_virtual_drive.cmd	(Option) Create virtual drive for project execution. See Xilinx AR#52787[6]

design_basic_settings.cmd	Settings for the other *.cmd files. Following Settings are available:
	• General Settings:
	  • (optional) **DO_NOT_CLOSE_SHELL**: Shell do not closed after processing
	  • (optional) **ZIP_PATH**: Set Path to installed Zip-Program. Currently 7-Zip are supported. IUsed for predefined TCL-function to Backup project.
	  • (optional) **ENABLE_SDSOC**: Enable SDSOC Setting. Currently only for some reference project as beta version!
	• Xilinx Setting:
	  • **XILDIR**: Set Xilinx installation path (Default: c:\Xilinx).
	  • **VIVADO_VERSION**: Current Vivado/LabTool/SDK Version (Example:2020.2). Don't change Vivado Version.
	  • Xilinx Software will be searched in:
	  • VIVADO (optional for project creation and programming): %XILDIR%\Vivado\ %VIVADO_VERSION%\
	  • Vitis (optional for software projects and programming): %XILDIR%\Vitis\ %VIVADO_VERSION%\
	  • LabTools (optional for programming only): %XILDIR%\Vivado_Lab\%VIVADO_VERSION%\
	• Board Setting:
	  • **PARTNUMBER**: Set Board part number of the project which should be created
	  • Available Numbers: (you can use ID,PRODID,BOARDNAME or SHORTNAME from TExxxx_board_file.csv list)
	  • Used for project creation and programming
	  • To create empty project without board part, used PARTNUMBER=-1 (use GUI to create your project. No block design tcl-file should be in / block_design)
	  • Example TE0726 Module :
	  • USE ID |USE PRODID PARTNUMBER=1 |PARTNUMBER=te0726-01
	• Programming Settings (program*file.cmd):
	  • **SWAPP**: Select Software App, which should be configured.
	  • Use the folder name of the "<project folder>/ prebuilt/boot_image/<partname>/*" subfolder. The *bin,*.mcs or *.bit from this folder will be used.

6 https://www.xilinx.com/support/answers/52787.html

File Name	Description
	• If you will configure the raw *.bit or *.mcs *.bin from the "<project folder>/prebuilt/hardware/<partname>/" folder, use @set SWAPP=NA or @set SWAPP="". • Example: SWAPP=hello_world → used the file from "<project folder>/prebuilt/boot_image/<partname>/hello_world" SWAPP=NA → used the file from "<project folder>/prebuilt/boot_image/<partname>/" • **PROGRAM_ROOT_FOLDER_FILE**: If you want to program design file from the rootfolder "<project folder>", set to 1 • Attention: it should be only one *.bit, *.msc or *.bin file in the root folder.
design_clear_design_folders.cmd	(optional) Attention: Delete "<project folder>/v_log/", "<project folder>/vivado/", "<project folder>/vivado_lab/", "<project folder>/sdsoc/", and "<project folder>/workspace/" directory with related documents! Type "Y" into the command line input to start deleting files
design_run_project_batchmode.cmd	(optional) Create Project with setting from "design_basic_settings.cmd" and source folders. Build all Vivado hardware and software files if the sources are available. Delete "<project folder>/vivado/", and "<project folder>/workspace/sdk/" directory with related documents before Project will created.
Hardware Design	
vivado_create_project_guimode.cmd	Create Project with setting from "design_basic_settings.cmd" and source folders. Vivado GUI will be opened during the process. Delete "<project folder>/vivado/", and "<project folder>/workspace/" directory with related documents before Project will created. If old vivado project exists, type "y" into the command line input to start project creation again.

File Name	Description
vivado_create_project_batchmode.cmd	(optional) Create Project with setting from "design_basic_settings.cmd" and source folders. Delete "<project folder>/vivado/", and "<project folder>/workspace/" directory with related documents before Project will created. If old vivado project exists, type "y" into the command line input to start project creation again.
vivado_open_existing_project_guimode.cmd	Opens an existing Project "<project folder>/vivado/<design_name>.xpr" and restore Script-Variables.
Software Design	
sdk_create_prebuilt_project_guimode.cmd	(optional) Create Vitis project with hardware definition file from prebuild folder. It used the *.xsa from: "<project folder>/prebuilt/hardware/<board_file_shortname>/". Set "<board_file_shortname>" and "<app_name>" in "design_basic_settings.cmd".
Programming	
program_flash.cmd	(optional) Programming Flash Memory via JTAG with specified *.bin (Zynq devices) or *.mcs (native FPGA). Used LabTools Programmer (Vivado or LabTools only. Default, it used the boot.bin from: "<project folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>". Settings are done in "design_basic_settings.cmd".
~~program_flash_binfile.cmd~~	obsolete ~~(optional) For Zynq Systems only. Programming Flash Memory via JTAG with specified Boot.bin. Used SDK Programmer (Same as SDK "Program Flash") or LabTools Programmer (Vivado or LabTools only), depends on installation settings. Default, it used the boot.bin from: "<project folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>". Settings are done in "design_basic_settings.cmd".~~
~~program_flash_mcsfile.cmd~~	obsolete ~~(optional) For Non-Zynq Systems only. Programming Flash Memory via JTAG with specified "<project folder>.mcs". Used LabTools Programmer (Vivado or LabTools only), depends on installation~~

