

### Features

- Centimeter-accurate relative positioning (Carrier phase RTK)
- 10 Hz position/velocity/time solutions
- Open-source software and board design
- Low power consumption - 500mW typical
- Small form factor - 53x53mm
- USB and dual UART connectivity
- External antenna input
- Full-rate raw sample pass-through over USB

### Applications

- Autonomous Vehicle Guidance
- GPS/GNSS Research
- Surveying Systems
- Precision Agriculture
- Unmanned Aerial Vehicles
- Robotics
- Space Applications

### Overview

Piksi™ is a low-cost, high-performance GPS receiver with Real Time Kinematics (RTK) functionality for centimeter-level relative positioning accuracy.

Its small form factor, fast position solution update rate and low power consumption make Pixsi ideal for integration into autonomous vehicles and portable surveying equipment.

Piksi's open source firmware allows it to be easily customized to the particular demands of end users' applications, easing system integration and reducing host system overhead.

In addition, Pixsi's use of the same open source GNSS libraries as Peregrine, Swift Navigation's GNSS post-processing software, make the combination of the two a powerful toolset for GNSS research, experimentation and prototyping at every level from raw samples to position solutions.

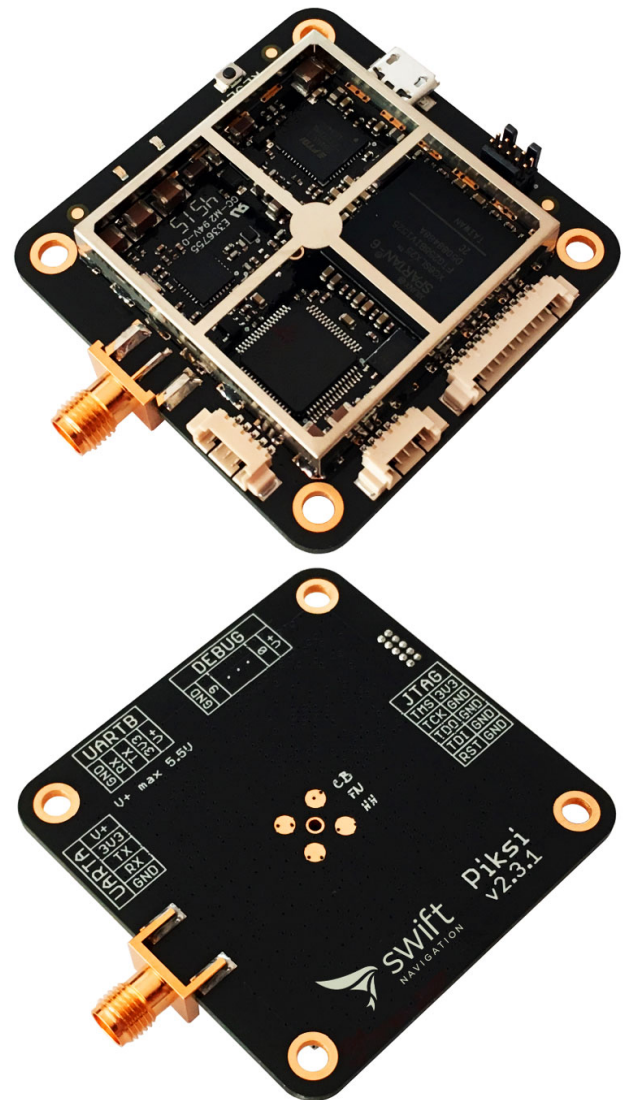


Figure 1: Pixsi front and back view

With these tools, developers can quickly move from prototyping software on a desktop to running it standalone on the Pixsi hardware.

A high-performance DSP on-board and our flexible Swift-NAP correlation accelerator provide Pixsi with ample computing resources with which advanced receiver techniques, such as multipath mitigation, spoofing detection and carrier phase tracking can be implemented.

## System Architecture

The Piksi receiver architecture consists of three main components. The RF front-end downconverts and digitizes the radio frequency signal from the antenna. The digitized signal is passed into the SwiftNAP which performs basic filtering and correlation operations on the signal stream. The SwiftNAP is controlled by a microcontroller which programs the correlation operations, collects the results and processes them all the way to position/velocity/time (PVT) solutions.

### Front-end

The RF front-end consists of a Maxim MAX2769 integrated down-converter and 3-bit analog-to-digital converter operating at 16.368 MS/s. This front-end is capable of covering the L1 GPS signal bands.

### SwiftNAP

The SwiftNAP consists of a Xilinx Spartan-6 FPGA that comes pre-programmed with Swift Navigation's SwiftNAP

firmware. The SwiftNAP contains correlators specialized for satellite signal tracking and acquisition. The correlators are flexible and fully programmable via a high-speed SPI register interface and are used as simple building blocks for implementing tracking loops and acquisition algorithms on the microcontroller.

While the SwiftNAP HDL is not open-source at this time, the Piksi has no restrictions against loading one's own firmware onto the on-board Spartan-6 FPGA.

