
GETTING STARTED GUIDE

INTRODUCTION

The Sidekiq X2 / X4 PDK includes either a Sidekiq X2 or X4 FMC card mounted on an FPGA carrier card and PCIe Gen3 x4 interface all hosted in a Thunderbolt™ 3 (TB3) PCIe carrier card chassis. The chassis connects to a TB3 enabled Linux laptop via the included TB3 cable. A USB cable is also included to connect the laptop with the GPS USB port to provide GPS configuration and raw data. The PDK laptop is pre-loaded with Epiq Solutions' libsidekiq API, test applications, ERA (Spectrum Analyzer), and device drivers. All support-related questions, product documentation, software, and FPGA reference designs are managed through Epiq Solutions' private web-based support forum* available at epiqsolutions.com/support.

*Registration is required to use the Epiq Solutions Customer Support Center. You can register at epiqsolutions.com/support

PROPER CARE AND HANDLING

Each Sidekiq X2 or X4 PDK is fully tested by Epiq Solutions before shipment, and is guaranteed functional at the time it is received by the customer.

Improper use of Sidekiq can cause it to become non-functional. In particular, a list of actions that may cause damage to the hardware include the following:

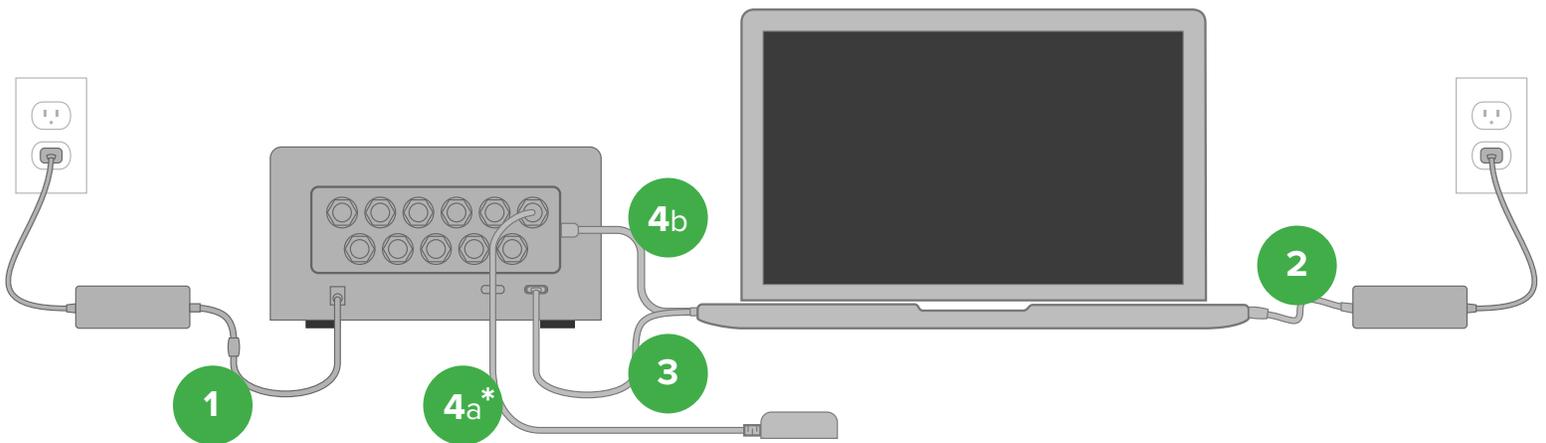
- Handling the unit without proper electrostatic precautions (ESD protection) when the housing is removed or opened up
- Inserting or removing Sidekiq from a host system when power is applied to the host system
- Connecting a transmitter to the RX port without proper attenuation – refer to Sidekiq X2 or X4 Hardware Users Manual for additional information.
- Executing custom software and/or an FPGA bitstream that was not developed according to our guidelines

AVAILABLE DOCUMENTATION

Documentation for Sidekiq X2/X4 can be accessed at epiqsolutions.com/docs. After providing the product's serial number and a valid email address, you will be granted immediate access to documentation, so you can get started even before your access to our support forums has been approved.

