Matchstiq™ Sx

RF Transceiver • Platform

EPIQ SOLUTIONS

GETTING STARTED GUIDE

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CHANGELOG

Revision	Date	Description	Author
1.0.0	2020-03-23	initial draft	Barry L

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INTRODUCTION

Congratulations! You are now the owner of Matchstiq S1x, a small form factor software defined radio transceiver which provides unprecedented capability and flexibility while maintaining an aggressively low power consumption. Matchstiq S1x combines Epiq Solutions' Sidekiq MiniPCIe card with a custom variant of the Gateworks Ventana GW5100 single board Linux computer module to provide a complete software defined radio platform.

PROPER CARE AND HANDLING

Each Matchstiq S1x unit is fully tested by Epiq Solutions before shipment, and is guaranteed to be functional at the time it is received by the customer. Improper handling and use of Matchstiq S1x can cause the unit to become non-functional. In particular, the following list of actions are known to cause damage to Matchstiq S1x hardware:

- Handling the unit without proper electrostatic precautions (ESD protection) when the housing is removed or opened up

- Connecting a transmitter to the RX port without proper attenuation – refer to Matchstiq S1x Hardware Users Manual for additional information

- Executing custom software and/or an FPGA bitstream that was not developed according to Epiq Solutions' guidelines

AVAILABLE DOCUMENTATION

Documentation for Matchstiq S1x can be accessed at epiqsolutions.com/docs. After providing a valid email address, an access code will be emailed and grant you immediate access to documentation, so you can get started even before your access to our support forums has been approved.

- The mPCIe Sidekiq Hardware User's Manual provides an overview and usage details of the multi-channel 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 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 User Manual provides an overview of ERA (Epiq RF Analyzer), a cross-platform compatible spectrum analyzer

EXTERNAL I/O PORTS
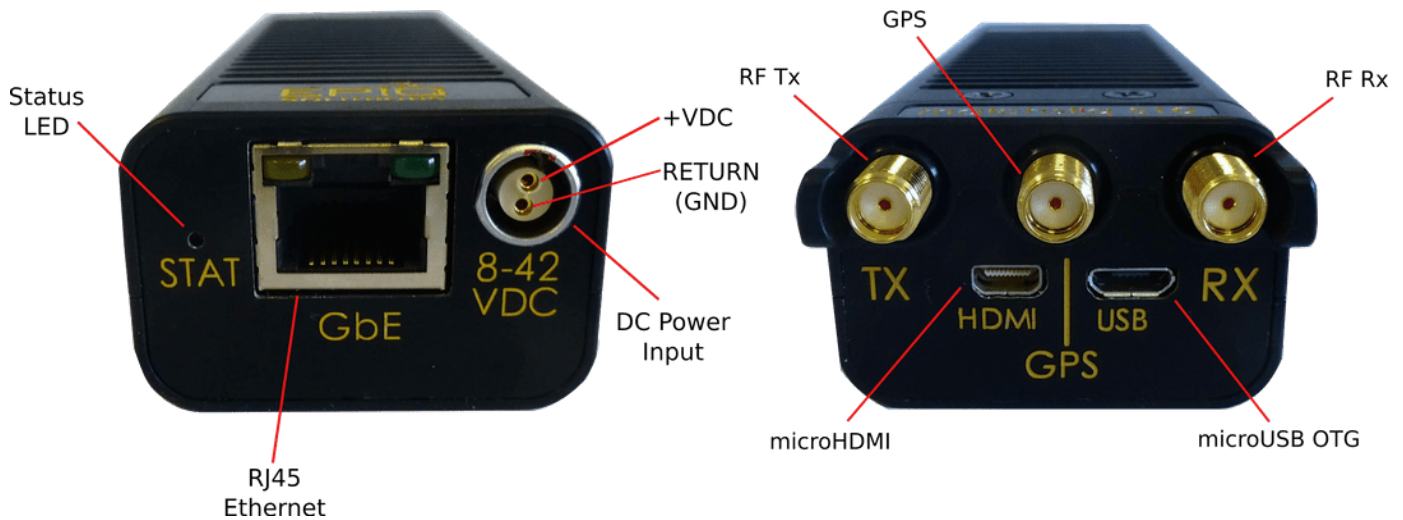
Matchstiq S1x has user I/O ports on both the front panel and the rear panel of the unit. The front panel of the unit contains the following ports:

- **RJ45 Ethernet:** This port is used to provide access to the 10/100/1000 Base-T Ethernet interface. This is the primary interface used for connecting the unit to an external computer network. This interface also supports passive Power over Ethernet, allowing the Matchstiq S1x unit to receive both power and Ethernet connectivity via a CAT5/6 Ethernet cable with the appropriate power injector. Contact Epiq Solutions for details.

