Evaluation Board for Microprocessor System Temperature Monitor

EVAL-ADM1024

FEATURES

Up to 9 Measurement Channels

Inputs Programmable to Measure Analog Voltage, Fan Speed or External Temperature

External Temperature Measurement with Remote Diode (Two Channels)
On-Chip Temperature Sensor

5 Digital Inputs for VID Bits
LDCM Support

I²C Compatible System Management Bus (SMBus)

Chassis Intrusion Detect
Interrupt and Overtemperature Outputs

Programmable RESET Input Pin

Shutdown Mode to Minimize Power Consumption

Limit Comparison of all Monitored Values

APPLICATIONS

Network Servers and Personal Computers

Microprocessor-Based Office Equipment

Test Equipment and Measuring Instruments

INTRODUCTION

The ADM1024 Evaluation Board allows the ADM1024 microprocessor system hardware monitor IC to be quickly and easily evaluated using a personal computer. Using the evaluation board and its accompanying software, the ADM1024 can be interfaced to any personal computer running Windows™ 95 or Windows™ 98 , via the computer's parallel printer port, or via the computer's SMBus using the DIMM interface card provided.

The evaluation board allows all the input and output functions of the ADM1024 to be exercised without the need for external components. The software allows control and monitoring of the ADM1024's internal registers.

THE ADM1024

The following gives a brief description of the ADM1024 and the system overview. Further information can be found in the data sheet for the device.

The ADM1024 is a complete system hardware monitor for microprocessor-based systems, providing measurement and limit comparison of various system parameters. Eight measurement inputs are provided, of which three are dedicated to monitoring +5V and +12V power supplies and the processor core voltage. The ADM1024 can monitor a fourth power-supply voltage by measuring its own V_{CC}. One input (two pins) is dedicated to a remote temperature-sensing diode. Two further pins can be configured as inputs to monitor a +2.5V supply and a second processor core voltage, or as a second temperature sensing input.The remaining two inputs can be programmed as general purpose analog inputs or as digital fan-speed measuring inputs.

Measured values can be read out via an I²C-compatible serial System Management Bus, and values for limit comparisons can be programmed in over the same serial bus. The high-speed successive-approximation ADC allows frequent sampling of all analog channels to ensure a fast interrupt response to any out-of-limit measurement.

The ADM1024's 2.8V to 5.5V supply voltage range, low supply current, and I²C compatible interface make it ideal for a wide range of applications. These include hardware monitoring and protection applications in personal computers, electronic test equipment, and office electronics.

EVALUATION SYSTEM PACKAGE CONTENTS

The evaluation system package contains the following items:

- This application note
- ADM1024 evaluation board
- DIMM interface card
- Centronics cable
- DIMM interface ribbon cable
- Evaluation software on 3 floppy disks

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EVALUATION BOARD HARDWARE

The ADM1024 evaluation board contains the following main components, which can be identified from the block diagram, printed circuit board silk screen and schematic diagram of figures 1, 2 and 3, overleaf.

- ADM1024 IC
- Two NPN temperature sensor transistors
- Fan with tachometer output
- LED indicators for Power, Reset, Interrupt, Thermal Interrupt and Chassis Intrusion
- Switches for selecting input sources, setting VID inputs and setting SMBus address
- Chassis Intrusion and Reset switches
- Trimpots for adjusting analog input voltages
- Interface buffers
- Connectors for parallel and SMBus interface
- Test connector
- Co-axial and terminal block power connectors