### Microcontroller

The on-board microcontroller is a STM32F4 with an ARM Cortex-M4 DSP core running at up to 168 MHz. This powerful processor performs all functions above the correlator level including tracking loop filters, acquisition management and navigation processing and is able to calculate PVT solutions at over 10 Hz in our default software configuration. All software running on the microcontroller is supplied open-source.

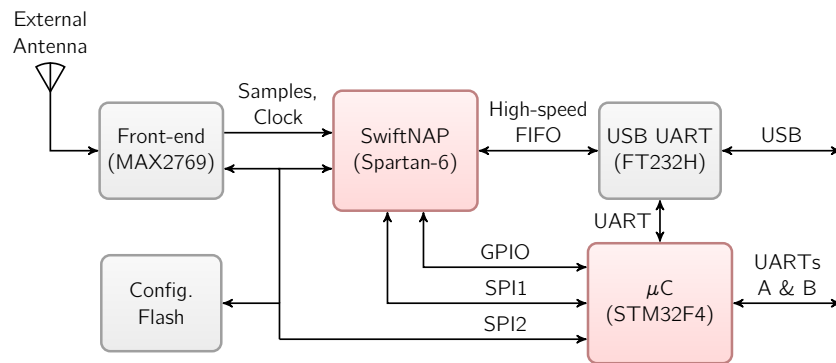


Figure 2: Piksi Block Diagram

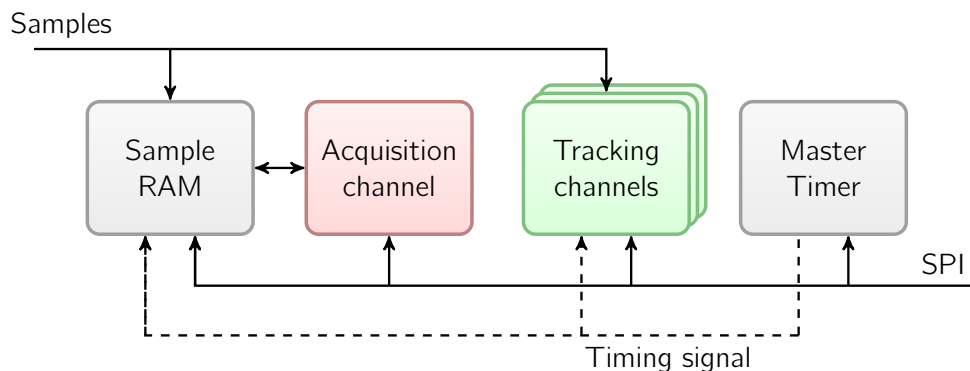
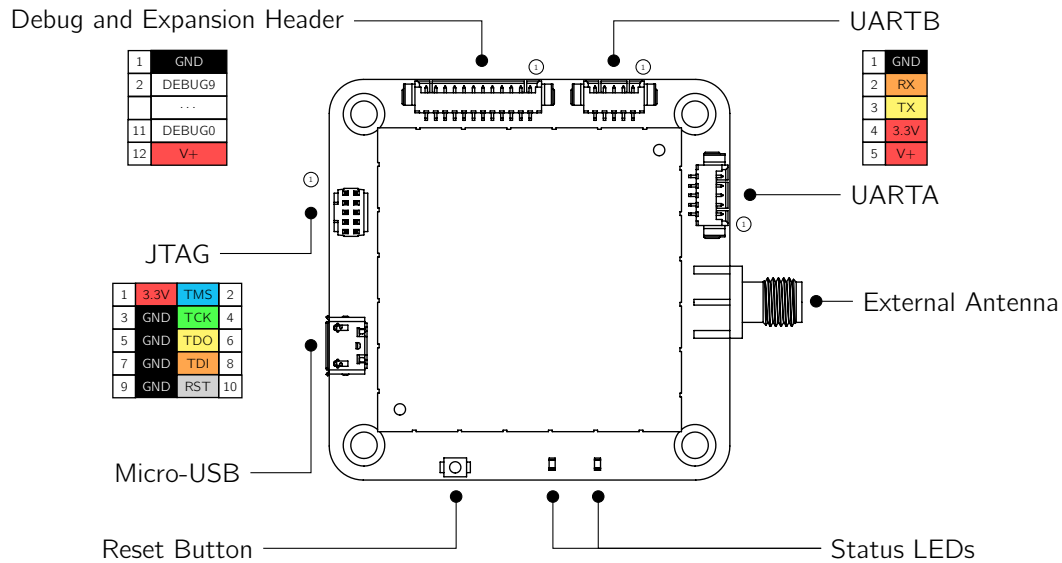


Figure 3: SwiftNAP Block Diagram

## Connections

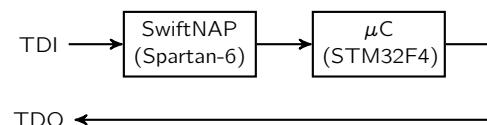


### USB

A Micro-USB socket provides USB connectivity to the host. This can be configured as a USB-Serial bridge to the microcontroller (the default) or as a high-speed FIFO interface to the SwiftNAP for streaming full-rate raw IF data samples to or from the host.