- **DC Power Input:** This port is used to provide input power to the platform. Input voltages between 8V DC and 42V DC are supported. The input power receptacle is the Lemo EGG.0B.302.CLL. The mating connector, the Lemo FGG.0B.302.CLAD35Z, can be found on the AC/DC power adapter included with the Matchstiq S1x unit.

- **Status LED:** This dual-LED status LED is used to provide visual feedback to the user. This LED includes both a green LED as well as a red LED. Both green and red LEDs can be turned on simultaneously to provide an orange color.

The rear panel of the unit contains the following ports:

- **RX:** This SMA port provides a 50 ohm interface to connect an external receive antenna to the RF receiver. *Note: The maximum safe RF input to this port without damage is **+20 dBm**.*
    - The Matchstiq S11 can operate as two phase coherent receivers (Rx1 & Rx2) or as 1 RX + 1 TX

- **TX:** This SMA port provides a 50 ohm interface to connect an external transmit antenna to the RF transmitter.

- **GPS:** This SMA port provides a 50 ohm interface to connect either a passive or active GPS antenna for the internal GPS receiver. An active GPS antenna is recommended, with a 3V DC bias provided on the center pin. *Note: The maximum safe RF input to this port without damage is **+11 dBm**.*

- **microUSB:** This microUSB port provides a USB OTG port that can support operation as either a USB host or a USB device. By default, this port is configured for USB host mode and provides 5V DC at 500 mA to power USB peripherals plugged in to this interface.

- **microHDMI:** This microHDMI interface port provides a video output interface through a standard micro-D connector.

SETUP

After you have removed and verified that all the package contents are present as outlined in the Matchstiq S1x Package Contents, setup the system as follows:

1. If you are using the GPS, connect the GPS antenna to the Matchstiq's GPS SMA connector.

2. Connect antenna or RF source to RX port before using any of the test applications or ERA.

3. For network access via SSH, connect a RJ-45 cable to the GbE port and your network.

   Optionally, you can also connect a monitor to microHDMI port along with a USB keyboard to the microUSB port and log in locally.

4. Power up the Matchstiq S1x by connecting the AC/DC power adapter (included with the Matchstiq S1x unit) to the DC Power Input (8-42VDC) and then to the wall outlet.

   Note: The Status LED illuminates a solid green until the Linux kernel has fully booted (after approximately 25 *seconds) after which it defaults to a blinking green "heartbeat".*

CONNECT MATCHSTIQ S1X TO A HOST PC

Once the unit is powered up and the Linux kernel has booted, the typical way to connect Matchstiq S1x to a host PC is through the RJ45 Ethernet interface. This interface has a **default** static IP address of **192.168.2.140**. In order to connect to this interface from a host PC, the host PC should have an IP address on the same 192.168.2.xxx subnet (such as 192.168.2.2). The user should be able to ping the Matchstiq S1x unit from a terminal shell on the host PC using the following command entered in to the terminal shell:

```
$ ping 192.168.2.140
PING 192.168.2.140(192.168.2.140) 56(84) bytes of data.
64 bytes from 192.168.2.140: icmp_req=1 ttl=64 time=0.323 ms
64 bytes from 192.168.2.140: icmp_req=2 ttl=64 time=0.390 ms
64 bytes from 192.168.2.140: icmp_req=3 ttl=64 time=0.225 ms
64 bytes from 192.168.2.140: icmp_req=4 ttl=64 time=0.405 ms
64 bytes from 192.168.2.140: icmp_req=5 ttl=64 time=0.343 ms
--- 192.168.2.140 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 3999ms
rtt min/avg/max/mdev = 0.225/0.337/0.405/0.064 ms
```

