

# MEAS TEMPERATURE SYSTEM SENSOR (TSYS02D) XPLAINED PRO BOARD

Digital Temperature  
Digital Component Sensor (DCS) Development Tools

## Performance

- ◆ -5°C to 50°C accuracy: 0.2°C
- ◆ -20°C to 100°C accuracy: 0.5°C
- ◆ -40°C to 125°C accuracy: 1°C
- ◆ Very low power consumption
- ◆ Operates from 1.5V to 3.6V
- ◆ Time constant – 4 seconds typical

## Features

- ◆ 20-pin Xplained Pro compatible connector
- ◆ I<sup>2</sup>C interface
- ◆ Xplained Pro hardware identification chip
- ◆ Atmel Studio 6 Project available for download
- ◆ µC C code available for download
- ◆ 24/16 bit resolution for temperature
- ◆ Parameters stored on chip

The Temperature System Sensor (TSYS02D) Xplained Pro provides the necessary hardware to interface the TSYS02D digital temperature sensor to any system that utilizes Xplained Pro compatible expansion ports configurable for I<sup>2</sup>C communication. The TSYS02D sensor is a self-contained temperature sensor that is fully calibrated during manufacture. The sensor can operate from 2.2V to 3.6V. The TSYS02D has a low power stand-by mode for power-sensitive applications.

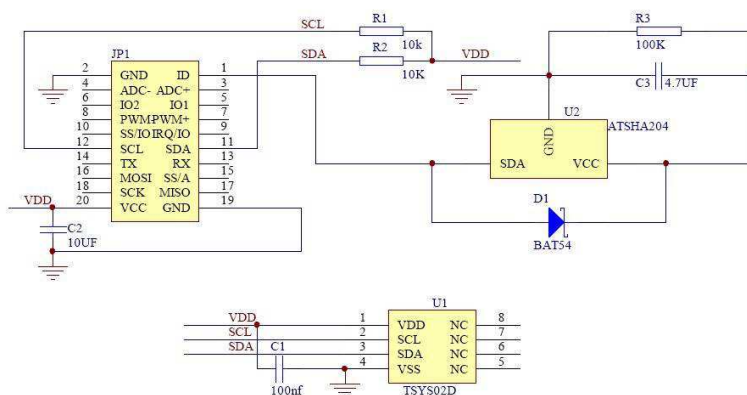
Refer to the TSYS02D data sheet for detailed information regarding operation of the IC:

<http://www.te.com/usa-en/product-G-NIMO-003.html>

## Specifications

- ◆ Measures temperature from -40°C to 125°C
- ◆ I<sup>2</sup>C communication
- ◆ Fully calibrated
- ◆ Fast response time
- ◆ Very low power consumption

## Schematic

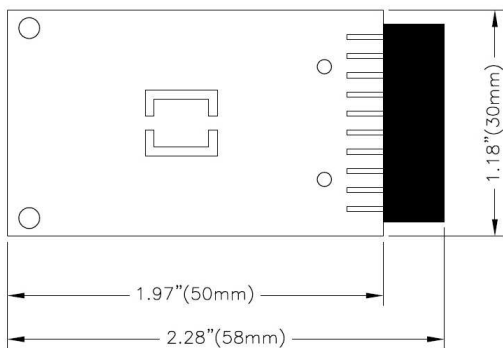


## Connector Pin Assignments (I<sup>2</sup>C Communications)

### System Plug

Connector JP1					
Pin No.	Signal	Description	Pin No.	Signal	Description
1	ID	Hardware identification	11	SDA	TWI Serial Data
2	GND	Ground	12	SCL	TWI Serial Clock
3	N/C	Not Connected	13	N/C	Not Connected
4	N/C	Not Connected	14	N/C	Not Connected
5	N/C	Not Connected	15	N/C	Not Connected
6	N/C	Not Connected	16	N/C	Not Connected
7	N/C	Not Connected	17	N/C	Not Connected
8	N/C	Not Connected	18	N/C	Not Connected
9	N/C	Not Connected	19	GND	Ground
10	N/C	Not Connected	20	Vdd	Power Supply

### Dimensions (mm)



### Detailed Description

#### I<sup>2</sup>C Interface

The peripheral module can interface to the host being plugged directly into an Xplained Pro extension port (configured for I<sup>2</sup>C) through connector JP1.

#### External Control Signals

The IC operates as an I<sup>2</sup>C slave using the standard 2 wire I<sup>2</sup>C connection scheme. The IC is controlled either by the host (through the Xplained Pro connector). In cases where one or more of the SCL and SDA signals are driven from an external source, 10k resistors R1, R2 provide pull-up. However, this also increases the apparent load to the external driving source. If the external source is not capable of driving these loads (10k), they should be removed.

#### Reference Materials

The complete software kit is available for download at: [Link to TSYS02D\\_CPROJ.zip](#)

## Drivers & Software

Detailed example software and drivers are available that execute directly without modification on a number of development boards that support an integrated or synthesized microprocessor. The download contains several source files intended to accelerate customer evaluation and design. The source code is written in standard ANSI C format, and all development documentation including theory/operation, register description, and function prototypes are documented in the interface file.

