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BASIC Stamp® 2px Microcontroller (BS2PX-IC)

This document is an addendum to the BASIC Stamp Syntax and Reference Manual v2.1 and provides information about the BASIC Stamp 2px that is not included in BASIC Stamp Manual. If, at the time you read this, Version 2.2 of the BASIC Stamp Syntax and Reference Manual is available, Parallax, Inc. highly recommends you use that manual instead of this document.

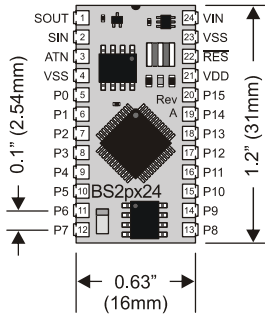
The BASIC Stamp 2px is the latest addition to the BASIC Stamp line of microcontrollers. It is 1.6 times faster than the BASIC Stamp 2p (executing approximately 19,000 PBASIC instructions/sec) and includes a built-in voltage comparator (I/O pins P0, P1 and P2) as well as built-in, user-configurable Pull-up Resistor, Schmitt Trigger and Logic Threshold circuitry on every I/O pin.

In order to use the BASIC Stamp 2px, you'll need to download and install BASIC Stamp Editor v2.2 available for free download from www.parallax.com.

The following pages contain only a summary of the details concerning the BASIC Stamp 2px. This information should be read in addition to any of the corresponding details provided by the BASIC Stamp Syntax and Reference Manual v2.1.

The BASIC Stamp 2px is available in the 24-pin DIP package shown below.

Table 1: BASIC Stamp 2px



Pin	Name	Description
1	SOUT	Serial Out: connects to PC serial port RX pin (DB9 pin 2 / DB25 pin 3) for programming.
2	SIN	Serial In: connects to PC serial port TX pin (DB9 pin 3 / DB25 pin 2) for programming.
3	ATN	Attention: connects to PC serial port DTR pin (DB9 pin 4 / DB25 pin 20) for programming.
4	VSS	System ground: (same as pin 23), connects to PC serial port GND pin (DB9 pin 5 / DB25 pin 7) for programming.
5-20	P0-P15	General-purpose I/O pins: each can source and sink 30 mA. However, the total of all pins should not exceed 75 mA (source or sink) if using the internal 5-volt regulator. The total per 8-pin groups P0 – P7 or P8 – 15 should not exceed 100 mA (source or sink) if using an external 5-volt regulator.
21	VDD	5-volt DC input/output: if an unregulated voltage is applied to the VIN pin, then this pin will output 5 volts. If no voltage is applied to the VIN pin, then a regulated voltage between 4.5V and 5.5V should be applied to this pin.
22	RES	Reset input/output: goes low when power supply is less than approximately 4.2 volts, causing the BASIC Stamp to reset. Can be driven low to force a reset. This pin is internally pulled high and may be left disconnected if not needed. Do not drive high.
23	VSS	System ground: (same as pin 4) connects to power supply's ground (GND) terminal.
24	VIN	Unregulated power in: accepts 5.5 - 12 VDC (7.5 recommended), which is then internally regulated to 5 volts. Must be left unconnected if 5 volts is applied to the VDD (+5V) pin.

Table 2, below, shows a summary comparison of all the BASIC Stamp modules, including the BS2px.

