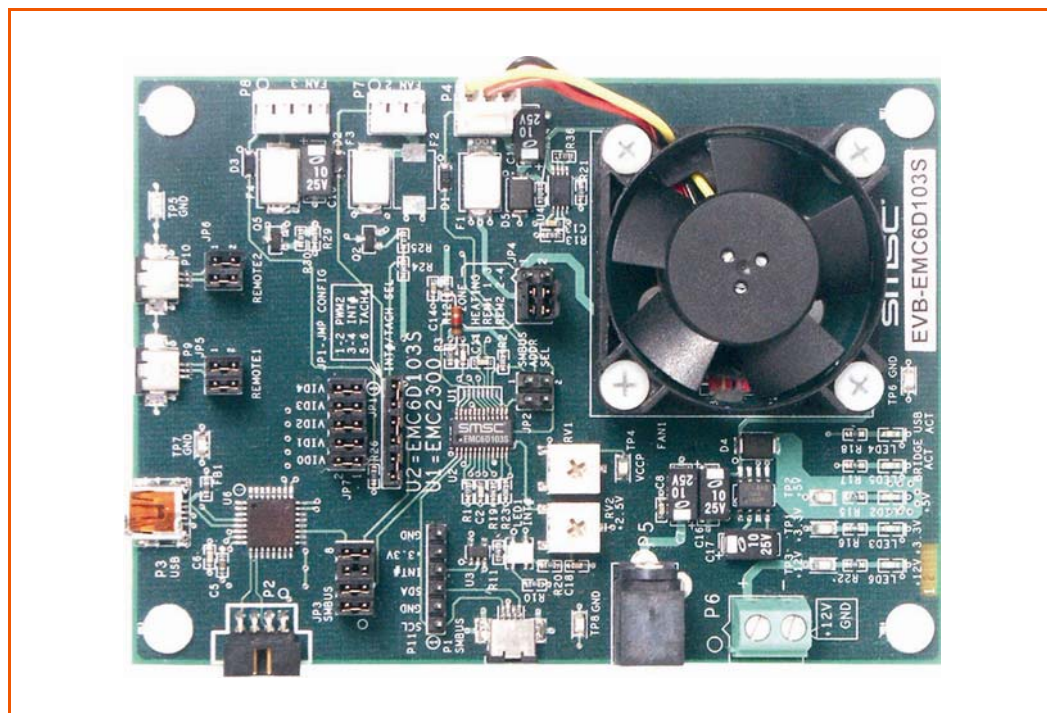# EVB-EMC6D103S User Manual

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1 Overview

The EMC6D103S is an environmental monitoring device with automatic fan control capability. This device can monitor up to 5 voltages, 3 thermal zones and the speed of up to four fans. It can control the speed of up to 3 fans using Pulse Width Modulator (PWM) outputs operating at a variety of high and low frequencies.

