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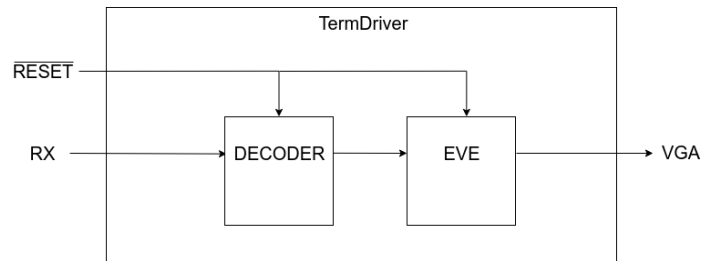
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1 Overview

SPIDriver is an easy-to-use tool for controlling SPI devices. It works with Windows, Mac, and Linux, and has a built-in color screen that shows a live logic-analyzer display of all SPI traffic.



2 Features

- live display shows you exactly what its doing all the time
- sustained SPI transfers at 500 Kbps
- USB line voltage monitor to detect supply problems, to 0.01 V
- target device high-side current measurement, to 5 mA
- two auxiliary output signals, A and B
- dedicated power out lines. two each of GND, 3.3 V and 5 V
- all signals color coded to match jumper colors
- all signals are 3.3 V, and are 5 V tolerant
- uses an FTDI USB serial adapter, and Silicon Labs automotive-grade EFM8 controller
- also reports uptime, temperature, and running CRC of all traffic
- all sensors and signals controlled using a simple serial protocol
- GUI, command-line, C/C++, and Python 2/3 host software provided for Windows, Mac, and Linux

3 Installation with Arduino

1. Disconnect power from the Arduino
2. Attach the SPIDriver to the Arduino
3. Connect the VGA plug to the SPIDriver and turn on the monitor
4. Apply power to the Arduino. You should see a blank screen with a blinking cursor at top-left
5. Load a sketch on the Arduino that prints text at 115200 baud, like the one below

```
void setup()
{
  Serial.begin(115200);
}

void loop()
{
  Serial.println("Hello world");
}
```

4 Operation

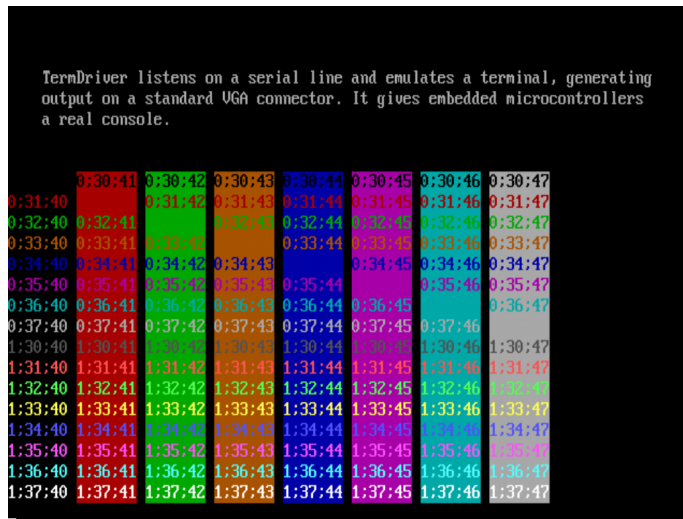


Figure 1: sample output at 80x25

SPIDriver monitors the serial line at 115200 baud, and draws any text on the VGA. There's nothing to set up or load. For example this Arduino sketch

```
void setup() {  
  Serial.begin(115200);  
}  
  
int counter;  
void loop() {  
  Serial.print("Counter is ");  
  Serial.println(counter++);  
}
```

Or this code in plain C

```
for (;;)   
  printf("Counter is %d\n", counter++);
```

Gives this output on the VGA:

```

Counter is 11
Counter is 12
Counter is 13
Counter is 14
Counter is 15
Counter is 16
Counter is 17
Counter is 18
Counter is 19
Counter is 20
Counter is 21
Counter is 22
Counter is 23
Counter is 24
Counter is 25
Counter is 26
Counter is 27
Counter is 28
Counter is 29
Counter is 30
Counter is 31
Counter is 32
Counter is 33
Counter is 34
    
```

