



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of "Quality Parts,Customers Priority,Honest Operation,and Considerate Service",our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

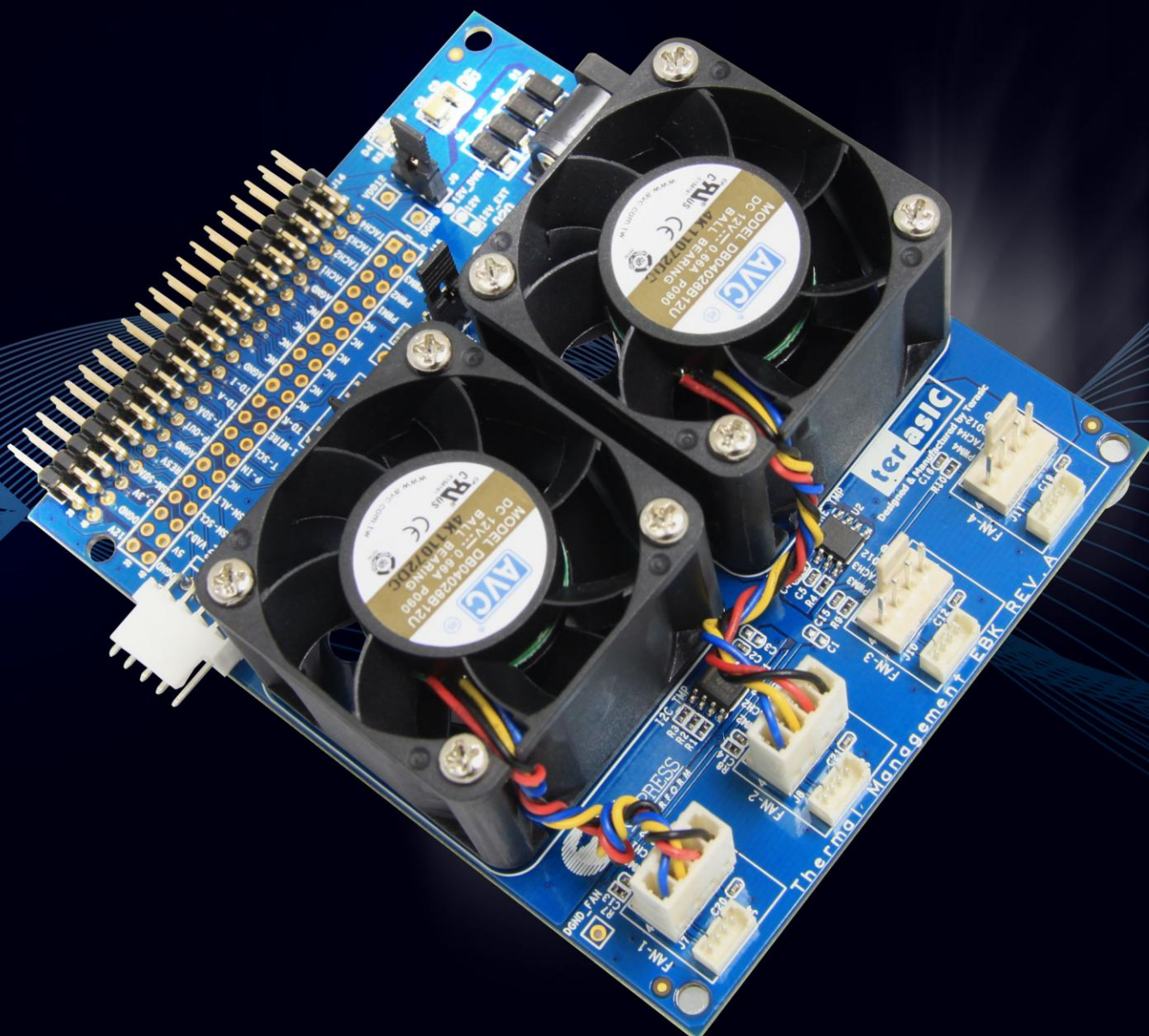
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



# PSoC

## Thermal Management Expansion Board Kit CY8CKIT-036

### User's Guide





# CONTENTS

<b>Chapter 1</b>	<b><i>INTRODUCTION TO THE TME EBK</i></b>	<b>3</b>
1.1	Features	4
1.2	About the KIT	5
1.3	PSoC Creator	6
1.4	Getting Help	6
<b>Chapter 2</b>	<b><i>TME EBK ARCHITECTURE</i></b>	<b>7</b>
2.1	Layout and Components	7
2.2	Thermal Management Solution on the TME	8
<b>Chapter 3</b>	<b><i>TME EBK HARDWARE OVERVIEW</i></b>	<b>10</b>
3.1	2x20 pin Interface Header	10
3.2	TME EBK Headers and Jumpers	11
3.3	PWM Output Digital Temperature Sensors	12
3.4	I2C Digital Temperature Sensor	13
3.5	1-Wire Digital Temperature Sensor	14
3.6	Diode Analog Temperature Sensors	15
3.7	4-Wire Fan Connectors	15
3.8	Development Kit (DVK) Compatibility	16
<b>Chapter 4</b>	<b><i>EXAMPLE PROJECTS FOR THE TME</i></b>	<b>17</b>
4.1	Introduction	17
4.2	Software Installation	17
4.3	Hardware Setup	18
4.4	Example Projects	21
<b>Chapter 5</b>	<b><i>TME SCHEMATICS</i></b>	<b>39</b>
5.1	Power Supply	39
5.2	4-Wire Fan Sockets	39
5.3	I2C/SMBus/PMBus Port	40
5.4	2x20 Pin DVK Connector and Test Points	40
5.5	1-Wire Temperature Sensor	40
5.6	Temperature Diodes	41
5.7	I2C Temperature Sensor	41



5.8 PWM Temperature Sensors .....	41
5.9 Layout.....	42
5.10 Top layer .....	42
5.11 Bottom layer .....	43
5.12 Top Silkscreen .....	43
5.13 Bill of Materials.....	44
<b>Chapter 6 APPENDIX.....</b>	<b>46</b>
6.1 Revision History .....	46
6.2 Copyright Statement .....	46

## Chapter 1

# *Introduction to the TME EBK*

---

In general terms, thermal management is a combination of temperature sensing, fan control and the algorithms or transfer functions that map temperature to fan speed. Thermal management is a critical, system-level function that needs to ensure that all components in the system operate within safe temperature limits, while at the same time minimizing power consumption and acoustic noise.

Typical solutions for thermal management include multiple devices such as CPLDs, mixed-signal ASICs and/or limited-functionality and inflexible discrete devices. Thermal management solutions need to be flexible enough to interface with many kinds of both digital and analog temperature sensors. To maximize efficiency, they must also be able to drive a multitude of fans independently. Finally, thermal management solutions must have enough intelligence built in to reliably control the cooling systems autonomously, independent of a master control processor in the event that communications are lost or the master control processors fail or go offline.

The PSoC® 3 architecture enables a flexible and unique method of thermal management in a single chip, combining analog sensing capabilities for any kind of analog temperature sensor such as remote diodes, thermistors, resistance temperature detectors (RTDs), etc. PSoC 3's versatile digital resource pool enables the integration of multiple I2C bus interfaces, capture timers and even full-custom logic to support interfaces to a wide variety of digital temperature sensors such as I2C based, pulse-width-modulated (PWM) based and other proprietary serial interface digital temperature sensors. PSoC 3's unique CPLD-like hardware blocks are also used to implement a full hardware closed loop fan control system for high reliability systems that require zero intervention from firmware running on the built-in MCU or running on an external master control processor. This frees up MCU processing power to run and manage algorithms or transfer functions of very high complexity to optimize fan speeds to achieve system cooling requirements.

The PSoC Thermal Management Expansion Board Kit (TME EBK) is a part of the PSoC development kit ecosystem and is designed to work with the CY8CKIT-001 PSoC Development Kit (DVK) and CY8CKIT-030 PSoC 3 Development Kit (DVK). It enables you to evaluate a system's thermal management functions and capabilities of PSoC 3 devices. You can evaluate the example projects described in this guide or design and customize your own thermal management solution using components in Cypress's PSoC Creator™ software (included in this kit) or by altering example projects provided with this kit.

