Arduino Forum (http://forum.arduino.cc/index.php) > Community (http://forum.arduino.cc/index.php#c5)

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 > SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.0)

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Topic: SPI library for ATtiny MCUs (Read 11594 times)

Jack Christensen (http://forum.arduino.cc/index.php?action=profile;u=35906)

(http://forum.arduino.cc/index.php?action=profile;u=35906)

⭐⭐
Faraday Member
Posts: 4,208

(http://adventuresinarduinoland.blogspot.com/)
Karma: 247 [add]
(http://forum.arduino.cc/index.php?action=karma;sa=applaud;uid=35906;cacd7429dd8=085e76c28fa83a4371adaab71743d8dd)

CODE is a mass noun and should not be used in the

SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.msg1442925#msg1442925)
Oct 26, 2013, 06:26 am (http://forum.arduino.cc/index.php?topic=195534.msg1442925#msg1442925)

I wrote an SPI master library for ATtiny44/84 and ATtiny45/85 MCUs that uses the ATtiny USI hardware module. As compared with using shiftOut(), it's faster, smaller and provides a much more consistent bit clock. All feedback welcome.
https://github.com/JChristensen/tinySPI

plural or with an indefinite article.

Adventures in Arduinoland (http://adventuresinarduinoland.blogspot.com/)

**nickgammon (http://forum.arduino.cc/index.php?action=profile;u=36095)**

(http://forum.arduino.cc/index.php?action=profile;u=36095)

⍣⍣⍣⍣⍣

Global Moderator

Nick Gammon

Brattain Member

Posts: 28,096

(http://www.gammon.com.au)

Karma: 1371  [add] (http://forum.arduino.cc/index.php?action=karma;sa=applaud;uid=36095;cacd7429dd8=085e76c28fa83a4371adaab71743d8dd)

Lua rocks!
http://www.gammon.com.au (http://www.gammon.com.au)

**Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.msg1442959#msg1442959)**

Oct 26, 2013, 08:05 am (http://forum.arduino.cc/index.php?topic=195534.msg1442959#msg1442959)

#1

Looks good, Jack.

Can I put a link to it on my SPI page?

Please post technical questions on the forum, not by personal message. Thanks!

More info: http://www.gammon.com.au/electronics

**Coding Badly (http://forum.arduino.cc/index.php?action=profile;u=10859)**

**Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.msg1442983#msg1442983)**

Oct 26, 2013, 09:15 am (http://forum.arduino.cc/index.php?topic=195534.msg1442983#msg1442983)

#2

> Quote from: Jack Christensen on Oct 26, 2013, 06:26 am (http://forum.arduino.cc/index.php?topic=195534.msg1442925#msg1442925)
>
> > *All feedback welcome.*

Excellent work!

https://github.com/JChristensen/tinySPI/blob/master/tinySPI.cpp#L23
You are setting all the bits.  I suggest something more "direct"...
[font=Courier New]  USICR = _BV(USIWM0) | _BV(USICS1) | _BV(USICLK);[/font]
My preference is this so as to document the value of every bit...
[font=Courier New]  USICR =
   (0 << USISIE) |
   (0 << USIOIE) |
   (0 << USIWM1) | (1 << USIWM0) |
   (1 << USICS1) | (0 << USICS0) |
   (1 << USICLK) |
   (0 << USITC);[/font]

https://github.com/JChristensen/tinySPI/blob/master/tinySPI.cpp#L24
Did you mean to strobe the clock in *begin*?

https://github.com/JChristensen/tinySPI/blob/master/tinySPI.cpp#L42
Is it necessary to block interrupts / ensure a consistent clock?

Have you considered moving the code (function bodies) to the header file?  That would allow the compiler to inline most / all of the code.

---

**nickgammon**
(http://forum.arduino.
cc/index.php?
action=profile;u=3609
5)

Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?
topic=195534.msg1443070#msg1443070)
Oct 26, 2013, 11:17 am (http://forum.arduino.cc/index.php?topic=195534.msg1443070#msg1443070)                    #3

I admit I've done the same, but for a reference implementation, remember the rules about underscores:

> Quote
>
> " 
>
> *In C++ these variable names are reserved:*
>
> *Reserved in any scope, including for use as implementation macros:*
>
> - *identifiers beginning with an underscore and an uppercase letter*
>
> - *identifiers containing adjacent underscores (or "double underscore")*

I've been gradually migrating my use of the _BV macro to the bit macro, eg.

