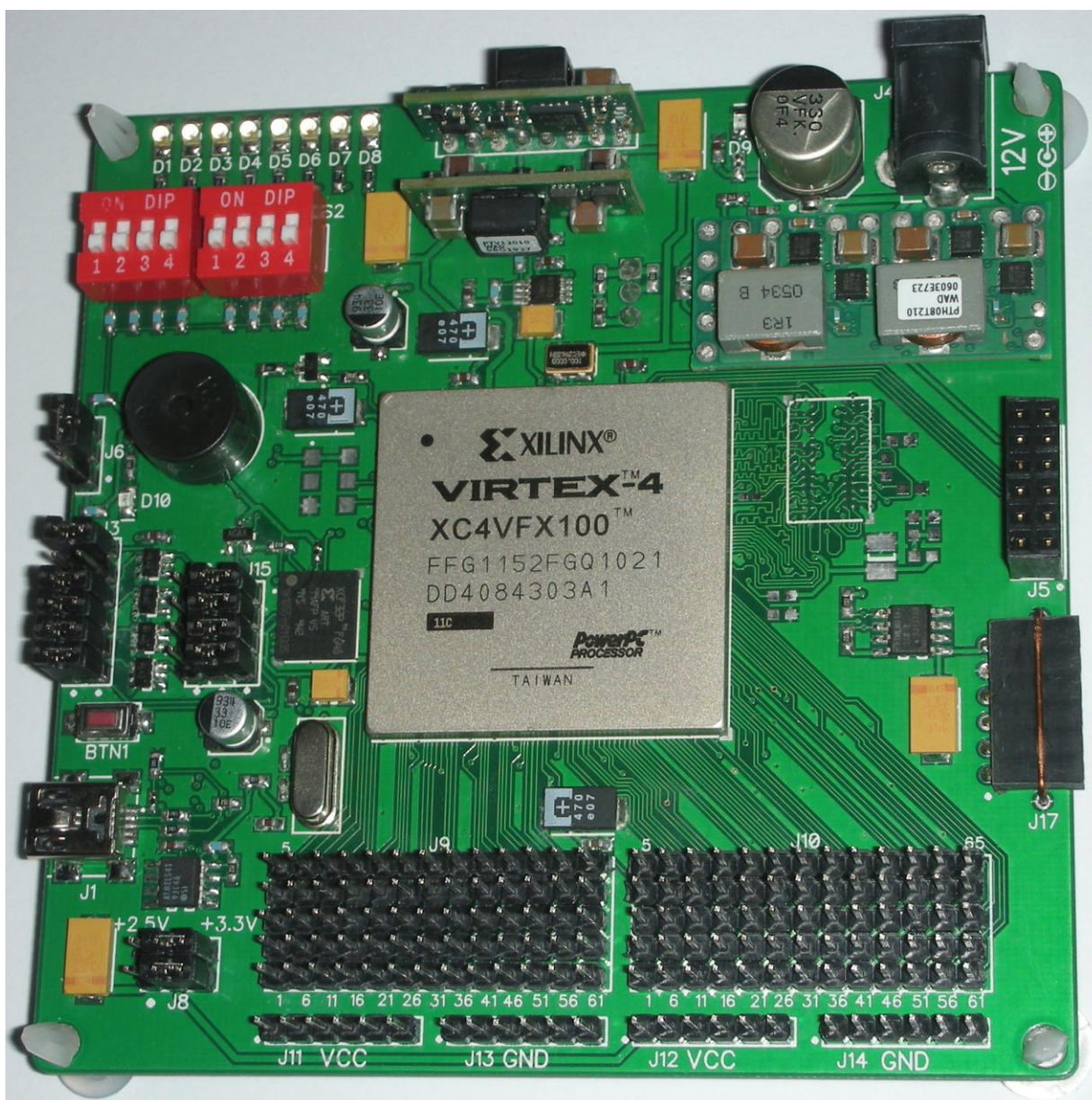


XILINX VIRTEX-4 FPGA KIT

USER's GUIDE

MODEL: XKF4-100-32 Revision A



Introduction

Xilinx Virtex-4 XKF4 FPGA kit is a low cost, powerful and easy to use tool. Designed for rapid prototyping and implementing FPGA designs. Kit can be used for educational purposes. Kit can work independently, or as control module in the bigger design.