The PSoC Thermal Management Expansion Board Kit (TME EBK) is used with the PSoC family of devices and is specifically designed and packaged for use with the PSoC 3 device family. PSoC 3 is a programmable system-on-chip platform that combines precision analog and digital logic with a high performance, single-cycle, 67MHz 8051 processor. With the flexibility of the PSoC architecture, you can easily create your own custom thermal management solution on chip with the exact functionality you need, in the way you want it—no more, no less.

## 1.1 Features

The TME EBK is intended to provide a demonstration and development platform for developing system thermal management co-processor solutions with compelling example projects that demonstrate a variety of modes:

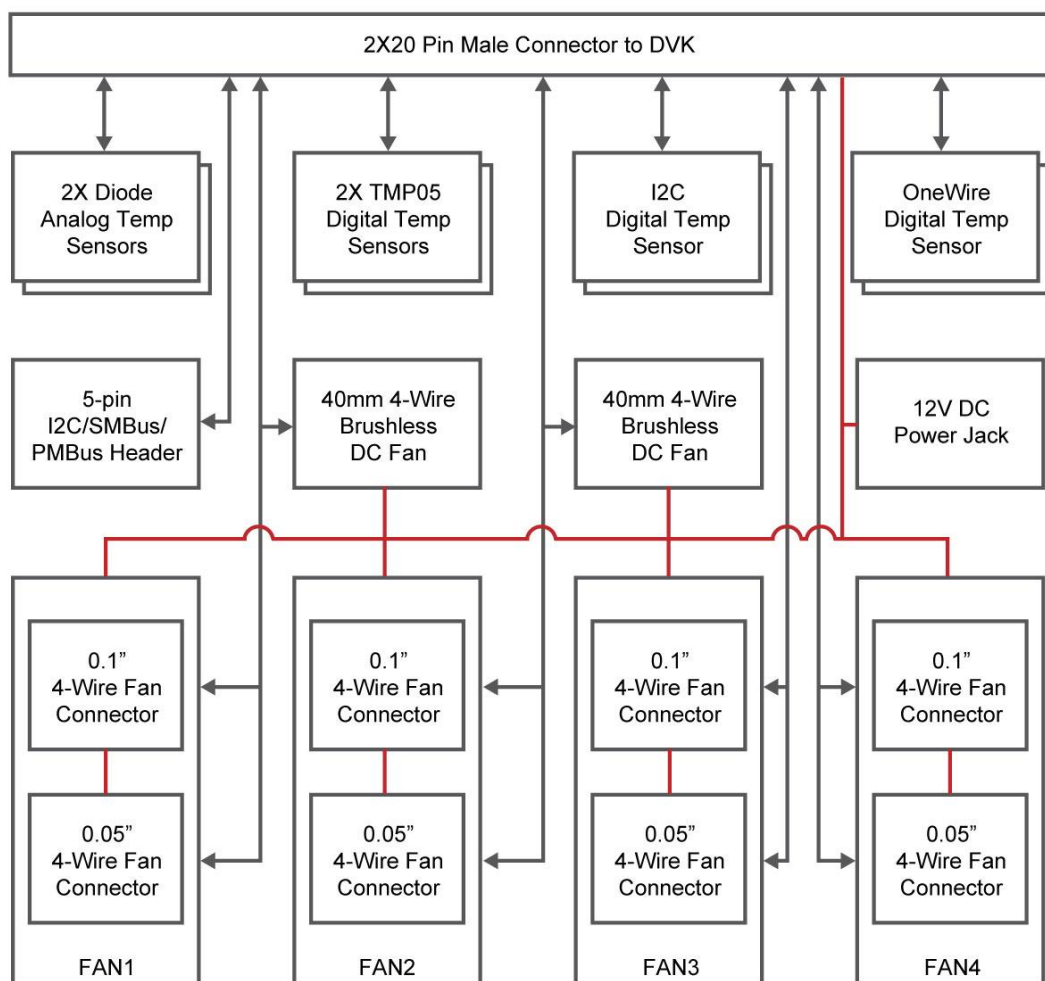
Temperature monitoring

Open-loop and closed-loop fan control

Thermal zone management: the relationship between temperatures and cooling functions

Algorithms to detect thermal and cooling failures or warnings

**Figure 1-1** shows a simplified block diagram of the components on the TME EBK and how they interact to aid in understanding of the hardware.



**Figure 1-1: TME EBK Block Diagram**

## 1.2 About the KIT

The PSoC Thermal Management Expansion board kit (TME) consists of:

Cypress TME EBK

Quick Start Guide

Power DC Adaptor 12V/2A

System CD containing:

- User's Guide (this document)
- PSoC Creator and pre-requisite software
- PSoC Programmer and pre-requisite software
- TME Example Firmware for the CY8CKIT-001 DVK
- Firmware based (open loop) Fan Control
- Hardware based (closed loop) Fan Control
- Thermal Management System
- TME Example Firmware for the CY8CKIT-030 DVK
- Firmware based (open loop) Fan Control
- Hardware based (closed loop) Fan Control
- Thermal Management System
- Application Note ([AN66627](#)) "PSoC® 3 and PSoC 5 Intelligent Fan Controller"
- Application Note ([AN60590](#)) "Temperature Measurement Using Diode"
- Datasheets for key TME EBK components

Figure 1-2 shows the photograph of the TME EBK contents.



Figure 1-2: TME EBK Package Contents



## 1.3 PSoC Creator

Cypress's PSoC Creator software is a state-of-the-art, easy-to-use integrated development environment (IDE) that introduces a game changing, hardware and software design environment based on classic schematic entry and revolutionary embedded design methodology.

With PSoC Creator, you can:

Draw a schematic of the hardware circuit you would like to build inside PSoC and the tool will automatically place and route the components for you

Eliminate external CPLDs or standard logic ICs by integrating state machines and simple glue logic in your design

Trade-off architecture decisions between hardware and software, allowing you to focus on what matters and getting you to market faster

PSoC Creator also enables you to tap into an entire tools ecosystem with integrated compiler tool chains, RTOS solutions, and production programmers to support PSoC 3.

## 1.4 Getting Help

Certified as a Cypress Authorized Design Partner, Terasic offers design expertise in rapidly developing PSoC Solutions to get your products into production quickly and reducing your development and BOM costs. Terasic provides customized board designs for academia and industry.

For additional information visit:

[www.cypress.com/go/CY8CKIT-036](http://www.cypress.com/go/CY8CKIT-036)

or

<http://tme.terasic.com>

For support please contact:

Online: [www.cypress.com/go/support](http://www.cypress.com/go/support)

Telephone (24x7): +1-800-541-4736 ext. 8 (USA)

+1-408-943-2600 ext. 8 (International)