Table 2: BASIC Stamp Comparison Chart

Products	BS1	BS2	BS2e	BS2sx	BS2p24	BS2p40	BS2pe	BS2px
Environment	0º - 70º C (32º - 158º F) **	0º - 70º C (32º - 158º F) **	0º - 70º C (32º - 158º F) **	0º - 70º C (32º - 158º F) **	0º - 70º C (32º - 158º F) **	0º - 70º C (32º - 158º F) **	0º - 70º C (32º - 158º F) **	0º - 70º C (32º - 158º F) **
Microcontroller	Microchip PIC16C56a	Microchip PIC16C57c	Ubicom SX28AC	Ubicom SX28AC	Ubicom SX48AC	Ubicom SX48AC	Ubicom SX48AC	Ubicom SX48AC
Processor Speed	4 MHz	20 MHz	20 MHz	50 MHz	20 MHz Turbo	20 MHz Turbo	8 MHz Turbo	32 MHz Turbo
Program Execution Speed	~2,000 instructions/ sec.	~4,000 instructions/ sec	~4,000 instructions/ sec	~10,000 instructions/ sec.	~12,000 instructions/ sec.	~12,000 instructions/ sec.	~6000 instructions/ sec.	~19,000 instructions/ sec.
RAM Size	16 Bytes (2 I/O, 14 Variable)	32 Bytes (6 I/O, 26 Variable)	32 Bytes (6 I/O, 26 Variable)	32 Bytes (6 I/O, 26 Variable)	38 Bytes (12 I/O, 26 Variable)	38 Bytes (12 I/O, 26 Variable)	38 Bytes (12 I/O, 26 Variable)	38 Bytes (12 I/O, 26 Variable)
Scratch Pad Ram	N/A	N/A	64 Bytes	64 Bytes	128 Bytes	128 Bytes	128 Bytes	128 Bytes
EEPROM (Program) Size	256 Bytes, ~80 instructions	2K Bytes, ~500 instructions	8 x 2K Bytes, ~4,000 inst	8 x 2K Bytes, ~4,000 inst.	8 x 2K Bytes, ~4,000 inst.	8 x 2K Bytes, ~4,000 inst.	16 x 2K Bytes (16 K for source)	8 x 2K Bytes, ~4,000 inst.
Number of I/O Pins	8	16 + 2 Dedicated Serial	16 + 2 Dedicated Serial	16 + 2 Dedicated Serial	16 + 2 Dedicated Serial	32 + 2 Dedicated Serial	16 + 2 Dedicated Serial	16 + 2 Dedicated Serial
Voltage Requirements	5 - 15 vdc	5 - 15 vdc	5 - 12 vdc	5 - 12 vdc	5 - 12 vdc	5 - 12 vdc	5 - 12 vdc	5 - 12 vdc
Current Draw@ 5 volts	1 mA Run, 25 µA Sleep	3 mA Run, 50 µA Sleep	25 mA Run, 200 µA Sleep	60 mA Run, 500 µA Sleep	40 mA Run, 350 µA Sleep	40 mA Run, 350 µA Sleep	15 mA Run, 150 µA Sleep	55 mA Run, 450 µA Sleep
Source/Sink Current per I/O	20 mA / 25 mA	20 mA / 25 mA	30 mA / 30 mA	30 mA / 30 mA	30 mA / 30 mA	30 mA / 30 mA	30 mA / 30 mA	30 mA / 30 mA
Source/ Sink Current per unit	40 mA / 50 mA	40 mA / 50 mA per 8 I/O pins	60 mA / 60 mA per 8 I/O pins	60 mA / 60 mA per 8 I/O pins	60 mA / 60 mA per 8 I/O pins	60 mA /60 mA per 8 I/O pins	60 mA / 60 mA per 8 I/O pins	60 mA / 60 mA per 8 I/O pins
PBASIC Commands*	32	42	45	45	61	61	61	63
PC Interface	Serial (w/BS1 Serial Adapter)	Serial (9600 baud)	Serial (9600 baud)	Serial (9600 baud)	Serial (9600 baud)	Serial (9600 baud)	Serial (9600 baud)	Serial (19200 baud)
Windows Text Editor Version	Stampw.exe (v2.1 and up)	Stampw.exe (v1.04 and up)	Stampw.exe (v1.096 and up)	Stampw.exe (v1.091 and up)	Stampw.exe (v1.1 and up)	Stampw.exe (v1.1 and up)	Stampw.exe (v1.33 and up)	Stampw.exe (v2.2 and up)

New BASIC Stamp Commands for the BS2px

The BS2px includes all the PBASIC commands supported by the BS2p plus two new commands: COMPARE and CONFIGPIN. Both of these commands are available when using either PBASIC 2.0 or PBASIC 2.5. Note that the BASIC Stamp Editor v2.2 is required to program the BS2px.

COMPARE *Mode*, *Variable*

Function

Enable or disable comparator, compare voltages on P1 and P2 and retrieve comparison result to store in *Variable*.

