AST-400 GPS-SBAS Miniature Module

Features

- High performance, Small sized and Low power GPS-SBAS Multi-chip Module
- Building block for a miniature GPS-SBAS receiver
- Extremely fast fix times
- Accurate timing output
- 16-channel Correlator for ultra low signal detection and tracking
- Rich set of interfaces
- Single 3.3V input supply
- NMEA0183 compatible message format and Custom binary message for host communication
- Ease of integration; faster time-to-market
- ARM7 based processing unit
- 8.2mm x 8.2mm FBGA package
- Fully ROHS compliant
- -40 to +85 C operating temperature

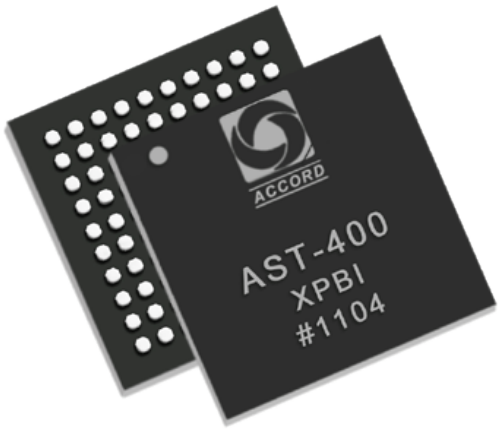


Figure 1. AST-400

Product Description

AST-400 is a complete GPS-SBAS module targeted at applications that require an extremely small GPS footprint. AST-400 combines a highly integrated GPS-SBAS RF front-end with a high performance GPS-SBAS digital baseband/processor along with the necessary discrete components into a single package for ease of integration into target application hardware.

The GPS-SBAS RF front-end is designed for GPS C/A receivers.

It has an in-built low noise amplifier (LNA), single down conversion stage, automatic gain controlled amplifier (AGC), on-chip IF band pass filter and a 2-bit analog-to-digital converter (ADC). In addition, it has in-built protection/detection circuitry for accidental short/open of the active GPS antenna.

The digital baseband is a revolutionary digital integrated circuit that combines a high performance GPS Correlator, ARM7 core and a host of rich peripherals. It delivers unmatched performance in conjunction with the RF front-end.

AST-400 supports USB 2.0 Full Speed device, SPI, TWI, Timers, GPIO and Battery backed counter/RTC.

AST-400 is available in an 8.2mm x 8.2mm FBGA package. It is RoHS certified and is qualified over the industrial temperature range of –40 ^{0}C to +85 ^{0}C.

AST-400 Hardware Details

A typical block diagram of the AST-400 is shown below.