File Name	Description
	~~settings. Default, it used the <design_name>.mcs from: "<project folder>/prebuilt/hardware/ <board_file_shortname>". Settings are done in "design_basic_settings.cmd".~~
program_fpga_bitfile.cmd	(optional) Programming FPGA via JTAG with specified "<design_name>.bit". Used LabTools Programmer (Vivado or LabTools only), depends on installation settings. Default, it used the "<design_name>.bit" from: "<project folder>/prebuilt/hardware/ <board_file_shortname>". Settings are done in "design_basic_settings.cmd".
labtools_open_project_guimode.cmd	(optional) Create or open an existing Vivado Lab Tools Project. (Additional TCL functions from Programming and Utilities Group are usable). Settings are done in "design_basic_settings.cmd".

5.4.2 Linux Command Files

File Name	Status	Description
Design + Settings		
_create_linux_setup.sh	available	Use to create bash files. With 2018.3 and newer also "Module Selection Guide" is included and with 2020.2 prebuilt export for the selected variant

design_basic_settings.sh	available	Settings for the other *.cmd files. Following Settings are avaliable:
		• General Settings:
		  • (optional) **DO_NOT_CLOSE_SHELL**: Shell do not closed after processing
		  • (optional) **ZIP_PATH**: Set Path to installed Zip-Program. Currently 7-Zip are supported. IUsed for predefined TCL-function to Backup project.
		  • (optional) **ENABLE_SDSOC**: Enable SDSOC Setting. Currently only for some reference project as beta version!
		• Xilinx Setting:
		  • **XILDIR**: Set Xilinx installation path (Default: /opt/Xilinx/).

File Name	Status	Description

		• **VIVADO_VERSION**: Current Vivado/ LabTool/SDK Version (Example:2020.2). Don't change Vivado Version.
		  • Xilinx Software will be searched in:
		  • VIVADO (optional for project creation and programming): %XILDIR%/Vivado/ %VIVADO_VERSION%/ and for SDSoC on %XILDIR%\SDx\ %VIVADO_VERSION%\Vivado\
		  • Vitis (optional for software projects and programming): %XILDIR%/SDK\ %VIVADO_VERSION%/
		  • LabTools (optional for programming only): %XILDIR%/ Vivado_Lab/ %VIVADO_VERSION%/
		• Board Setting:
		  • **PARTNUMBER**: Set Board part number of the project which should be created
		  • Available Numbers: (you can use ID,PRODID,BOARDNAME or SHORTNAME from TExxxx_board_file.csv list)
		  • Used for project creation and programming
		  • To create empty project without board part, used PARTNUMBER=-1 (use GUI to create your project. No block design tcl-file should be in / block_design)
		  • Example TE0726 Module :
		  • USE ID |USE PRODID PARTNUMBER=1 | PARTNUMBER=te0726-01
		• Programming Settings(program*file.cmd):
		  • **SWAPP**: Select Software App, which should be configured.
		  • Use the folder name of the "<project folder>/prebuilt/ boot_image/<partname>/*" subfolder. The *bin,*.mcs or *.bit from this folder will be used.
		  • If you will configure the raw *.bit or *.mcs *.bin from the "<project folder>/prebuilt/ hardware/<partname>/" folder,

File Name	Status	Description
		use @set SWAPP=NA or @set SWAPP="". • Example: SWAPP=hello_world → used the file from prebuilt/boot_image/<partname>/hello_world SWAPP=NA → used the file from <project folder>/prebuilt/boot_image/<partname>/ • **PROGRAM_ROOT_FOLDER_FILE**: If you want to program design file from the rootfolder "<project folder>", set to 1 • Attention: it should be only one *.bit, *.msc or *.bin file in the root folder.
design_clear_design_folders.sh	not available	(optional) Attention: Delete "<project folder>/v_log/", "<project folder>/vivado/", "<project folder>/vivado_lab/", "<project folder>/sdsoc/", and "<project folder>/workspace/" directory with related documents! Type "Y" into the command line input to start deleting files
design_run_project_bashmode.sh	not available	(optional) Create Project with setting from "design_basic_settings.cmd" and source folders. Build all Vivado hardware and software files if the sources are available. Delete "<project folder>/vivado/", and "<project folder>/workspace/sdk/" directory with related documents before Project will created.
Hardware Design		
vivado_create_project_guimode.sh	available	Create Project with setting from "design_basic_settings.cmd" and source folders. Vivado GUI will be opened during the process. Delete "<project folder>/vivado/", and "<project folder>/workspace/" directory

