Web Site: www.parallax.com
Forums: forums.parallax.com
Sales: sales@parallax.com
Technical: support@parallax.com

Office: (916) 624-8333
Fax: (916) 624-8003
Sales: (888) 512-1024
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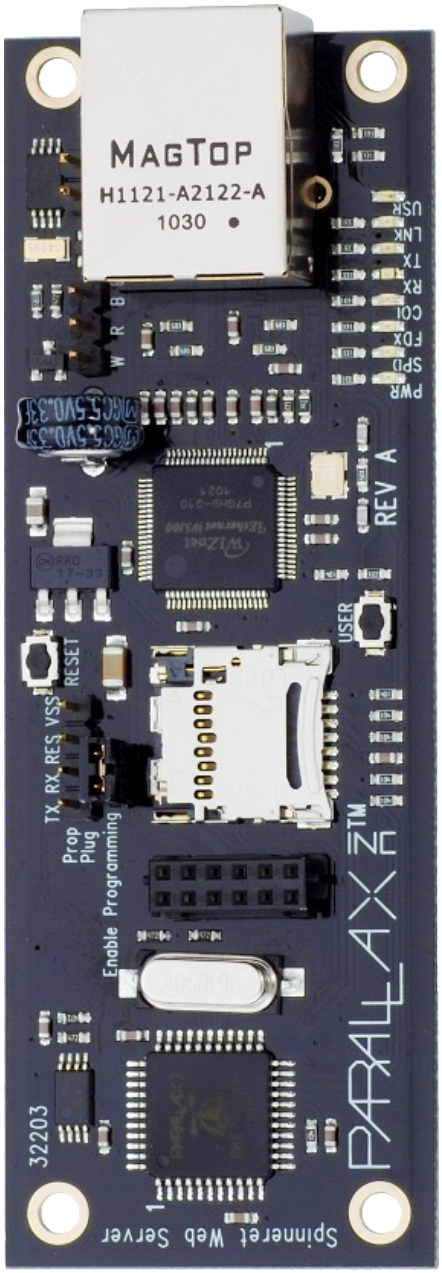
Spinneret Web Server (#32203)

The Parallax Propeller microcontroller teamed with the WIZnet W5100 Ethernet controller provide an ideal chipset for low-cost, low-power embedded Ethernet applications. The Propeller microcontroller's multicore architecture and the W5100's hardware Ethernet stack allow a new level of parallelism and data throughput for robust and reliable embedded network applications.



The Spinneret Web Server may be small—at less than 1½ by 4 inches—but it is a feature packed development platform. The built-in MicroSD card socket and real-time clock allow ample room for time-stamped file and data storage, and the oversized EEPROM can store non-volatile data for use when there is no MicroSD card present.

As an open-source hardware design, all design files—including layout, schematics, and firmware—are available under licenses that allow free distribution and reuse. This means that the Spinneret Web Server's design can be incorporated into new applications royalty free and without a non-disclosure agreement.

Features

- Propeller microcontroller
- WIZnet W5100 Ethernet controller
- MicroSD card socket
- Real-time clock controller with backup capacitor

Key Specifications

- Power Requirements: 3.0 to 3.6 or 4 to 9 VDC, 175 mA typical when idle
- Communication Interface: 10BaseT/100BaseTX Ethernet and 3.3 to 5 volt asynchronous serial
- Operating temperature: -40 to +185 °F (-40 to +85 °C)
- Dimensions: 3.8 x 1.35 x 0.67 in (9.7 x 3.4 x 1.7 cm) mounting hole centers separated by 3.5 x 1.0 in (88.9 x 25.4 mm)

Application Ideas

- Embedded web server or network appliance
- Network to serial bridge
- Sensor network
- Embedded networked control system

Synopsis

The Spinneret Web Server is an Ethernet-based development board for the Propeller microcontroller. Web page content, files, and logs can be stored on a MicroSD card. The serial EEPROM has 32 KB for storing a Propeller program and 32 KB for non-volatile data storage, independent of the MicroSD card. There is a real-time clock controller for timestamping files and events and a backup capacitor that will keep the clock running through extended power outages. There is a serial programming header and there are two auxiliary I/O connections: one is a header for level-shifted open-collector communications over a three-pin data/power/ground cable, and the second is a 12-pin socket for direct 3.3 volt I/O connections. There are eight status LEDs on the PCB, two of which are repeated on the Ethernet jack. One of the status LEDs is user controllable and shares an I/O pin with a button that can be read under user control. A second button resets the Propeller to reload any firmware from the EEPROM.