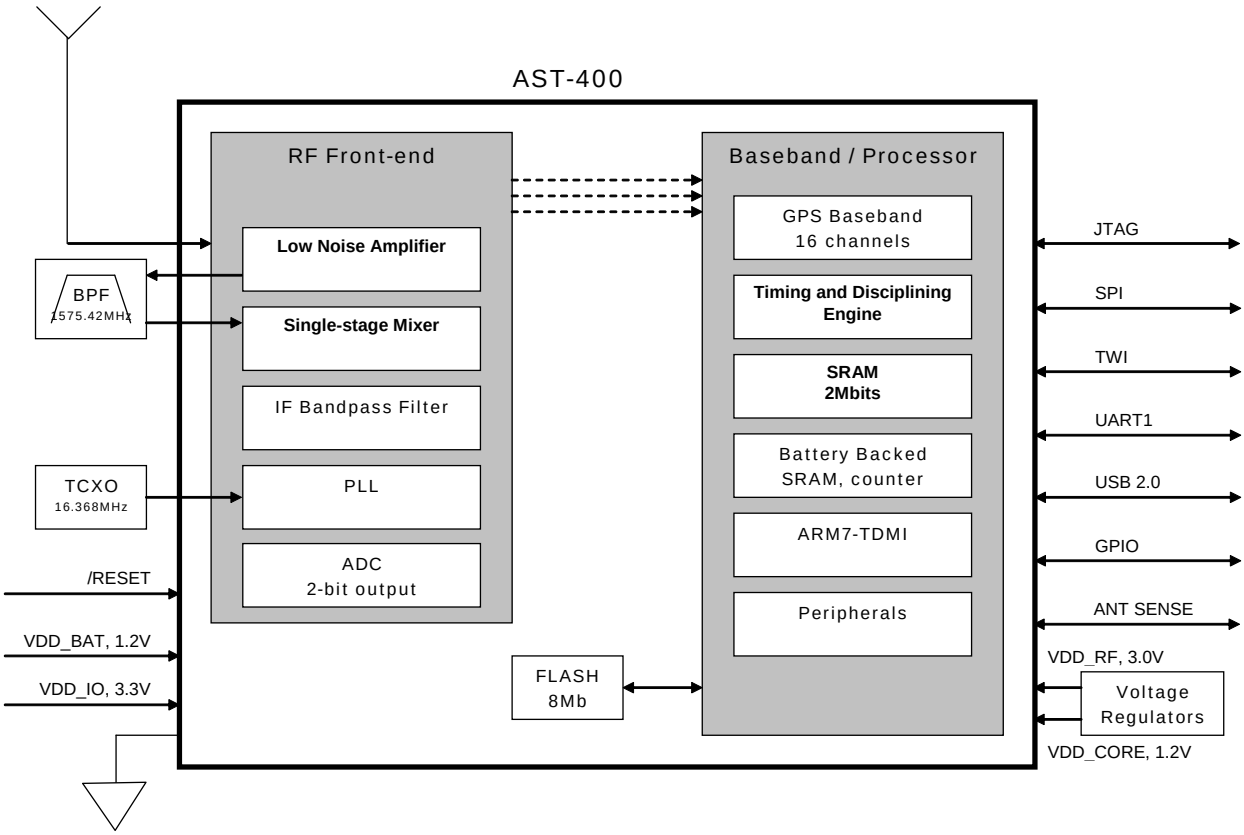


Figure 2. Block Diagram of the AST-400

The RF block of the AST-400 has a high-gain, low noise amplifier. This block has a very low noise figure of 1.2dB. The RF block derives its clock from an external TCXO of 16.368MHz. The internal PLL up-converts this frequency to the desired Local Oscillator frequency and down-converts the incoming GPS frequencies to a low IF. The AST-400 makes use of an innovative IF filter to remove out-of-band frequencies from entering into the ADC. The ADC is driven with a sampling clock of 16.368MHz and delivers a 2-bit output.

The sampling clock and the ADC outputs are fed as inputs to the GPS baseband on the AST-400. The clock input of 16.368MHz is in-turn fed to a PLL that up-converts to 180.048MHz. This clock is used as a source to all digital blocks of the AST-400. The core of the AST-400 is an ARM7-TDMI core running at 90MHz. The AHB and APB standard buses connect several functional blocks and peripherals, thereby making the AST-400 a versatile chip.

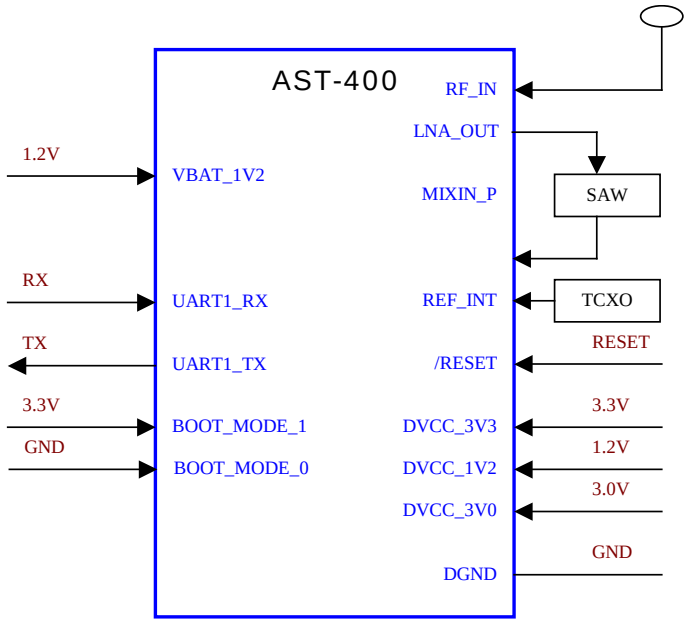
To realize a complete GPS-SBAS receiver, a few supporting components such as Crystal Oscillator, Band Pass Filter, Voltage regulators and discrete components will have to be interfaced with the AST-400. This ensures that the AST-400 can be seamlessly integrated into any host application with minimum of design challenges.

The AST-400 is packaged in a 8.2mm x 8.2mm FBGA with 95 functional and power supply balls.