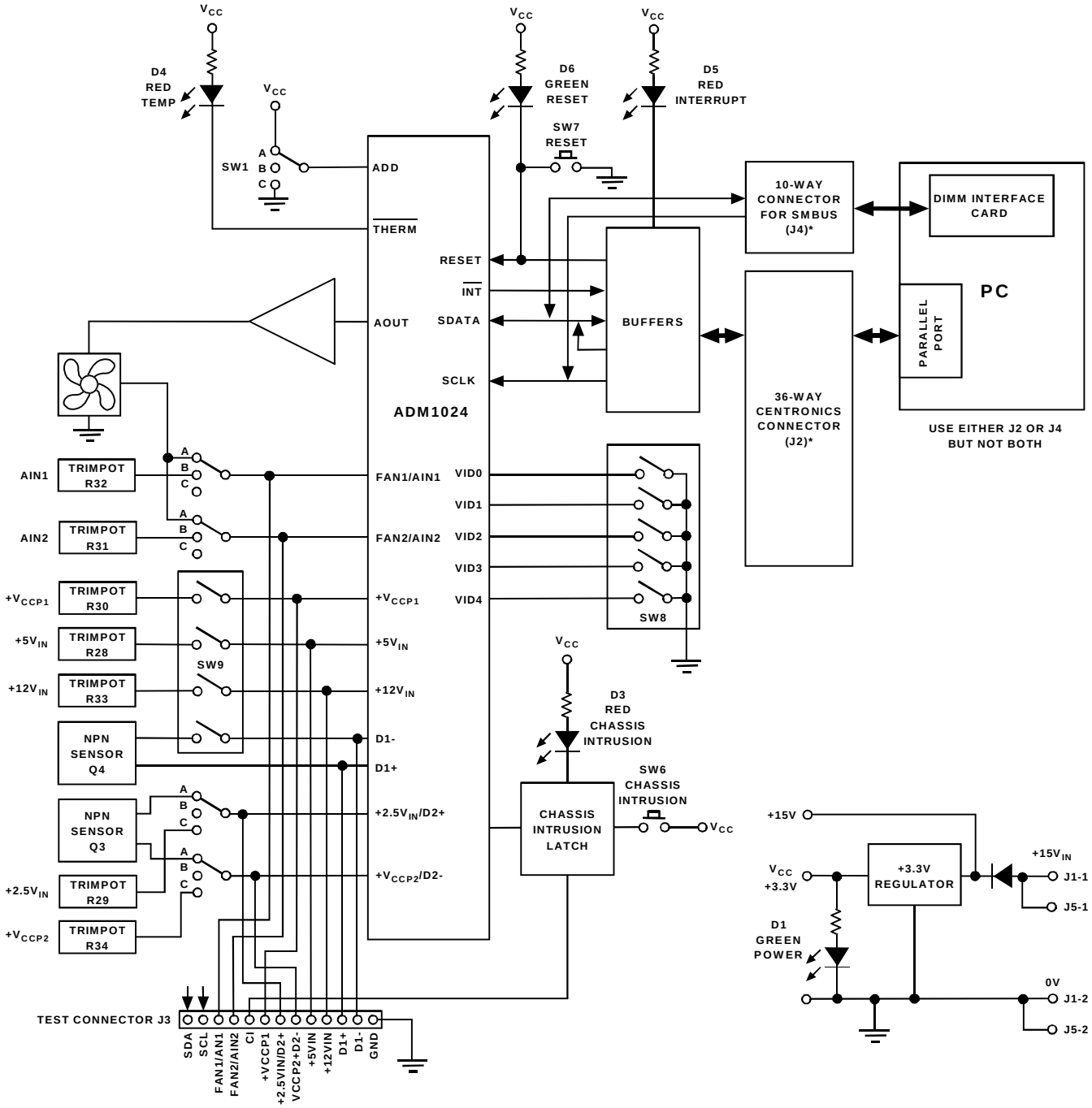

Figure 1. ADM1024 Evaluation Board Block Diagram