The EVB provides circuitry to exercise all EMC6D103S functionality. A windows demo application provides a graphical user interface (GUI) for display of temperature, fan PWM and Tach values and utilities to modify fan control settings and all registers. A USB to SMBus bridge allows easy connection to a PC and provides +5V power to the EVB for the +5Vdc fan and zone heater resistors. A block diagram of the EVB is shown in Figure 1.1 below:
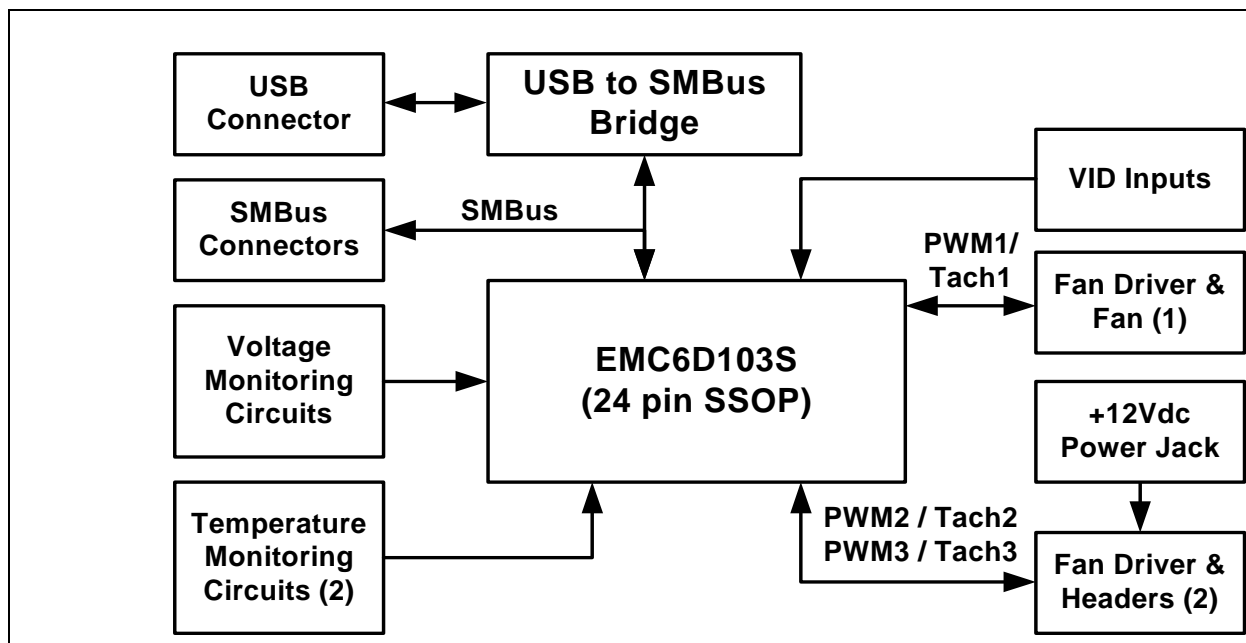

Figure 1.1 EVB Block Diagram

1.1   Related Documents

The CD included with the evaluation board contains the following documents:

n   Evaluation Board Checklist

n   Bill Of Materials

n   Schematic

n   Jumper Settings and Connector List

n   EMC6D103S Datasheet

n   Demo.exe Manager Application

n   EMC6D103S.ini Register Definition Files

2 Getting Started

2.1 System Requirements

To use the EVB you will need:

n   A PC running Windows 2000 or XP

n   Display resolution 800x600 (or larger to view several windows simultaneously)

n   An available USB port

2.1.1 Feature Summary

n   Three fan drive circuits utilizing linear, 3-wire and 4-wire PWM drive approaches

n   The Demo.exe application provides graphical representations of the temperature, fan drive% and tachometer (fan speed)

n   Demo.exe application facillitates display and modification of register values

n   +5V power supplied via USB connection with auxiliary +12Vdc power jacks for +12Vdc fans

n   USB communication to evaluation board; an external SMBus master may also be used