Figure 2: Counter example output

4.1 ANSI escape codes

The following standard **CSI codes** are supported:

Code	Effect
ESC [n A	Cursor up
ESC [n B	Cursor down
ESC [n C	Cursor forward
ESC [n D	Cursor back
ESC [r;c H	Cursor position
ESC [n J	Erase display
ESC [n m	Select graphic rendition
ESC [s	Save cursor position
ESC [u	Restore cursor position

In addition the following sequences are specific to SPIDriver:

Code	Effect
ESC [n h	Set display mode. 0 is 80x25, 1 is 128x48, 2 is 96x64 (rotated)
ESC [n S	Screen-saver. 0 stops video output, 1 restarts video output

For example this C program displays all available foreground and background

colors.

```
#include <stdio.h>

int main()
{
    int attr, fg, bg;

    printf(
        "TermDriver listens on a serial line and emulates a "
        "terminal, generating\noutput on a standard VGA connector."
        "It gives embedded microcontrollers\na real console.\n\n");
    for (attr = 0; attr <= 1; attr++) {
        for (fg = 30; fg <= 37; fg++) {
            for (bg = 40; bg <= 47; bg++) {
                printf("\e[%d;%d;%dm%d;%d;%d\e[m",
                    attr, bg, fg, attr, bg, fg);
            }
            printf("\n");
        }
    }

    return 0;
}
```

4.2 High-resolution modes

In addition to standard 80x25 text mode, SPIDriver supports a higher density 128x48 mode, and a portrait orientation 96x64 mode. Both are very readable because they match SPIDriver's native 1024x768 @ 60 Hz VGA output.

CHAPTER I. Loomings.

Call me Ishmael. Some years ago—never mind how long precisely—having little or no money in my purse, and nothing particular to interest me on shore, I thought I would sail about a little and see the wotery part of the world. It is a way I have of driving off the spleen and regulating the circulation, whenever I find myself growing grim about the mouth; whenever it is a damp, drizzly November in my soul; whenever I find myself involuntarily pausing before coffin warehouses, and bringing up the rear of every funeral I meet; and especially whenever my hypos get such an upper hand of me, that it requires a strong moral principle to prevent me from deliberately stepping into the street, and methodically knocking people's hats off—then, I account it high time to get to sea as soon as I can. This is my substitute for pistol and ball. With a philosophical flourish Cato throws himself upon his sword; I quietly take to the ship. There is nothing surprising in this. If they but knew it, almost all men in their degree, some time or other, cherish very nearly the same feelings towards the ocean with me.

There now is your insular city of the Manhattans, belted round by wharves as Indian Isles by coral reefs—commerce surrounds it with her surf. Right and left, the streets take you waterward. Its extreme downtown is the Battery, where that noble mole is washed by waves, and cooled by breezes, which a few hours previous were out of sight of land. Look at the crowds of water-jazzers there.

Circumnavigate the city of a dreamy Sabbath afternoon. Go from Corlears Hook to Coenties Slip, and from thence, by Whitehall, northward. What do you see?—Posted like silent sentinels all around the town, stand thousands upon thousands of mortal men of wood in ocean rewerics. Some leaning against the spiles; some seated upon the pier-heads; some looking over the bulwarks of ships from China; some high aloft in the rigging, as if striving to get a still better seaward peep. But these are all landmen; of weak days pent up in lath and plaster—tied to counters, nailed to benches, clinched to desks. How then is this?—Are the green fields gone? What do they here?

But look! here come more crowds, pacing straight for the water, and seemingly bound for a dice. Strangest! Nothing will content them but the extreme limit of the land; loitering under the shady lee of yonder warehouses will not suffice. No, they must get just as nigh the water as they possibly can without falling in. And there they stand—miles of them—leagues. Inlanders all, they come from lanes and alleys, streets and avenues—north, east, south, and west. Yet here they all unite. Tell me, does the magnetic virtue of the needles of the compasses of all those ships attract them thither?

Once more. Say you are in the country. In some high land of lakes. Take almost any path you please, and ten to one it carries you down in a dale, and leaves you there by a pool. There is magic in it, let the most absent-minded of men be plunged in his deepest reveries—stand that man on his legs, set his feet a-going, and he will infallibly lead you to water, if water there be in all that region. Should you ever be athirst in the great American desert, try this experiment, if your caravan happen to be supplied with a metaphysical professor. Yes, as every one knows, meditation and water are wedded for ever.