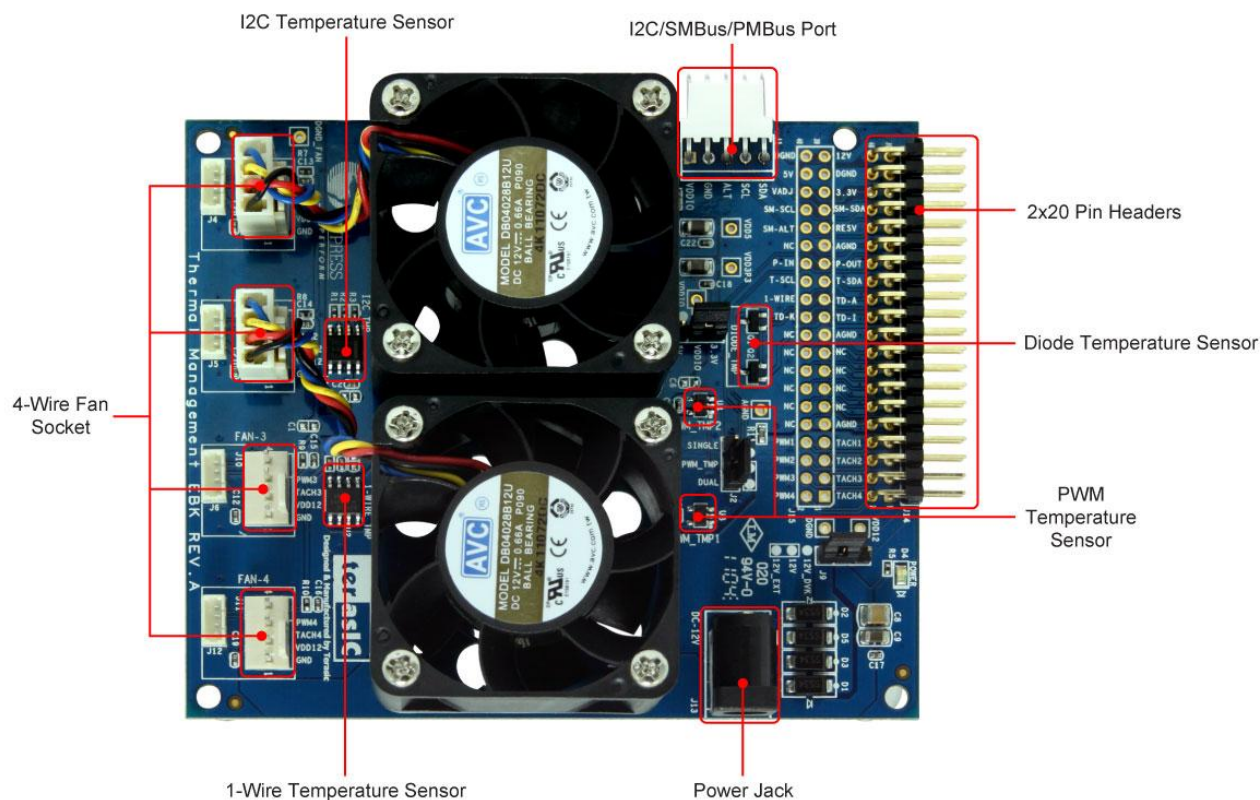


## TME EBK Architecture

This chapter provides information about the architecture and block diagram of the TME EBK.

### 2.1 Layout and Components

The picture of the TME EBK is shown in **Figure 2-1** and **Figure 2-2**. They depict the layout of the board and indicate the locations of the connectors and key components.



**Figure 2-1: TME PCB (Top)**

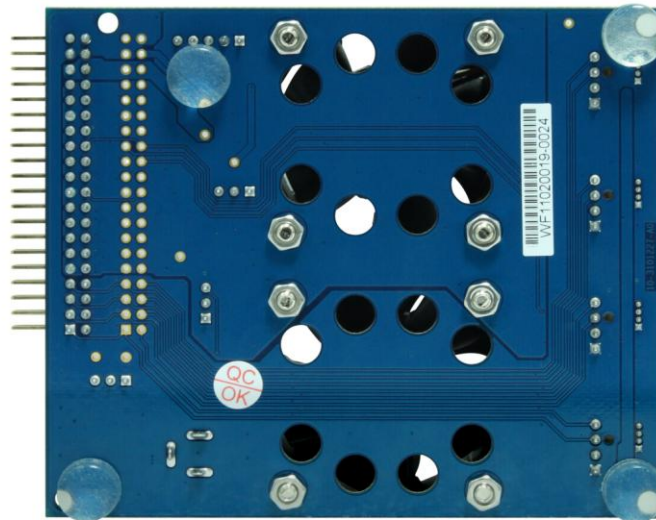


Figure 2-2: TME PCB (Bottom)

## 2.2 Thermal Management Solution on the TME

The TME EBK contains two 4-wire, 12V brushless DC fans with connectors to support an additional 2 fans for designers who need to prototype with their own specific fan models. 6 temperature sensors (4 different kinds) are also installed on the kit: 1) TMP175 I2C digital temperature sensor, 2) 2x TMP05 PWM output digital temperature sensors, 3) DS18S20 “One Wire” digital temperature sensor and 4) 2x MMBT3094 temperature diodes. This combination of hardware elements enables designers to rapidly prototype thermal management solutions in a variety of configurations.

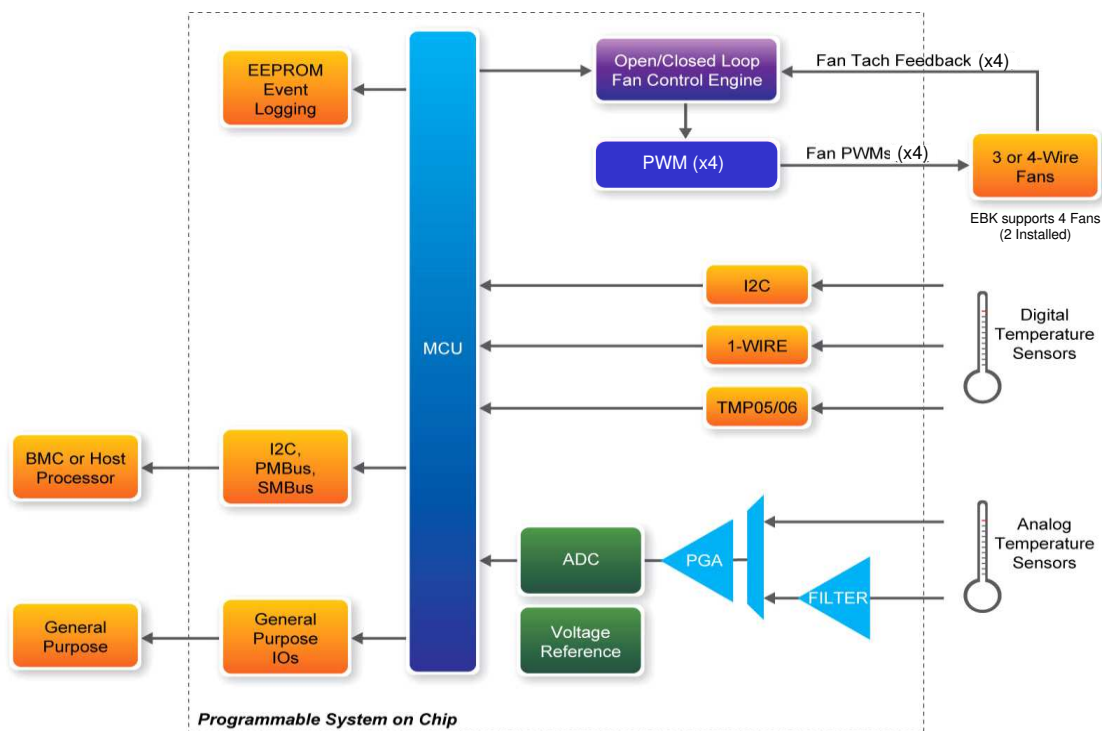
TME EBK also provides an I2C/SMBus/PMBus compatible header to support systems that have a requirement for communication with a host controller. All of this functionality is implemented on a single PSoC 3. The TME routes all the input/output signals for thermal management to a PSoC 3 mounted on a development kit platform such as the CY8CKIT-001 PSoC Development Kit or CY8CKIT-030 PSoC 3 Development Kit. PSoC 3 is not mounted on the TME EBK itself.

**Figure 2-3** shows a functional diagram of the PSoC Thermal Management solution. This solution enables control of up to 4x 4-wire fans using MCU based firmware control or hardware control. Fan drive signals are generated by independent hardware PWM blocks in PSoC to drive the 4 wire fans. Tachometer signals from the fans are interpreted by PSoC to determine fan rotational speeds. In hardware control mode, speed control is implemented entirely in hardware (no MCU intervention required). In firmware control mode, speed control can be achieved by the firmware running on PSoC with CPU intervention. In both cases, fan stall or rotor lock faults are detected by hardware.

To support digital sensor temperature sensing, standard PSoC interfaces are used where possible (such as I2C) and custom PSoC components have been developed for non-typical digital sensors such as the PWM output TMP05 sensor. This is explained in Section 4 of this User’s Manual. For analog sensors, PSoC also provides on-board filtering, multiplexing and a 0.1% accurate internal voltage reference for high resolution and highly accurate temperature sensor measurement.