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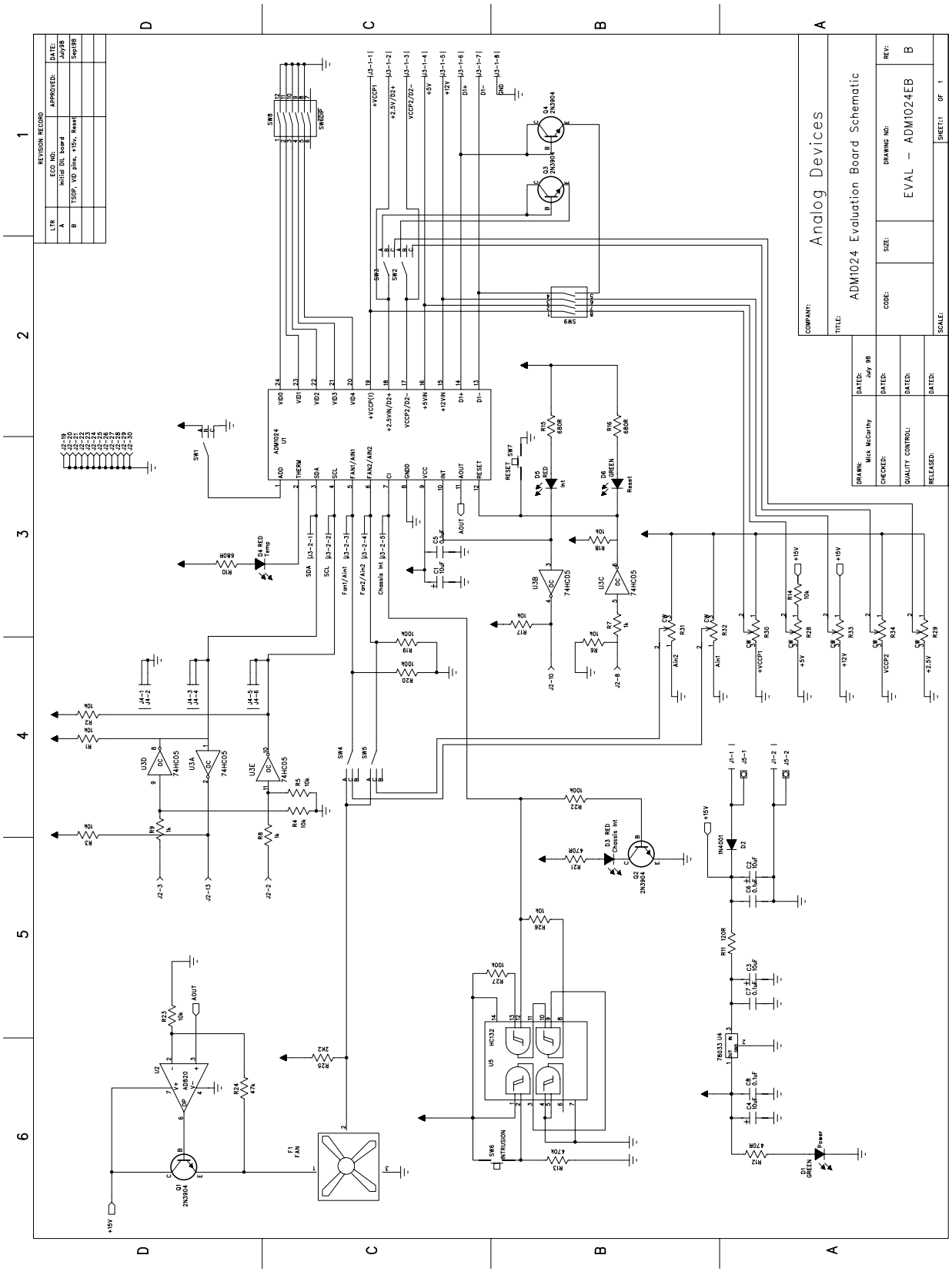