Code: [Select]

```
USICR = bit (USIWM0) | bit (USICS1) | bit (USICLK);
```

Quote

> 66
>
> *My preference is this so as to document the value of every bit...*

As for that, I'm not sure.

When you are asked what you had for dinner, do you say what you **didn't** have?

- We had fish.

- And chips.

- No pasta.

- No pizza.

- No beef.

- No chicken.

Code: [Select]

```
    (0 << USIWM1) | (1 << USIWM0) |
```

I look at that and think "he used USIWM1 and USIWM0". Oh, no, wait. He **didn't** use USIWM1. It's adding to the workload.

Please post technical questions on the forum, not by personal message. Thanks!

More info: http://www.gammon.com.au/electronics

**Jack Christensen (http://forum.arduino.cc/index.php?action=profile;u=35906)**

(http://forum.arduino.cc/index.php?action=profile;u=35906)
⭐⭐
Faraday Member
Posts: 4,208

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**Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.msg1443232#msg1443232)**
Oct 26, 2013, 02:46 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443232#msg1443232) Last Edit: Oct #4
26, 2013, 02:52 pm by Jack Christensen Reason: 1

> Quote from: Nick Gammon on Oct 26, 2013, 08:05 am (http://forum.arduino.cc/index.php?topic=195534.msg1442959#msg1442959)
>
> > ❝
> > *Looks good, Jack.*
> > *Can I put a link to it on my SPI page?*

> Quote from: Coding Badly on Oct 26, 2013, 09:15 am (http://forum.arduino.cc/index.php?topic=195534.msg1442983#msg1442983)
>
> > ❝
> > *Excellent work!*

Nick, absolutely, and thanks to you both very much! I'll try to explain my thinking a bit, please give me any further thoughts, your input is very much appreciated!

> Quote
>
> > ❝
> > *https://github.com/JChristensen/tinySPI/blob/master/tinySPI.cpp#L23*
> > *You are setting all the bits.  I suggest something more "direct"...*

I think Nick caught it, I am preserving the value of USIWM1. This is in case the user previously set SPI_MODE1, then did end() then another begin(), I wanted that setting to stick. That's probably a long shot; initializing USICR could have been coded more simply otherwise. I debated this for a while, but that's where I ended up. Of course, begin() could be documented as "resets the data mode to SPI_MODE0". Probably here and elsewhere I should add some more comments.

> Quote
>
> > ❝
> > *https://github.com/JChristensen/tinySPI/blob/master/tinySPI.cpp#L24*
> > *Did you mean to strobe the clock in begin?*

I just meant to initialize the registers and pins in begin(). The example code in the datasheet loads the data register and then initializes USICR and strobes the clock immediately before the transfer loop, so that works there, but I did all the strobing in the transfer loop in the interest of consistency, although at the cost of one more trip through the loop.

> **Quote**
>
> ❝
>
> https://github.com/JChristensen/tinySPI/blob/master/tinySPI.cpp#L42
> *Is it necessary to block interrupts / ensure a consistent clock?*

Every once in a while I'd see a clock that was maybe ten times longer. I assumed this may have been the millis() timer overflow interrupt handler. That seemed like a long time (100-200µs with a 1MHz clock) but I didn't dig into it. Would you expect the overflow handler to take that long?

As I think about this some more, I'm not sure why a slave would care about the occasional stretched clock and I'd of course rather not inhibit interrupts. What are your thoughts? OTOH when I looked at shiftOut(), its clock is all over the board, amazingly inconsistent.

> **Quote**
>
> ❝
>
> *Have you considered moving the code (function bodies) to the header file?  That would allow the compiler to inline most / all of the code.*

I was not aware of that, sounds like something I should learn about.

> **Quote**
>
> ❝
>
> *I've been gradually migrating my use of the _BV macro to the bit macro*

Is that your macro? I like it, I always thought _BV looked a "bit" clunky.
EDIT: Duh... That'd be Arduino's macro.

Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.msg1443347#msg1443347)
Oct 26, 2013, 05:09 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443347#msg1443347)

#5

Here are examples of the SPI clock timings I'm seeing without inhibiting interrupts.  These come from an input capture sketch running on a 328P*.  For bit 0, the value in the count

column is just the raw timer value, for bits 1-7 it's the delta. Less than one percent of the bits get stretched with USI; shiftout() has a little different profile, more frequent stretches but not as extreme as compared to the average.

* I've been wanting one of those logic analyzers, this may be justification 😉

(http://adventuresinarduinoland.blogspot.com/)
Karma: 247 [add] (http://forum.arduino.cc/index.php?action=karma;sa=applaud;uid=35906;cacd7429dd8=085e76c28fa83a4371adaab71743d8dd)

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**nickgammon** (http://forum.arduino.cc/index.php?action=profile;u=36095)

(http://forum.arduino.cc/index.php?action=profile;u=36095)
⭐⭐⭐⭐⭐
**Global Moderator**
Nick Gammon
Brattain Member
Posts: 28,096

(http://www.gammon.com.au)

**Re: SPI library for ATtiny MCUs** (http://forum.arduino.cc/index.php?topic=195534.msg1443634#msg1443634)
Oct 26, 2013, 09:33 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443634#msg1443634)

#6

> Quote from: Jack Christensen on Oct 26, 2013, 05:09 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443347#msg1443347)
>
> 66
>
> *Here are examples of the SPI clock timings I'm seeing without inhibiting interrupts. These come from an input capture sketch running on a 328P*.*

Could you post an example of this usage so I can reproduce it?

Please post technical questions on the forum, not by personal message. Thanks!

More info: http://www.gammon.com.au/electronics

nickgammon
(http://forum.arduino.
cc/index.php?
action=profile;u=3609
5)

**Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?
topic=195534.msg1443640#msg1443640)**
Oct 26, 2013, 09:38 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443640#msg1443640)

#7

Never mind, I see you provided examples.

---

Please post technical questions on the forum, not by personal message. Thanks!

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**Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.msg1443654#msg1443654)**

Oct 26, 2013, 09:59 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443654#msg1443654)

#8

Let me ask this, Jack. What do you mean by "stretched clock" exactly?

My preliminary analysis does not indicate this. What are you measuring?

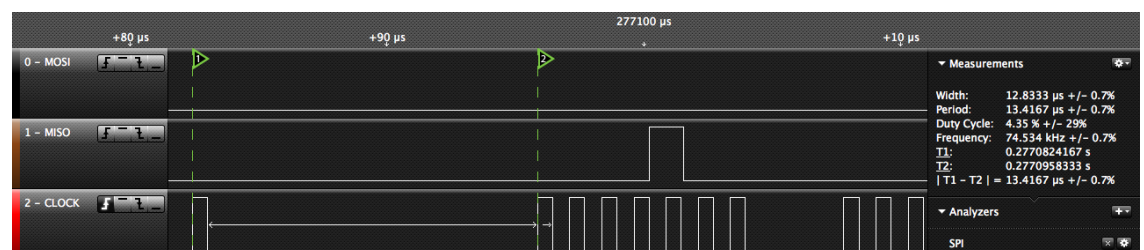Please post technical questions on the forum, not by personal message. Thanks!

More info: http://www.gammon.com.au/electronics

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**Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.msg1443669#msg1443669)**

Oct 26, 2013, 10:13 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443669#msg1443669)

#9

OK, I've spotted it.



The clock is stretched after the first clock bit. As you realize no doubt, because the clock bits are clocked out in the tight timing loop there is a chance for an interrupt to occur

Code: [Select]

```
uint8_t tinySPI::transfer(uint8_t spiData)
{
    USIDR = spiData;
    USISR = _BV(USIOIF);                //clear counter and counter overf
    ATOMIC_BLOCK(ATOMIC_RESTORESTATE) { //ensure a consistent clock perio
        while ( !(USISR & _BV(USIOIF)) ) USICR |= _BV(USITC);
    }
    return USIDR;
```

It is stretched by around 13 μS which sounds about right for a Timer 0 interrupt.

Since the time taken to clock out a byte is around 9 μS I am inclined to leave it how you had it. A no-interrupt pause to clock out a single byte would not inhibit the Timer 0 timing noticeably, and it is not as if you are going to be doing much else.