One of the example projects provided with the TME EBK shows an example of how to aggregate temperature sensor readings using a variety of methods and the resultant “zone” temperature used to set individual fan speeds – this is referred to as defining a “thermal zone”. The example project shows how each fan can be configured independently to be dependent on any of the available temperature sensors in any combination. It also gives some examples of how the composite “zone temperature” can be used to determine the required fan speed to achieve system cooling needs.

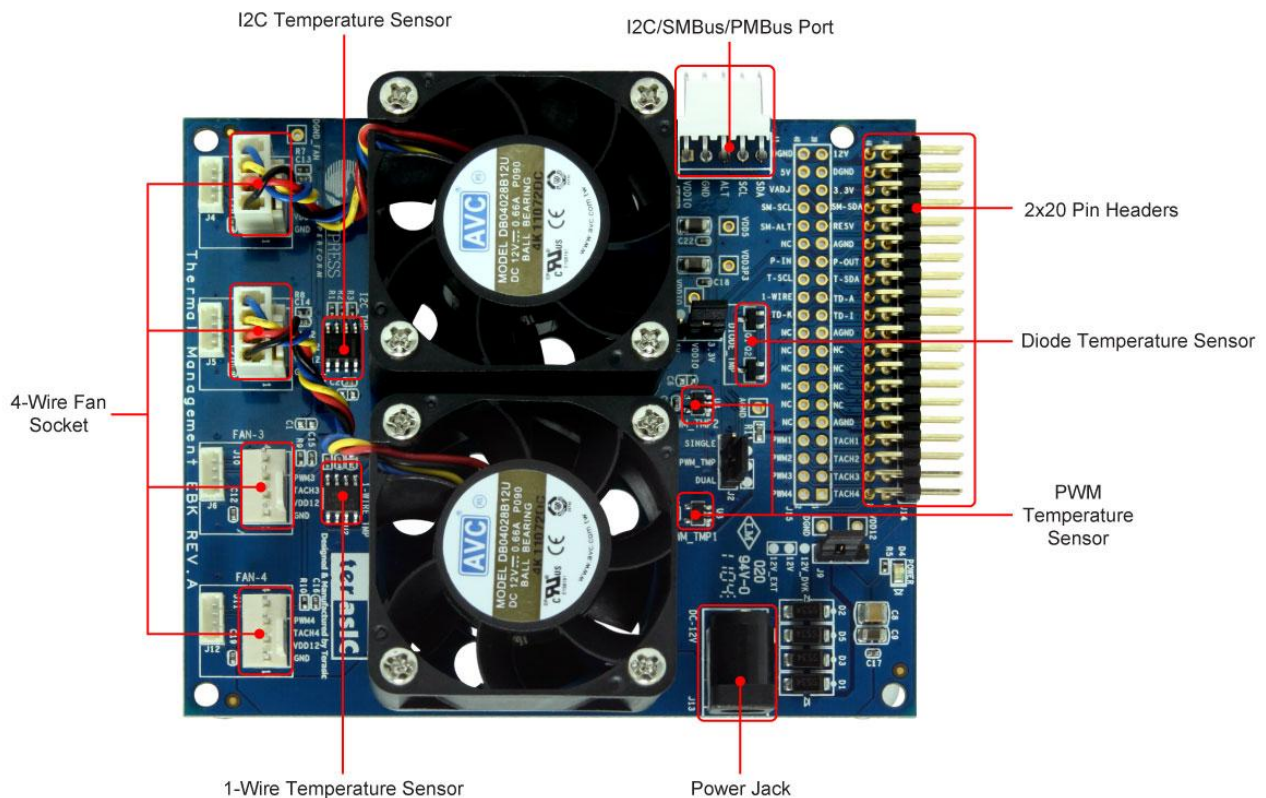
Although not included in the example projects provided, PSoC 3 devices also include non-volatile EEPROM memory that can be used to store sensor calibration information or for event/fault logging purposes. Communication with a host controller or management processor can be achieved via I2C, SMBus, PMBus or a variety of other communications protocols implemented with easy-to-use PSoC Creator component blocks.



**Figure 2-3: Thermal Management Functional Block Diagram**

Note that TME EBK hardware limits support to a maximum of 4 fans. The PSoC 3 Thermal Management solution can be easily extended to support up to 16 fans or more in a single device. Contact Cypress for further information on the full PSoC Thermal Management solution.

## TME EBK Hardware Overview



**Figure 3-1: TME Hardware Components**

This chapter describes the specifications of the components used on the TME EBK.

### 3.1 2x20 pin Interface Header

The 40-pin interface (2x20 pin header) provides a mechanism to connect the TME EBK to a Cypress development kit platform.

Table 3-1 lists the pin assignments of the 2x20 connector.

**Table 3-1: 2x20 Header (J14) Pin Definition**

<i>Description</i>	<i>Signal</i>	<i>Pin</i>	<i>Pin</i>	<i>Signal</i>	<i>Description</i>
Tachometer signal from Fan #4	TACH4	1	2	PWM4	PWM speed control for Fan #4
Tachometer signal from Fan #3	TACH3	3	4	PWM3	PWM speed control for Fan #3
Tachometer signal from Fan #2	TACH2	5	6	PWM2	PWM speed control for Fan #2
Tachometer signal from Fan #1	TACH1	7	8	PWM1	PWM speed control for Fan #1
Analog Ground	AGND	9	10	NC	-
-	NC	11	12	NC	-
-	NC	13	14	NC	-
-	NC	15	16	NC	-
-	NC	17	18	NC	-
Analog Ground	AGND	19	20	NC	-
Temperature diode current source	TD-I	21	22	TD-K	Temperature diode cathode
Temperature diode anode	TD-A	23	24	1-WIRE	One wire temperature sensor
I2C temperature sensor data	T-SDA	25	26	T-SCL	I2C temperature sensor clock
PWM temperature sensor output	P-OUT	27	28	P-IN	PWM temperature sensor input
Analog Ground	AGND	29	30	NC	-
Reserved	RESV	31	32	SM-ALT	Alert Signal (I2C/SMBus/PMBus)
Serial Data (I2C/SMBus/PMBus)	SM-SDA	33	34	SM-SCL	Serial Clock (I2C/SMBus/PMBus)
3.3V power from DVK	3.3V	35	36	VADJ	unused
Digital Ground	DGND	37	38	5V	5V power from DVK
Optional 12V power from DVK	12V	39	40	DGND	Digital Ground

## 3.2 TME EBK Headers and Jumpers

A number of jumpers are provided on the TME EBK.

Table 3-2 lists the default jumper settings for the board.

**Table 3-2: TME Jumper Settings**

<i>Headers and Jumpers</i>	<i>Description</i>	<i>Factory Default Configuration</i>
J1	5-pin header for connecting an external host or management processor via I2C/SMBus/PMBus	Connector fitted
J2	3-pin header to choose between single sensor or dual sensor (daisy chain) connection for the PWM temperature sensors. Place jumper in 1-2 position to enable dual sensor daisy-chain mode	1-2 position (dual sensor daisy chain)
J3	3-pin header to set logic signal levels for digital temperature sensors. Place in 1-2 for 5V interfacing. Place in 2-3 position to 3.3V interfacing	2-3 position (3.3V interfacing)
J4	4-pin header (1.25mm pitch) to connect Fan 1. Supplies 12V power, ground, PWM drive and tachometer	Not connected

	feedback. All signals replicated on J7	
J5	4-pin header (1.25mm pitch) to connect Fan 2. Supplies 12V power, ground, PWM drive and tachometer feedback. All signals replicated on J8	Not connected
J6	4-pin header (1.25mm pitch) to connect Fan 3. Supplies 12V power, ground, PWM drive and tachometer feedback. All signals replicated on J10	Not connected
J7	4-pin header (2.54mm pitch) to connect Fan 1. Supplies 12V power, ground, PWM drive and tachometer feedback. All signals replicated on J4	Connected to Fan 1
J8	4-pin header (2.54mm pitch) to connect Fan 2. Supplies 12V power, ground, PWM drive and tachometer feedback. All signals replicated on J5	Connected to Fan 2
J9	3-pin header for fan power supply. Place in 1-2 position to source external power from the power jack (J13). Place in 2-3 position to source 12V power from the DVK.	1-2 position (fan power from J13)
J10	4-pin header (2.54mm pitch) to connect Fan 3. Supplies 12V power, ground, PWM drive and tachometer feedback. All signals replicated on J6	Not connected
J11	4-pin header (2.54mm pitch) to connect Fan 4. Supplies 12V power, ground, PWM drive and tachometer feedback. All signals replicated on J12	Not connected
J12	4-pin header (1.25mm pitch) to connect Fan 4. Supplies 12V power, ground, PWM drive and tachometer feedback. All signals replicated on J11	Not connected
J13	Power Jack. 12V DC nominal	Connector fitted
J14	2×20 pin header for connecting to PSoC DVK	Connector fitted
J15	2×20 pin header that replicates signals on J14 for easy connection to a logic analyzer or oscilloscope	Open