- The **Sidekiq X2 and X4 Hardware User’s Manuals** provide an overview and usage details of the multichannel RF transceiver card.
- The **Sidekiq Software Development Manual** provides the details required to enable a software developer to develop software applications utilizing the Sidekiq SDR.
- The **Sidekiq API Manual** provides an overview and usage details of libsidekiq - Sidekiq Library
- The **Sidekiq X2 / X4 FPGA Development Manual** provides an overview of the FPGA reference design, with the intention of empowering the user to build upon the design to create custom applications.
- The **ERA Manual** provides an overview of ERA (Epiq RF Analyzer) Lite, a cross-platform compatible spectrum analyzer, when used in conjunction with the full line of Epiq Solutions’ software defined radios (SDR)

SETUP



Sidekiq X4 PDK Assembled *see **RF PORTS** to locate GPS connector on Sidekiq X2

After you have removed and verified that all the package contents are present as outlined in the Sidekiq X2/ X4 PDK Package Contents, setup the system as follows:

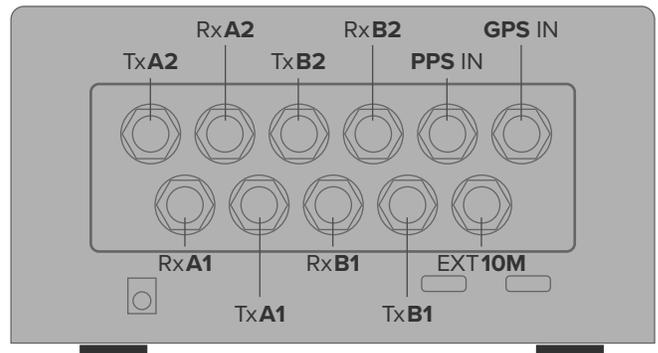
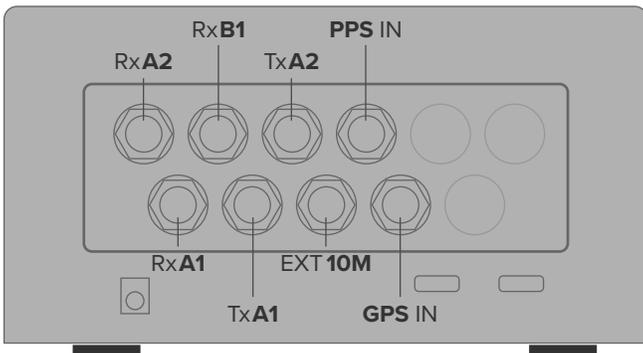
1. Connect the Thunderbolt 3 (TB3) chassis power supply and cable from the TB3 chassis’ DC barrel connector to the wall outlet.
2. Connect the laptop power supply and cable to the laptop’s DC barrel connector.
3. Connect the TB3 chassis Thunderbolt-3 port to the laptop’s TB3 port with the provided TB3 cable.
4. *If you are using the GPS disciplined oscillator (GPSDO):* Connect the GPS antenna to J8 for the Sidekiq X2 or J11 for the Sidekiq X4 (**a**). Also connect the USB cable to the USB-B port on the chassis and a USB-A port on the laptop (**b**); for more details, see “RF Ports” on the next page.
5. Connect an antenna or RF source to RXA1, J2 for the Sidekiq X2 or J2 for the Sidekiq X4, before using any of the test applications or ERA; for more details, see “RF Ports” on the next page.

6. Power on the laptop; this will also power-on the connected TB3 chassis. The laptop will indicate that it is starting up Ubuntu Linux and then it will show a login page. A blue LED (on the Sidekiq card, behind the front RF connector panel) will turn on when the chassis is completely on.
7. Log into Ubuntu with the user credentials:
 - Username: **sidekiq**
 - Password: **sidekiq**
8. Launch a terminal window (can be launched by pressing **Ctrl-Alt-T**)
9. Verify that the TB3 / PCIe connection to the Sidekiq X2 / X4 is established by running the `lspci` command the PCI identifier for the Sidekiq X2 or X4 is 19aa:5832.

```
$ lspci -d 19aa:
xx:00.0 Signal processing controller: Device 19aa:5832 (rev 04)
```

10. If running `lspci -d 19aa:` returns no results, power everything down and repeat steps 5 – 9. If the PCIe interface is still not seen with `lspci`, please contact Epiq Solutions for further assistance at: epiqsolutions.com/support.