Figure 2. ADM1024 Evaluation Board Schematic

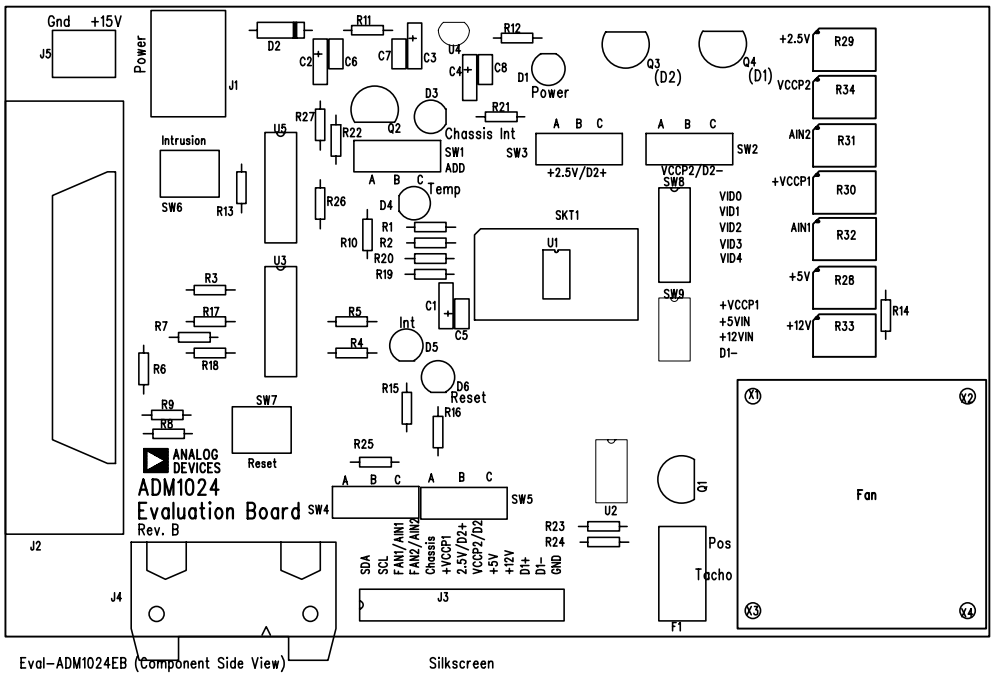


Figure 2. ADM1024 Evaluation Board SilkScreen

USING THE HARDWARE

The evaluation board requires only a +15V, 100mA power supply in order to function. All inputs to the ADM1024 can be exercised without the need for any external components. Analog inputs can be adjusted using the 7, on-board trimpots provided, whilst two on-board transistors are provided for temperature sensing. A fan is provided with tachometer output so that its speed can be measured. The fan speed is controlled by the analog output of the ADM1024. Alternatively, analog voltage, fan speed and temperature inputs may all be supplied from external sources, allowing the user to evaluate the ADM1024 with "real-world" inputs.

As some inputs of the ADM1024 can be configured for different purposes, various switches are provided on the evaluation board to allow the inputs to be connected to internal or external sources of the appropriate kind. The function of the various, switches, connectors and indicators is decribed below.

POWER CONNECTORS J1 AND J5

The evaluation board must be powered from a regulated 15V supply capable of supplying 100mA. This is required to drive the on-board fan and also to supply analog voltages in excess of +12V for the $+12V_{IN}$ input. The supply may be connected to the co-axial power connector J1 (center positive) or to the terminal block J5. If the supply is connected with incorrect polarity, the evaluation board wil not be damaged due to an on-board blocking diode, but the unit will not function.

CENTRONICS INTERFACE CONNECTOR J2

If the personal computer being used with the evaluation board does not have a System Management Bus on the motherboard, connection between the evaluation board should be made via a parallel printer port, using the cable provided. The connections to J2 are as follows:

TABLE 1. J2 CONNECTIONS

J2 Pin	ADM1024 Function	Parallel Port Function
2	Serial Clock (SCLK)	DB0
3	Serial Data In (SDATA)	DB1
8	$\overline{\text{RESET}}$ IN	DB6
10	$\overline{\text{INT}}$ OUT	$\overline{\text{ACKNLG}}$
13	Serial Data Output	SLCT IN

TEST CONNECTOR J3

Test connector J3 allows various functions of the ADM1024 to be monitored with a DVM or oscilloscope. External sources may be connected to some of the pins of J3, see Table 2 below. The function of J3 will depend on the setting of various switches