- *Mode* is a variable/constant/expression (0 – 2) that enables or disables the comparator (input pins P1 and P2) and determines if the optional comparator output pin (pin P0) is enabled or not. See Table 3 for an explanation of the *Mode* values.
- *Variable* is a variable (usually a bit) in which the comparison result is stored.

Quick Facts

Table 3: COMPARE Quick Facts.

	BS2px
***Mode* Values**	0: Disables comparator
	1: Enables comparator with P0 as result output
	2: Enables comparator without P0 as result output
***Variable* Values**	0: Voltage P1 > P2; P0 optionally outputs 0
	1: Voltage P1 < P2; P0 optionally outputs 1

Explanation

The COMPARE command enables or disables the built-in comparator hardware on the BS2px's I/O pins P0, P1, and P2. I/O pins P1 and P2 are the comparator inputs and P0 is optionally the comparator result output pin.

By default, the comparator feature is disabled. Using the COMPARE command with a *Mode* argument of 1 or 2 enables the comparator feature (using input pins P1 and P2) and returns the result of the comparison in *Variable*. If *Mode* is 1, the result of the comparison is also output on I/O pin P0. The following is an example of the COMPARE command:

```
Result   VAR   Bit
COMPARE  1,    Result
```

This example enables the comparator (setting P0 to output the result, with P1 and P2 as the comparator inputs) and writes the result of the comparison into *Result*. Both *Result* and the output pin P0 will be 0 if the input voltage on P1 was greater than that of P2. *Result* and the output pin P0 will be 1 if the input voltage on P1 was less than that of P2.

Note that the comparator hardware operates independently of the execution speed of the BS2px and will continue to run and update P0 if *Mode* = 1, even during sleep mode (execution of END, NAP, POLLWAIT 8, or SLEEP commands). To avoid spurious current draw during sleep mode, disable the comparator first.

Demo Program (COMPARE.bpx)

```
' COMPARE.bpx
' This example demonstrates the use of the COMPARE command.
' Connect two variable voltage sources (0 to 5 volts) on I/O pins
' P1 and P2 (or a button on each pin connected to ground).  Run the program
' and watch the Debug Terminal display as you adjust the variable voltage
' or press the buttons.

' {$STAMP BS2px}
' {$PBASIC 2.5}

Result VAR Bit

#IF $STAMP <> BS2PX #THEN
  #ERROR "This program requires a BS2px."
#ENDIF

Setup:
  CONFIGPIN DIRECTION, %0000000000000001   'P0 = output, all others = input
  CONFIGPIN PULLUP,    %0000000000000110   'Enable pull-ups on P1 and P2
  DEBUG "BS2px COMPARATOR DEMONSTRATION", CR,
        "============================", CR,
        "Input Voltage: P1 > P2", CR,
        "Output State:  P0 = 0"

Main:
DO                                    'Display P1/P2 comparison
  COMPARE 1, Result
  IF Result = 0 THEN
    DEBUG CRSRXY,18,2,">"
  ELSE
    DEBUG CRSRXY,18,2,"<"
  ENDIF
  DEBUG CRSRXY,20,3,BIN1 Result
LOOP
```

CONFIGPIN *Mode*, *PinMask*

Function

Configure special properties of I/O pins.

- *Mode* is a variable/constant/expression (0 – 3), or one of four predefined symbols, that specifies the I/O pin property to configure: Schmitt Trigger, Logic Threshold, Pull-up Resistor or Output Direction. See Table 4 for an explanation of *Mode* values.
- *PinMask* is a variable/constant/expression (1 – 65535) that indicates how *Mode* is applied to I/O pins. Each bit of *PinMask* corresponds to an individual I/O pin. A high bit (1) enables the *Mode* and a low bit (0) disables the *Mode* on the corresponding I/O pin.

Quick Facts

Table 4: CONFIGPIN Quick Facts.

	BS2px
***Mode* Values**	0 (or SCHMITT): Schmitt Trigger
	1 (or THRESHOLD): Logic Threshold
	2 (or PULLUP): Pull-up Resistor
	3 (or DIRECTION): Output Direction
Related Commands (For DIRECTION Mode)	INPUT and OUTPUT, and the DIRx = # assignment statement

Explanation

The CONFIGPIN command enables or disables special I/O pin properties on all 16 I/O pins at once. There are four properties, or modes, available: Schmitt Trigger, Logic Threshold, Pull-up Resistor, and Output Direction. Each I/O pin on the BS2px contains special hardware dedicated to each of these properties.