But here is an artist. He desires to paint you the dreamiest, shadiest, quietest, most enchanting bit of romantic landscape in all the valley of the sacre. What is the chief element he employs? There stand his trees, each with a hollow trunk, as if a hermit and a crucifix were within; and here sleeps his meadow, and there sleep his cattle; and up from yonder cottage goes a sleepy smoke. Deep into distant woodlands winds a mazy way, reaching to overlapping spurs of mountains bathed in their hill-side blue. But though the picture lies thus traced, and though his pine-tree shakes down its sigh-like leaves upon this shepherd's head, get all were vain, unless the shepherd's eye were fixed upon the magic stream before him. Go visit the Prairies in June, when for scores on scores of miles you wade knee-deep among Tiger-lilies—what is the one charm wanting?—Water—there is not a drop of water there! Here Niagara but a contact of sand, would you travel your thousand miles to see it? Why did the poor poet of Tennessee, upon suddenly receiving two handfuls of silver, deliberate whether to buy him a coat, which he sadly needed, or invest his money in a pedestrian trip to Rockaway Beach? Why is almost every robust healthy boy with a robust healthy soul in him, at some time or other ready to go to sea? Why upon your first voyage as a passenger, did you yourself feel such a mystical vibration, when first told that you and your ship were now out of sight of land? Why did the old

Figure 3: mode 1 (128x48)

CHAPTER I. Loomings.

Call me Ishmael. Some years ago—never mind how long precisely—having little or no money in my purse, and nothing particular to interest me on shore, I thought I would sail about a little and see the watery part of the world. It is a way I have of driving off the spleen and regulating the circulation. Whenever I find myself growling about the mouth; whenever it is a damp, drizzly November in my soul; whenever I find myself involuntarily pausing before coffin warehouses, and bringing up the rear of every funeral I meet; and especially whenever my hypos get such an upper hand of me, that it requires a strong moral principle to prevent me from deliberately stepping into the street, and methodically knocking people's hats off—then, I account it high time to get to sea as soon as I can. This is my substitute for pistol and ball. With a philosophical flourish Cato throws himself upon his sword; I quietly take to the ship. There is nothing surprising in this. If they but knew it, almost all men in their degree, some time or other, cherish very nearly the same feelings towards the ocean with me.

There now is your insular city of the Manhattoes, belted round by wharves as Indian isles by coral reefs—commerce surrounds it with her surf. Right and left, the streets take you waterward. Its extreme downtown is the battery, where that noble mole is washed by waves, and cooled by breezes, which a few hours previous were out of sight of land. Look at the crowds of water-gazers there.

Circumnavigate the city of a dreamy Sabbath afternoon. Go from Corlears Hook to Coenties Slip, and from thence, by Whitehall, northward. What do you see?—Posted like silent sentinels all around the town, stand thousands upon thousands of mortal men fixed in ocean reveries. Some leaning against the spiles; some seated upon the pier-heads; some looking over the bulwarks of ships from China; some high aloft in the rigging, as if striving to get a still better seaward peep. But these are all landsmen; of week days pent up in lath and plaster—tied to counters, nailed to benches, clinched to desks. How then is this? Are the green fields gone? What do they here?

But look! here come more crowds, pacing straight for the water, and seemingly bound for a dive. Strange! Nothing will content them but the extremest limit of the land; loitering under the shady lee of yonder warehouses will not suffice. No, they must get just as nigh the water as they possibly can without falling in. And there they stand—miles of them—leagues. Inlanders all, they come from lanes and alleys, streets and avenues—north, east, south, and west. Yet here they all unite. Tell me, does the magnetic virtue of the needles of the compasses of all those ships attract them thither?

Once more. Say you are in the country; in some high land of lakes. Take almost any path you please, and ten to one it carries you down in a dale; and leaves you there by a pool in the stream. There is magic in it. Let the most absent-minded of men be plunged in his deepest reveries—stand that man on his legs, set his feet a-going, and he will infallibly lead you to water, if water there be in all that region. Should you ever be athirst in the great American desert, try this experiment, if your caravan happen to be supplied with a metaphysical professor. Yes, as every one knows, meditation and water are wedded for ever.