TABLE 2. J3 PIN FUNCTIONS

J3 Pin	Function
1-1	Input to V_{CCP1} from external source, or monitor V_{CCP1} from on-board trimpot R30
1-2	Input to $2.5V_{IN}$ from external source, from anode (D2+) of external temperature sensor diode, or monitor $+2.5V_{IN}$ from on-board trimpot R29
1-3	Input to V_{CCP2} from external source, from cathode (D2-) of external temperature sensor diode, or monitor +VCCP2 from on-board trimpot R34
1-4	Input to $+5V_{IN}$ from external source, or monitor $+5V_{IN}$ from on-board trimpot R28
1-5	Input to +12VIN from external source, or monitor $+12V_{IN}$ from on-board trimpot R33
1-6	Monitor anode of on-board temperature sensor (D1+), or connect anode of external temperature sensor when SW8-4 open
1-7	Monitor cathode of on-board temperature sensor (D1-), or connect cathode of external temperature sensor when SW8-4 open
1-8	GND. System ground
2-1	Monitor Serial Data line SDA
2-2	Monitor Serial Clock line SCL
2-3	Input to FAN1/AIN1 from external source, or monitor FAN1/AIN1 from on-board source
2-4	Input to FAN2/AIN2 from external source, or monitor FAN2/AIN2 from on-board source
2-5	Input to Chassis Intrusion latch from external source, or monitor output of Chassis Intrusion latch

SMBUS INTERFACE CONNECTOR J4

The SMBus interface connector J4 allows the evaluation board to be connected direct to the SMBus of a personal computer using the DIMM interface card provided. To make this connection it may be necessary to remove one of the DIMM memory modules on the PC motherboard, if all DIMM sockets are occupied. This will affect the BIOS setup and Windows 95, and should only be attempted by a competent user.

SWITCHES

SW1

The ADM1024 has a 7-bit serial bus slave address, 01011 (A1)(A0), where A1 and A0 are the two LSBs.

Slide switch SW1 is connected to the ADD input (pin 1) of the ADM1024 and allows the two LSB's of the device's slave serial bus address to be set. ADD is a three-state input, giving three possible addresses.

TABLE 3. ADM0124 ADDRESSES

SW1 Position	ADD Pin	A1	A0
A	V_{CC}	0	1
B	No Connect	0	0
C	GND	1	0

Note that ADD is only sampled at power-up. Changing ADD while power is on will have no effect until the device is powered off then on again.

SW2,SW3

Slide switches SW2 and SW3 allow pins 17 and 18 to be connected to adjustable analog input voltages when they are configured as analog inputs, or to a second remote temperature sensor diode, D2, when they are configured as a temperature input. With both SW2 and SW3 set to position 'A', pins 17 and 18 are connected to D2. With SW2 set to position 'B', pin 17 is

TABLE 4. SW2 AND SW3 SETTINGS

SW3	SW2	Channel Mode Reg Bit 2	Pin 18	Pin17	J3-1-2	J3-1-2
A	A	1	D2+	D2-	Monitor On-board D2+	Monitor On-board D2-
A	B	0	NA	V_{CCP2}	NA	External V_{CCP2}
A	C	0	NA	V_{CCP2}	NA	Monitor On-board V_{CCP2}
B	A	0	V_{CCP2}	NA	External 2.5V	NA
B	B	0 or 1	V_{CCP2}	$2.5V_{IN}$	External 2.5V or connect ext. D2+	External V_{CCP2} or connect ext. D2-
B	C	0	V_{CCP2}	$2.5V_{IN}$	External 2.5V	Monitor On-board V_{CCP2}
C	A	0	V_{CCP2}	NA	Monitor On-board 2.5V	NA
C	B	0	V_{CCP2}	$2.5V_{IN}$	Monitor On-board 2.5V	External V_{CCP2}
C	C	0	V_{CCP2}	$2.5V_{IN}$	Monitor On-board 2.5V	Monitor On-board V_{CCP2}

NA = not applicable, invalid setting

connected to J3-1 pin 3. Similarly, with SW3 set to position 'B', pin 18 is connected to J3-1 pin 2. These may be connected to external analog inputs or to an external sensor diode if both SW2 and SW3 are set to position 'B'.

With SW2 set to position 'C', pin 17 is to the wiper of R34, which allows an adjustable analog input from an on-board source. Similarly, with SW3 set to position 'C', pin 18 is connected to the wiper of R29. Bit 2 of the channel mode register must be cleared to measure voltage and set to measure temperature.