Output Direction

By default, all BASIC Stamp I/O pins are set to inputs. Enabling the Output Direction mode sets an I/O pin's direction to output. Disabling the Output Direction mode sets an I/O pin's direction to input. This has the same effect as using the OUTPUT or INPUT commands, or the DIRx = # assignment statement to configure I/O pin directions. The following is an example of the CONFIGPIN command using the Output Direction mode:

```
CONFIGPIN  DIRECTION, %0000000100010011
```

Every high bit (1) in the *PinMask* argument enables the output direction for the corresponding I/O pin while every low bit (0) disables the output direction. In the above example, I/O pins 8, 4, 1, and 0 are set to the output direction and all other I/O pins are set to the input direction. This is similar to the following statement:

```
DIRS = %0000000100010011
```

Pull-up Resistors

Pull-up resistors are commonly used in circuitry where a component, such as a button, provides an open/drain signal; the signal is either floating (open) or is driven to ground (drain). Since the BASIC Stamp input pins must always be connected to either 5 volts or ground (0 volts) in order to read a reliable logic state with them, a pull-up resistor is required on circuitry, such as the button circuit mentioned above, so that the signal is never left floating (electrically disconnected).

The following example enables internal pull-up resistors on I/O pins 15, 12, 6, and 3, and disables internal pull-up resistors on all other I/O pins:

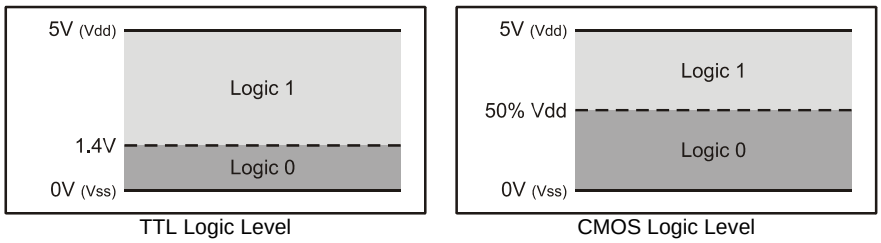
```
CONFIGPIN  PULLUP, %1001000001001000
```


Note that the internal pull-up resistors are intentionally weak, about 20 kΩ. Additionally, the internal pull-up resistors can be activated for all pins, regardless of pin direction, but really matter only when the associated pin is set to input mode.

Logic Threshold

An input pin's logic threshold determines the voltage levels that are interpreted as logic high (1) and logic low (0). Most microcontrollers, and other integrated circuits use one of two types of logic threshold: TTL Level or CMOS Level. The BASIC Stamp I/O pins are, by default, configured for TTL level logic thresholds. Figure 1 is an illustration of the difference between TTL and CMOS logic levels.

Figure 1: TTL and CMOS Logic Level Threshold Voltages



The logic threshold for TTL is 1.4 volts; a voltage below 1.4 is considered to be a logic 0 while a voltage above 1.4 is considered to be a logic 1. The logic threshold for CMOS is 50% of Vdd; a voltage below ½ Vdd is considered a logic 0 while a voltage above ½ Vdd is considered a logic 1.

For the CONFIGPIN command's THRESHOLD mode, a high bit (1) in the *PinMask* argument sets the corresponding I/O pin to CMOS threshold level, and a low bit sets it to a TTL threshold level. The following example sets CMOS threshold level on I/O pins 3, 2, 1, and 0, and TTL threshold level on all other I/O pins.

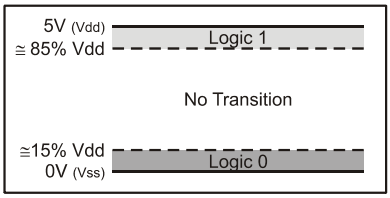
```
CONFIGPIN  THRESHOLD, %0000000000001111
```

The threshold level can be set for all pins, regardless of pin direction, but really matters only when the associated pin is set to input mode.