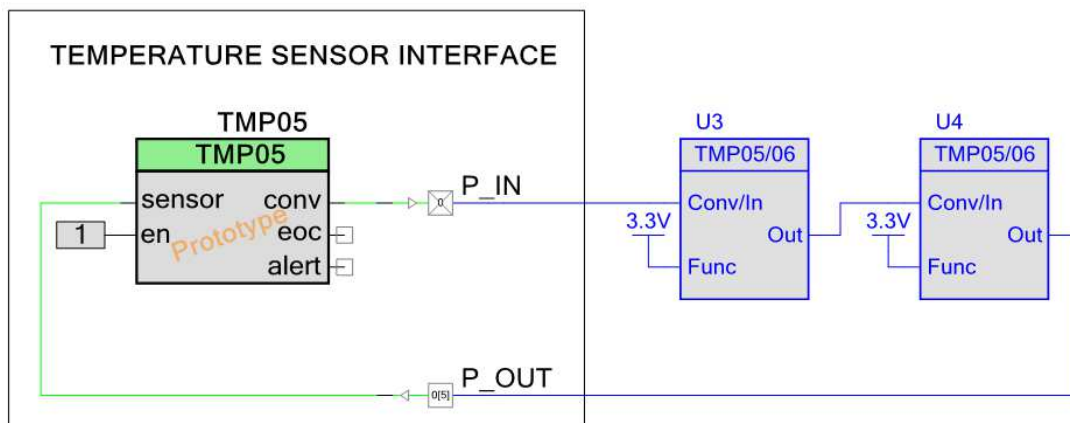
### 3.3 PWM Output Digital Temperature Sensors

The TMP05 is a monolithic temperature sensor that generates a modulated serial digital output (PWM) signal. The duty cycle of this PWM signal is proportional to the ambient temperature measured by the device. The high period (TH) of the PWM remains generally static over all temperatures, while the low period (TL) varies. The ratio of TH/TL provides a method for determining the temperature as per this formula: Temperature (°C) = 421 – (751 × TH/TL).

The TMP05 sensors have a 2 pin interface: 1) CONV/IN input that when pulsed by PSoC initiates a new temperature measurement, 2) OUT output that provides a PWM signal that can be decoded using the formula above to determine ambient temperature. The TMP05 sensors support a daisy chain mode of operation where the OUT signal of the first sensor can be directly connected to the CONV/IN input of the subsequent sensor. The OUT of the 2<sup>nd</sup> sensor carries the PWM signals from both sensors. Many sensors can be daisy chained in this fashion, with the final OUT signal carrying the PWM temperature encodings from all sensors in the daisy chain.

This sensor is generally operated in one of two modes: (1) one-shot mode and (2) continuous mode. For more detailed information, please refer to the TMP05 device datasheet which is available on the device manufacturer’s website or under the datasheet folder of the kit CD.

**Figure 3-2** shows the *TMP05 Digital Temperature Sensor Interface* custom component instantiated in a PSoC Creator Schematic configured to support the 2 TMP05 sensors on the TME in daisy chain mode. A single *TMP05 Digital Temperature Sensor Interface* component supports up to 4x TMP05 sensors in a single daisy chain. P\_IN and P\_OUT are the TMP05 sensor signals available on the 2x20 pin header on TME EBK.



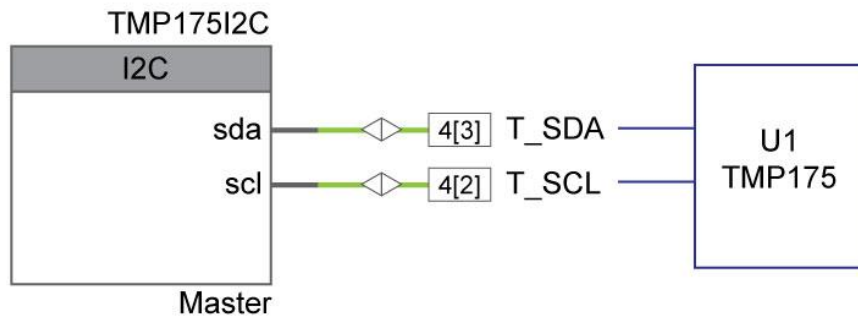
**Figure 3-2: TMP05 Temperature Sensor Connectivity**

More information regarding the *TMP05 Digital Temperature Sensor Interface Component* is available in [AN65977](#) – “PSoC® 3 and PSoC 5 - Creating an Interface to a TMP05/TMP06 Digital Temperature Sensor”.

### 3.4 I2C Digital Temperature Sensor

The PSoC TME EBK demonstrates I2C temperature sensing capability using a two-wire I2C compatible digital temperature sensor, the TMP175. I2C digital temperature sensors are very common sensors for thermal management and are used in a variety of communication, computer, consumer, environmental, industrial and instrumentation applications due to the popularity of the I2C bus. For more detailed information, please refer to its datasheet which is available on manufacturer’s website or under the datasheet folder of the kit CD.

**Figure 3-3** shows the standard PSoC Creator *I2C Master* component instantiated in a PSoC Creator Schematic connected to the TMP175 sensor on the TME EBK. T\_SDA and T\_SCL represent serial data and serial clock respectively which are available on the 2x20 pin header on TME EBK.



**Figure 3-3: I2C Temperature Sensor Connectivity**

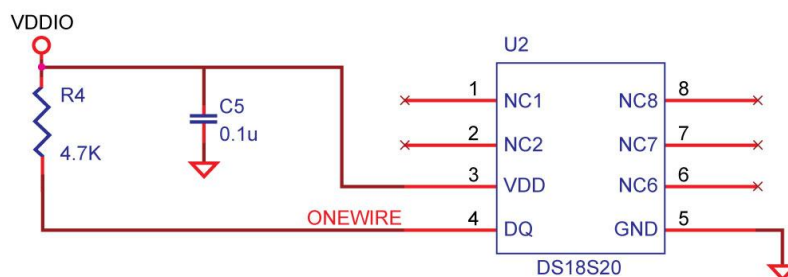
The *I2C Master* component can be configured to run the I2C interface at 50, 100 or 400 kbps. Like any I2C bus application, multiple I2C temperature sensors such as the LM75 or TMP175 can be connected to the same I2C bus I/O pins on PSoC. Refer to the *I2C Master* component datasheet inside PSoC Creator for more details on this block.

### 3.5 1-Wire Digital Temperature Sensor

The TME EBK has a Maxim DS18S20 1-wire high precision digital temperature sensor installed. The DS18S20 digital thermometer provides 9-bit resolution Celsius temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS18S20 communicates over a proprietary 1-wire bus that by definition requires only one data line (and ground) for communication with a host microprocessor. It has an operating temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . For more detailed information, please refer to its datasheet which is available on the manufacturer's website or under the datasheet folder of the kit CD.

A one wire protocol interface PSoC Creator component is currently planned for future development, but is not yet available and is therefore not provided in this release of the TME EBK. Check the TME EBK link: [www.cypress.com/go/CY8CKIT-036](http://www.cypress.com/go/CY8CKIT-036) for upgrades to the TME that might include this interface component in the future.