Open-source hardware

The Spinneret Web Server is an open-source hardware design that is well suited for use as a reference design, built into a custom product, or used as a stand-alone board containing a custom firmware application. All design files are available under various open-source licenses, as included with each file.

Parallax provides a Spinneret Web Server forum, available from http://forums.parallax.com/, that can be used to collaborate on projects, request input and assistance from others, or help others with their projects. If assistance is needed beyond what is available from the forums, see http://www.parallax.com/support for more information about authorized consultants and our free technical support.

Getting started

The Spinneret Web Server is a development platform, so its functionality varies depending in the program loaded into it. A Prop Plug (part number 32201) or similar device is needed to load firmware programs onto the Spinneret Web Server. See http://www.parallax.com/go/spinneret for more information.

There are three methods for powering the Spinneret Web Server, depending on the power source. To provide power from a 3.0 to 3.6 VDC source, use J1 and connect pin 2 to ground, and either pin 1 to power. For a 4.0 to 9.0 VDC supply, either use J1 and connect pin 2 to ground and pin 12 to power, or use J6 and connect pin 3, labeled 'B', to ground and pin 2, labeled 'R', to power. When providing power from a 4.0 to 9.0 VDC supply on either J1 or J6, the same voltage will be output on the corresponding pin of the other connector. Pin 12 of J1 will also output a regulated 3.3 VDC supply. Make sure that any connected devices are tolerant of these voltages. Do not simultaneously supply power to multiple pins.

Caution: If the Spinneret Web Server is powered from a 4.0 to 9.0 VDC source, the same voltage will be present on J1 and J6. Ensure that all connected devices are tolerant of the input voltage.

Warning: Power should only be provided through a single pin at any given time. Simultaneously powering the Spinneret Web Server from multiple sources may damage the Spinneret Web Server or any connected devices.

Component functionality

The Spinneret Web Server allows for easy expansion while containing a minimal set of components required by most Ethernet applications. The included features are listed below.

Parallax P8X32A-Q44 Propeller Microcontroller

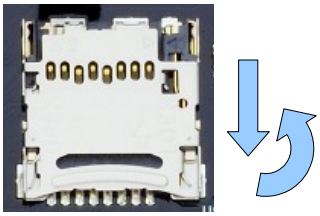
The Propeller microcontroller is an 8-core low power microcontroller with 32 KB SRAM and up to 20 MIPS per core. By partitioning separate tasks into separate cores, the Propeller can load programs and features and reallocate resources on the fly, without the overhead of an operating system. Features that often require dedicated hardware can be defined in software and run in parallel. When running at a total of 160 MIPS, the power consumption is usually less than 80 mA. For more information, refer to the Parallax P8X32A Propeller datasheet.

WIZnet W5100

The W5100 provides an Ethernet connection to the Propeller microcontroller through both SPI and parallel connections. The SPI pins, P0 through P3, are shared with the parallel data pins. The parallel bus is connected in indirect mode, using P0 through P7 for data, P8 and P9 for address, and P10 through P12 for signal lines. P13 receives interrupts from the W5100, and P14 will reset the W5100 when driven low. For more information, refer to the WIZnet W5100 Propeller datasheet.

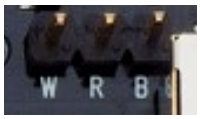
Micro SD card socket

To open slide, then lift



The MicroSD card socket is connected to pins Propeller pins P16 through P21. All pins except the clock pin are pulled to 3.3 volts through 100 kΩ resistors. For more information regarding communications with an SD card, refer to the "SD Specifications Part 1 Physical Layer Simplified Specification" published by the SD Association. The MicroSD card socket is a locking hinged socket. To insert a card, slide the top of the socket toward the lower edge of the board, lift it up, insert the card into the lid, then reverse the process to close the socket.