File Name	Status	Description
		with related documents before Project will created. If old vivado project exists, type "y" into the command line input to start project creation again.
vivado_create_project_bashmode.sh	not available	(optional) Create Project with setting from "design_basic_settings.cmd" and source folders. Delete "<project folder>/vivado/", and "<project folder>/workspace/" directory with related documents before Project will created. If old vivado project exists, type "y" into the command line input to start project creation again.
vivado_open_existing_project_guimode.sh	available	Opens an existing Project "<project folder>/vivado/<design_name>.xpr" and restore Script-Variables.
Software Design		
sdk_create_prebuilt_project_guimode.sh	not available	(optional) Create SDK project with hardware definition file from prebuild folder. It used the *.hdfxsa from: "<project folder>/prebuilt/hardware/<board_file_shortname>/". Set "<board_file_shortname>" and "<app_name>" in "design_basic_settings.cmd".
Programming		
program_flash.sh	not available	(optional) Programming Flash Memory via JTAG with specified *.bin (Zynq devices) or *.mcs (native FPGA). Used LabTools Programmer (Vivado or LabTools only. Default, it used the boot.bin from: "<project folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>". Settings are done in "design_basic_settings.sh".

File Name	Status	Description
labtools_open_project_guimode.sh	not available	(optional) Create or open an existing Vivado Lab Tools Project. (Additional TCL functions from Programming and Utilities Group are usable). Settings are done in "design_basic_settings.cmd".

5.5 TE-TCL-Extentions

Name	Options	Description (Default Configuration)
TE::help		Display currently available functions. Important: Use only displayed functions and no functions from sub-namespaces
Hardware Design		
TE::hw_blockdesign_create_bd	[-bd_name] [-msys_local_mem] [-msys_ecc] [-msys_cache] [-msys_debug_module] [-msys_axi_periph] [-msys_axi_intc] [-msys_clk] [-help]	Create new Block-Design with initial Setting for PS, for predefined bd_names: fsys → Fabric Only, msys → Microblaze, zsys → 7Series Zynq, zusys → UltraScale+ Zynq Type TE::hw_blockdesign_create_bd -help for more information
TE::hw_blockdesign_export_tcl	[-no_mig_contents] [-no_validate] [-mod_tcl] [-svntxt <arg>] [-board_part_only] [-help]	Export Block Design to project folder "<project folder>/block_design/" . Old *bd.tcl will be overwritten!
TE::hw_build_design	\[-disable_synth\] \[-disable_bitgen\] \[-disable_hdf\] \[-disable_mcsgen\] \[-disable_reports\] \[-export_prebuilt\] \[-export_prebuilt_only\] \[-help\]	Run synthesis, Implement, and generate Bit-file, optional MCS-file and some report files
Software Design		

Name	Options	Description (Default Configuration)
~~TE::sw_run_hsi~~	[-run_only] [-prebuilt_hdf <arg>] [-no_hsi] [-no_bif] [-no_bin] [-no_bitmcs] [-clear] [-help]	**obsolete** Copies current Hardware files and reports from the vivado project to the prebuilt folder, if -prebuild_hdf <arg> isn't set. Copy the Hardware Definition file to the working directory: "<project folder>/workspace/hsi" Run HSI in "<project folder>/workspace/hsi" for all Programs listed in "<project_folder>/sw_lib/apps_list.csv" If HSI is finished, BIF-GEN and BIN-Gen are running for these Apps in the prebuilt folders "<project folder>/prebuilt/..." You can deactivate different steps with following args : • -no_hsi : *.elf files generation is disabled • -no_bif : *.bif files generation is disabled • -no_bin : *.bin files generation is disabled • -no_bitmcs: *.bit and *.mcs file (with software design) is disabled
~~TE::sw_run_sdk~~	[-open_only] [-update_hdf_only] [-prebuilt_hdf <arg>] [-clear] [-help]	**obsolete** Copies current Hardware files and reports from the vivado project to the prebuilt folder, if -prebuild_hdf <arg> isn't set. Copy the Hardware Definition file to the working directory: "<project folder>/workspace/sdk" Start SDK GUI in this workspace
TE::sw_run_vitis	[-all] [-gui_only] [-no_gui] [-workspace_only] [-prebuilt_xsa_only] [-prebuilt_xsa <arg>] [-clear] [-help]	Copies current Hardware files and reports from the vivado project to the prebuilt folder, if -prebuild_xsa <arg> or -prebuilt_xsa_only isn't selected. Copy the XSA File to the working directory: "<project folder>/workspace/sdk" Generates Vitis workspace with platform project and start Vitis. Optional parameter • -all : generate all apps defined in apps_list.csv and export results into the prebuild folder