But here is an artist. He desires to paint you the dreamiest, shadiest, quietest, most enchanting bit of romantic landscape in all the valley of the Saco. What is the chief element he employs? There stand his trees, each with a hollow trunk, as if a hermit and a crucifix were within; and here sleeps his meadow, and there sleep his cattle; and up from yonder cottage goes a sleepy smoke. Deep into distant woodlands winds a mazy way, reaching to overlapping spurs of mountains bathed in their hill-side blue. But though the picture lies thus tranced, and though this pine-tree shakes down its sighs like leaves upon this shepherd's head, yet all were vain, unless the shepherd's eye were fixed upon the magic stream before him. Go visit the Prairies in June, when for scores on scores of miles you wade knee-deep among Tiger-lilies—what is the one charm wanting?—Water—there is not a drop of water there! Were Niagara but a cataract of sand, would you travel your thousand miles to see it? Why did the poor poet of Tennessee, upon suddenly receiving two handfuls of silver, deliberate whether to buy him a coat, which he sadly needed, or invest his money in a pedestrian trip to Rockaway Beach? Why is almost every robust healthy boy with a robust healthy soul in him, at some time or other crazy to go to sea? Why upon your first voyage as a passenger, did you yourself feel such a mystical vibration, when first told that you and your ship were now out of sight of land? Why did the old Persians hold the sea holy? Why did the Greeks give it a separate deity, and own brother of Jove? Surely all this is not without meaning. And still deeper the meaning of that story of Narcissus, who

Figure 4: mode 2 (96x64)

5 Hardware



Figure 5: Arduino Uno

SPIDriver connects directly to any Arduino or Arduino-compatible. It requires four connections:

- GND
- 5V
- RESET
- TX

To use another MCU, make the above four connections. Note that RESET is active-low. The serial protocol on TX is 115200 bps, 8 bits, no parity, 1 stop bit. This is frequently described as 115200-8N1. All signaling is 3.3V, but 5V tolerant.

6 Raw protocol

SPIDriver uses a serial protocol to send and receive SPI commands. Connect to the SPIDriver at 460800 baud, 8 bits, no parity, 1 stop bit (460800 8N1). Many SPIDriver commands are ASCII, you can control it interactively from any terminal application that can connect at 460800 baud. For example typing u and s toggles the CS line and ? displays the status info. Commands are:

?	transmit status information (see below)
e <i>byte</i>	echo <i>byte</i>
s	select
u	unselect
a <i>byte</i>	set A output to 0/1
b <i>byte</i>	set B output to 0/1
x	disconnect from SPI bus
0x80-bf	write and read 1-64 bytes
0xc0-ff	write 1-64 bytes

So for example to select, then transfer two bytes 0x12, and unselect, the host sends 5 bytes:

```
s
0x81
0x12
0x34
u
```

The command 0x81 is a two byte send/receive, so two bytes are returned to the PC. The status information is always 80 characters, space padded. For example:

```
[spidriver1 D000QS8D 000007219 4.807 045 25.4 1 1 1 49c1 ]
```

The fields are space-delimited:

spidriver1	fixed identifier
serial	serial code identifier
uptime	SPIDriver uptime 0-999999999, in seconds
voltage	USB bus voltage, in volts
current	attached device current, in mA
temperature	junction temperature, in C
CS	CS line state
A	A line state
B	B line state
crc	16-bit CRC of all input and output bytes (CRC-16-CCITT)

7 Specifications

7.1 DC characteristics

	min	typ	max	units
Voltage accuracy		0.01		V
Current accuracy		5		mA
Temperature accuracy		± 2		C
MISO				
low voltage			0.6	V
high voltage	2.7		5.8	V
Output signal current (SCK, MOSI, CS, A, B)			8	mA
Output current			470	mA
Current consumption		25		mA

7.2 AC characteristics

	min	typ	max	units
SPI speed	495	500	505	Kbps
Uptime accuracy		150		ppm
Uptime wrap		31.7		years
Startup time			200	ms

8 Support information

Technical and product support is available at support@excamera.com