Schmitt Trigger

Normally, if a signal on an input pin is somewhat noisy (the voltage level randomly rises and falls beyond the logic threshold boundary) then reading that pin's input value will result in spurious highs and lows (1s and 0s). Schmitt Triggers are circuits that make inputs more steady and reliable by adding a region of hysteresis around the logic threshold that the signal must completely traverse before the logic level is interpreted as being changed. By default BASIC Stamp I/O pins are set to normal input mode, but the BS2px can be configured for Schmitt Trigger mode as well. Figure 2 illustrates Schmitt Trigger characteristics.

Figure 2: Schmitt Trigger Characteristics



In Schmitt Trigger mode, the threshold for a logic 0 is approximately 15% of Vdd and the threshold for a logic 1 is approximately 85% of Vdd. The input pin defaults to an unknown state until the initial voltage crosses a logic 0 or logic 1 boundary. Thereafter, the voltage must cross above 85% of Vdd to be interpreted as a logic 1 and must cross below 15% of Vdd to be interpreted as a logic 0. If the voltage

transitions somewhere between the two thresholds, the interpreted logic state remains the same as the previous state.

For the CONFIGPIN command's SCHMITT mode, a high bit (1) in the *PinMask* argument enables the Schmitt Trigger on the corresponding I/O pin and a low bit (0) disables the Schmitt Trigger. The following example sets Schmitt Triggers on I/O pins 7, 6, 5, and 4, and sets all other I/O pins to normal mode.

```
CONFIGPIN  SCHMITT, %0000000011110000
```

Schmitt Trigger mode can be activated for all pins, regardless of pin direction, but really matters only when the associated pin is set to input mode.

Demo Program (CONFIGPIN.bpx)

```
' CONFIGPIN.BPX
' This example demonstrates the use of the CONFIGPIN command.
' All I/O pins are set to inputs with various combinations of
' Pull-Up Resistor, Logic Threshold and Schmitt-Trigger properties.
' While running, this program will constantly display the state of all
' input pins along with an indication of the configuration for each group
' of pins.  Try connecting different input signals to the I/O pins (such as
' buttons, a function generator with a slowing sweeping signal (0 to 5
' VDC)) or simply running your fingers across the I/O pins and note how
' they react based upon their configured property.

' {$STAMP BS2px}
' {$PBASIC 2.5}

#IF $STAMP <> BS2PX #THEN
  #ERROR "This program requires a BS2px."
#ENDIF

Setup:
  CONFIGPIN DIRECTION, %0000000000000000   'Set all I/O pins to inputs
  CONFIGPIN PULLUP,    %1111111111110000   'Enable pull-ups on pins 4 - 15
  CONFIGPIN THRESHOLD, %0000111100000000   'Set P8-P11 to CMOS, others TTL
  CONFIGPIN SCHMITT,   %1111000000000000   'Enable Schmitt-Triggers P12-P15

  DEBUG CLS
  DEBUG "         BS2px INPUT PIN CONFIGURATION TEST", CR,
        "============================================================", CR,
        "      P15-P12: Pull-Up Resistors, TTL & Schmitt-Triggers", CR,
        "     /", CR,
        "    /    P11-P8: Pull-Up Resistors & CMOS", CR,
        "   /    /", CR,
        "  |    /     P7-P4: Pull-Up Resistors & TTL", CR,
        "  |    |    /", CR,
        "  |    |    |     P3-P0: Normal", CR,
        "  |    |    |    /", CR,
        "  |    |    |    |", CR,
        "---- ---- ---- ----"

Main:
DO
  'Display input pin states
  DEBUG CRSRXY,0,12, BIN4 IND, " ", BIN4 INC, " ", BIN4 INB, " ", BIN4 INA
LOOP
```

BS2px Facts for Other PBASIC Commands

The BS2px supports all PBASIC 2.0 and PBASIC 2.5 commands. The following pages include brief details regarding aspects of commands that vary between different models of the BASIC Stamp module. Usually these variances are related to timing. For complete information about these and all other PBASIC commands, please refer to the BASIC Stamp Manual version 2.1, available to purchase in print, or as a free download from www.parallax.com.