Please post technical questions on the forum, not by personal message. Thanks!

More info: http://www.gammon.com.au/electronics

Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?
topic=195534.msg1443682#msg1443682)
Oct 26, 2013, 10:28 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443682#msg1443682)    #10

Unless your pin mappings are different to mine, aren't you using the same pin for MOSI and SS?

Code: [Select]

```
// ATMEL ATTINY 25/45/85 / ARDUINO
//
//                   +-\/-+
// Ain0 (D 5) PB5  1|    |8  Vcc
// Ain3 (D 3) PB3  2|    |7  PB2 (D 2) Ain1  - SCK  (USCK)
// Ain2 (D 4) PB4  3|    |6  PB1 (D 1) pwm1  - MISO (DO)
//            GND  4|    |5  PB0 (D 0) pwm0  - MOSI (DI)
//                   +----+
```

You used D0 for LATCH:

Code: [Select]

```
//pin definitions
const int LATCH_PIN = 0;          //storage register clock (slave select)
const int DATA_PIN = 1;           //data in
const int CLOCK_PIN = 2;          //shift register clock
```

The others agree (SCL = D2, MISO = D1)

Please post technical questions on the forum, not by personal message. Thanks!

More info: http://www.gammon.com.au/electronics

---

**nickgammon**
(http://forum.arduino.
cc/index.php?
action=profile;u=3609
5)

(http://forum.arduino.cc
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action=profile;u=36095)

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/index.php?
action=karma;sa=applau
d;uid=36095;cacd7429dd
8=085e76c28fa83a4371a
daab71743d8dd)

#11

In fact I think the terminology is confusing there:

Code: [Select]

```
const int LATCH_PIN = 0;              //storage register clock (slave select)
```

I call slave select "the thing brought low to start a transmission". However "register clock"
would be SCK wouldn't it?

Code: [Select]

```
tinySPI::tinySPI()
{
}
```

If the constructor doesn't do anything you can omit it.

Please post technical questions on the forum, not by personal message. Thanks!

More info: http://www.gammon.com.au/electronics

**Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.msg1443692#msg1443692)**
Oct 26, 2013, 10:38 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443692#msg1443692)  Last Edit: #12
Oct 26, 2013, 10:41 pm by Jack Christensen Reason: 1

Nick, it may not technically be a stretched clock pulse, it may be a stretched wait between two pulses, which is what your image shows.  At any rate, it can only be seen if the ATOMIC_BLOCK (https://github.com/JChristensen/tinySPI/blob/master/tinySPI.cpp#L42) is removed.  Pin definitions and all are the same as yours.

I'm now leaning towards taking it out, and worrying about it if and when it actually causes a problem.

Thanks!  Gotta get one of those Saleae analyzers!

---

**Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?topic=195534.msg1443697#msg1443697)**
Oct 26, 2013, 10:45 pm (http://forum.arduino.cc/index.php?topic=195534.msg1443697#msg1443697)  #13

Well, that stretched clock is much longer than the whole byte, so I am inclined to leave it how you had it. Putting the ATOMIC_BLOCK in stops the stretching and would only have a marginal side-effect.

---

Please post technical questions on the forum, not by personal message. Thanks!

More info: http://www.gammon.com.au/electronics

Re: SPI library for ATtiny MCUs (http://forum.arduino.cc/index.php?
topic=195534.msg1443843#msg1443843)
Oct 27, 2013, 01:27 am (http://forum.arduino.cc/index.php?topic=195534.msg1443843#msg1443843)          #14

> Quote from: Nick Gammon on Oct 26, 2013, 10:45 pm (http://forum.arduino.cc/index.php?
> topic=195534.msg1443697#msg1443697)
>
> > 66
> >
> > *Well, that stretched clock is much longer than the whole byte, so I am inclined to leave it how you had it.
> > Putting the ATOMIC_BLOCK in stops the stretching and would only have a marginal side-effect.*

Yeah, I don't know that it'd really cause an issue but it just seems cleaner to have the
consistency.  I'm good with it either way, we can pick one and see if it causes any
problems down the road, burn that bridge when we get to it 😁

So your feeling on having interrupts inhibited for ~80μs is that that's not too long?

Coding Badly, any strong feelings one way or the other?

land.blogspot.com/)

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