Name	Options	Description (Default Configuration)
		• -gui_only : open only Vitis on the default workspace • -no_gui : Vitis will not opened after project generation • -workspace_only : copy XSA file only into the workspace • -prebuilt_xsa* : use prebuilt XSA
Programming		
TE::pr_init_hardware_manager	[-help]	Open Hardware manager, autoconnect target device and initialise flash memory with configuration from *_board_files.csv.
TE::pr_program_jtag_bitfile	[-used_board <arg>] [-swapp <arg>] [-available_apps] [-used_basefolder_bitfile] [-help]	Copies current Hardware files and reports from the vivado project to the prebuilt folder, if -used_board <arg> isn't set (Vivado only). Programming Bitfile from "<project folder>/prebuilt/hardware/<board_file_shortname>" to the fpga device. If "-used_basefolder_bitfile" is set, the Bitfile (*.bit) from the base folder ("<project folder>") is used instead of the prebuilds. Attention: Take only one Bitfile in the basefolder! (MicroBlaze only) If "-swapp" is set, the Bitfile with *.elf configuration is used from "<project_folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>"
TE::pr_program_flash	[-swapp <arg>] [-swapp_av] [-reboot] [-erase] [-setup] [-used_board] [-basefolder] [-def_fsbl] [-help]	Program flash with the given swapp from the prebuilt folder ("<project folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>"). Available app can be checked with -swapp_av, specify app with -swapp <app_name> Erase flash only with -erase

Name	Options	Description (Default Configuration)
TE::pr_putty	[-available_com] [-com] [-speed] [-help]	Show available COM ports and open automatically the UART COM port, in case only one is selectable Important: • Need putty installed in global path enviroments • Linux currently not supported
~~TE::pr_program_flash_binfile~~	~~[-no_reboot] [-used_board <arg>] [-swapp <arg>] [-available_apps] [-force_hw_manager] [-used_basefolder_binfile] [-help]~~	~~Attention: For Zynq Systems only! Program the Bootbin from "<project folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>" to the fpga device. Appname is selected with: -swapp <app_name> After programming device reboot from memory will be done. Default SDK Programmer is used, if not available LabTools Programmer is used. If "-used_basefolder_binfile" is set, the Binfile (*.bin) rom the base folder (<project folder>) is used instead of the prebuilts. Attention: Take only one Binfile in the basefolder!~~

Name	Options	Description (Default Configuration)
~~TE::pr_program_flash_mcsfile~~	~~[-no_reboot] [-used_board <arg>] [-swapp <arg>] [-available_apps] [-used_basefolder_mcsfile] [-help]~~	~~Copies current Hardware files and reports from the vivado project to the prebuilt folder, if -used_board <arg> isn't set (Vivado only).~~ ~~Initialise flash memory with configuration from *_board_files.csv~~ ~~Programming MCSfile from "<project folder>/prebuilt/hardware/<board_file_shortname>" to the Flash Device.~~ ~~After programming device reboot from memory will be done.~~ ~~If "-used_basefolder_binfile" is set, the MCSfile (*.mcs) from the base folder (<project folder>) is used instead of the prebuilds. Attention: Take only one MCSfile in the basefolder!~~ ~~(MicroBlaze only) If "-swapp" is set, the MCSfile with *.elf configuration is used from "<project folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>"~~
Utilities		
TE::util_zip_project	[-save_all] [-remove_prebuilt] [-manual_filename <arg>] [-help]	Make a Backup from your Project in "<project folder>/backup/" Zip-Program Variable must be set in start_settings.cmd. Currently only 7-Zip is supported.
TE::util_package_length	[-help]	Export Package IO length information to *.csv on the doc folder
Beta Test (Advanced usage only!)		
TE::ADV::beta_util_sdsoc_project	[-check_only] [-help]	Create SDSOC-Workspace. Currently only on some Reference-Designs available. Run [-check_only] option to check SDSOC ready state.

Name	Options	Description (Default Configuration)
TE::ADV::beta_hw_remove_board_part	[-permanent] [-help]	Reconfigure Vivado project as project without board part. Generate XDC-File from board part IO definitions and change ip board part properties. No all IPs are supported.
TE::ADV::beta_hw_export_rtl_ip	\[-help\]	Save IPs used on rtl designs as *.xci in "<project folder>hdl/xci". If sub folder "<board_file_shortname>" is defined this will be saved there.
TE::ADV::beta_hw_create_board_part	\[-series <arg>\] \[-all\] \[-preset\] \[-existing_ps\] \[-help\]	create PS or preset.xml PS settings from external tcl scripts
TE::ADV::beta_hw_export_binary	\[-mode <arg>\] \[-app <arg>\] \[-folder <arg>\] \[-all\] \[-help\]	export prebuilt files to an given folder (based from project folder). Special folder is used, if empty