Auxiliary Serial I/O header



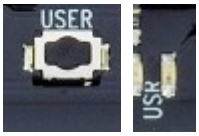
The Auxiliary Serial I/O header, J6, contains a signal pin, a power in pin, and a ground pin. The signal pin is connected to the P22 through a bidirectional open-collector level converter with 4.7 kΩ pull-up resistors, suitable for communications up to one megabaud. The unregulated power pin accepts up to 9 volts DC and requires at least 4 volts to power the Spinneret Web Server. The unregulated power is used to power the level converter and the unregulated power for the daughterboards.

Caution: When the Spinneret Web Server is powered from a 4.0 to 9.0 VDC source, the same voltage will be present on J1 and J6. Ensure that all connected devices are tolerant of the input voltage.

Auxiliary Daughterboard Header

The Auxiliary Daughterboard Header has four general purpose I/O pins, connected to P24 through P27, two I2C I/O pins that are pulled high through 4.7 kΩ resistors, P28 and P29, and two I/O pins that are shared with the programming header, P30 and P31, which can be used as general purpose I/O pins after the boot process has completed. There are also connections to the 3.3 volt power and the unregulated power pin shared with J6.

User Button and LEDs



The user button and LEDs share an I/O pin. When the P23 is an input, it is pulled low but will read high on button press. When P23 is driven high the user LEDs will turn on. When the button is pressed while P23 is an input, the user LEDs may glow dimly, so it is recommended to drive the pin low unless actively reading it.

Serial EEPROM

The 64 KB EEPROM is connected to the I2C bus on P27 and P28. The lower 32 KB contain the program that the Propeller loads on reset. The upper 32 KB should be used for non-volatile data storage, such as network settings. For more information, refer to the AT24C512 datasheet.

Real-time Clock Controller

The real time clock controller (RTCC) is also connected to the I2C bus on P27 and P28. Two interrupt pins are available through the J4. The interrupt pins do not provide over-voltage protection and should be handled appropriately. A 0.33 farad capacitor provides backup power to keep the clock running through extended power outages.

Voltage Regulator

The unregulated power pins on J1 and J6 are connected to the input of a 3.3 volt 1 amp regulator. The regulator powers the Spinneret Web Server circuitry, as well as the 3.3 volt line on J1. The unregulated input is directly connected between J1 and J6 and it also supplies the voltage for the data pin on J6. When providing power through J1 or J6, ensure that the voltage is within specifications for any device connected to the other header.

Status LEDs

There are eight unique status LEDs, plus the LNK and USR status lines are mirrored on J7. See the following chart for the LED color and indications.

Label	Color	On state	Off state
PWR	Green	Power present	No power
SPD	Green	100 Mbps Ethernet speed	10 Mbps Ethernet speed
FDX	Green	Full-duplex Ethernet connection	Half-duplex Ethernet connection
COL	Orange	Collision occurring	No collisions
RX	Blue	Data receive line active	Data receive line inactive
TX	Red	Data transmit line active	Data transmit line inactive
LNK	Green	Link present, blinking when active	No activity
USR	Yellow	P23 high	P23 low

Reset Button

The reset button, when pressed, will force the Propeller to reset which will cause it to reload any code present in the EEPROM.

Programming Header and Jumper

The Programming header, J2, is designed for connecting a Prop Plug to P29, P30, and the reset line. When there is a shunt present on J3, the Prop Plug will be able to reset the Propeller to begin the programming process. When the shunt is not present, the Prop Plug will be able to communicate with the Propeller, but it will not be able to reset or program it.