Features

- 1) XILINX XC4VFX100 FPGA
 - 94896 Logic Cells
 - 160 XtremeDSP Slices
 - 376x 18Kb RAM blocks (6768Kb, 500MHz)
 - 12 Digital Clock Managers
 - 4 Ethernet MACs
 - 2 PowerPC Processor Blocks
 - 768 User I/O (194 routed on this board)
- 2) XILINX XCF32P FLASH
 - 32Mbit Platform Flash PROM
 - IEEE Standard 1149.1/1532 Boundary-Scan (JTAG) support for programming
 - Endurance of 20000 Program/Erase Cycles
- 3) FTDI FT2232D USB controller
 - Can be used as onboard USB JTAG programmer
 - Can be used for communication in UART/FIFO/MPSSE modes
 - Buffered port for programming external JTAG devices. Vref 1.65V -5.5V
- 4) Onboard IO peripherals
 - 100MHz CMOS oscillator
 - 8 LEDs
 - 8 DIP switches
 - Speaker
 - AT24C1024 1024Kbit EEPROM
- 5) Handy configuration
 - Configuration from onboard USB programmer
 - Configuration from external programmer
 - Mode select jumper (JTAG or FLASH)
 - DONE LED
 - Push button for manual initiation of configuration process
 - Reset supervision by voltage monitor
- 6) Onboard power supply
 - 3.3V 8A (IO, PERIPHERALS)
 - 2.5V 8A (VCCAUX, IO)
 - 1.2V 30A (CORE VOLTAGE)
 - 5V 1.5A (USB controller)
 - 1.8V 1.5A (FLASH)
 - Input voltage range 11V – 13V
 - POWER-ON LED
 - Jumpers for selecting IO voltage
- 7) 142 independent I/O routed to the connectors
 - Two 5x13 male pin arrays (130 IO) with selectable IO voltage

- One 2x6 female connector (8 IO, 2 GND, 2 VCC 3.3V)
- One 1x6 female connector (4 IO, 1 GND, 1 VCC 3.3V)
- Peripheral modules support
- 2.54mm pitch for all connectors
- Test points for FPGA temperature diode

8) Small 100x100mm PCB

Instructions

- 1) Combining Advanced Silicon Modular Block (ASMBL™) architecture with a wide variety of flexible features, the Virtex®-4 family from Xilinx greatly enhances programmable logic design capabilities, making it a powerful alternative to ASIC technology. This board has XC4VFX100 FF1152 11C FPGA (1152 ball package, speed grade 11, commercial temperature range 0°C to +85°C)
 - Virtex-4 Family Overview:
http://www.xilinx.com/support/documentation/data_sheets/ds112.pdf
 - Virtex-4 FPGA DC and Switching Characteristics:
http://www.xilinx.com/support/documentation/data_sheets/ds302.pdf
 - Virtex-4 FPGA User Guide:
http://www.xilinx.com/support/documentation/user_guides/ug070.pdf
 - Virtex-4 FPGA Configuration User Guide:
http://www.xilinx.com/support/documentation/user_guides/ug071.pdf
 - PowerPC 405 Processor Block Reference Guide:
http://www.xilinx.com/support/documentation/user_guides/ug018.pdf
 - XtremeDSP for Virtex-4 FPGAs User Guide:
http://www.xilinx.com/support/documentation/user_guides/ug073.pdf
- 2) XILINX XCF32P is 32 Mbit platform Flash PROM with JTAG interface. Demo design will be stored to flash during manufacturing. With this demo, most of the kit functions can be tested. XCF32P is wired in parallel mode.
 - Platform flash PROM user guide:
http://www.xilinx.com/support/documentation/user_guides/ug161.pdf
- 3) XKF4 FPGA kit has FTDI FT2232D USB controller onboard. This controller can be used for programming onboard FPGA, FLASH or external JTAG device. Also, it can be used for communication with FPGA in UART, FIFO or MPSSE modes. To program FPGA or FLASH, connect J7 to J16 and J2 to J3 with jumpers. Connect 12V to J4. Connect XKF4 kit to USB port, and install FT2232D drivers, what can be downloaded from FTDI website, if your PC doesn't install them automatically.
It is recommended to use program "XC3SPROG", for programming XKF4 kit.
 - 1) Download latest version of xc3sprog from <http://sourceforge.net/projects/xc3sprog/>
 - 2) Place xc3sprog.exe to the folder of your ISE project, where .bit file is located.
 - 3) Create shortcuts on your desktop:
"C:\...\xc3sprog.exe -c ftdi -v -p 1 FILE_NAME.bit" to program XKF4 FPGA
"C:\...\xc3sprog.exe -c ftdi -X parallel -R -v -p 0 FILE_NAME.bit" to program XKF4 FLASH
 - 4) If something went wrong, or you want to explore more options, start "xc3sprog" from CMD