This allows capture of raw IF data for processing on the host or running the Piksi from pre-recorded data or simulator output for hardware-in-the-loop testing.

For advanced debugging, a 0.05" pitch micro JTAG header compatible with the ARM Cortex-M standard pinout<sup>1</sup> is provided on the board. This allows access to the Spartan-6 FPGA and STM32F4 microcontroller JTAG interfaces.



### UARTs A & B

Two UARTs provide high-speed 3.3V LVTTTL level asynchronous serial interfaces which can be configured to transmit NMEA-0183 messages or binary navigation solution data, system status and debugging information and receive commands or differential corrections from the host or another Piksi board.

When configured in USB-Serial bridge mode, the USB interface functions identically to the two dedicated UARTs.

### Debug and Expansion Header

Access is provided to debugging signals from the SwiftNAP and I/O for future expansion boards and accessories. Assignment of these signals varies depending on the SwiftNAP firmware configuration.

### External Antenna

An external active antenna input is provided on an SMA connector and features a software switchable 3.3V bias.

### Power

Power may be supplied to the board either over USB or through the V+ pins on the UART connectors. A 3.3V output from the on-board switching regulator is provided to power any external peripherals.

### JTAG

No JTAG adapter is required to develop for the Piksi as the board is supplied with a built-in bootloader.

<sup>1</sup>ARM Cortex-M Debug Connector specification, <http://bit.ly/ICb6W6>

## Electrical Specifications

Supply voltage ..... 3.5 – 5.5 V  
 Maximum voltage rating ..... 5.5 V<sup>(1)</sup>  
 Power consumption ..... 500 mW<sup>(2)</sup>  
 Max. 3.3V output current draw ..... 500 mA

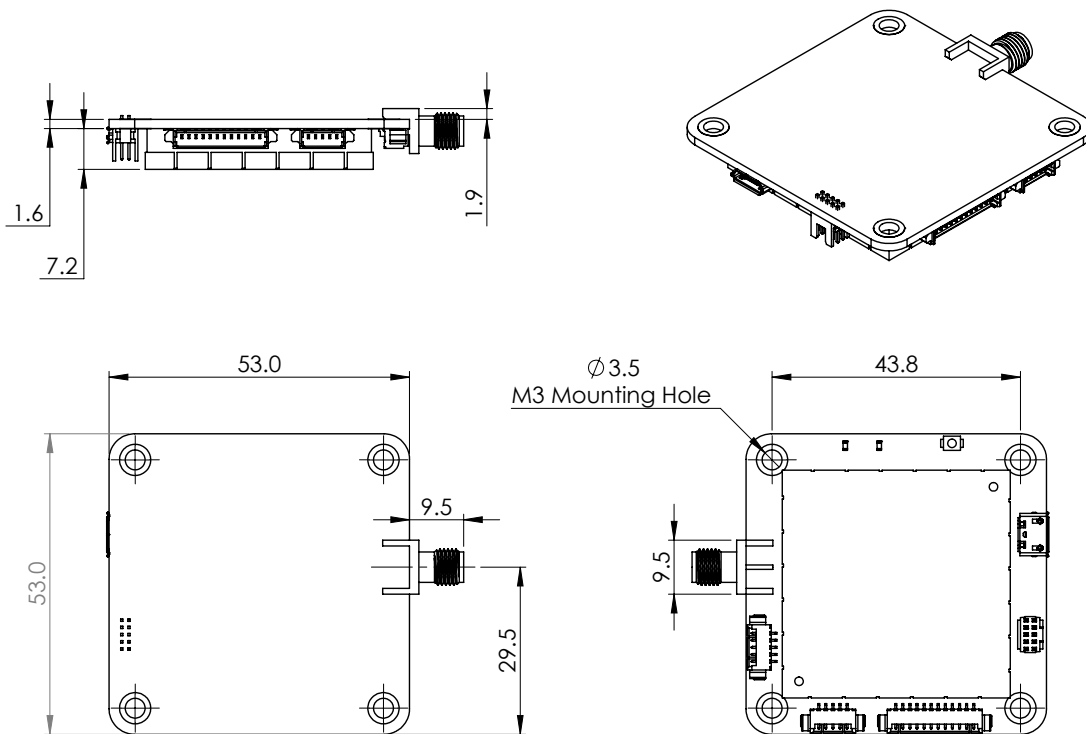
Active antenna input impedance ..... 50 Ω  
 Active antenna bias voltage ..... 3.3 V<sup>(3)</sup>  
 Max. antenna bias current draw ..... 57 mA

<sup>(1)</sup>Piksi provides no overvoltage protection and even momentary overvoltage can permanently damage the device.

<sup>(2)</sup>Typical, dependant on firmware configuration.

<sup>(3)</sup>Switchable in software

## Mechanical Drawing



All dimensions are in millimeters. Drawing not to scale.

## Notes

1. Mass 32g.
2. M3 mounting holes are plated through and connected internally to ground.
3. 3D CAD models are available from our website, <http://www.swiftnav.com>.