Propeller I/O Connections

I/O pin	Connection	Function
P0	W5100 parallel data bit 0	W5100 bidirectional I/O
	W5100 SPI data out	W5100 output
P1	W5100 parallel data bit 1	W5100 bidirectional I/O
	W5100 SPI data in	W5100 input
P2	W5100 parallel data bit 2	W5100 bidirectional I/O
	W5100 SPI inverted slave select	W5100 input
P3	W5100 parallel data bit 3	W5100 bidirectional I/O
	W5100 SPI clock	W5100 input
P4	W5100 parallel data bit 4	W5100 bidirectional I/O
P5	W5100 parallel data bit 5	W5100 bidirectional I/O
P6	W5100 parallel data bit 6	W5100 bidirectional I/O
P7	W5100 parallel data bit 7	W5100 bidirectional I/O
P8	W5100 parallel address bit 0	W5100 input
P9	W5100 parallel address bit 1	W5100 input
P10	W5100 parallel inverted write enable	W5100 input
P11	W5100 parallel inverted read enable	W5100 input
P12	W5100 parallel inverted chip select	W5100 input
P13	W5100 inverted interrupt	W5100 output
P14	W5100 inverted reset	Pulled high Drive low for 2 µs to reset the W5100
P15	W5100 SPI inverted enable input	Pulled high Drive low and reset the W5100 for SPI mode
P16	MicroSD parallel data bit 0	MicroSD bidirectional I/O
	MicroSD SPI data out	MicroSD output
P17	MicroSD parallel data bit 1	MicroSD bidirectional I/O
P18	MicroSD parallel data bit 2	MicroSD bidirectional I/O
P19	MicroSD parallel data bit 3	MicroSD bidirectional I/O
	MicroSD SPI chip select	MicroSD input
	MicroSD card detect pin	Pulled high, driven low on card insertion
P20	MicroSD parallel command line	MicroSD input
	MicroSD SPI data in	MicroSD input
P21	MicroSD clock line	MicroSD input
P22	Auxiliary serial I/O line	Pulled high Open collector level-shifted signal on J1
P23	User controlled LEDs	Drive high to light the LED
	User push button	Pulled low, driven high on button press
P24	Auxiliary I/O bit 0	Bidirectional I/O
P25	Auxiliary I/O bit 1	Bidirectional I/O
P26	Auxiliary I/O bit 2	Bidirectional I/O

I/O pin	Connection	Function
P27	Auxiliary I/O bit 3	Bidirectional I/O
P28	I2C clock	EEPROM and RTC input
P29	I2C data	EEPROM and RTC bidirectional I/O
P30	Propeller boot loader transmit	Transmit during boot process
	Auxiliary I/O bit 4	Bidirectional I/O
P31	Propeller boot loader receive	Receive during boot process
	Auxiliary I/O bit 5	Bidirectional I/O

Design Considerations

Several factors were taken into consideration when designing the Spinneret Web Server to improve its usability and performance. Please note the following design considerations when beginning a project.

Propeller and W5100 interconnect

The Spinneret Web server can be used to develop and evaluate designs with the Propeller and W5100 communicating either through an SPI or a parallel interface. Designs that prioritize network throughput over I/O pin usage can take advantage of the parallel bus, and those that prioritize I/O pin usage over network throughput can take advantage of the SPI bus.

The parallel and SPI buses share I/O pins. The W5100 will normally boot into parallel mode, but it can be switched to SPI mode by driving P15 low, and resetting the W5100 by pulsing P14 low for two or more microseconds.

The parallel data bus is byte aligned at P0 through P7, and the SPI pins are nibble aligned at P0 through P3. The Propeller can use a video generator for high-speed output in both modes.

MicroSD Card socket

All signal pins for the MicroSD Card socket are connected to the Propeller, allowing all communications methods with the MicroSD Card. The DAT0 through DAT3 pins are nibble aligned, so that the Propeller can use a video generator for high-speed output.