RF PORTS



Sidekiq X2 RF Ports

Sidekiq X4 RF Ports

SMA Label	X2 RF Ports	X2 Software Handle	X4 RF Ports	X4 Software Handle
J1	Rx A2	skiq_rx_hdl_A2	Tx A2	skiq_tx_hdl_A2
J2	Rx A1	skiq_rx_hdl_A1	Rx A1	skiq_rx_hdl_A1
J3	Rx B1 / ORBX	skiq_rx_hdl_B1	Rx A2 / ObsRx A	skiq_rx_hdl_A2
J4	Tx A1	skiq_tx_hdl_A1	Tx A1	skiq_tx_hdl_A1
J5	Tx A2	skiq_tx_hdl_A2	Tx B2	skiq_tx_hdl_B2
J6	External 10 MHz		Rx B1	skiq_rx_hdl_B1
J7	PPS Input		Rx B2 / ObsRx B	skiq_rx_hdl_B2
J8	GPS Input		Tx B1	skiq_tx_hdl_B1
J9	N/A		PPS Input	
J10	N/A		External 10 MHz	
J11	N/A		GPS Input	

Input Level Ranges

10 MHz Input (**EXT 10M**): +2.5 dBm to +8.5 dBm

GPS Input (**GPS IN**): +15 dBm (max). *This port also provides 3V at 50mA for powering an active antenna.*

PPS Input (**PPS IN**): 0 to 5V (V_HIGH min. ~1.5V)

Sidekiq X2

RF full scale input (at max gain): -30 dBm (up to 3 GHz) and ~-21 dBm @ 6 GHz

Max RF input signal (without damage): +25 dBm

Sidekiq X4

RF full scale input (at max gain): -20 dBm (frequency dependent)

Max RF input signal (without damage): +27 dBm

GPS DISCIPLINED OSCILLATOR

The Sidekiq X2/X4 TB3 platform includes a Global Navigation Satellite System (GNSS) add-on card which is based on a uBlox LEA-M8F GNSS module (www.u-blox.com/en/product/lea-m8f-module). The GPS module is capable of using GNSS (9BeiDou, GLONASS, GPS/QZSS), external 10 MHz frequency sources, and an internal VCTCXO as its disciplining source. GNSS, if present, will always be used and if GNSS is lost, then the module has 2 options to fallback on: 1) an external 10 MHz frequency source (if present), and 2) the internal VCTCXO.

The GPS module has been set up to always use the 10 MHz source as the disciplining source if it is present on EXT_10M. GNSS, if present, will be used if the external 10 MHz is not present. If GNSS is lost, then the M8F will fallback to the internal VCTCXO.

Connect the GPS antenna to the GPS_IN SMA connector (see **RF PORTS**) if you wish to use GPSDO or connect a 10 MHz reference to the EXT_10M SMA connector.

Note: Once a GPS fix has been acquired, a 1PPS signal is also provided. The 1PPS persists after a GPS fix has been lost.

The NMEA data stream can be viewed by connecting the USB A-Male to B-Male cable from the host computer's USB port to the X2/X4 TB3 chassis' (USB for NMEA data). USB Port (Ubuntu): **/dev/ttyUSB0** is the NMEA data stream. *Different serial & GPS drivers might name the port differently.*

```
sudo screen /dev/ttyUSB0
```

INCLUDED APPLICATIONS

Several applications are included with the PDK in order to help you test and verify your setup, such as our standard Sidekiq command-line test applications and ERA, a spectrum analyzer.