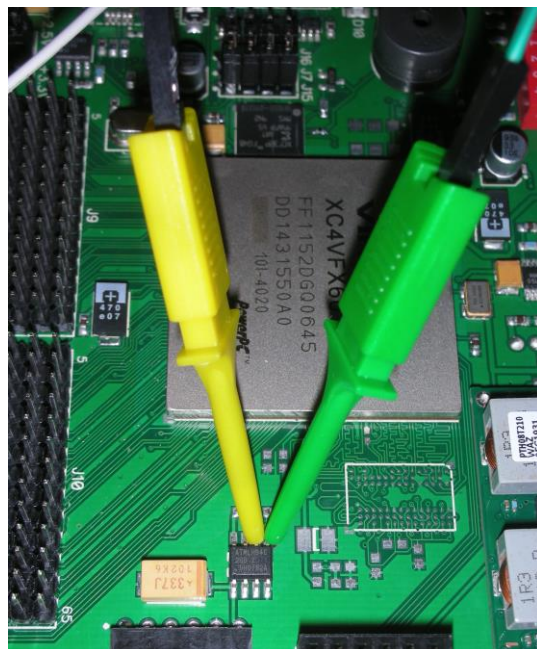
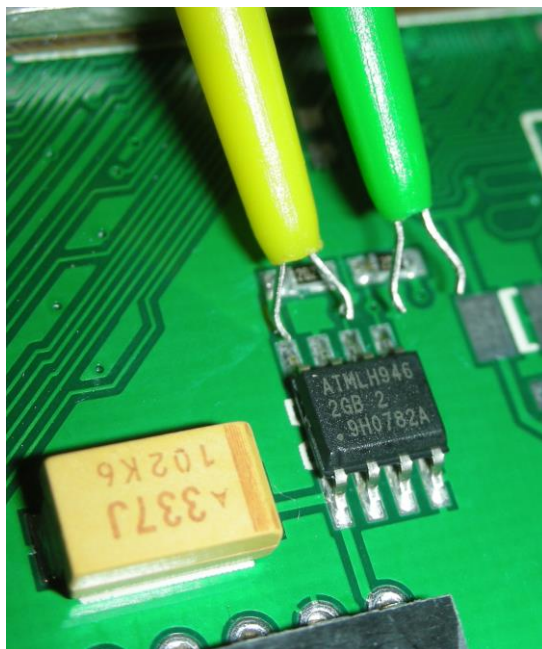
To program external JTAG device, with XKF4 onboard USB programmer, remove jumpers from J2 and J3, connect external device to J2. J2 is connected to buffer IC's. They are needed to amplify

driving current and to widen the supported voltage levels. Programmer can work with Vref from 1.65v to 5.5v. This includes 1.8v, 2.5v, 3.3v and 5v standard signal levels. If you wish to program XKF4 kit with external programmer, you can connect it to J3.

To use all FT2232D ports for communication with FPGA, connect J7 to J15 with jumpers.

Configure FT2232D, accordingly to your needs, with program "FT_PROG". To restore factory settings, use file "FT.xml". By default, PORT B of FT2232D is configured as UART interface and PORT A as JTAG.

- FT2232D datasheet:
http://www.ftdichip.com/Support/Documents/DataSheets/ICs/DS_FT2232D.pdf
 - FTDI's program "FT prog":
http://www.ftdichip.com/Support/Utilities/FT_Prog_v2.8.2.0.zip
 - Drivers and more info about FT2232D:
<http://www.ftdichip.com/Products/ICs/FT2232D.htm>
 - More info about XC3SPROG:
<http://xc3sprog.sourceforge.net/>
 - XKF4 FPGA kit also can be programmed with program "urjtag":
<http://urjtag.org/>
 - FT2232D is not supported by iMPACT, but can be used as virtual cable with "mlab_xvcd.exe":
<http://www.mlab.cz/PermaLink/XVC-SOFTWARE/XVC-1x/BIN>
- 4) Board has few simple peripherals onboard: 8 yellow LEDs, 8 active-low DIP switches with pull up resistors, 16 ohm passive speaker. XKF4 kit is equipped with 100 MHz CMOS crystal oscillator. You can use DCM to divide or multiply clock frequency. Additional clock signals can be connected from outside. Board has AT24C1024 1024Kbit EEPROM. To restore factory settings, of this EEPROM, use "xkf4_a.bin". To program AT24C1024, use external programmer. Connect external programmer with hook type grabbers.



