Controlling over I2C port

Applies to EVB.1.2.0 firmware where I2C is implemented

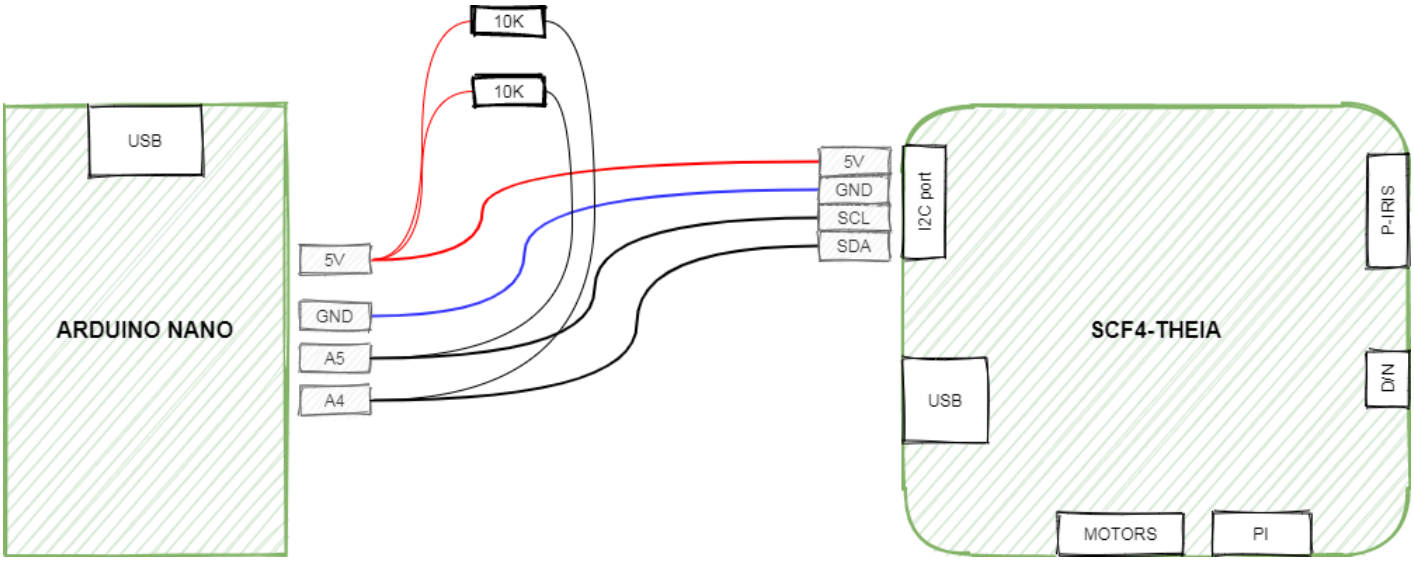
Slave address: 0x33

About

In order to simplify I2C communication, firmware utilizes one one direction read/write operations. All commands expect 5 bytes, where first byte is function address, remaining bytes is payload.

USB-CDC works in parallel with I2C functionality and independently, but it is recommended to use single communication channel once controller is initialized.

Wiring



In order to avoid power loops, do not connect both (SCF4 and Arduino) USB ports at the same time.

Write data

All commands are fixed length consisting of 5 bytes.

W: I2C ADDR	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4

Read data

First issue write command (register values are ignored). This step performs necessary calculations and fills memory with registers ready for reading in next step.

W: I2C ADDR	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4

Read command also consists of 5 bytes. FUNCTION repeats last write command value.

R: I2C ADDR	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4

Commands

ADDR	REGISTER NAME	R/W	FUNCTION
0x02	**RESET_CPU**	W	Reset STM32 CPU
0x03	**INIT_DRV**	W	Reset and initialize motor driver
0x05	**AUX_OUT**	W	Control AUX output on/off
0x06	**MODE**	W	Normal / forced move
0x07	**STOP**	W	Compulsory stop
0x08	**PI_LEDS**	W	Switch on ON or OFF PI LEDs
0x09	**MOTOR_SLEEP_PWR**	W	Set motor sleep power
0x0A	**MOTOR_DRV_PWR**	W	Set motor working power
0x0B	**MOTOR_SPEED**	W	Set motor speed
0x0C	**PI_THRESHOLD**	W	Set PI detector thresholds
0x0D	**READ_STATUS**	R	Read controller status
0x0E	**SET_MOTOR_POS**	W	Set current motor position
0x0F	**SET_MICROSTEPPING**	W	Set motor micro-stepping mode
0x10	**DN_SWITCH**	W	IR fitler

0x20	**MOVE**	W	Move motor

Command explanation

`RESET_CPU` - Reset CPU

Resets CPU. Other values are ignored.