## Functions Summary

### Enumerations

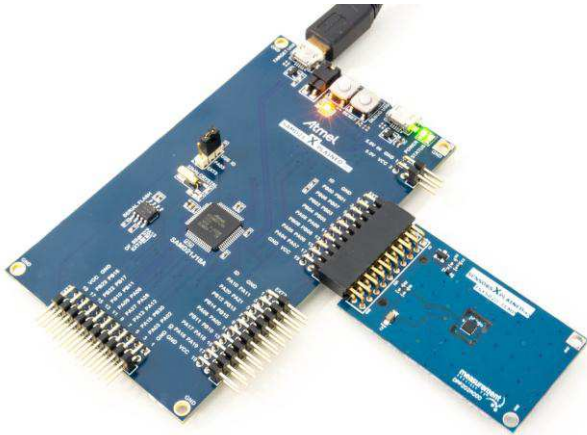
enum	<b>tsys02d_i2c_master_mode</b> { <b>tsys02d_i2c_hold</b> , <b>tsys02d_i2c_no_hold</b> }
enum	<b>tsys02d_status</b> { <b>tsys02d_status_ok</b> , <b>tsys02d_status_no_i2c_acknowledge</b> , <b>tsys02d_status_i2c_transfer_error</b> , <b>tsys02d_status_crc_error</b> }
enum	<b>tsys02d_resolution</b> { <b>tsys02d_resolution_t_14b</b> , <b>tsys02d_resolution_t_13b</b> , <b>tsys02d_resolution_t_12b</b> , <b>tsys02d_resolution_t_11b</b> }
enum	<b>tsys02d_battery_status</b> { <b>tsys02d_battery_ok</b> , <b>tsys02d_battery_low</b> }
enum	<b>tsys02d_heater_status</b> { <b>tsys02d_heater_off</b> , <b>tsys02d_heater_on</b> }

### Functions



void	<b>tsys02d_init</b> (void) Configures the SERCOM I2C master to be used with the TSYS02D device.
bool	<b>tsys02d_is_connected</b> (void) Check whether TSYS02D device is connected.
enum tsys02d_status	<b>tsys02d_reset</b> (void) Reset the TSYS02D device.
enum tsys02d_status	<b>tsys02d_read_serial_number</b> (uint64_t *) Reads the tsys02d serial number.
enum tsys02d_status	<b>tsys02d_set_resolution</b> (enum tsys02d_resolution) Set temperature ADC resolution.
void	<b>tsys02d_set_i2c_master_mode</b> (enum tsys02d_i2c_master_mode) Set I2C master mode.
enum tsys02d_status	<b>tsys02d_read_temperature</b> (float *) Reads the temperature ADC value and compute the degree Celsius one.
enum tsys02d_status	<b>tsys02d_get_battery_status</b> (enum tsys02d_battery_status *) Provide battery status.
enum tsys02d_status	<b>tsys02d_enable_heater</b> (void) Enable heater.
enum tsys02d_status	<b>tsys02d_disable_heater</b> (void) Disable heater.
enum tsys02d_status	<b>tsys02d_get_heater_status</b> (enum tsys02d_heater_status *) Get heater status.

### Project Setup

This project is based on ATSAM20J18 board with Measurement Specialties Xplained Pro extension board connected to EXT1 pad as shown on figure below.



### Running the Application

1. Download the TSYS02D Xplained Pro example package on [TE Website](#)
2. Decompress the archive file
3. Open the .cproj project file with Atmel Studio 6
4. You will now be able to build the TSYS02D example project - 
5. Finally, run the build result on your Xplained Pro Board - 

### Application Code

This section is intended to provide a basic example of functionality.

```
/**
 * \file main.c
 *
 * \brief TSYS02D temperature monitoring application file
 *
 * Copyright (c) 2014 Measurement Specialties. All rights reserved.
 */

#include <asf.h>

float temperature;
uint64_t serial;

int main (void)
{
    enum tsys02d_status status;
    float last_temperature = 0;
```

```
float variation = 0;
enum tsys02d_heater_status heater;

system_init();
delay_init();

// Configure device and enable
tsys02d_init();

if( !tsys02d_is_connected() )
    return -1;

// Reset TSYS02D
status = tsys02d_reset();
if( status != tsys02d_status_ok)
    return -1;

// Monitor temperature every 500ms
while (1) {
    tsys02d_read_temperature( &temperature);
    if( status != tsys02d_status_ok)
        return -1;
    variation += temperature - last_temperature;
    // Look for significant temperature variation
    if ( variation >= 0.5 ) {
        // Yes, so turn LED on.
        port_pin_set_output_level(LED_0_PIN, LED_0_ACTIVE);
        variation = 0;
    } else if ( variation <= -0.5 ) {
        // No, so turn LED off.
        port_pin_set_output_level(LED_0_PIN, LED_0_INACTIVE);
        variation = 0;
    }
    delay_ms(500);
    last_temperature = temperature;
}
return 0;
}
```

## MEAS TSYS02D XPLAINED PRO BOARD

Digital Temperature DCS Development Tools

### Ordering Information

Description	Part Number
MEAS TSYS02D XPLAINED PRO BOARD	DPP202A000

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