Piksi Datasheet

Flexible, high-performance GPS receiver platform running open-source software

Features

- Centimeter accurate relative positioning (Carrier phase RTK)
- 50 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
- Integrated patch antenna and external antenna input
- Full-rate raw sample pass-through over USB
- 3-bit, 16.368 MS/s L1 front-end supports GPS, GLONASS, Galileo and SBAS signals

Applications

- Autonomous vehicle guidance, e.g. UAV formation flight and autonomous landing
- GPS/GNSS research
- Surveying systems

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 Piksi 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, Piksi'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.

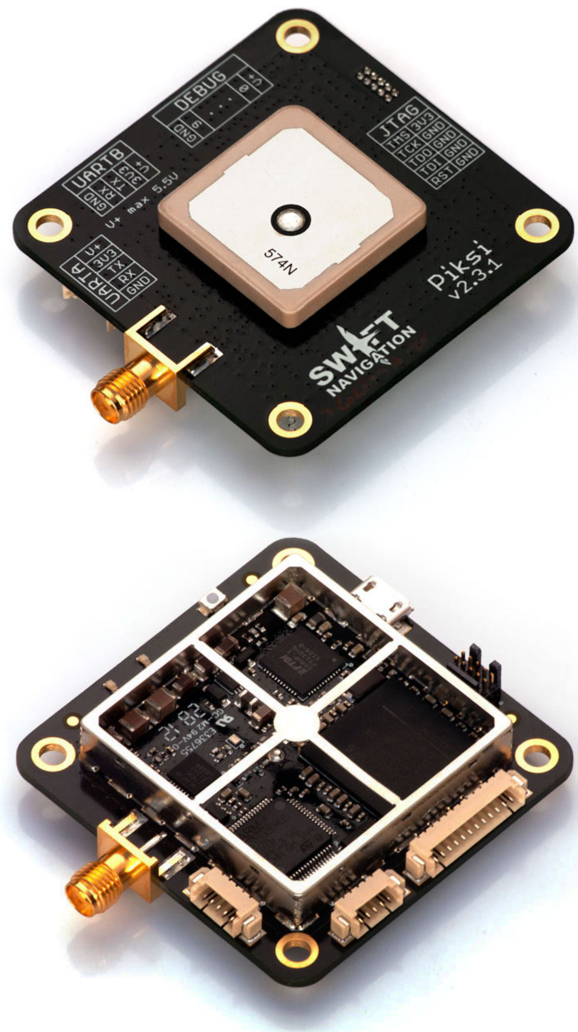


Figure 1: Piksi front and back view

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

A high-performance DSP on-board and our flexible SwiftNAP correlation accelerator provide Piksi 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 up to 32.736 MS/s (16.368 MS/s typical). This front-end is capable of covering the L1 GPS, GLONASS, Galileo and SBAS signal bands.

The input to the front-end can be switched between an on-board patch antenna or an external active antenna.

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, as well as programmable digital notch filters for CW noise nulling. 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.

Whilst 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. More detail on the SwiftNAP is available from the SwiftNAP datasheet[1].

Microcontroller

The on-board microcontroller is an 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 50 Hz in our default software configuration. All software running on the microcontroller is supplied open-source.

