<u>Peralex SKARAB Programming Golden and Multiboot Image via the JTAG (to be used for bricked boards only)</u>

Software and Hardware Setup

- OS Required/suggested: Ubuntu 14.04 LTS
- Programming software needed: Xilinx Vivado 2016.2
- Firmware BSP files from repo in Github: https://github.com/ska-sa/skarab_bsp_images (master branch). You will need the *.mcs and *.prm files for both golden and multi-boot images. The multiboot is image is the filename without "golden" added to it.
- Optional: Samtec 20 pin header, ESQ-110-69-G-D-LL (see Figure A) to mate the USB Platform programmer fly leads (14 pin to 20 pin). You can connect the flyleads directly to the JTAG JP3 header, but when you remove them then you will need to remember how to connect them again. If you use the Samtec connector then you just have to remove the connector, which is easier. It is possible that the Samtec Connector now comes standard with the new SKARABs.
- Xilinx, USB Flyleads and adapter for USB cable, XLXHW-USB-FLYLEADS-G (see Figure B).
- Xilinx, Platform Cable Programmer or latest one - see Figure B.
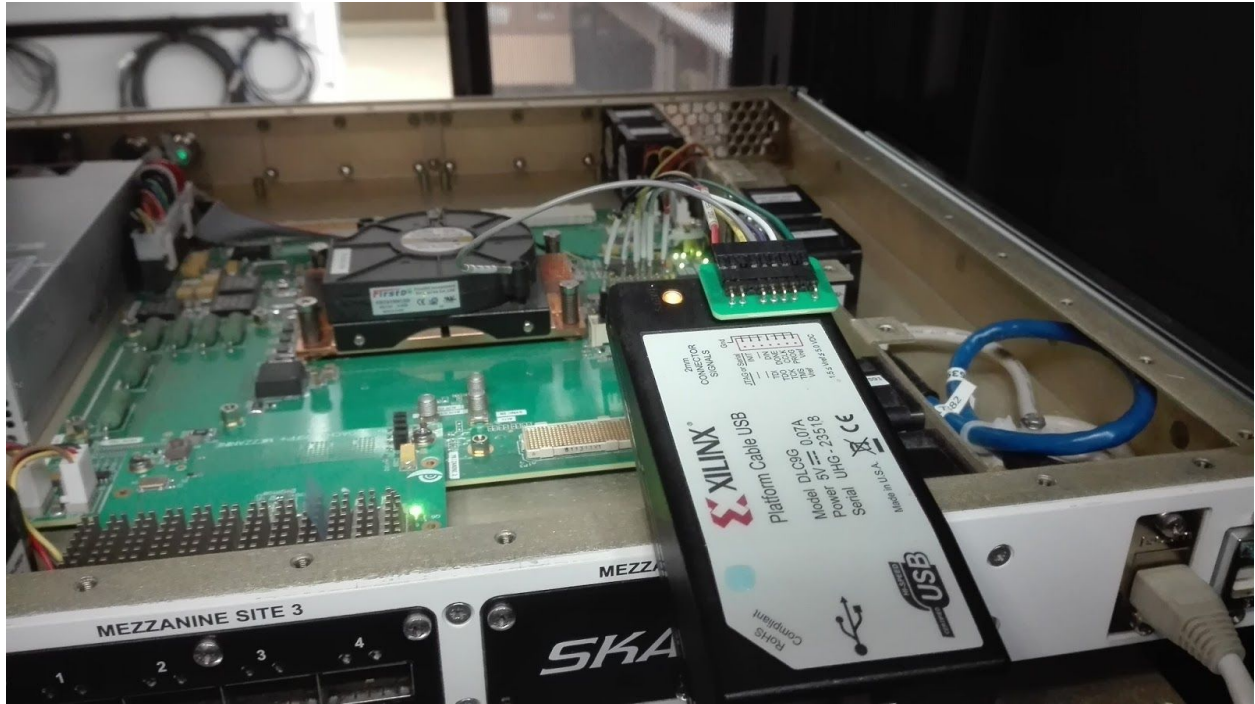