Figure 3-4 shows the connections for DS18S20 1-wire temperature sensor



**Figure 3-4: 1-Wire Temperature Sensor Connectivity**



### 3.6 Diode Analog Temperature Sensors

MMBT3904 is a bipolar junction transistor (BJT) designed as a general purpose amplifier and switch. The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier. The delta Vbe method described in Cypress Application Note [AN60590](#) – “Temperature Measurement Using Diode” can be used with the TME EBK. Refer to that application note for the theory of operation and relevant mathematical equations. The implementation described in that application note is primarily driven by firmware due to the complexities associated with varying the source current fed to the BJT, filtering the ADC measurements and calibrating the analog sub-system all of which are required to achieve sufficiently high accuracy with these low cost temperature sensors.

Figure 3-5 shows the connections between PSoC and MMBT3904

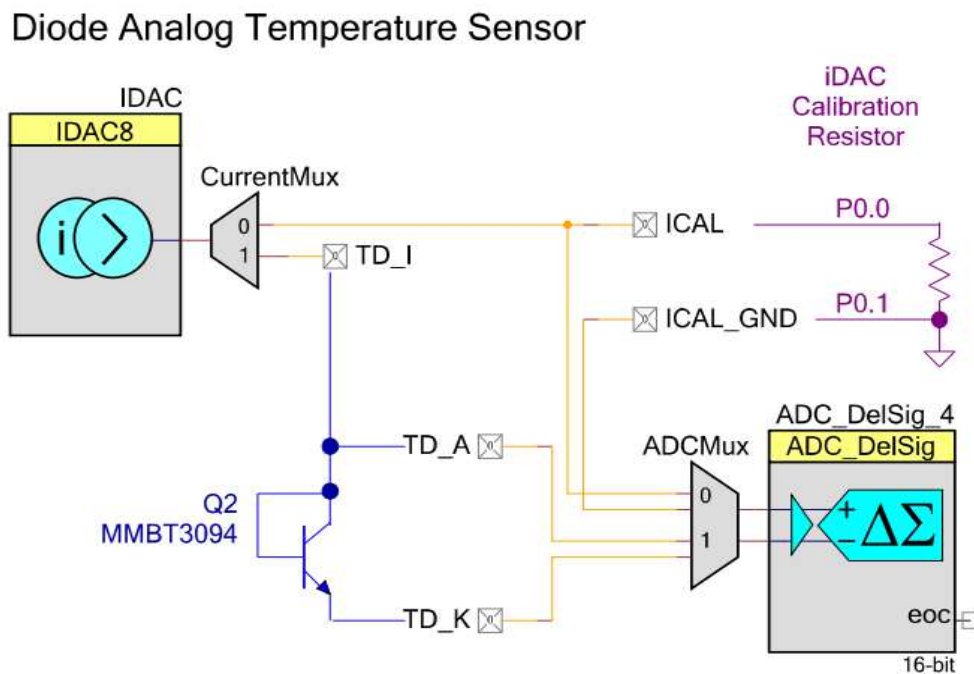


Figure 3-5: Diode Analog Temperature Sensor Connectivity

### 3.7 4-Wire Fan Connectors

The TME EBK provides 8 (4 pairs) industry standard 4-wire fan interface connectors, and two AVC 12V brushless DC fans. The fan speeds are controllable up to 13,000 RPM via PWM control, with tachometer output to calculate actual fan speeds. For more detailed information please refer to its datasheet which is available on the manufacturer’s website or under the datasheet folder of the kit CD.

Table 3-3: Fan Connector Pinouts

Pin Number	Name	Colors	Description
1	GND	Black	GND
2	POWER	Red	12V DC power
3	TACH	Yellow	Frequency Generator Signal
4	PWM	Blue	PWM Control Signal

Figure 3-6 shows the connections between PSoC and the 2 fans installed on the TME EBK.

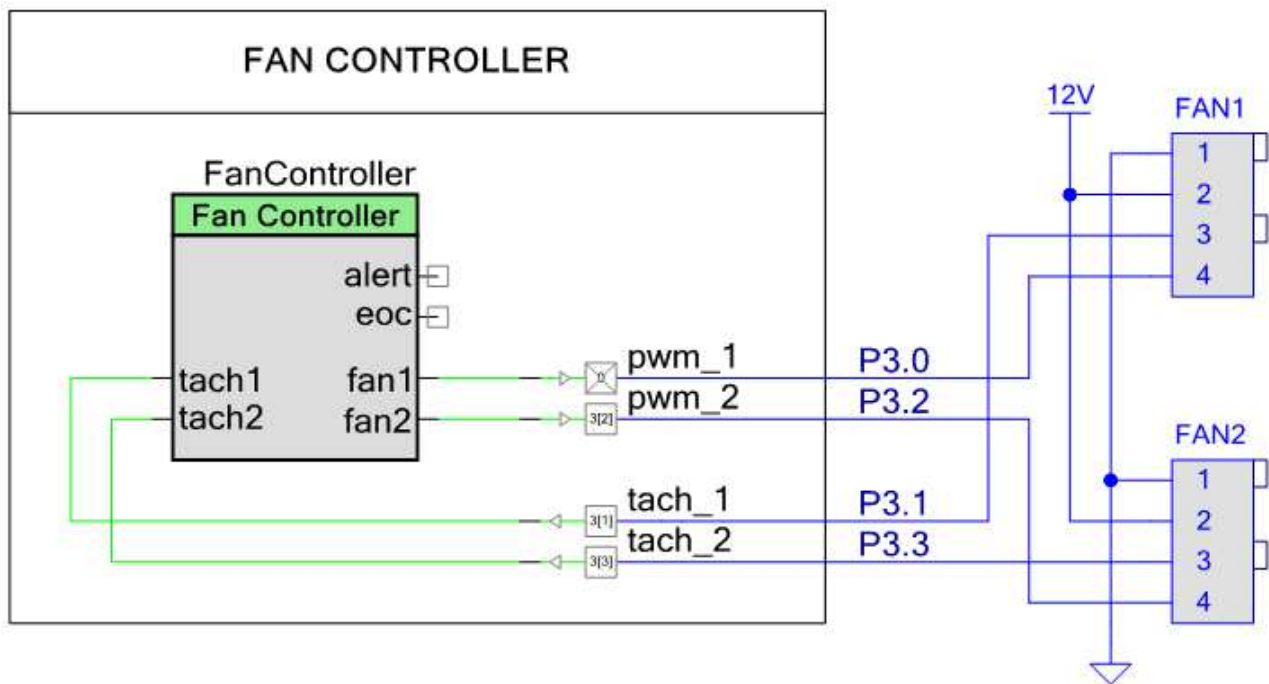


Figure 3-6: Fan Connectivity to PSoC

### 3.8 Development Kit (DVK) Compatibility

This kit contains an expansion board only and requires a Cypress development kit platform in order to use it. This kit is compatible with both the CY8CKIT-001 PSoC DVK and the CY8CKIT-030 PSoC 3 DVK.

**NOTE:** Early revisions of the CY8CKIT-001 PSoC Development Kit contained an early engineering sample release (ES2) of the PSoC 3 CY8C38xxx Device Family Processor Module which is not compatible with the example projects that accompany this kit. If you have an early revision of the kit you can upgrade free of charge at [www.cypress.com/go/psokitupgrade](http://www.cypress.com/go/psokitupgrade)

## Chapter 4

# Example Projects for the TME

### 4.1 Introduction

This section provides details on how to operate the hardware and run the example projects provided.

### 4.2 Software Installation

Perform the following steps to install the PSoC TME EBK software: Insert the kit CD into the CD drive of your PC. The CD is designed to auto-run and the kit menu should appear. (See **Figure 4-1**)



**Figure 4-1: CD Autorun Kit Menu**

**NOTE:** If auto-run does not execute, double-click **AutoRun** on the root directory of the CD. After the installation is complete, the kit contents are available at the following location:

C:\Program Files\Terasic\PSoC Thermal Management EBK\1.0

On 64-bit Windows 7 installations, replace “C:\Program Files” with “C:\Program Files (x86)”

When installing the PSoC Thermal Management EBK software, the installer checks if your system has the required software. This includes PSoC Creator, PSoC Programmer, Windows Installer, .NET



framework, Adobe Acrobat Reader, and KEIL Compiler. If these applications are not installed, then the installer prompts you to install all pre-requisite software, which is also available on the kit CD. The software can be uninstalled using one of the following methods:

Go to **Start > Control Panel > Add or Remove Programs**; select appropriate software package; select the **Remove** button.