COUNT *Pin, Duration, Variable*

Count the number of cycles (0-1-0 or 1-0-1) on the specified *Pin* during the *Duration* time frame and store that number in *Variable*.

Table 5: COUNT Quick Facts.

NOTE: All timing values are approximate.

	BS2, BS2e	BS2sx	BS2p	BS2pe	BS2px
Units in *Duration*	1 ms	400 µs	287 µs	720 µs	287 µs
***Duration* range**	1 ms to 65.535 s	400 µs to 26.214 s	287 µs to 18.809 s	720 µs to 47.18 s	287 µs to 18.809 s
Minimum pulse width	4.16 µs	1.66 µs	1.20 µs	3.0 µs	1.20 µs
Maximum frequency (square wave)	120,000 Hz	300,000 Hz	416,700 Hz	166,667 Hz	416,700 Hz

DEBUG *OutputData* { , *OutputData* }

Display information on the PC screen within the BASIC Stamp Editor's Debug Terminal.

Table 6: DEBUG Quick Facts.

	BS1	BS2, BS2e, BS2sx BS2p, BS2pe	BS2px
Serial Protocol	Asynchronous 4800, N, 8, 1 True polarity Custom packetized format	Asynchronous 9600, N, 8, 1 Inverted polarity Raw data	Asynchronous 19200, N, 8, 1 Inverted polarity Raw data

DEBUGIN *InputData* { , *InputData* }

Accept information from the user via the Debug Terminal within the BASIC Stamp Editor program.

Table 7: DEBUGIN Quick Facts.

	BS2, BS2e, BS2sx, BS2p, BS2pe	BS2px
Serial Protocol	Asynchronous 9600 baud N, 8, 1 Inverted Polarity, Raw Data	Asynchronous 19200 baud N, 8, 1 Inverted Polarity, Raw Data

DTMFOUT *Pin*, { *OnTime*, *OffTime*, } **[** *Tone* {, *Tone…*} **]**

Generate dual-tone, multifrequency tones (DTMF, i.e., telephone "touch" tones).

Table 8: DMTFOUT Quick Facts.

	BS2, BS2e	BS2sx	BS2p	BS2pe	BS2px
Default *OnTime*	200 ms	80 ms	55 ms	196 ms	34 ms
Default *OffTime*	50 ms	50 ms	50 ms	50 ms	50 ms
Units in *OnTime*	1 ms	0.4 ms	0.265 ms	1 ms	0.166 ms
Units in *OffTime*	1 ms	1 ms	1 ms	1 ms	1 ms

FREQOUT *Pin, Duration, Freq1* { , *Freq2* }

Generate one or two sine-wave tones for a specified *Duration*.

Table 9: FREQOUT Quick Facts.

	BS2, BS2e	BS2sx	BS2p	BS2pe	BS2px
Units in *Duration*	1 ms	0.4 ms	0.265 ms	1 ms	0.166 ms
Units in *Freq1* and *Freq2*	1 Hz	2.5 Hz	3.77 Hz	1.51 Hz	6.03 Hz
Range of Frequency	0 to 32767 Hz	0 to 81917 Hz	0 to 123531 Hz	0 to 49478 Hz	0 to 197585 Hz

I2CIN *Pin, SlaveID,* { *Address* { *****LowAddress }, } **[** *InputData* **]**
Receive data from a device using the I²C protocol.

Table 10: I2CIN Quick Facts.

	BS2p, BS2pe, and BS2px	
Values for *Pin*	*Pin* = 0	*Pin* = 8
I/O Pin Arrangement	0: Serial Data (SDA) pin 1: Serial Clock (SCL) pin	8: Serial Data (SDA) pin 9: Serial Clock (SCL) pin
Transmission Rate	Approximately 81 kbits/sec on a BS2p, 45 kbits/sec on a BS2pe, and 83 kbits/sec on a BS2px (not including overhead).	

I2COUT *Pin, SlaveID,* { *Address* { *****LowAddress }, } **[** *OutputData* **]**
Send data to a device using the I²C protocol.

Table 11: I2COUT Quick Facts.