Figure A: Samtec Connector

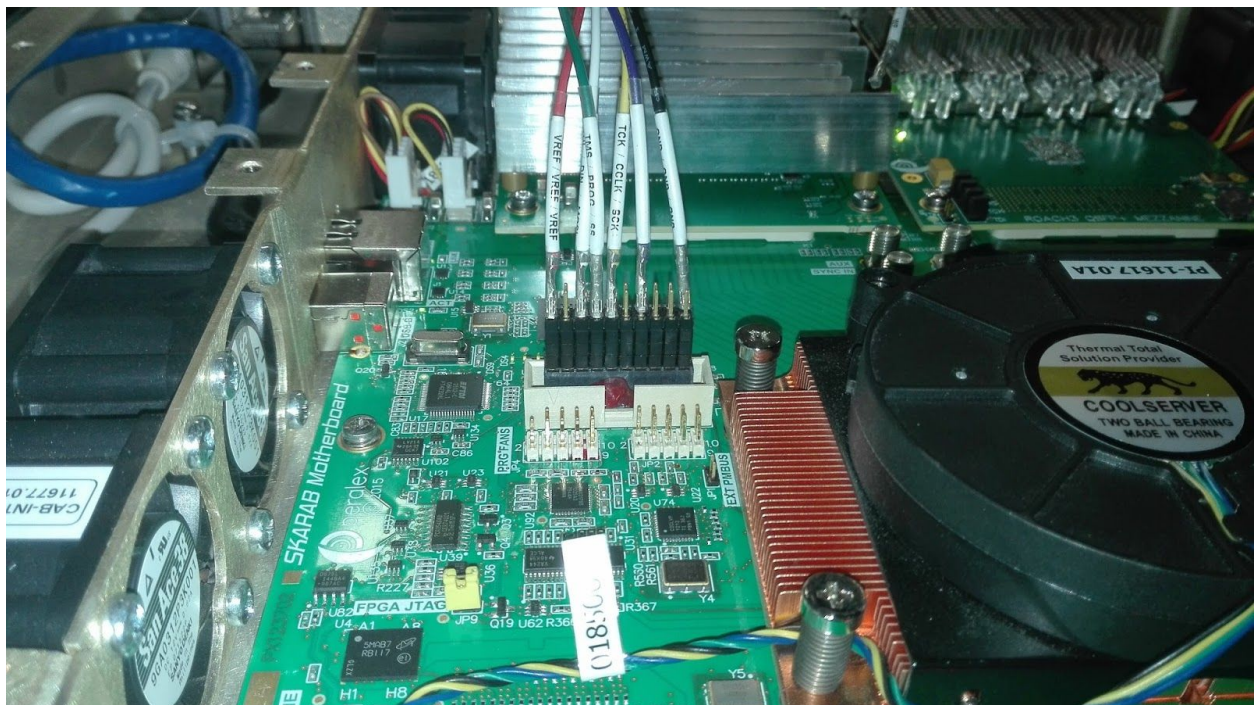**Figure B: Platform Cable USB Programmer and Flyleads connected to the SKARAB**

**Figure C: Samtec Connector Orientation (JP3) and JP9 Jumper Location**

1) Install Xilinx Vivado 2016.2 by following the steps in the Vivado install How To https://github.com/ska-sa/skarab_docs (master branch) . Make sure you implement the steps for the USB driver install.

2) Open the lid of the SKARAB by unscrewing the securing screws. NB: Keep these screws in a safe place for securing later. Be sure to use the right screw driver, as you don't want to strip these screws.

3) Connect the Flyleads to the Platform Cable Programmer as shown in Figure B.

4) The next step is to connect the flylead ends to the Samtec connector or the JP3 header directly. The ends of the flyleads are labelled. Just make sure that the JTAG signals correspond to the JP3 JTAG pins when connected - refer to Table below for exact connections. If you are using the 20 pin Samtec connector then I would suggest marking where pin 1 lies for future use. Pin 1 is power and Pin 20 is ground - refer to Figure C which shows the correct orientation of pin 1 with the Samtec connector connected to JP3. The red VREF flylead is connected to JP3 Pin 1, which is closest to the reader. **NB: The gray flylead (HALT/INIT/WP) does not get connected.**

FlyLead Cable JTAG Labels	Samtec or SKARAB JP3 Header Pin Out
VREF (red)	Pin 1
TDI (white)	Pin 5
TMS (green)	Pin 7
TCK (yellow)	Pin 9
TDO (purple)	Pin 13
GND (black)	Pin 20

5) Ensure that the Platform Cable Programmer LED is illuminated as shown in Figure B to the left of the flylead PCB connector on the Platform Cable Programmer. This indicates that the USB drivers have been properly installed.