Go to **Start > All Programs > Cypress > Cypress Update Manager > Cypress Update Manager**; select the **Uninstall** button for the appropriate software package.

Insert the kit CD and click **Install the kit contents from CD** button. In the **CyInstaller for PSoC Thermal Management EBK 1.0 window**, select **Remove** from the Installation Type drop-down menu. Follow the instructions to uninstall. (**NOTE: this method will only un install the kit software and not all the other material/software that may have been installed along with the kit software**)

### 4.3 Hardware Setup

The kit includes example projects for both the CY8CKIT-001 PSoC DVK and the CY8CKIT-030 PSoC 3 DVK hardware platforms. The main difference between the projects for the two hardware platforms is the PSoC pin mapping. Other differences will be highlighted in the sections that describe details of the example projects. The following sections describe how to set up the hardware to run the example projects. For a given DVK base platform, the same hardware configuration applies to both example projects.

#### ■ CY8CKIT-001 PSoC DVK

Using the pin header/prototyping breadboard area of the PSoC DVK base board, use jumper wires to make the following connections:

- “VR” to P1\_2
- “SW1” to P1\_4
- “SW2” to P1\_5

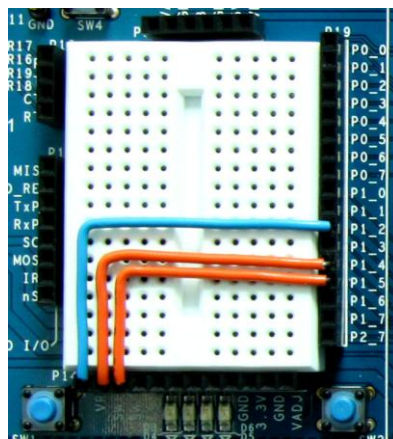
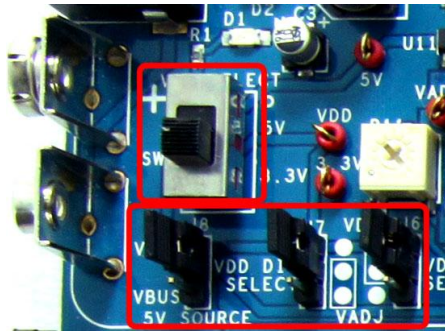


Figure 4-2: CY8CKIT-001 PSoC DVK Breadboard

Set the system to run at 3.3V using SW3 and set J6 “VDD DIG” and J7 “VDD ANLG” to VDD=3.3V using J6 and J7 as shown below:



**Figure 4-3: CY8CKIT-001 PSoc DVK Power Jumpers**

Ensure that the LCD character display included with PSoc DVK is attached and that the LCD POWER jumper (J12) is in the ON position:



**Figure 4-4: CY8CKIT-001 PSoc DVK LCD Power Jumper**

Ensure that the VR\_PWR jumper (J11) is installed:



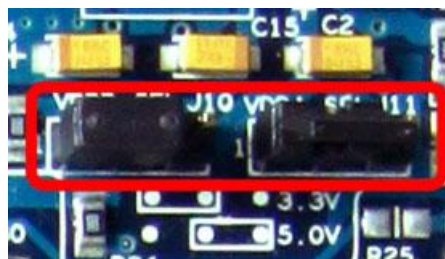
**Figure 4-5: CY8CKIT-001 PSoc DVK VR\_POWER Jumper**

**CAUTION:** Do not attach the TME EBK to the PSoC DVK until you have programmed the PSoC with one of the example projects. Some of the GPIOs routed to the TME EBK are tied to ground and this could cause hard shorts on PSoC I/O pins if firmware previously programmed into PSoC drives those pins. Instructions on how to program the example projects are covered in the example projects section.

## ■ CY8CKIT-030 PSoC 3 DVK

No jumper wires are required for the PSoC 3 DVK examples since the buttons and potentiometer are hardwired to GPIOs. Ensure that the LCD character display included with the PSoC 3 DVK is attached.

Set VDDD and VDDA to 3.3V using J10 and J11.



**Figure 4-6: CY8CKIT-030 PSoC 3 DVK Power Jumpers**

Ensure that POT\_PWR is enabled by installing a jumper on J30.



**Figure 4-7: CY8CKIT-030 PSoC 3 DVK Potentiometer Power**

**CAUTION:** Do not attach the TME EBK to the PSoC DVK until you have programmed the PSoC with one of the example projects. Some of the GPIOs routed to the TME EBK are tied to ground and this could cause hard shorts on PSoC I/O pins if firmware previously programmed into PSoC drives those pins. Instructions on how to program the example projects are covered in the example projects section.

## 4.4 Example Projects

The TME EBK includes three example projects:

- Firmware Based Fan Control
- Closed-Loop Hardware Based Fan Control
- Thermal Management System

The kit includes project workspaces for both the CY8CKIT-001 PSoC DVK and the CY8CKIT-030 PSoC 3 DVK.

To begin, go to the *Start Page* in PSoC Creator and under the *Examples and Tutorials* section, expand The *Kits and Solutions* entry as shown below. Expand the *TME EBK* entry and double click on the workspace file that matches your development kit (*CY8CKIT-001\_Examples.cywrk* or *CY8CKIT-030\_Examples.cywrk*). The example projects will be copied to any location you specify on your hard drive and then opened automatically.

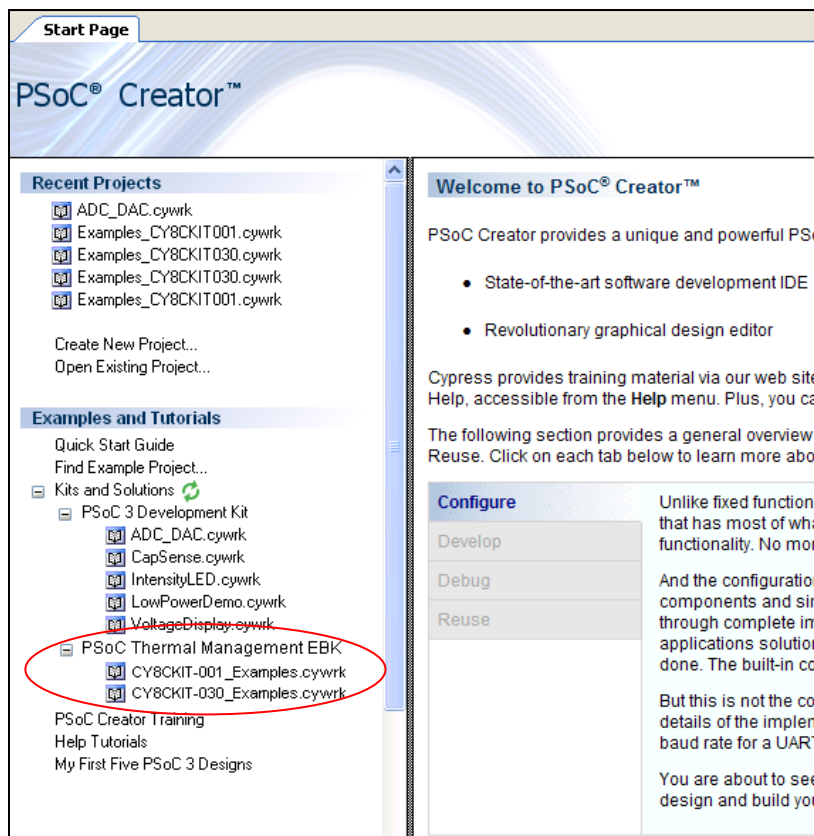
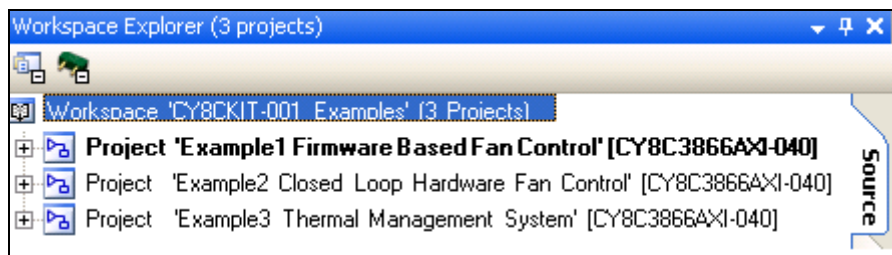