	BS2p, BS2pe, and BS2px	
Values for *Pin*	*Pin* = 0	*Pin* = 8
I/O Pin Arrangement	0: Serial Data (SDA) pin 1: Serial Clock (SCL) pin	8: Serial Data (SDA) pin 9: Serial Clock (SCL) pin
Transmission Rate	Approximately 81 kbits/sec on a BS2p, 45 kbits/sec on a BS2pe, and 83 kbits/sec on a BS2px (not including overhead).	
Special Notes	The SDA and SCL pins must have 1 kΩ - 4.7 kΩ pull-up resistors. The I2CIN command does not allow for multiple masters. The BASIC Stamp cannot operate as an I²C slave device.	
Related Command	I2CIN	

NAP *Duration*
Enter sleep mode for a short time. Power consumption is reduced as indicated in Table 12 assuming no loads are being driven.

Table 12: NAP Quick Facts.

Note: Current measurements are based on 5-volt power, no extra loads, and 75°F ambient temperature.

	BS1	BS2	BS2e	BS2sx	BS2p	BS2pe	BS2px
Current Draw During Run	1 mA	3 mA	25 mA	60 mA	40 mA	15 mA	55 mA
Current Draw During NAP	25 µA	50 µA	200 µA	500 µA	350 µA	36 µA	450 µA
Accuracy of Nap	-50 to 100% (±10% @ 75°F with stable power supply)						

POLLWAIT *Duration*
Pause program execution, in a low-power mode, in units of *Duration* until any polled-input pin reaches the desired poll state.

Table 13: POLLWAIT Quick Facts.

	BS2p	BS2pe	BS2px
Current draw during POLLWAIT	350 µA	36 µA	450 µA
Response Time with *Duration* set to 8	Less than 160 µs	Less than 250 µs	Less than 100 µs

PULSIN *Pin, State, Variable*
Measure the width of a pulse on *Pin* described by *State* and store the result in *Variable*.

Table 14: PULSIN Quick Facts.

	BS1	BS2	BS2e	BS2sx	BS2p	BS2pe	BS2px
Units in *Variable*	10 µs	2 µs	2 µs	0.8 µs	0.8 µs	2 µs	0.81 µs
Maximum Pulse Width	655.35 ms	131.07 ms	131.07 ms	52.428 ms	52.428 ms	123.6 ms	53.08 ms

PULSOUT *Pin, Duration*

Generate a pulse on *Pin* with a width of *Duration*.

Table 15: PULSOUT Quick Facts.

	BS1	BS2	BS2e	BS2sx	BS2p	BS2pe	BS2px
***Duration* units**	10 µs	2 µs	2 µs	0.8 µs	0.8 µs	2 µs	0.8 µs
Maximum Pulse Width	655.35 ms	131.07 ms	131.07 ms	52.428 ms	52.428 ms	131.07 ms	52.428 ms

PWM *Pin, Duty, Cycles*

Convert a digital value to analog output via pulse-width modulation.

Table 16: PWM Quick Facts

	BS1	BS2	BS2e	BS2sx	BS2p	BS2pe	BS2px
Units in *Cycles*	5 ms	1 ms	1 ms	0.4 ms	0.65 ms	1.62 ms	0.4 ms

RCTIME *Pin, State, Variable*

Measure time while *Pin* remains in *State;* usually to measure the charge/discharge time of resistor/capacitor (RC) circuit.

Table 17: RCTIME Quick Facts.

	BS2	BS2e	BS2sx	BS2p	BS2pe	BS2px
Units in *Variable*	2 µs	2 µs	0.8 µs	0.75 µs	2 µs	0.75 µs
Maximum Pulse Width	131.07 ms	131.07 ms	52.428 ms	49.151 ms	131.07 ms	49.151 ms

RUN *ProgramSlot*

Switches execution to another BASIC Stamp program (in a different program slot).

Table 18: RUN Quick Facts.

	BS2e	BS2sx	BS2p	BS2pe	BS2px
Time Delay to Switch Between Program Slots	770 µs	300 µs	250 µs	736 µs	195 µs

SERIN *Rpin* { *****_Fpin_ }, *Baudmode*, { *Plabel*, } { *Timeout, Tlabel*, } **[** *InputData* **]**

Receive asynchronous serial data (e.g., RS-232 data).