6) Short out the connector P9 on the SKARAB by adding a jumper as shown in Figure C - this is the yellow jumper next to the text "FPGA JTAG".

7) Using the Ubuntu terminal, source the "settings64.sh" file where your Vivado install is located. Example:
Type in the terminal: "source /opt/Xilinx/Vivado/2016.2/settings64.sh"

8) Using the Ubuntu terminal, open the Vivado IDE by doing the following:
Type in the terminal: "vivado". The following GUI should appear.
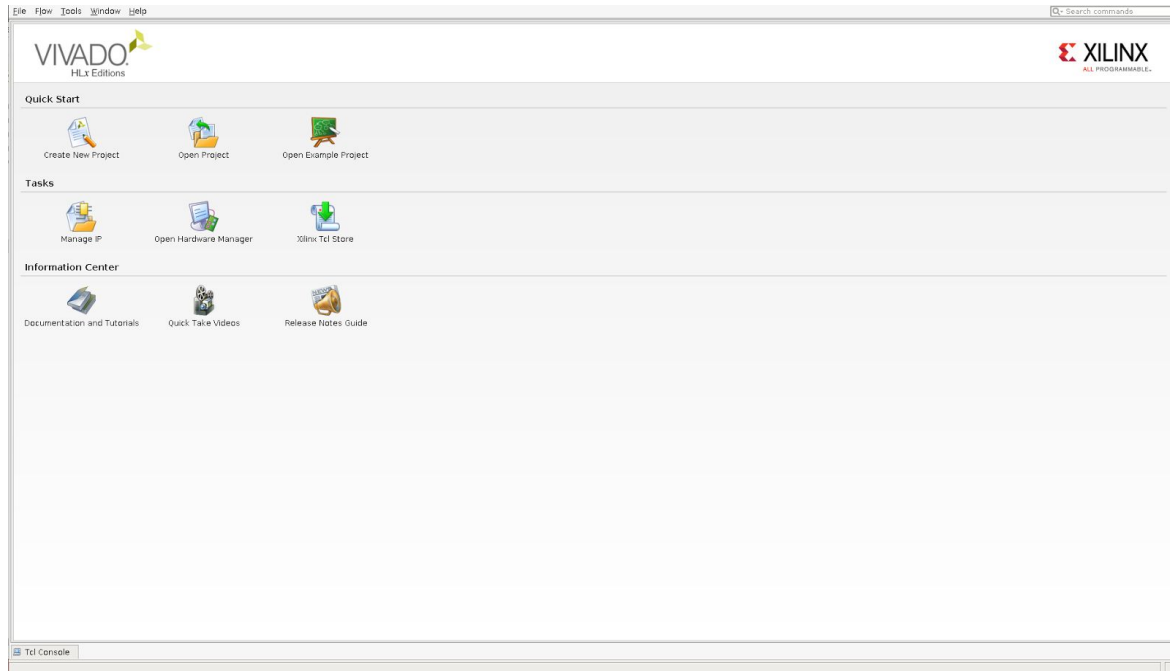