Another method of connecting the Matchstiq S1x to a host PC is through the USB OTG (micro-B connector) interface. This interface has a default static IP address of 192.168.3.99.

```
$ ping 192.168.3.99
PING 192.168.3.99 (192.168.3.99) 56(84) bytes of data.
64 bytes from 192.168.3.99: icmp_seq=1 ttl=64 time=0.306 ms
64 bytes from 192.168.3.99: icmp_seq=2 ttl=64 time=0.262 ms
64 bytes from 192.168.3.99: icmp_seq=3 ttl=64 time=0.239 ms
64 bytes from 192.168.3.99: icmp_seq=4 ttl=64 time=0.244 ms
64 bytes from 192.168.3.99: icmp_seq=5 ttl=64 time=0.247 ms
--- 192.168.3.99 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4086ms
rtt min/avg/max/mdev = 0.239/0.259/0.306/0.030 ms
```

With a successful ping session complete, network connectivity between the Matchstiq S1x and the host PC has been confirmed. From here, the user can proceed to establish a secure shell (SSH) connection to the Matchstiq S1x unit from the host Linux PC.

The default login credentials are:

- username: **root**

- password: **root**

```
epiq@HostLinuxBox $ ssh root@192.168.2.140
root@192.168.2.140's password:

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                        Û  Û  Û


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      ÛÛ       ÛÛÛÛÛÛÛ  ÛÛ ÛÛ     ÛÛ
      ÛÛ       ÛÛ       ÛÛ ÛÛ  ÛÛÛÛ
      ÛÛÛÛÛÛÛÛ ÛÛ       ÛÛ    ÛÛÛÛÛÛ
                                 ÛÛ
       === Matchstiq S1x / S2x ===
           === Release 13.1 ===

root@OpenWrt:~#
```

INCLUDED APPLICATIONS

Several applications are included with the Matchstiq S1x 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 /root/sidekiq_image_current/test_apps

```
root@OpenWrt:~# cd /root/sidekiq_image_current/test_apps/
```

Run *switch_to nothing* to stop any EPIQ application that may currently be using the Sidekiq card:

```
root@OpenWrt:~# switch_to nothing
   usage: switch_to <app-name>
   app selection: 'nothing'
   app status:
    [ ] - era
    [ ] - floodlight
    [*] - skylight
    [ ] - sodor
    [ ] - spotlight
    [*] - srfs

    [*] = Installed, [R] = Running, [ ] Not Installed
```

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 application should return results that look something like the following:

```
# ./version_test
1 card(s) found: 0 in use, 1 available!
Card IDs currently used      :
Card IDs currently available: 0
Info: initializing 1 card(s)...
SKIQ[4682]: <INFO> libsidekiq v4.12.1 (g9136e76d5)
version_test[4682]: <INFO> Sidekiq card 0 is serial number=#####, hardware MPCIE C (rev C),
product SKIQ-MPCIE-001 (PCIe) (part ES004202-C0-00)
version_test[4682]: <INFO> Sidekiq card 0 firmware v2.9
version_test[4682]: <INFO> Sidekiq card 0 FPGA v3.13.0, (date 20011315, FIFO size 16k)
version_test[4682]: <INFO> Sidekiq card 0 is configured for an internal reference clock
version_test[4682]: <INFO> Loading calibration data for Sidekiq PCIe, card 0
*********************************************************
* libsidekiq v4.12.1
*********************************************************
*********************************************************
* Sidekiq Card 0
  Card
    accelerometer present: true
    part type: PCIe
    part info: ES004202-C0-00
    serial: #####
    xport: PCIe
  FPGA
    version: 3.13.0
    git hash: 0x06f5a1a9
    build date (yymmddhh): 20011315
```

```
 FW
     version: 2.9
   RF
     reference clock: internal
     reference clock frequency: 40000000 Hz

version_test[4682]: <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:

```
./rx_samples -c 0 --handle=A1 -r 7e6 -b 5.6e6 -f 1e9 -d /tmp/out
```

This command will save I/Q samples to a file named /tmp/out.a1 using values for 7 Msps sample rate, 5.6 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*

ERA - EPIQ RF ANALYZER

EPIQ RF Analyzer (ERA) is installed on the Matchstiq S1x. 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 support.epiqsolutions.com.

Running ERA

```
root@OpenWrt:~# switch_to era
Saving application selection ...
Stopping running services ...

INFO: Started era-controller era-ui era-triggeragent services for 'era'
```

Next, open a web browser on the PC or laptop connected to the Matchstiq. In the address bar, enter the address http://A.B.C.D:3000, where A.B.C.D is the IP address of the Matchstiq, default address is:

http://192.168.2.140:3000/