Figure 4-8: PSoC Creator Start Page

The example projects will be displayed in the *Workspace Explorer* window as shown in the example below for the CY8CKIT-001 PSoC DVK:



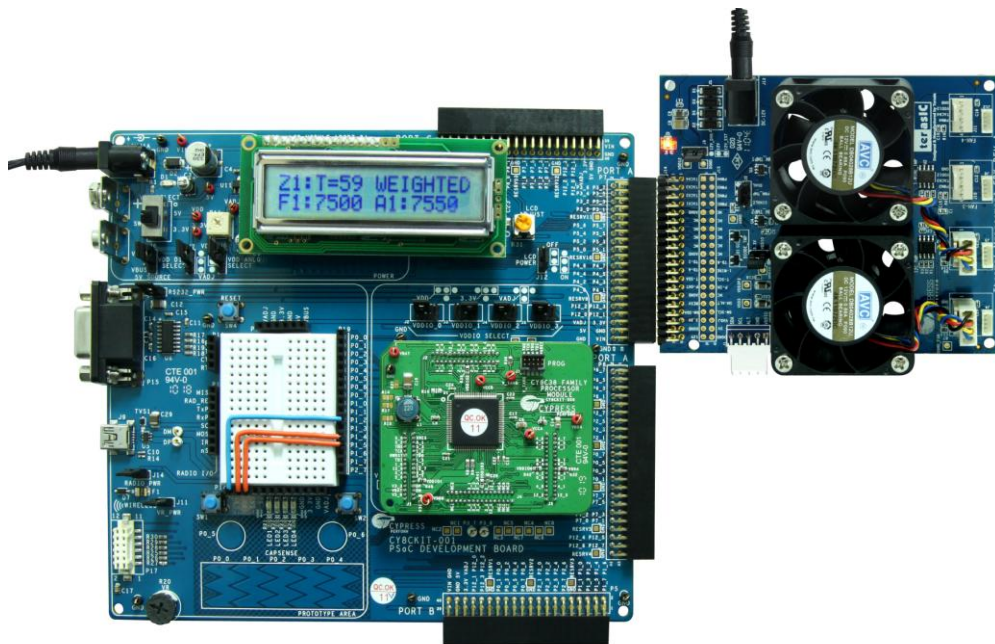
**Figure 4-9: Workspace Explorer View**

## ■ Running the Example Firmware: CY8CKIT-001 PSoC DVK

Make sure the hardware has been configured according to the Hardware Setup section.

1. If this is the first time that the example project firmware is being programmed into PSoC, make sure the TME EBK is not connected to the PSoC DVK
2. Apply 12 VDC power to the PSoC DVK
3. Attach the MiniProg3 first to a USB port on the PC and then to the PROG port on the CY8CKIT-009 PSoC 3 Processor Module
4. In PSoC Creator, set the appropriate example project as active by right clicking on it in the *Workspace Explorer* and selecting *Set As Active Project*
5. In PSoC Creator, select *Debug > Program* to program PSoC
6. Remove power from the PSoC DVK and attach the TME EBK to Port A of the PSoC DVK
7. The PSoC DVK and the TME EBK boards should be powered separately. Power the PSoC DVK first
8. The TME EBK includes a 12V DC high-current power supply that is capable of supplying the inrush current needed by the fans installed on that kit. Use that power supply connected to the power connector (J13) and set the power jumper (J9) on the TME EBK board to “12V\_EXT” (the default setting)
9. If the TME EBK cannot be detected by PSoC, status debug messages will be displayed on the LCD to assist with rectifying the problem





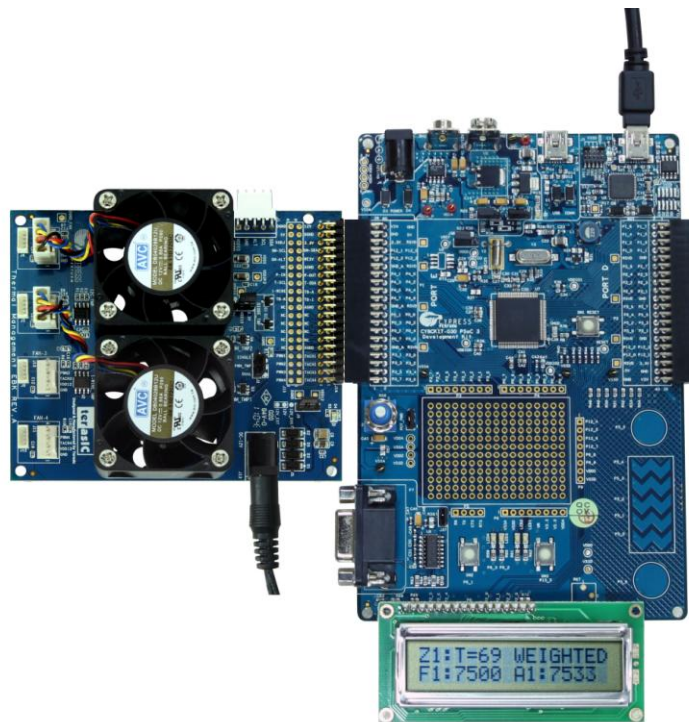
**Figure 4-10: CY8CKIT-001 PSoC DVK with TME EBK Connected to Port A**

**(Running Example 3)**

### ■ Running the Example Firmware: CY8CKIT-030 PSoC 3 DVK

Make sure the hardware has been configured according to the Hardware Setup section.

1. If this is the first time that the example project firmware is being programmed into PSoC, make sure the TME EBK is not connected to the PSoC 3 DVK
2. Attach a USB cable from the PC to the PSoC 3 DVK Program/Debug USB port (use J1 - the USB connector closest to the corner of the board)
3. In PSoC Creator, set the appropriate example project as active by right clicking on it in the *Workspace Explorer* and selecting *Set As Active Project*
4. In PSoC Creator, select *Debug > Program* to program PSoC
5. Remove the USB cable from the PSoC 3 DVK and attach the TME EBK to Port E of the PSoC 3 DVK
6. Re-attach a USB cable from the PC to the PSoC 3 DVK Program/Debug USB port (use J1 - the USB connector closest to the corner of the board)
7. The TME EBK includes a 12 VDC high-current power supply that is capable of supplying the inrush current needed by the fans installed on that kit. Use that power supply connected to the power connector (J13) and set power jumper (J9) on the TME EBK board to “12V\_EXT” (the default setting)
8. If the TME EBK cannot be detected by PSoC, status debug messages will be displayed on the LCD to assist with rectifying the problem
9. Going forward, every time PSoC is re-programmed, press the Reset (SW1) button on the PSoC 3 DVK to run the newly programmed firmware image



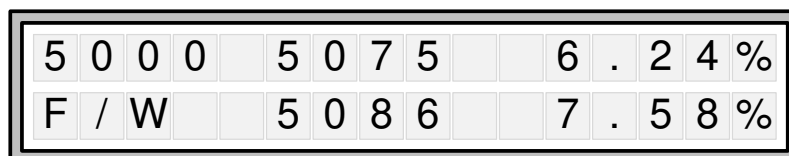
**Figure 4-11: CY8CKIT-030 PSoC 3 DVK with TME EBK Connected to Port E  
(Running Example 3)**

■ **Example1: Firmware Based Fan Control**

■ **Overview**

The purpose of this example is to demonstrate the Fan Controller Component controlling the two fans on the TME EBK in *Firmware (CPU)* control mode. It is called Open Loop to describe the fact the hardware components used in this implementation are not regulating the fan speeds by themselves. Instead, PSoC firmware is entirely responsible for managing fan speeds.

If the project is running correctly, the text displayed on the debug LCD should display something like **Figure 4-12**:



**Figure 4-12: Example1 LCD Display**