n   Adjustment potentiometers for Vccp and +2.5V monitors

n   LEDs for $\overline{\text{Int}}$ (red/green), +3.3V, +5V, +12V, USB and bridge activity
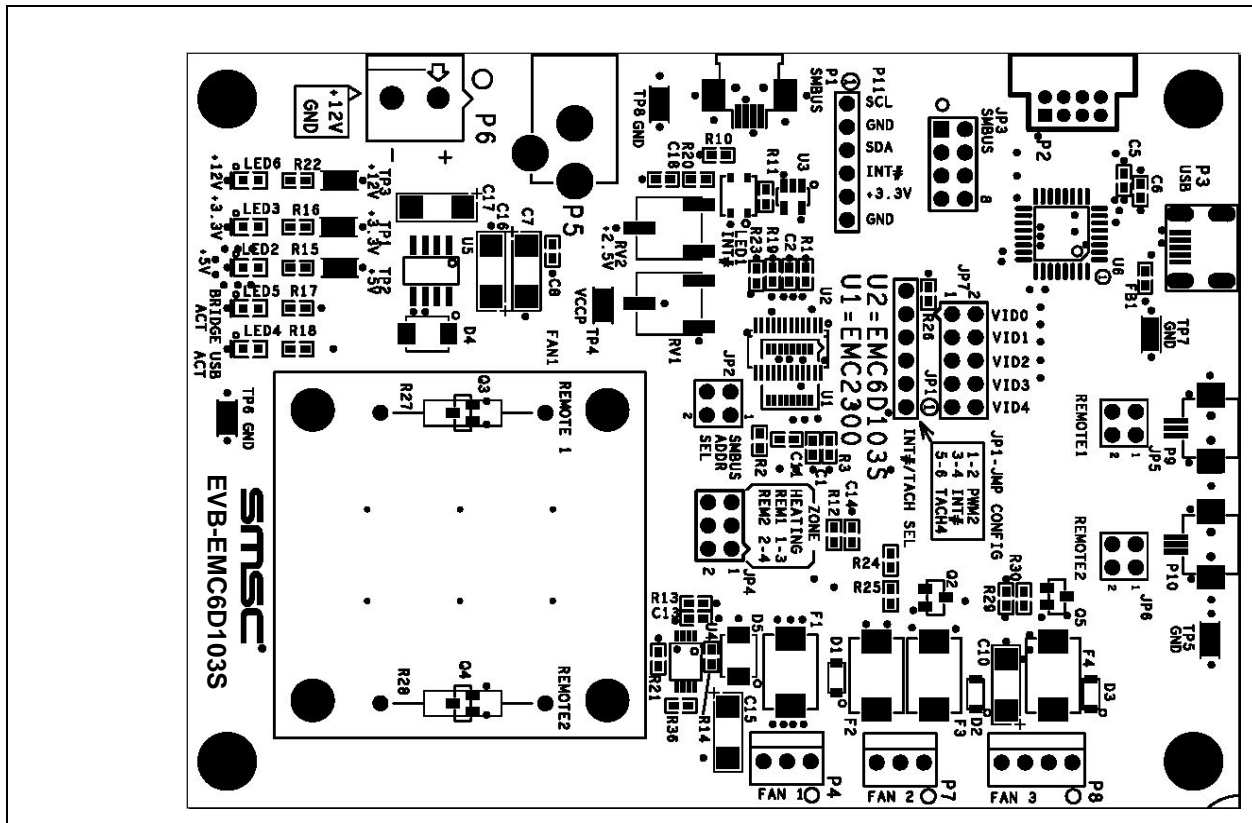
2.1.2 Board Layout

Figure 2.1 EMC6D103S Board Outline and Silkscreen

2.1.3   Installing the EVB

1. Install the Demo application and device driver on a PC by running Setup.exe from the EVB-EMC6D103S distribution CD. A revision history and install/uninstall notes may be found in the readme.txt file on the disk.

2. Connect the supplied USB cable to an available USB port on the PC. Plug the "mini-B" end of the USB cable into EVB connector P3. The +3.3V, +5V, Bridge ACT and Int LEDs should illuminate. After the EVB is connected to the PC the "Find New Hardware" wizard will pop up for USB driver installation. Follow the instructions in the readme.txt file to complete the installation process.