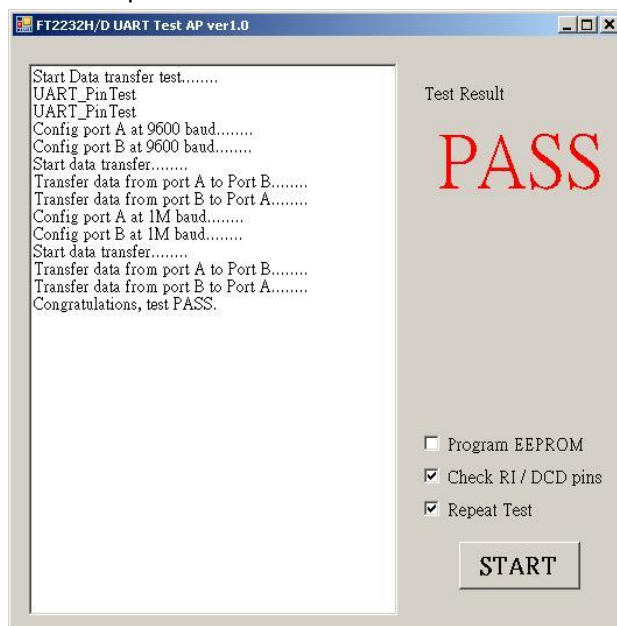
- 5) Red button BTN1 is connected to FPGA PROGRAM_B signal. When it is pressed – FPGA is forced to start reconfiguration process. PROGRAM_B also can be pulled low by U4, MAX809TEUR voltage monitor. As described in chapter 3, of this guide, XKF4 kit can be programmed by onboard USB programmer or by external JTAG programmer. D10 is FPGA DONE LED. It turns on, after FPGA has finished configuration process. J6 is for setting FPGA mode. When jumper is in position "F", this is Master SelectMAP mode (loading from flash). When jumper is in position "J",

this is JTAG mode (waiting configuration from JTAG, not loading from the flash). To configure or reconfigure FPGA from FLASH, set J6 jumper to “F”, and press BTN1. To clear FPGA configuration and put it in JTAG mode – set J6 jumper to “J”, and press BTN1.