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Reset CPU	0x02	ignored	ignored	ignored	**0x32**

`INIT_DRV` - Reset motor driver

Resets and initializes motor controller. Other values are ignored.

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Initialize motor driver	0x03	ignored	ignored	ignored	**0x32**

`AUX_OUT` - Control AUX output

Controls GPIO output

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Set AUX to Low	0x05	ignored	ignored	ignored	**0x00**
Set AUX to High	0x05	ignored	ignored	ignored	**0x01**

`MODE` - Normal / forced move

Selects between normal and normal+forced move mode

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Normal move mode	0x06	ignored	ignored	**Channel**	**0x00**
Normal+Forced move mode	0x06	ignored	ignored	**Channel**	**0x01**

Channel encoding:

Channel	BYTE3 value
A	0x01

B	0x02
C	0x03

`STOP` - Compulsory stop

Stop movement of all motors

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Reset CPU	0x07	ignored	ignored	ignored	**0x32**

`PI_LEDS` - Switch on ON or OFF PI LEDs

Control LEDs used in homing procedure.

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
OFF	0x08	ignored	ignored	ignored	**0x00**
ON	0x08	ignored	ignored	ignored	**0x01**

`MOTOR_SLEEP_PWR` - Set motor sleep power

Set motor sleep current

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Set current	0x09	ignored	ignored	**Channel**	**Power**

Channel encoding:

Channel	BYTE3 value
A	0x01
B	0x02
C	0x03

`MOTOR_DRV_PWR` - Set motor working power

Set motor operating current

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Set current	0x0A	ignored	ignored	**Channel**	**Power**

Channel encoding:

Channel	BYTE3 value
A	0x01
B	0x02
C	0x03
D	0x04

`MOTOR_SPEED` - Set motor speed

Set motor speed

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Set speed	0x0B	ignored	**Channel**	**Speed [15:8]**	**Speed [7:0]**

Channel encoding:

Channel	BYTE2 value
A	0x01
B	0x02
C	0x03

`PI_THRESHOLD` - Set PI detector thresholds

Set limit switch optocoupler detector thresholds

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Set threshold	0x0C	ignored	**Channel**	**Signal [15:8]**	**Signal [7:0]**

Channel encoding:

Channel	BYTE2 value
A LOW	0x01
B LOW	0x02

C LOW	0x03
A HIGH	0x04
B HIGH	0x05
C HIGH	0x06

`READ_STATUS` - Read controller status

Read motor status, PI status and motor positions

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Set current	0x0D	ignored	ignored	ignored	**Channel**

Channel encoding:

Channel	BYTE2 value
A position	0x01
B position	0x02
C position	0x03
PI_A status	0x04
PI_B status	0x05
PI_C status	0x06
A moving	0x07
B moving	0x08
C moving	0x09

Returns:

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Status return value	0x0D	**Value [31:24]**	**Value [23:16]**	**Value [15:8]**	**Value [7:0]**

`SET_MOTOR_POS` - Set position

Redefine current position

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Set position	0x0E	**Channel**	**Speed [23:16]**	**Speed [15:8]**	**Speed [7:0]**

Channel encoding:

Channel	BYTE1 value
A	0x01
B	0x02
C	0x03

`SET_MICROSTEPPING` - Set microstepping mode

Set microstepping mode for defined channel

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
Set microstepping	0x0F	ignored	ignored	**Channel**	**Mode**

Channel encoding:

Channel	BYTE1 value
A	0x01
B	0x02
C	0x03

`MOVE` - Move motor

Move motor defined step count.

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4

Steps	0x20	**Channel**	**Direction**	**Steps [15:8]**	**Steps [7:0]**

Channel encoding:

Channel	BYTE2 value
A	0x01
B	0x02
C	0x03

> MAX steps is: 0xFFFF-1 = **0xFFFE**

> Theia lens exceeds 0xFFFF step count, thus absolute positioning has to be implemented on client side code

`DN_SWITCH` - IR filter swith

Switch filter to day or night position

Description	FUNCTION	BYTE1	BYTE2	BYTE3	BYTE4
POS1	0x10	ignored	ignored	ignored	**0x00**
POS2	0x10	ignored	ignored	ignored	**0x01**

Arduino sketch example

Demo output should look like

```
SCF4-M I2C tester


Init driver
Set microstepping
Move mode
PI LEDS
Set drive pwr
Set sleep pwr
Set motor speeds
Set PI thresholds
Read status: posA
```

```
D 0 0 0 0
Read status: PI A
D 0 0 0 1
Homing A
Homing B
Move +A
Move -A
Move +B
Move -B
Move +C
Move -C
Set position
DN 0
DN 1
DN 0
DN 1
Last return from I2C port: ok
Loop...
```