3. Start the EVB Software by selecting the EMC Demo application from the SMSC folder from the Programs Windows Start menu. The EVB will initialize and the startup screen will appear as in Figure 2.2. The USBAct LED should be blinking when the Demo application is running. The application window may now be resized or maximized and additional windows may be opened by clicking on the items in the Monitor pane on the left or on the graphical elements on the startup screen.
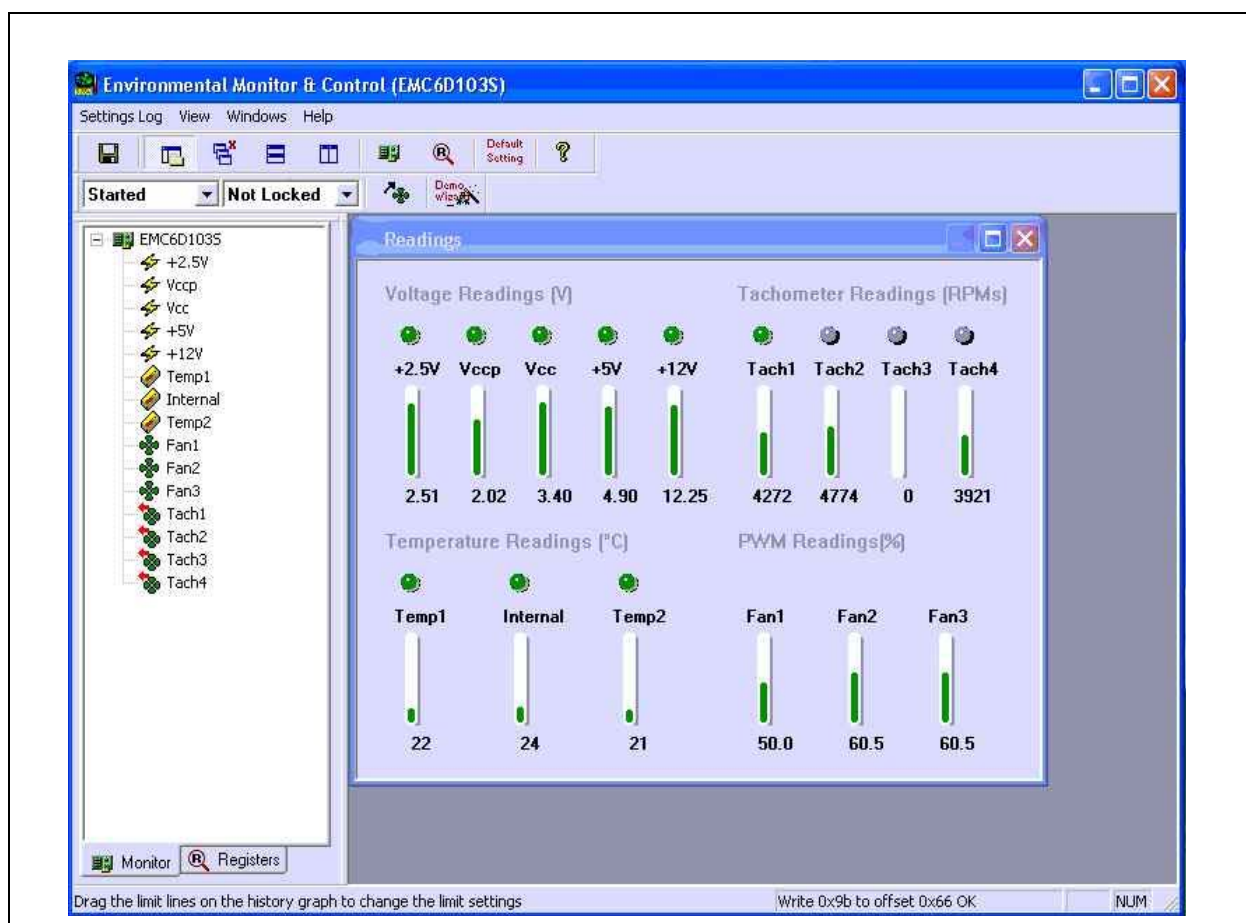

Figure 2.2 Demo Startup Screen

3 Circuit Description

3.1   Introduction

The following section describes the EVB hardware circuits which demonstrate the EMC6D103S features. Detailed information on the hardware can be found on the schematic included on the distribution CD.

3.2   EMC6D103S

The EMC6D103S is a fan control IC capable of driving up to 3 fans and monitoring the speed of up to 4 fans. Fan control can be either automatic, based on 1 or more monitored temperature zone or driven manually by a host controller. Up to 3 temperature zones and 5 voltages can also be monitored. All monitored values have associated limit registers that can be enabled to cause assertion of the interrupt pin ($\overline{\text{Int}}$) if the values exceed programmed limits.