6 Design Environment: Usage

6.1 Reference-Design: Getting Started

- Install **Xilinx Vivado Design Suite** or **Xilinx Vivado Webpack** (free license for some FPGA only: see http://www.xilinx.com/products/design-tools/vivado/vivado-webpack.html)
  (optional) Install **Xilinx Vivado LabTools** (Lab Edition)
- Automatically configuration of the reference-designs (only with 2018.3 scripts and newer):
  - Run "_create_win_setup.cmd" or "_create_linux_setup.sh"
    - select "module selection guide" and follow instructions.
      - "**design_basic_settings.cmd**" will be configured over this menu
- (optional for 18.3 or newer) Manual Configure the reference-design (Note: batch/bash files works only in the basefolder of the project, use _create_*_setup.cmd/sh or copy manually):
  1. Open "**design_basic_settings.cmd**" with a text-editor:
     a. Set correct Xilinx Environment:
        @set XILDIR=C:/Xilinx
        @set VIVADO_VERSION=2020.2
        Program settings will be search in :
        %XILDIR%/VIVADO/%VIVADO_VERSION%/
        %XILDIR%/Vivado_Lab/%VIVADO_VERSION%/
        %XILDIR%/Vitis/%VIVADO_VERSION%/
        Example directory: c:/Xilinx/Vivado/2020.2/
        Attention: Scripts are supported only with predefined Vivado Version!
     b. Set the correct module part-number:
        @set PARTNUMBER=x
        You found the available Module Numbers in "<project folder>/board_files/<board_series>_board_files.csv"
     c. Set Application name (for programming with batch-files only):
        @set SWAPP=NA
        NA (No Software Project) used *.bit or *.mcs from "<project folder>/prebuilt/hardware/<board_file_shortname>"
        <app_name> (Software Project) used *.bit or *.mcs or *.bin from "<project folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>"
- Create all prebuilt files in one step:
  2. Run "**design_run_project_batchmode.cmd**"
- (optional to Step 2) Create all prebuilt files in single steps:
  3. Run "**vivado_create_project_guimode.cmd**":
     A Vivado Project will be create and open in ./vivado
  4. Type "TE::hw_build_design" on Vivado TCL-Console:
     Run synthesis, Implement and create Bitfile and optional MCSfile
  5. Type "TE::sw_run_vitis -all -no_gui" on Vivado TCL-Console:
     Create all Software Applications from "<project folder>/sw_lib/apps_list.csv"
  6. (optional to Step 5) Type "TE::sw_run_vitis " on Vivado TCL-Console:
     Create a SDK Project in "<project folder>/workspace/sdk"
     Include Hardware-Definition-File, Bit-file and local Software-libraries from "<project folder>/sw_lib/sw_apps"
- Programming FPGA or Flash Memory with prebuilt Files:
  7. Connect your Hardware-Modul with PC via JTAG.
  With Batch-file:
  8. (optional) Zynq-Devices Flash Programming (*.bin) or FPGA-Device Flash Programming (*.mcs):
     Run "**program_flash.cmd**"
  10. (optional) FPGA-Device Programming (*.bit):
      Run "**program_fpga_bitfile.cmd**"
  With Vivado/Labtools TCL-Console:

11. Run “**vivado_open_existing_project_guimode.cmd**” or “**labtools_open_project_guimode.cmd**” to open Vivado or LabTools
12. (optional) Zynq-Devices Flash Programming (*.bin):
    Type “TE::pr_program_flash -swap <app_name>” on Vivado TCL-Console
    Used **.bin(Zynq)/.mcs(native FPGA)** "<project folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>"
13. (optional) FPGA-Device Programming (*.bit):
    Type “TE:: pr_program_jtag_bitfile -swap <app_name>” on Vivado TCL-Console
    Used *.bit from "<project folder>/prebuilt/boot_images/<board_file_shortname>/<app_name>"

6.2 Basic Design Settings

6.2.1 Initialise TE-scripts on Vivado/LabTools

- Variant 1 (recommended):
  - Start the project with the predefined command file (**vivado_open_existing_project_guimode.cmd)** respectively LabTools with **(labtools_open_project_guimode.cmd)**
- Variant 2:
  - Create your own Initialisation Button on the Vivado GUI:
    - Tools → Customize Commands → Customize Commands...
    - Push 
    - Type Name ex.: Init Scripts
    - Press Enter
    - Select Run command and insert:
      - for Vivado: cd [get_property DIRECTORY [current_project]]; source -notrace "../scripts/reinitialise_all.tcl"
      - for LabTool: cd [pwd]; source -notrace "../scripts/reinitialise_all.tcl"
    - Press Enter
    - A new Button is shown on the Vivado GUI: All Scripts are reinitialised, if you press this Button.
- Variant 3:
  - Reinitialise Script on Vivado TCL-Console:
    - Type: source ../scripts/reinitialise_all.tcl