In order to build a complete GPS receiver using the module, all it takes are a few connections. The diagram below depicts the interconnections to be done in order to use the AST-400.

1. Connect a 50Ω trace between the RF_IN ball and the antenna connector
2. An active low power ON reset of at least 25ms should be provided on the /RESET ball
3. The host communication can be tapped at the UART1_RX and UART1_TX lines
4. Mains power of 3.3V +/- 5% should be applied at DVCC_3V3. The maximum current draw of the board would be about 50mA (excluding antenna current)
5. A backup battery of 1.2V should be connected at VBAT_1V2. The recharge circuitry (in case of a rechargeable battery) should be provisioned on the motherboard

Circuit Interconnection Diagram and Pinout



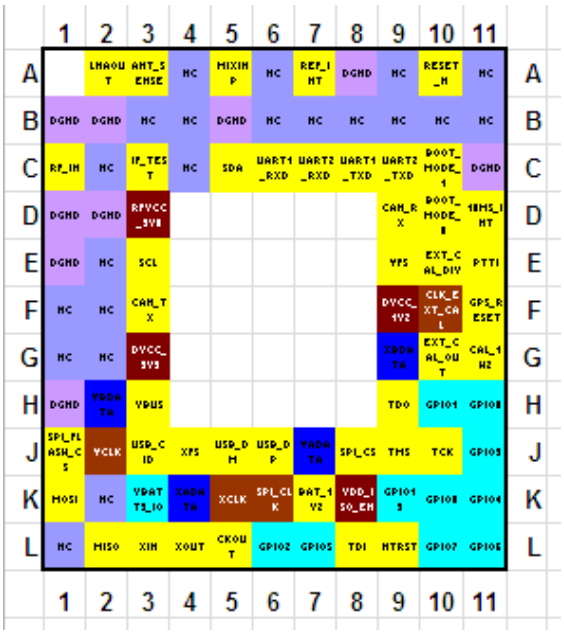


Figure 3. Circuit Interconnection using AST-400 and AST-400 pinout

Processor

Processor core	ARM7-TDMI
Instruction speed	90MHz
Host bus clock speed	45MHz (max)
Peripheral clock speed	22.5MHz (max)

GPS System Specifications

Channels	16 Acquisition, 16 Tracking		
Acquisition Sensitivity	-155dBm (Hot start, 1SV @ -144dBm) -160dBm (Reacquisition)		
Tracking Sensitivity	-163dBm		
Hot Start TTFF (with valid ephemeris, almanac, position and time estimate)	1 sec (typical) switch OFF/ON cycle less than 1 hour, open sky		
Warm Start TTFF (with almanac, position and time estimate)	18 to 36 sec, open sky		
Cold Start TTFF (without almanac, time, or position)	18 to 36 sec, open sky		
Position Accuracy (Horizontal)	2.5 m, CEP (50%)	10 m, 90%	@ -130 dBm
Position Accuracy with SBAS (Horizontal)	2.0 m, CEP (50%)	5 m, 90%	@ -130 dBm
Velocity Accuracy		0.1 m/sec, 90%	@ -130 dBm
1PPS Accuracy		+/- 15ns (2σ no errors)	@ -130 dBm

Memory

Internal Memory	2Mbits SRAM, 8Mbits NOR Flash
Battery Backed	32Kbits SRAM
Expansion	External SRAM / Serial Flash

SPI

Configuration	CS, CLK, MOSI, MISO, Serial Flash select
Clock	22.5MHz
Slave selects	5

TWI

Configuration	SDA, SCLK
Data transfer	400Kbits / sec

UART

Configuration	TX, RX (2 Ports)
Baud Rate	Up to 1Mbps
Message Formats	5, 6, 8 data bits, even / odd parity

USB

Configuration	Full-Speed DM, DP, VBUS
Functionality	Device
Endpoints	Control endpoint: 1 RX endpoints: 7 TX endpoints: 7

GPIO

Configuration	10 GPIO's
Features	Independently programmable as input or output Multiplexed with SPI Slave select lines Capable of detecting external edge / level sensitive interrupts

Others

Antenna Sense	AST-400 can sense an open circuit on the active antenna line by monitoring the drop across an external resistor. The value of the resistor needs to be designed in accordance with the antenna current.

Electrical

Supply Current (@ 3.3V)	50mA (peak), 30mA (Tracking)
Battery Current (@ 1.2V)	8μA (peak)

Table 1. Specifications of AST-400

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