`tester.ino`

```
#include <Wire.h>

#define CH_A 0x01
#define CH_B 0x02
#define CH_C 0x03
#define CH_D 0x04

#define CCW  0
#define CW   1


void err_print(byte err)
{
    if (err == 0)
    {
      Serial.println("ok");
    }
    else if (err==4)
    {
```

```
      Serial.println("failed");
    }
}

void setup()
{
  Wire.begin();
  Serial.begin(115200);
  while (!Serial);
  Serial.println("\nSCF4-M I2C tester\n");
}

void loop()
{
    byte error;

    Serial.println("Init driver");
    SCF4_INIT_DRIVER();

    Serial.println("Set microstepping");
    SCF4_MICROSTEPPING(2, CH_A);
    SCF4_MICROSTEPPING(2, CH_B);
    SCF4_MICROSTEPPING(6, CH_C);

    Serial.println("Move mode");
    SCF4_MODE(0x00, CH_A);
    SCF4_MODE(0x00, CH_B);
    SCF4_MODE(0x00, CH_C);

    Serial.println("PI LEDS");
    SCF4_PI_LEDS(0x01);

    Serial.println("Set drive pwr");
    SCF4_DRV_PWR(180, CH_A);
    SCF4_DRV_PWR(180, CH_B);
    SCF4_DRV_PWR(180, CH_C);
    SCF4_DRV_PWR(90, CH_D);

    Serial.println("Set sleep pwr");
    SCF4_SLEEP_PWR(50, CH_A);
```

```
SCF4_SLEEP_PWR(50, CH_B);
SCF4_SLEEP_PWR(50, CH_C);

Serial.println("Set motor speeds");
SCF4_MOTOR_SPEED(5000, CH_A);
SCF4_MOTOR_SPEED(5000, CH_B);
SCF4_MOTOR_SPEED(5000, CH_C);


Serial.println("Set PI thresholds");
SCF4_PI_THRESHOLD(2000, 0x01);
SCF4_PI_THRESHOLD(2000, 0x02);
SCF4_PI_THRESHOLD(2000, 0x03);
SCF4_PI_THRESHOLD(3000, 0x04);
SCF4_PI_THRESHOLD(3000, 0x05);
SCF4_PI_THRESHOLD(3000, 0x06);


Serial.println("Read status: posA");
SCF4_READ_STATUS(0x01);
Serial.println("Read status: PI A");
SCF4_READ_STATUS(0x04);


Serial.println("Homing A");
MOVE(30000, CW, CH_A);
delay(2000);
SCF4_MODE(0x01, CH_A);
MOVE(0x100, CCW, CH_A);
delay(15000); // status reading is not implemented, for testing 15s timeout is used
SCF4_MODE(0x00, CH_A);
SET_MOTOR_POS(100, CH_A);

Serial.println("Homing B");
MOVE(30000, CW, CH_B);
delay(2000);
SCF4_MODE(0x01, CH_B);
MOVE(0x100, CCW, CH_B);
delay(15000); // status reading is not implemented, for testing 15s timeout is used
SCF4_MODE(0x00, CH_B);
```

```
    SET_MOTOR_POS(100, CH_B);



    // normal operation starts here



    Serial.println("Move +A");
    MOVE(0xFFFE, CW, CH_A);
    delay(5000);
    Serial.println("Move -A");
    MOVE(0xFFFE, CCW, CH_A);
    delay(5000);

    Serial.println("Move +B");
    MOVE(0xFFFE, CW, CH_B);
    delay(5000);
    Serial.println("Move -B");
    MOVE(0xFFFE, CCW, CH_B);
    delay(5000);

    Serial.println("Move +C");
    MOVE(1000, CW, CH_C);
    delay(2000);
    Serial.println("Move -C");
    MOVE(1000, CCW, CH_C);
    delay(2000);

    Serial.println("Set position");
    //SET_MOTOR_POS(100, 0x01);
    //SET_MOTOR_POS(200, 0x01);
    //SET_MOTOR_POS(300, 0x01);

    //STOP();

    Serial.println("DN 0");
    DN_SWITCH(0);
    delay(1000);
    Serial.println("DN 1");
```

```
    DN_SWITCH(1);
    delay(1000);
    Serial.println("DN 0");
    DN_SWITCH(0);
    delay(1000);
    Serial.println("DN 1");
    DN_SWITCH(1);
    delay(1000);



    Serial.print("Last return from I2C port: ");
    err_print(error);

    Serial.println("Loop...");
    while(1)
    {
    }
}
```