3.3   USB to SMBus Bridge

The USB to SMBus bridge is based on an 8051 microcontroller with integrated USB and SMBus interfaces as well as internal flash and RAM. During EVB manufacture, firmware is loaded into the bridge that provides the interface between the SMBus and the USB driver. Power is sourced to the MCU from the USB interface.

3.4   SMBus Address Selection

The SMBus address is selected based on the JP2 jumper positions which strap the TACH4/Address Select and PWM3/$\overline{\text{Address Enable}}$ pins either high or low. The default SMBus address, 010 1110, is selected when both pins are pulled up to +3.3V. Pulling pin13 (PWM3/ADDREN#) low enables selection of alternate addresses. See the "Jumper Settings and Connector List for EMC6D103S Customer EVB" document or the schematic for details.

Note: Selecting alternate addresses disables PWM3/$\overline{\text{Address Enable}}$ and will disable TACH4/Address Select if it is strapped low.

3.5   Remote Diodes and Zone Heaters

The EVB-EMC6D103S has 2 on-board temperature sensing diodes, which are 2N3904 transistors in a diode-connected configuration. Each diode has an associated "zone" heater; this is a power resistor that is thermally bonded to the temperature sensing diode. When enabled, the power resistors will increase the diode temperature by 15-30degC; the resistor associated with Zone 1 has a greater heating capacity than the Zone 2 resistor to allow more complex evaluation of the multi-zone control algorithm.

To activate the heaters, move the jumpers on JP4 from their storage locations to the "enabled" positions. See the "Jumper Settings and Connector List for EMC2300 Customer EVB" document or the schematic for details.

The on-board thermal diodes may be disconnected by removing the jumpers on JP5 (remote 1) or JP6 (remote 2). Disconnecting the on-board thermal diodes permits connection of external temperature sensing diodes to JP5, 6, 9 or 10. See the "Jumper Settings and Connector List for EMC6D103S Customer EVB" document or the schematic for connection details.

3.6 Fan Drive Circuits

The EMC6D103S has 3 PWM outputs for fan drive. This EVB has 3 different drive circuit types to demonstrate various popular drive approaches. Table 3.1 summarizes the circuit type and characteristics for each fan drive circuit.

Table 3.1 Fan Drive Circuit Characteristics

Fan#	Drive Type	Voltage	Current (max.)
Fan1	Linear, 3 Wire	5V	200mA
Fan2	PWM, 3 Wire	12V (+5V Optional)	500mA
Fan3	PWM, 4 Wire	12V	500mA

3.6.1 Fan1 Drive Circuit

This drive circuit linearizes the PWM output to convert a 0-100% duty cycle PWM signal into a 0-5V voltage driver. Components R12 and C14 integrate the PWM signal and present 0-3.3V dc to the non-inverting input of op-amp U4A. The op-amp output drives the gate of power FET Q1. Resistors R13 and R14 provide gain to scale the fan drive signal to a 0-5V range and the location of the feedback tap compensates for the gate-source voltage required to turn on the drive FET.

Schottky diode D5 is included to clamp back EMF created by the fan and capacitor C15 smooths the ripple caused by the fan motor switching. The op-amp's V+ supply is set @ 10Vdc to provide enough compliance voltage to allow Q1's gate to be driven to the 7-8Vdc required to drive the source to +5V to fully turn on the fan.

Note: In general, linear fan drive is audibly quieter than PWM drive because the PWM drive and the fan's motor will interact to set up beat frequencies that can be quite annoying. Most +5V fans require at least 2V to start up so the usable drive voltage range is about 2.5-5Vdc (50-100%). PWM drive can generally control a fan over a wider speed range, often as low as 25%.

3.6.2 Fan2 Drive Circuit

The Fan2 driver is designed to drive 3 wire, +12Vdc fans. When the PWM2 signal is high, FET Q2 is ON and full voltage is applied to the fan. When the PWM2 signal is low, Q2 turns off, interrupting power to the fan by removing the fan's connection to ground. The frequency of this PWM signal may be set to various rates from 11 to 87hz and also at 25khz.