9) Click on the "Open Hardware Manager" icon. The following window should appear.
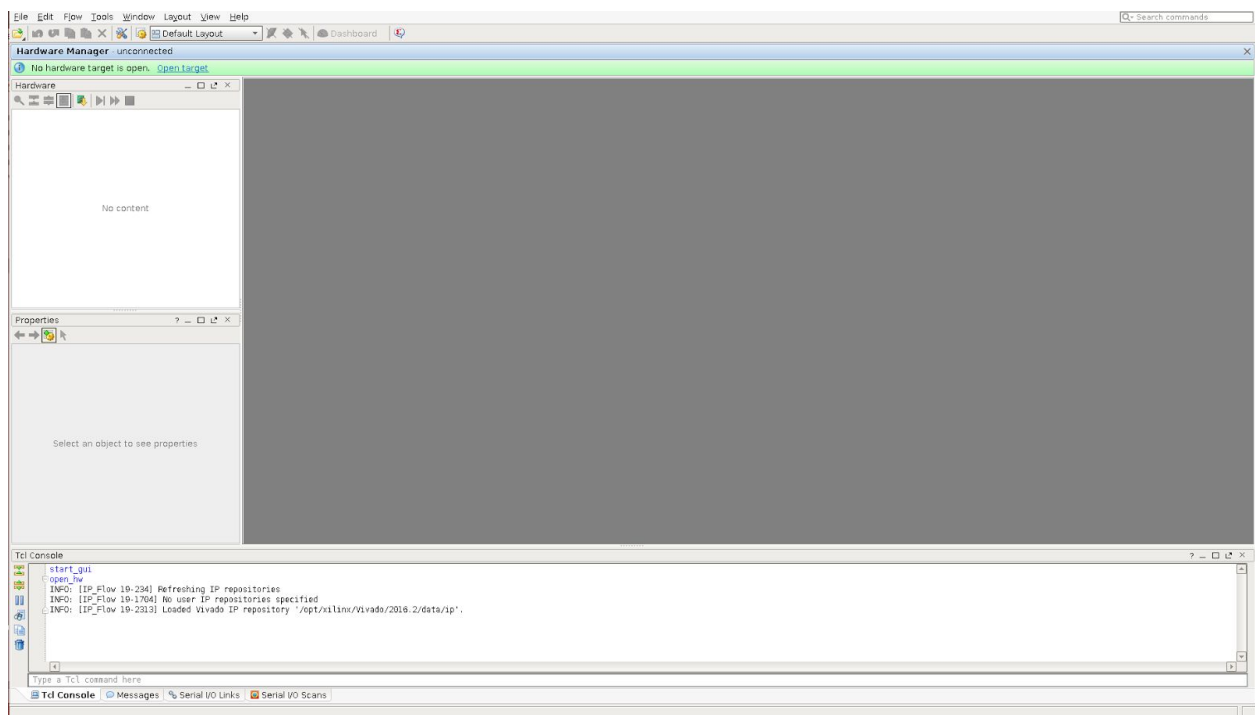
10) Click on "Open Target" near the the top left of the window above. Then click on "auto connect". The following window will appear is everything connects correctly:
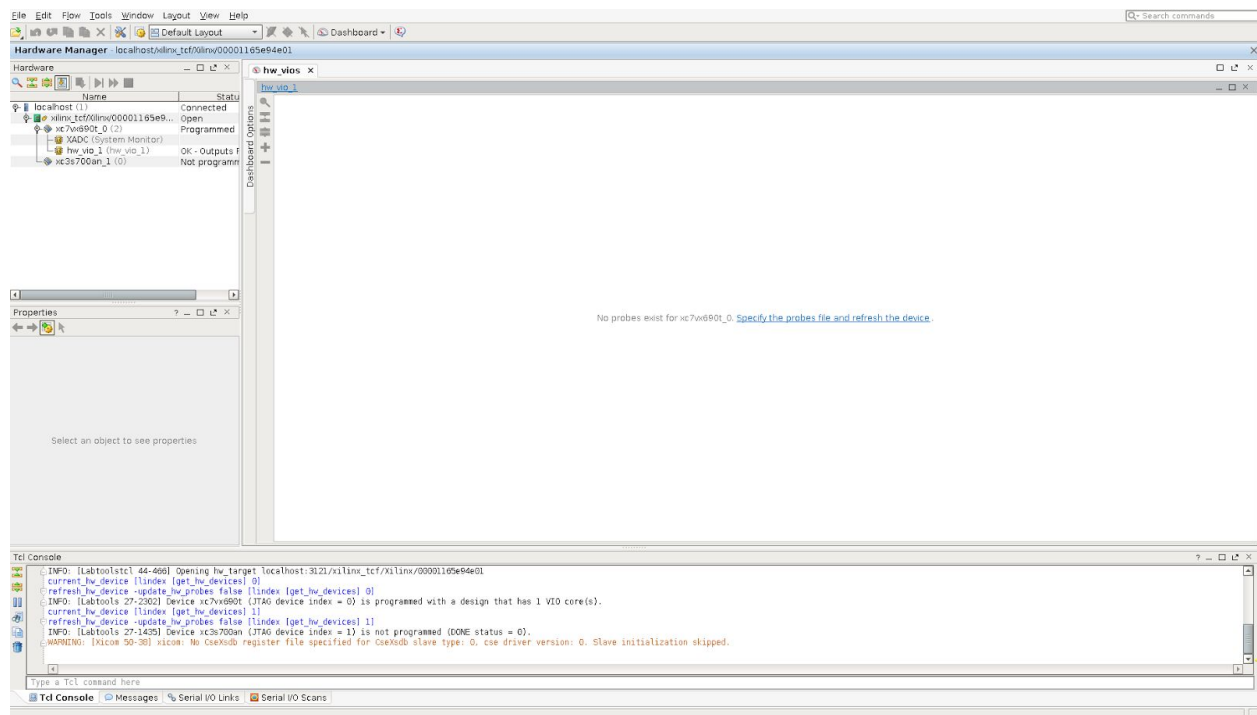
Note: The JTAG is picking up the Virtex 7 device (xcvx690t_0) and the Spartan device (xc3s700an_1) - see hardware window near top left.