6.2.2 Use predefined TE-Script functions

- Variant 1 (recommended):
  - Type function on Vivado TCL Console, ex.: TE::help
  - TE::help
    - Show all predefined TE-Script functions.
  - TE:<function_name> -help
    - Show short description of this function.
    - Attention: If -help argument is set, all other args will be ignored.
- Variant 2:
  - Create your own function Button on the Vivado GUI:
    - Tools → Customize Commands → Customize Commands...
    - Push +
    - Type Name ex.: Run SDK
    - Press Enter
    - Select Run command and insert function:

- Variante 1 (no Vivado request window for args):
  - insert function and used args, ex.: TE::sw_program_zynq -swapp hello_world
- Variant 2 (Vivado request window for args):
  - insert function, ex.:TE::sw_program_zynq
  - Press Define Args...
  - For every arg:
    - Push ➕
    - Type Name, Comment, Default Value and set optional
    - Press Enter
    - Example for args:
      - Push ➕
      - Index, Key Name, -swapp, ✔
      - Push ➕
      - Appname, Arg, hello_world, ✔

- Press Enter
- A new Button is shown on the Vivado GUI.

6.3 Environment Variables

6.3.1 Local

Files	Note
<project folder>/ **design_basic_settings.cmd/sh**	General local variables for project generation
<project folder>/settings/ **design_settings.tcl**	Design setting like Device Filter, UART Speed and Port
<project folder>/settings/ **development_setting.tcl**	Development settings which can manipulate execution steps

6.3.2 Global

Name	Value	Note
TE_SERIAL_PS	<path>	Internal usage only
TE_COM	<path>	path to putty, in case it's not installed global
TE_TIMEOUT	<time>	timeout for jobs, unit in minutes, def 120

Name	Value	Note
TE_RUNNING_JOBS	<count>	max jobs (depends on available CPUs) which can be started by Vivado, default 4

6.4 Hardware Design

6.4.1 Board Part Files

More details see TE Board Part Files[7]

Structure Board Parts

Board Parts are located on subfolder "board_files", with the name of the special board. Revisions are split in the subfolder of the board part <boardpart_name><version>

Every Version of a Board Parts consists of four files:

- board.xml
- part0_pins.xml
- preset.xml
- picture.jpg or picture.png

Board Part or Design Extension

Board Part Extensions are TCL-Scripts, which can be sourced in Vivado Block Design. Thy are usable with TE-Scripts only. It contains additional settings of PS-settings or special carrier-board design changes.

Use Reference Designs or Vivado TCL-Console (TE-Script extensions, see Initialise TE-scripts on Vivado/ LabTools(see page 27)): TE::hw_blockdesign_create_bd -help to create PS with full settings. Or source the TCL file manually direct after "Run Block Automation"

Possible:

- Board Part PS settings are located on subfolder "board_files/preset_extension/" with file name *_preset.tcl.
- Design modifications are located on subfolder "board_files/bd_mod/" with file name *_bd.tcl.

Board Part CSV Description

Board Part csv file is used for TE-Scripts only.

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

Name	Description	Value
ID	ID to identify the board variant of the module series, used in TE-Scripts	Number, should be unique in csv list
PRODID	Product ID	Product Name
PARTNAME	FPGA Part Name, used in Vivado and TE-Scripts	Part Name, which is available in Vivado, ex. xc7z045ffg900-2
BOARDNAME	Board Part Name, used in Vivado and TE-Scripts	set Board Part Name or "NA", which is available in Vivado, NA is not defined to run without board part and board part ex. trenz.biz[8]:te0782-02-45:part0:1.0
SHORTNAME	Subdirectory name, used for multi board projects to get correct sources and save prebuilt data	name to save prebuilt files or search for sources
ZYNQFLASHTYP	Flash type used for programming Zynq-Devices via SDK-Programming Tools (program_flash)	"qspi_single" or "NA", NA is not defined
FPGAFLASHTYP	Flash type used for programming Devices via Vivado/LabTools	"<Flash Name from Vivado>|<SPI Interface>|<Flash Size in MB>" or "NA" , NA is not defined, ex. s25fl256s-3.3v-qspi-x4-single|SPIx4|32 Flash Name is used for programming, SPI Interface and Size in MB is used for *.mcs build. For Zynq and ZynqMO only Flash name is necessary
PCB_REV	Supported PCB Revision	"<supported PCB Revision>|<supported PCB Revision>", for ex. "REV02" or "REV03|REV02"
DDR_SIZE	Size of Module DDR	use GB or MB, for ex. "2GB" or "512MB" or "NA" if not available
FLASH_SIZE	Size of Module Flash	use MB, for ex. "64MB" or "NA" if not available

8 http://trenz.biz

Name	Description	Value
EMMC_SIZE	Size of Module EMMC	use GB or MB, for ex. "4GB" or "NA" if not available
OTHERS	Other module relevant changes to distinguish assembly variants	
NOTES	Additional Notes	
DESIGN	Specify the allowed variants for different designs.	see also <design folder>\settings\design_settings.tcl