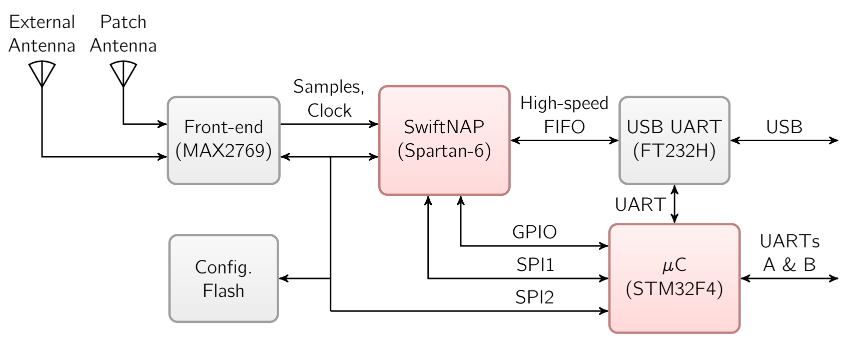


Figure 2: Piksi Block Diagram

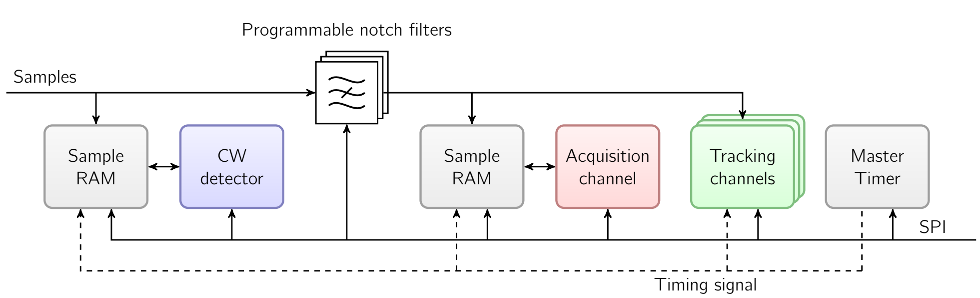
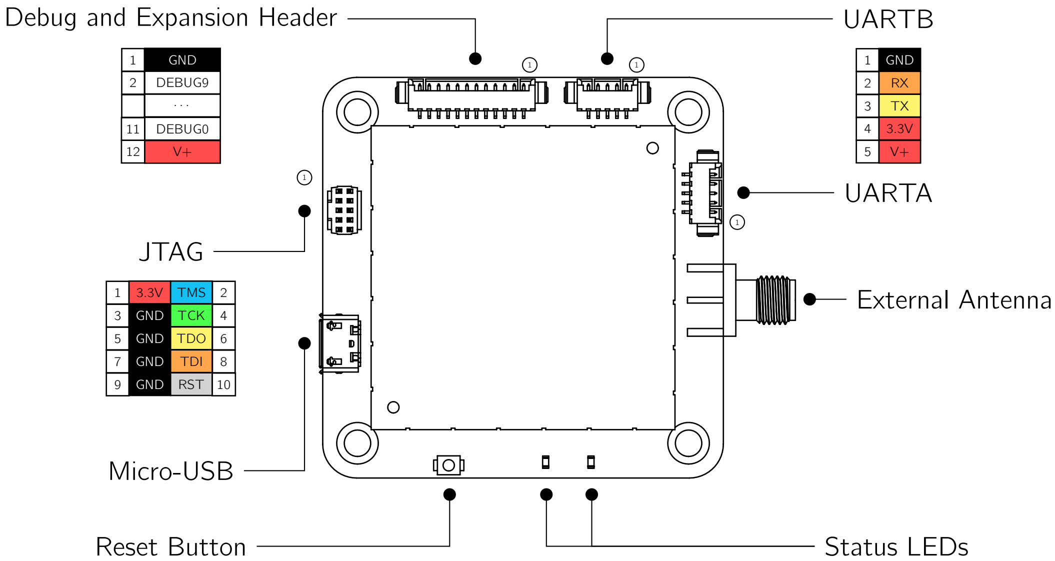


Figure 3: SwiftNAP Block Diagram

[1]Link to SwiftNAP datasheet

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.

UARTs A & B

Two UARTs provide high-speed 3.3V LVTTL 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.

External Antenna

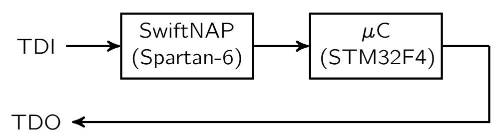
In addition to the on-board patch antenna, an external active antenna input is provided on an SMA connector and features a software switchable 3.3V bias.