SEROUT *Tpin* { *****_Fpin_ }, *Baudmode*, { *Pace*, } { *Timeout, Tlabel*, } **[** *OutputData* **]**

Transmit asynchronous serial data (e.g., RS-232 data).

Table 19: SERIN and SEROUT Quick Facts.

	BS1	BS2	BS2e	BS2sx	BS2p	BS2pe	BS2px
Units in *Pace*	n/a	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms
Units in *Timeout*	n/a	1 ms	1 ms	0.4 ms	0.4 ms	1 ms	0.4 ms
Baud range	300, 600, 1200, and 2400 only	243 to 50K	243 to 50K	608 to 115.2K	608 to 115.2K	243 to 50K	972 to 115.2K
Baud limit with flow control	n/a	19.2K	19.2K	19.2K	19.2K	19.2K	19.2K
I/O pins available	0 - 7	0 – 15	0 - 15	0 – 15	0 – 15 (in current I/O block)	0 – 15 (in current I/O block)	0 – 15 (in current I/O block)

Table 20: SERIN and SEROUT BS2px common baud rates and corresponding *Baudmodes.*

Baud Rate	8-bit no-parity inverted	8-bit no-parity true	7-bit even-parity inverted	7-bit even-parity true
1200	19697	3313	27889	11505
2400	18030	1646	26222	9838
4800	17197	813	25389	9005
9600	16780	396	24792	8588

SHIFTIN *Dpin, Cpin, Mode,* **[** *Variable* { *****Bits* } {, *Variable* { *****Bits* }…} **]**
Shift data in from a synchronous serial device.

Table 21: SHIFTIN Quick Facts.

	BS2/BS2e	BS2sx/BS2p	BS2pe	BS2px
Timing of T_h and t_l	14 µs / 46 µs	5.6 µs / 18 µs	14 µs / 46 µs	3.6 µs / 11.8 µs
Transmission Rate	~16 kbits/sec.	~42 kbits/sec.	~16 kbits/sec.	~ 65 kbits/sec.

SHIFTOUT *Dpin, Cpin, Mode,* **[** *OutputData* { *****Bits* } { ,*OutputData* { *****Bits* }…} **]**
Shift data out to a synchronous serial device.

Table 22: SHIFTOUT Quick Facts.

	BS2, BS2e	BS2sx, BS2p	BS2pe	BS2px
Timing of t_h and t_l,	14 µs / 46 µs	5.6 µs / 18 µs	14 µs / 46 µs	3.6 µs / 11.8 µs
Timing of t_a and t_b	15 µs / 30 µs	6.3 µs / 12.5 µs	15 µs / 30 µs	4 µs / 7.8 µs
Transmission Rate	~16 kbits/sec.	~42 kbits/sec.	~16 kbits/sec.	~65 kbits/sec.

SLEEP *Duration*
Put the BASIC Stamp into low-power mode for a specified time.

Table 23: SLEEP Quick Facts.

NOTE: Current measurements are based on 5-volt power, no extra loads and 75° F ambient temperature.

	BS1	BS2	BS2e	BS2sx	BS2p	BS2pe	BS2px
Current Draw during Run	1 mA	3 mA	25 mA	60 mA	40 mA	15 mA	55 mA
Current Draw during SLEEP	25 µA	50 µA	200 µA	500 µA	350 µA	36 µA	450 µA
Accuracy of SLEEP	±1% @ 75°F with stable power supply						

Reserved Words for the BS2px

The BS2px has all the reserved words common to all BS2 models (listed on page 460 of the BASIC Stamp Syntax and Reference Manual version 2.1) plus those shown below. These additional words are reserved in both PBASIC 2.0 and PBASIC 2.5.

Table 24: Additional Reserved Words for the BS2px.

BS2px			
AUXIO	IOTERM	POLLIN	RUN
COMPARE	LCDCMD	POLLMODE	SCHMITT
CONFIGPIN	LCDIN	POLLOUT	SPSTR
DIRECTION	LCDOUT	POLLRUN	STORE
GET	MAINIO	POLLWAIT	THRESHOLD
I2CIN	OWIN	PULLUP	
I2COUT	OWOUT	PUT	

BASIC Stamp 2px Schematic (Rev A)