- 6) Board has powerful power supply, to serve the needs of VIRTEX-4 FPGA. Core voltage for FPGA is provided by PTH08T210W. Together with 2350uF tantalum capacitors and TurboTrans™ Technology, it is very stable, accurate and powerful solution. PTH08T210W can deliver up to 30A current for FPGA core. 3.3V and 2.5V supplies are built with two 8A DC-DC converters, PTV12010W. 3.3V is used by board peripherals and by FPGA IO banks. 2.5V is used for FPGA VCCAUX and also can be used to supply FPGA IO banks. Supply voltage for banks 4,8,12,7,11 can be selected between 3.3V and 2.5V, with J8 jumpers. If some of these banks will have huge load, it is recommended to replace jumpers with solder bridges, to achieve better current flow. There is voltage regulator, to produce 5V for powering USB controller. Another, voltage regulator, converts 5V to 1.8V for XCF32P core voltage. Input power voltage must be within range of 11V to 13V. There must be at least 0.5A current, to start the board with demo design. Much bigger current may be required, for your custom FPGA design. Use J4 DC jack to connect DC power adapter. Be careful with voltage polarity, positive “inside”, negative “outside”. D9 is a POWER-ON LED with red color. When it is on, it means that there is input DC voltage connected.
- 7) There are total 142 I/O pins, what are routed to the connectors, and can be used in your design. Please refer to the board schematics, to get information about connections. All I/O are independent and not crossing with any module peripherals. J9 and J10 are 65-pin male arrays. J9 is routed to BANK4, BANK8 and BANK12. J10 is routed to BANK7 and BANK11. Voltage for banks 4, 8 and 12 can be set to 3.3V by connecting J8 pin6 to J8 pin4, to 2.5V by connecting J8 pin2 to J8 pin4. Voltage for banks 7 and 11 can be set to 3.3V by connecting J8 pin5 to J8 pin3, to 2.5V by connecting J8 pin1 to J8 pin3. Caution: J8 jumpers can be removed only when board is turned OFF. J11 and J13 are power connectors, corresponding to banks 4, 8, 12 and connector J9. J12 and J14 are power connectors, corresponding to banks 7, 11, and connector J10. J5 is 6x2 female connector. It has 8 IO, 2 VCC 3.3V and 2 GND. J17 is 6x1 female connector. It has 4 IO, 1 VCC 3.3V and 1 GND. These female connectors are designed specially to support peripheral modules. Peripheral modules, with compatible male connectors, can be ordered from PLDkit web site, or from some other suppliers. Please note that you must use I/O standard “LVCMOS33” or “LVTTTL”, if IO voltage is 3.3V, and “LVCMOS25”, if IO voltage is 2.5V. Please note that HSWAPEN FPGA pin is connected to GND, this means that when FPGA is not configured, all IO pull-up resistors are enabled. When demo design is loaded to FPGA, IO connectors can be tested. Use fly wire, to connect IO pins one by one to BANK VCC. Test is passed, if LEDs are turning on, every time when one of IO pins is connected to VCC. If there is missing contact or short circuit between IO - LEDs will not turn on. Be careful, and don’t make short circuit between VCC and GND. All connectors have 2.54mm pitch. Internal FPGA thermal diode is routed to test points TP2 (TDP_0) and TP1 (TDN_0). By connecting this diode to an external signal conditioning IC (thermal monitor), the die temperature could be determined. With some designs, FPGA can heat quite fast. Adhesive heatsink can be mounted on top of FPGA.
- 8) Board size is quite small – 100mm x 100mm. It can be easily mounted inside of some other device.

Powering up the board for the first time

- 1) Connect 12V 1A to J4, with correct polarity.
- 2) Demo design will be automatically loaded into FPGA from the flash, if jumper J6 is in position "F".
- 3) LEDs D1-D8 will start blinking. Red power LED and green DONE LED must be constantly ON.
- 4) Connect XKF4 to your computer with mini-USB cable. Install drivers. Establish UART terminal connection with settings 115200-8-n-1.
- 5) XKF4 will send welcome note to UART, if any key, except "1", "2", "3" or "4", is pressed.
- 6) If button "1" is pressed, XKF4 will enter to FTDI test mode. In this mode, FTDI connections to FPGA can be tested. To perform this test, connect J7 to J15 with jumpers. Download FTDI test utility from here: http://www.ftdichip.com/Support/Utilities/FT2232H_UART.rar Unzip it, close UART terminal, and start "FT2232_UART.exe" from folder "\\FT2232H_UART\\bin\\Release". Tick options "program EEPROM" and "Check RI/DCD pins". Press button "start". Now, EEPROM is reprogrammed. Unplug USB, and plug again. Wait until driver is installed. Untick "program EEPROM" and tick "Repeat Test". Press button "start". Test should fail, if DIP switch 1 or 2 is ON. Otherwise, if everything is done correctly, test must pass.



XKF4 enters FTDI test mode for 5 minutes, so, if it is returned to normal mode, while you were preparing, enter again. When testing is finished, connect J7 to J16 with jumpers. Use program "FT_PROG" and file "FT.xml", to restore XKF4 93c46 EEPROM factory settings.

- 7) If button "2" is pressed, XKF4 will enter AT24C1024 EEPROM reprogramming mode. In this mode, AT24C1024 can be reprogrammed. More details on page 4, of this guide.
- 8) If button "3" is pressed, XKF4 will enter IO/DIP test mode. S1, S2, J10, J9, J5 and J17 can be tested. Turn on DIP switches one by one or connect IO pins to VCC 3.3V one by one. If one IO pin is connected to VCC, or one DIP is ON - all LEDs will turn ON. If none or several pins connected at the same time - LEDs will stay OFF. When LEDs turns on, beep sound is produced.
- 9) If button "4" is pressed, XKF4 will perform quick speaker test.