Fan2 may be driven by either a +5V or +12V supply. The default setting is +12V; the voltage may be changed to +5V by de-soldering thermal fuse F3 and re-positioning it at location F2.

Note: PWM control of the power leads of some fans can produce undesirable audible noise. Disconnecting the low side also corrupts the tachometer signal to the extent that it is not usable for accurate speed measurement. The tachometer signal may be usable for locked rotor/stall detection. PWM control of 3 wire fans has the advantage of low cost and wide a speed control range.

3.6.3 Fan3 Drive Circuit

The Fan3 circuit drives 4 wire fans that use the PWM signal as a speed control input. 4 wire fans always have power available to the drive circuit. This results in quiet operation, good speed control and a tachometer signal that is always valid.

Some 4 wire fans require a pullup to +12V on the PWM signal which would violate the maximum voltage the PWM3 pin can tolerate so power FET Q5 is included to handle the higher voltage. Q5 may not be needed for 4 wire fans that can be controlled with a PWM signal in the +3.3 to +5V range. Also, Q5 can be used to drive the low side of a fan to ground if required.

3.7 Int/Tach Option Header

The $\overline{\text{Int}}$/Tach Option Header, JP1, permits selection of the $\overline{\text{Int}}$ signal source, which may be either the PWM2/$\overline{\text{Int}}$ pin or the Tach3/$\overline{\text{Int}}$ pin. This header also allows routing the Tach3 signal to either the Tach3/$\overline{\text{Int}}$ or Tach4/Address Select pin. Consult the datasheet for detailed description of these options.

3.8 Voltage Monitors

Five voltage monitor inputs on the EMC6D103S monitor Vccp, 2.5V, 3.3V, 5V and 12V. The EVB has potentiometers to adjust the Vccp and 2.5V levels. The 3.3V, 5V and 12V inputs are connected directly to supplies on the EVB.

Note: The 12V input will read 0V if no 12V supply is applied to the EVB.

3.9 VID Inputs

The EMC6D103S has 5 VID input pins which may also be used as general purpose inputs. Jumper block JP7 is used to strap these inputs low.

3.10 Power Source

This demo board derives +5V power from the USB port. The bridge microcontroller has an internal voltage regulator that supplies +3.3V to the EMC6D103S and other EVB circuits including the zone heaters. When driving +12V fans, an external +12V supply is required. +12Vdc may be supplied through either Power Jack P5 or the screw terminal connector P6.

Note: A recommended +12V power supply is P/N: CUI-Stack DTS120420UTC-P5P-SZ.

3.11 System Interrupt / LED

The $\overline{\text{Int}}$ output drives a dual-color LED to indicate the Normal (green) and Alert (red) status. The $\overline{\text{Int}}$ line is also routed to the USB bridge to provide Alert status to the Demo application.

3.12 Direct SMBus Connect Option

It is possible to communicate with the EMC6D103S using an external SMBus master. To do so, the on-board USB to SMBus bridge master must be disconnected. This is accomplished by removing the jumpers connecting pins 1-2, 3-4, 5-6 and 7-8 on JP3. Once the bridge is disconnected, the SMBus master may be connected via P1 or P11.

Note: +5V power must be applied to the EVB, either through the USB cable or the +5V test point.

Note: The pullup resistors for the SMBus SDA, SCL and $\overline{\text{Int}}$ signals are also disconnected so external pullups will need to be supplied by the SMBus Master.

3.13 Test Points

Test points are provided for:

- Ground
- +3.3V power
- +5V power
- +12V
- Vccp

3.14 LED Indicators

LEDs indicate the status of the following signals:

- $\overline{\text{Int}}$, EMC6D103S pin 5 (Green normal, Red alert)
- +3.3V
- +5V_USB
- +12V
- USB Activity - blinking indicates USB traffic
- Bridge Activity, when ON indicates the Bridge is functioning