11) Right click on "xc7vx690t_0" and select "Add Configuration Memory Device…". Select the Micron "mt28gu01gaax1e-bpi-x16" device. The window should like like below:
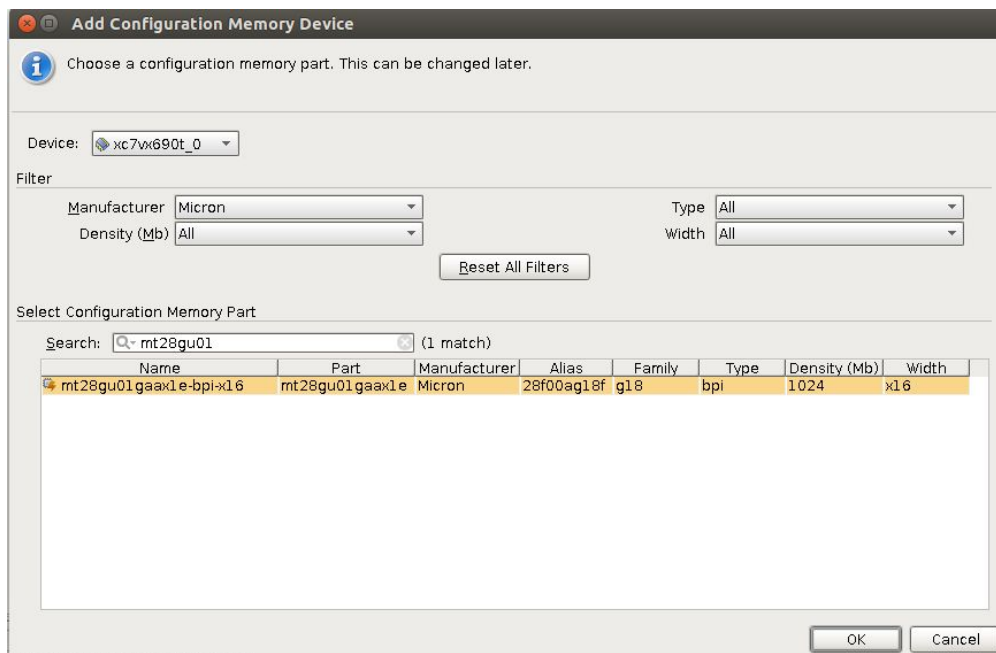
Click "OK".