Selection between the on-board patch and the external antenna is made in software or can be set to automatically detect the presence of an external active antenna and switch accordingly.

JTAG

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

For advanced debugging, a 0.05" pitch micro JTAG header compatible with the ARM Cortex-M standard pinout[2] is provided on the board. This allows access to the Spartan-6 FPGA and STM32F4 microcontroller JTAG interfaces.



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.

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.

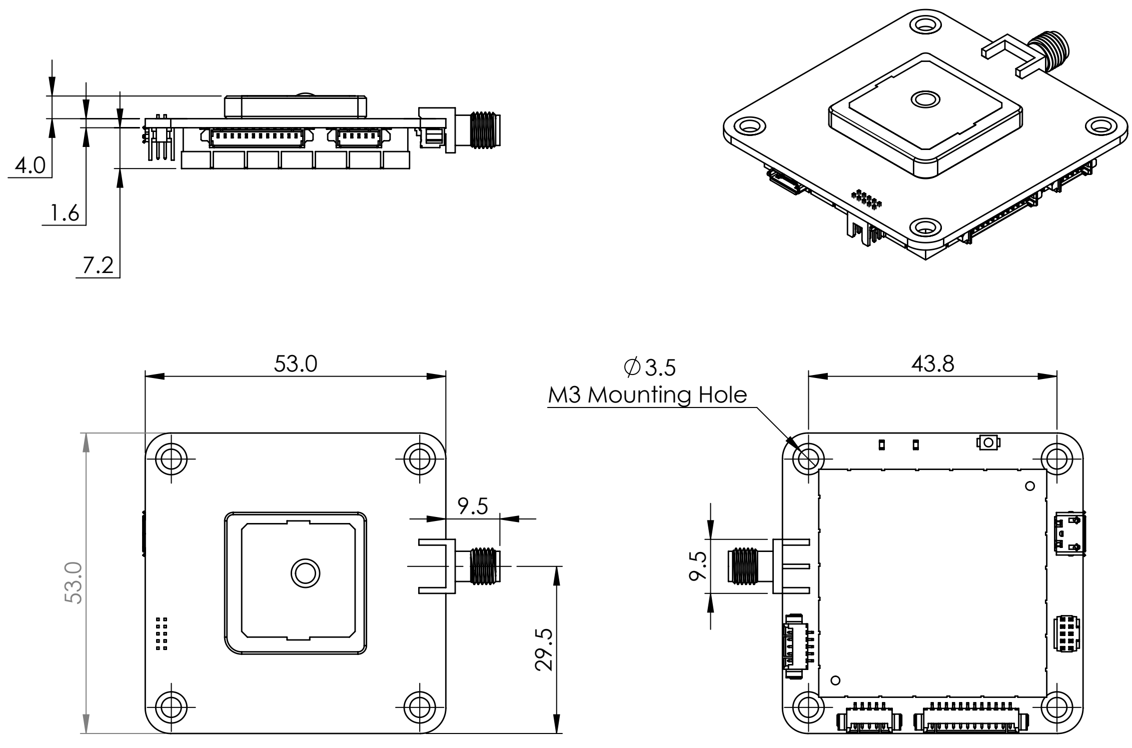
[2] ARM Cortex-M Debug Connector specification, http://bit.ly/ICb6W6

Electrical Specifications

Supply voltage .... 3.5 – 5.5 V
Power consumption .... 500 mW(1)
Max. 3.3V output current draw .... 500 mA
Active antenna input impedance .... 50 Ω
Active antenna bias voltage .... 3.3 V(2)
Max. antenna bias current draw .... 57 mA

(1)Typical, dependant on firmware configuration.
(2)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.swift-nav.com.
4. If the on-board patch antenna is used, care should be taken to mount the Piksi such that the antenna has as clear and unobstructed view of the sky as possible. No conductive objects should be placed close to the antenna.