Auxiliary Serial I/O header

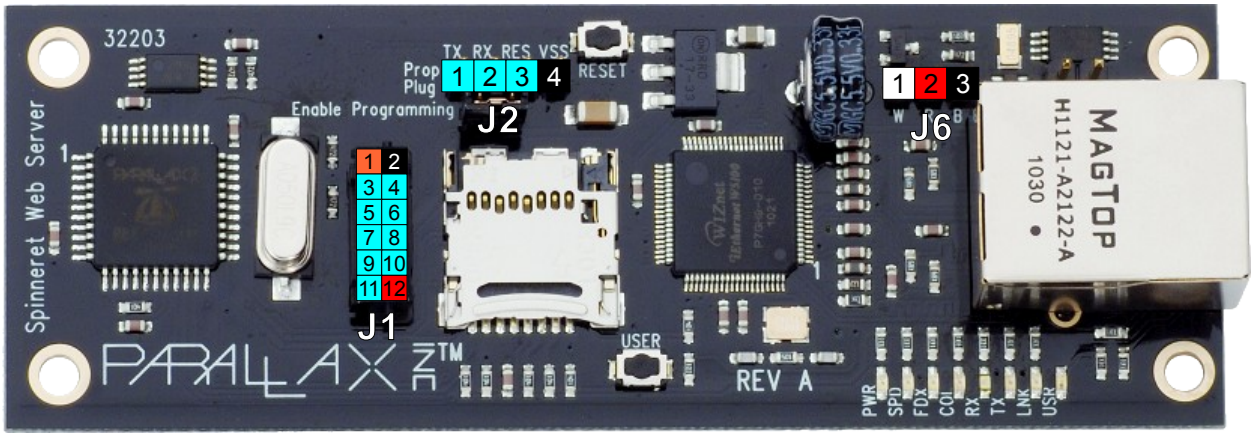
The three-pin auxiliary serial I/O header, J6, provides two functions, power input and level shifting. The power pin is run through a 3.3 volt regulator, so if the data pin on J6 is not being used, and any connections to J1 allow it, the Spinneret Web Server can operate with a 4 to 9 VDC input on J6.

J6 can also be used to integrate the Spinneret Web Server into designs with 5-volt I/O and power. The data pin provides a level-shifted bidirectional open-collector interface with an I/O voltage equal to the voltage on the power input pin. Using a three-pin connection the Spinneret Web Server can draw power from the 5-volt system and communicate at up to 1 megabaud at the appropriate voltage.

Auxiliary Daughterboard Socket

The auxiliary daughter board socket, J1, is the same form factor as the BASIC Stamp 2pe Motherboard and the Propeller Backpack, and most daughterboards can be used interchangeably. Pin 12, which is typically the 5-volt power line on the daughter boards, connects directly to the power pin on J6 and provides its I/O voltage. If connections to J1 and J6 both support it, the Spinneret Web Server can run off of 4 to 9 volts on Pin 12 of J1.

Connection diagram



= VSS = VDD, 4 to 9 VDC = VIN, 3 to 3.6 VDC = I/O driven by VDD = I/O driven by VIN

J1

Pin	Function
1	3.0 to 3.6 volt input
	Regulated 3.3 volt output
2	Ground
3	Receive during boot process
	Auxiliary I/O, P31
4	Transmit during boot process
	Auxiliary I/O, P30
5	I2C data
6	I2C clock
7	Auxiliary I/O, P27
8	Auxiliary I/O, P26
9	Auxiliary I/O, P25
10	Auxiliary I/O, P24
11	No connection
12	4 to 9 volt input
	Power from J6

J2

Pin	Function
1	Transmit during boot process
	Auxiliary I/O, P30
2	Receive during boot process
	Auxiliary I/O, P31
3	Inverted reset
4	Ground

J6

Pin	Label	Function
1	W	Open collector level-shifted bidirectional signal from P22
2	R	4 to 9 volt input
		Power from J1
3	B	Ground

Specifications

Symbol	Parameter	Minimum	Typical	Maximum	Units
Vin	Supply Voltage on J1 pin 12 or J6 pin 2	4.0	5.0	9.0	V
Vdd	Supply Voltage on J1 pin 1	3.0	3.3	3.5	V
Iin	Power consumption when idle with no Ethernet link		175.0		mA

Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum	Units
Vin	Supply Voltage on J1 pin 12 or J6 pin 2	-0.5	12	V
Vdd	Supply Voltage on J1 pin 1	-0.5	3.6	

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