Libsidekiq Test Applications

Test Applications are located in `/home/sidekiq/sidekiq_image_current/test_apps`. Launch a terminal window from Dash (search for “Terminal”) or by pressing Ctrl-Alt-T.

```
cd /home/sidekiq/sidekiq_image_current/test_apps/
```

A user can scan the system for Sidekiq cards, displaying version information for one or all card(s) upon detection by running the **version_test** application by executing the command:

```
./version_test
```

The applications should return results that look something like the following:

```
1 card(s) found: 0 in use, 1 available!
Card IDs currently used :
Card IDs currently available: 0
Info: initializing 1 card(s)...
SKIQ[9326]: <INFO> libsidekiq v4.9.2 (g36ae80d0)
version_test[9326]: <INFO> Sidekiq card 0 is serail number-####...
version_test[9326]: <INFO> Sidekiq card 0 FPGA vM.m.p...
version_test[9326]: <INFO> Sidekiq card 0 is configured for an internal reference...
version_test[9326]: <INFO> Loading calibration data for Sidekiq X4, card 0
***** libsidekiq v4.9.2 *****
***** Sidekiq Card 0 *****
Card
  accelerometer present: false part type: X4
  part info: ES024201-B0-01 serial: ####
  xport: PCIe
FPGA
  version: 3.11.1
  git hash: 0x1f4f2374
  build date (yymmddhh): 19022521 tx fifo size: 64k samples
RF
  reference clock: internal
  reference clock frequency: 10000000 Hz last calibration year: 2019
  last calibration week number: 7 recalibration interval: 0 years
version_test[9326]: <INFO> Unlocking card 0
```

Raw I/Q Capture

A user can perform an RF capture of I/Q samples using the default configuration by executing the **rx_samples** application as follows:

Sidekiq X2

```
./rx_samples -b 25000000 --rate=30720000 -c 0 -d /tmp/out -f 1000000000
--handle=A1 -words=25000000
```

This command will save I/Q samples to a file named `/tmp/out.a1` using values for 30.72 Msps sample rate, 25 MHz channel bandwidth, 1 GHz tune frequency. The data is stored in the file as 16-bit I/Q pairs with ‘I’ samples stored in the upper 16-bits of each word, and ‘Q’ samples stored in the lower 16-bits of each word. Additional available options are described by executing:

```
./rx_samples -h
```

Sidekiq X4

```
./rx_samples -b 50000000 --rate=61440000 -c 0 -d /tmp/out -f 1000000000  
--handle=A1 --words=25000000
```

This command will save I/Q samples to a file named **/tmp/out.a1** using values for 61.44 Msps sample rate, 50 MHz channel bandwidth, 1 GHz tune frequency. The data is stored in the file as 16-bit I/Q pairs with ‘I’ samples stored in the upper 16-bits of each word, and ‘Q’ samples stored in the lower 16-bits of each word. Additional available options are described by executing:

```
./rx_samples -h
```

Note: It is highly recommended that a user profile their system by running the benchmark test applications (more details in the Sidekiq SDK Manual, Appendix 8 - Assessing Throughput Performance)

ERA - Epiq RF Analyzer

EPIQ RF Analyzer (ERA) is installed on the Sidekiq X2 / X4 PDK laptop. ERA is an application that provides a realtime view of spectrum and allows you to configure radio frequency, sample rate, and filtering configuration of an Epiq radio. ERA documentation can be found on the support forum, available at epiqsolutions.com/support.

ERA Release Information

- The included version does not provide “Pro” features of ERA for X2 or X4 (e.g. recording, see User Manual for all Pro-only features). Future releases of ERA will be posted on the support forum (epiqsolutions.com/support) for download.
- ERA support for Sidekiq X2/X4 hardware is preliminary; supported sample rates are limited to:
 - 30.72 Msps - X2
 - 61.44 Msps - X4

Running ERA

To run ERA, choose the Ubuntu icon in the top-left corner of the desktop and type “ERA”; the icon should appear in the “Applications” section.

Note: The ERA User’s manual available on support forum (epiqsolutions.com/support), gives instructions on the features and operation of ERA; some of these features described in the manual require the purchase of an ERA Pro license, which is not currently supported with the X2 or X4.