scf4_i2c.ino

```
// SCL - A5
// SDA - A4

#include <Wire.h>
#define SCF4_ADDR 0x33

// SCF4 is not signaling busy status, thus fixed delay is added
// If next I2C command is sent too soon it might be ignored
#define I2C_SLEEP 200



byte SCF4_AUX(byte status)
{
  byte function = 0x05;
  byte error;

  //byte w1 = (counter&0xFF);
  //byte w2 = ((counter>>8)&0xFF);
  //byte w3 = ((counter>>16)&0xFF);
  //byte w4 = ((counter>>24)&0xFF);
```

```
  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(0);
  Wire.write(status);
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_RESET_CPU(void)
{
  byte function = 0x02;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(0);
  Wire.write(0x32);
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_INIT_DRIVER(void)
{
  byte function = 0x03;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(0);
  Wire.write(0x32);
```

```
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_MODE(byte mode, byte ch)
{
  byte function = 0x06;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(ch);
  Wire.write(mode);
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_PI_LEDS(byte mode)
{
  byte function = 0x08;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(0);
  Wire.write(mode);
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_SLEEP_PWR(byte pwr, byte ch)
```

```
{
  byte function = 0x09;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(ch);
  Wire.write(pwr);
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_DRV_PWR(byte pwr, byte ch)
{
  byte function = 0x0A;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(ch);
  Wire.write(pwr);
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_MOTOR_SPEED(int speed, byte ch)
{
  byte function = 0x0B;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
```

```
  Wire.write(ch);
  Wire.write(highByte(speed));
  Wire.write(lowByte(speed));
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_PI_THRESHOLD(int level, byte ch)
{
  byte function = 0x0C;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(ch);
  Wire.write(highByte(level));
  Wire.write(lowByte(level));
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_READ_STATUS(byte ch)
{
  byte function = 0x0D;
  byte error;

  /*
  * channel:
  * 0x00 - dummy, reads 0x87, 0x65, 0x43, 0x21
  * 0x01 - chA.position
  * 0x02 - chB.position
  * 0x03 - chC.position
  * 0x04 - piA.status
  * 0x05 - piB.status
  * 0x06 - piC.status
  * 0x07 - chA.moving
```

```
* 0x08 - chB.moving
* 0x09 - chC.moving
*/

Wire.beginTransmission(SCF4_ADDR);
Wire.write(function);
Wire.write(0);
Wire.write(0);
Wire.write(0);
Wire.write(ch);
error = Wire.endTransmission();

delay(I2C_SLEEP);

byte w1 = 0xff;
byte w2 = 0xff;
byte w3 = 0xff;
byte w4 = 0xff;
byte w5 = 0xff;

Wire.requestFrom(SCF4_ADDR, 5);
w1 = Wire.read();
w2 = Wire.read();
w3 = Wire.read();
w4 = Wire.read();
w5 = Wire.read();

Serial.print(w1, HEX);
Serial.print(" ");
Serial.print(w2, HEX);
Serial.print(" ");
Serial.print(w3, HEX);
Serial.print(" ");
Serial.print(w4, HEX);
Serial.print(" ");
Serial.print(w5, HEX);
Serial.println();

delay(I2C_SLEEP);

// TODO: return read values
```

```
  return error;
}


byte SET_MOTOR_POS(int pos, byte ch)
{
  byte function = 0x0E;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(ch);
  Wire.write(0);
  Wire.write(highByte(pos));
  Wire.write(lowByte(pos));
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte MOVE(unsigned int steps, byte dir, byte ch)
{
  byte function = 0x20;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(ch);
  Wire.write(dir);
  Wire.write(highByte(steps));
  Wire.write(lowByte(steps));
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte DN_SWITCH(byte mode)
{
  byte function = 0x10;
```

```
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(0);
  Wire.write(mode);
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte SCF4_MICROSTEPPING(byte stepping, byte ch)
{
  byte function = 0x0F;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(ch);
  Wire.write(stepping);
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}

byte STOP(void)
{
  byte function = 0x07;
  byte error;

  Wire.beginTransmission(SCF4_ADDR);
  Wire.write(function);
  Wire.write(0);
  Wire.write(0);
  Wire.write(0);
```

```
  Wire.write(0x32);
  error = Wire.endTransmission();
  delay(I2C_SLEEP);

  return error;
}
```

Revision #76
Created 9 August 2020 13:14:02 by Saulius
Updated 6 February 2021 12:09:15 by Saulius