6.4.2 Block Design Conventions

- Only one Block-Design per project is supported
- Recommended BD-Names (currently importend for some TE-Scripts):

Name	Description
zsys	Identify project as Zynq Project with processor system (longer name with *zsys* are supported too)
zusys	Identify project as UltraScaleZynq Project with processor system (longer name with *zusys* are supported too)
msys	Identify project as Microblaze Project with processor system (longer name with *msys* are supported too)
fsys	Identify project as FPGA-fabric Project without processor system (longer name with *fsys* are supported too)

- Create Basic Block Design with PS Board-Part Preset and Carrier-Board extended settings (only if subfolder carrier_extension with tcl files is available), use TE::hw_blockdesign_create_bd -help

6.4.3 XDC Conventions

- All *.xdc from <project folder>/constrains/ are load into the vivado project on project creation. Attention: If subfolder <project folder>/constrains/<board_file_shortname> is defined, it will be used the subfolder constrains only for this module!
- Recommended XDC-Names (used for Vivado XDC-options):

Property	Name part	Description
Set Processing Order	*_e_*	*set to* early
	*_l_*	set to late
		set to normal
Set Used In	*_s_*	used in synthesis only
	*_i_*	used in implement only
		used in both, synthesis and implement

6.4.4 Backup Block Design as TCL-File

- Backup your Block-Design with TCL-Command "TE::hw_blockdesign_export_tcl" in <project folder>/block_design/
  It will be saved as *_bd.tcl
  Attention: If subfolder <project folder>/block_design/<board_file_shortname> or <project folder>/block_design/PCB Revision> is defined, it will be saved there!
  Only one *.tcl file should be in the backup folder respectively the subfolder <board_file_shortname>

6.4.5 Microblaze Firmware

- Microblaze Firmware (*.elf) can be add to the source folder <project folder>/firmware/<Microblaze IP Instance>.
- For MCS-Core use MCS IP Instance Name. This name must use *mcs* or *syscontrol* in the name.

6.5 Software Design

6.5.1 Vitis: Generate predefined software from libraries

- To generate predefined software from libraries, run "TE::sw_run_vitis -all -no_gui" on Vivado TCL-Console
- All programs in in <project folder>/sw_lib/apps_list.csv are generated automaticity
- Supported are local application libraries from <project folder>/sw_lib/sw_apps or the most Xilinx SDK Applications found in %XILDIR%/SDK/%VIVADO_VERSION%/data/embeddedsw/lib/sw_app

6.5.2 VITIS: Create user software project

- To start SDK project, run "TE::sw_run_vitis" on Vivado TCL-Console or run "TE::sw_run_vitis -workspace_only" on Vivado TCL-Console
  Include Hardware-Definition-File (XSA), Bit-file and local Software-libraries from "<project folder>/sw_lib/sw_apps"
- To use Hardware-Definition-File, Bit-file from prebuilt folder without building the vivado hardware project, run "**sdk_create_prebuilt_project_guimode.cmd**" or type "TE::sw_run_vitis -prebuilt_xsa <board_number>" on Vivado-TCL-Console
- To open an existing SDK-project without update HDF-Data, type "TE::sw_run_vitis -gui_only" on Vivado-TCL-Console

6.6 Advanced Usage

Attention not all features of the TE-Scripts are supported in the advanced usage!

6.6.1 User defined board part csv file

To modify current board part csv list, make a copy of the original csv and rename with suffix "_mod.csv", ex.TE0782_board_files.csv as TE0782_board_files_mod.csv. Scripts used modified csv instead of the original file.

See Chapter Board Part Files(see page 29) for more information.

6.6.2 User defined Settings

- Vivado settings:
  - Vivado Project settings (corresponding TCL-Commands) can be saved as a user defined file "<project folder>/settings/project_settings.tcl". This file will be loaded automatically on project creation.
- Script settings:
  - Additional script settings (only some predefined variables) can be saved as a user defined file "<project folder>/settings/development_settings.tcl". This file will be loaded automatically on script initialisation.
- Design settings:
  - Additional script settings (only some predefined variables) can be saved as a user defined file "<project folder>/settings/design_settings.tcl". This file will be loaded automatically on script initialisation.
- ZIP ignore list:
  - Files which should not be added in the backup file can be can be defined in this file: "<project folder>/settings/zip_ignore_list.tcl". This file will be loaded automatically on script initialisation.
- SDSOC settings:
  - SDSOC settings will are deposited on the following folder: "<project folder>/settings/sdsoc"

6.6.3 User defined TCL Script

TCL Files from "<project folder>/settings/usr" will be load automatically on script initialisation.