12) The new flash device will be added under the xc7vx690t device in the hardware window and you will be prompted if you want to configure the device now. Click "OK". The window will look like this:
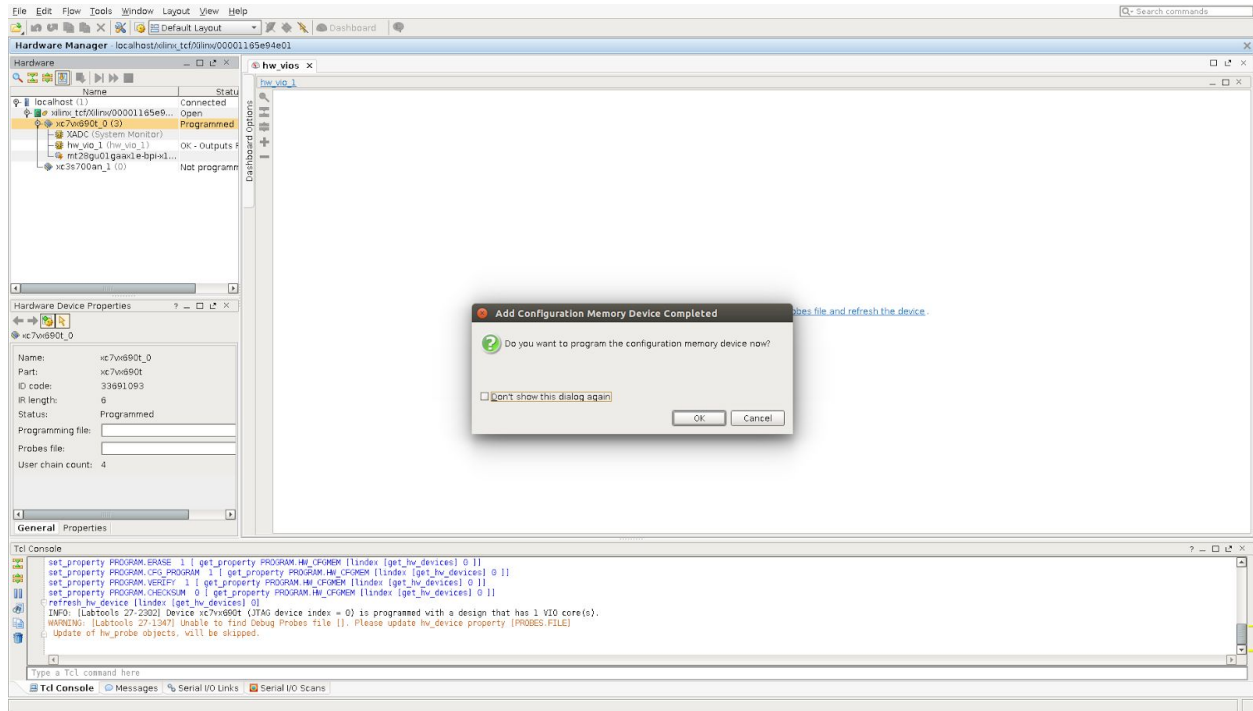
13) The "Program Configuration Memory Device" window will open and you will need to select the mcs file, the prm file and specify the RS (Reconfigure Select) pins as 25:24. The window after setup should look like the window below:

Program Configuration Memory Device

Select a configuration file and set programming options.

Memory Device:	mt28gu01gaaxle-bpi-x16
Configuration file:	rk/toolflow_test/frm123701u1r1_mez3_ska_sa.mcs
PRM file:	rk/toolflow_test/frm123701u1r1_mez3_ska_sa.prm
State of non-config mem I/O pins:	Pull-none

Program Operations

Address Range: Configuration File Only

RS Pins: 25:24

☑ Erase
☐ Blank Check
☑ Program
☑ Verify
☐ Verify Checksum

SVF Options

☐ Create SVF Only (no program operations)

SVF File:

OK   Cancel   Apply

Click "OK" when ready. The flash programming will commence. The flash will be erased, programmed and verified. This will take about 3 minutes, so do not stop the process.

14) The Tcl Console window at the bottom of the screen will indicate that programming is successful and a pop up window appears indicating completion. The window should look like this:

File Edit Flow Tools Window Layout View Help

Hardware Manager - localhost/xilinx_tcf/Xilinx/00001165e94e01

There are no debug cores. Program device Refresh device

Hardware

Name | Status
localhost (1) | Connected
xilinx_tcf/Xilinx/00001165e9... | Open
xc7vx690t_0 (2) | Programmed
XADC (System Monitor) |
mt28gu01gaax1e-bpi-x1... |
xc3s700an_1 (0) | Not programm

Hardware Device Properties

xc7vx690t_0

Name: xc7vx690t_0
Part: xc7vx690t
ID code: 33691093
IR length: 6
Status: Programmed
Programming file:
Probes file:
User chain count: 4

General Properties

hw_vios
hw_vio_1

No content

Tcl Console

```
Mfg ID : 89   Memory Type : 88b0   Memory Capacity : 0   Device ID 1 : 0   Device ID 2 : 0
Performing Erase Operation...
Erase Operation successful.
Performing Program and Verify Operations...
Program/Verify Operation successful.
INFO: [Labtoolstcl 44-377] Flash programming completed successfully
program_hw_cfgmem: Time (s): cpu = 00:00:04 ; elapsed = 00:02:23 . Memory (MB): peak = 6018.008 ; gain = 15.199 ; free physical = 314 ; free virtual = 14506
endgroup
```

Type a Tcl command here

Tcl Console | Messages | Serial I/O Links | Serial I/O Scans

15) Power the SKARAB down and then up again. The new image should be loaded. Repeat the steps above for a new image that needs to be configured.