6.6.4 ~~SDSOC-Template~~

~~SDSOC description and files to generate SDSoC project are deposited on the following folder: "<project folder>/settings/sdsoc"~~

6.6.5 HDL-Design

HDL files can be saved in the subfolder "<project folder>/hdl/" as single files or <project folder>/hdl/folder/ and all subfolders or "<project folder>/hdl/<shortname>" and all subfolders of "<project folder>/hdl/<shortname>". They will be loaded automatically on project creation. Available formats are *.vhd, *.v and *.sv. A own top-file must be specified with the name "<project folder>_top.v" or "<project folder>_top.vhd".

To set file attributes, the file name must include "_simonly_" for simulation only and "_synonly_" for synthesis only.

IP-cores (*.xci). can be saved in the subfolder "<project folder>/hdl/xci" or "<project folder>/hdl/xci/<shortname>". They will be loaded automatically on project creation.

IP -TCL description (*_preset.tcl). can be saved in the subfolder "<project folder>/hdl/tcl" or "<project folder>/hdl/tcl/<shortname>". They will be loaded automatically on project creation.

- *_preset.tcl must include
  - TCL part for IP creation: create_ip -name ...
  - TCL part for IP configuration: set_property -dict...
  - TCL part for IP target generation: generate_target {instantiation_template} .....

7 Checklist / Troubleshoot

1. Are you using exactly the same Vivado version? If not then the scripts will not work, no need to try.
2. Are you using Vivado in Windows PC? Vivado works in Linux also, but the scripts are tested on Windows only.
3. Is you PC OS Installation English? Vivado may work on national versions also, but there have been known problems.
4. Win OS only: Use short path name, OS allows only 256 characters in normal path.
5. Linux OS only: Use bash as shell and add access rights to bash files. Check with "ls ls /bin/sh". It should be display: /bin/sh -> bash. Access rights can be changed with "chmod"
6. Are space character on the project path? Sometimes TCL-Scripts can't handle this correctly. Remove spaces from project path.
7. Did you have the newest reference design build version? Maybe it's only a bug from a older version.
8. Check <project folder>/v_log/vivado.log? If no logfile exist, wrong xilinx paths are set in design_basic_settings.cmd
9. On project creation process old files will be deleted. Sometimes the access will be denied by os (synchronisation problem) and the scripts cancelled. Please try again.
10. If nothing helps, send a mail to Trenz Electronic Support (support[at]trenz-electronic.de[9]) with subject line "[TE-Reference Designs] ", the complete zip-name from your reference design and the last log file (<project folder>/v_log/vivado.log)

9 mailto:support@trenz-electronic.de

8 References

1. Vivado Design Suite User Guide - Getting Started (UG910)
2. Vivado Design Suite User Guide - Using the Vivado IDE (UG893)
3. Vivado Design Suite User Guide - I/O and Clock Planning (UG899)
4. Vivado Design Suite User Guide - Programming and Debugging (UG908)
5. Zynq-7000 All Programmable SoC Software Developers Guide (UG821)
6. SDSoC Environment User Guide - Getting Started (UG1028)
7. SDSoC Environment - User Guide (UG1027)
8. SDSoC Environment User Guide - Platforms and Libraries (UG1146)

9 Document Change History

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

Date	Revision	Vivado Version	Authors	Description
2021-05-06	v.162(see page 6)	2020.2	@ Manuela Strücker[10]	working in process
2020-11-26	v.157	2019.2	John Hartfiel	Last Vivado 2019.2 supported project delivery version
2019-12-18	v.148	2018.2	John Hartfiel	Last Vivado 2018.3 supported project delivery version
---	---	2018.2	John Hartfiel	Last Vivado 2018.2 supported project delivery version • no document update was done
2019-07-10	v.142	2017.4	John Hartfiel	Last Vivado 2017.4 supported project delivery version
2017-11-03	v.134	2017.2	John Hartfiel	Last Vivado 2017.2 supported project delivery version
2017-09-12	v.131	2017.1	John Hartfiel	Last Vivado 2017.1 supported project delivery version

10 https://wiki.trenz-electronic.de/display/~m.struecker

Date	Revision	Vivado Version	Authors	Description
2017-04-12	v.126	2016.4	John Hartfiel	Last Vivado 2016.4 supported project delivery version
2017-01-16	v.114	2016.2	John Hartfiel	Last Vivado 2016.2 supported project delivery version
2016-06-21	v.83	2015.4	John Hartfiel	Last Vivado 2015.4 supported project delivery version
2013-03-11	v.1	---	Antti Lukats	Initial release
	All		@ Antti Lukats[11], John Hartfiel[12], Manuela Strücker[13], Susanne Kunath[14]	

11 https://wiki.trenz-electronic.de/display/~antti.lukats
12 https://wiki.trenz-electronic.de/display/~j.hartfiel
13 https://wiki.trenz-electronic.de/display/~m.struecker
14 https://wiki.trenz-electronic.de/display/~s.kunath