See Table 4, previous page.

SW4, SW5

Slide switches SW4 and SW5 allow pins 5 and 6 to be connected to a fan tacho output when these inputs are configured as fan inputs, or to an adjustable analog voltage when these inputs are configured as analog inputs. 'A', FAN1/AIN1 (pin 5) is connected to the tacho output of fan F1. Similarly, with SW5 in position 'A' FAN2/AIN2 (pin 6) is also connected to the tacho output of fan F1. (Only one fan is provided on the evaluation board). With SW4 in position 'C', FAN1/AIN1 is connected to the wiper of trimpot R32, which allows an adjustable analog input from an on-board source. Similarly, with SW5 set in position 'C', FAN2/AIN2 is connected to the wiper of trimpot R31.

When pins 5 and 6 of the ADM1024 are connected to the on-board fan or analog sources, the fan speed or analog voltage may be monitored on test connector pins J3-2-3 and J3-2-4.

If SW4 and/or SW5 are set to position B, the on-board sources are disconnected and external sources may be connected to J3-2-3 and J3-2-4.

Whatever source is connected, pins 5 and 6 must be configured as fan or analog input using bits 0 and 1 of the Channel Mode Register.

TABLE 5. SW4 SETTINGS

SW4	Pin 5 Function	Source	J3-2-3	Channel Mode Bit 0
A	FAN1	On-board Fan	Monitor Fan	0
B	FAN1 or AIN1	J3-2-3	Ext. Fan or AIN1	0 or 1
C	AIN1	Trimpot R32	Monitor AIN1	1

TABLE 6. SW5 SETTINGS

SW4	Pin 5 Function	Source	J3-2-3	Channel Mode Bit 1
A	FAN2	On-board Fan	Monitor Fan	0
B	FAN2 or AIN2	J3-2-4	Ext. Fan or AIN2	0 or 1
C	AIN2	Trimpot R31	Monitor AIN2	1

TABLE 7. CHANNEL MODE REGISTER SETTINGS

Bit	Bit = 0 (default)	Bit = 1
0	Pin 5 = FAN1	Pin 5 = AIN1
1	Pin 6 = FAN2	Pin 6 = AIN2
2	Pin 18 = $2.5V_{IN}$ Pin 17 = V_{CCP2}	Pin 18 = D2+ Pin 17 = D2-
3	Int V_{CC} = 3.3V	Int V_{CC} = 5V

SW6

Pushbutton switch SW6 allows a chassis intrusion event to be simulated by setting the chassis intrusion latch U5. This may be reset from the evaluation software.

SW7

Pushbutton switch SW7 allows manual resetting of the ADM1024.

SW8

DIP switch SW8 allows the processor voltage ID inputs to the ADM1024 (VID0 to VID4, pins 24 through 20) to be configured. These bits can then be read back from the VID registers using the evaluation software. When a switch is on, the corresponding VID bit is '0'. When the switch is open the corresponding VID bit is '1'. Note that only sections 1 to 5 of this switch are used.

SW9

DIP switch SW9 allows the V_{CCP1}, $+5V_{IN}$ and $+12V_{IN}$ inputs to be connected to an on-board source or an external source. With SW9-1 closed, V_{CCP1} (pin 19) is connected to the wiper of R30, which allows an adjustable analog input from an on-board source. The voltage may be monitored on test connector J3-1 pin 1. With SW9-1 open, V_{CCP1} may be fed from an external source connected to J3-1 pin 1. Similarly, by closing or opening

TABLE 8. SW9 SETTINGS

SW9 Position	Switch Open	Switch Closed
1	On-board V_{CCP1} from trimpot R30. Monitor at J3-1-1	Ext. V_{CCP1} from J3-1-1
2	On-board +5V from trimpot R28. Monitor at J3-1-4	Ext. +5V from J3-1-4
3	On-board +12V from trimpot R33. Monitor at J3-1-5	Ext. +12V from J3-1-5
4	Connect Ext. temperature sensor from J3-1-6 to J3-1-7	On-board sensor Q4 connected. Monitor at J3-1-6/7

SW9-2 and/or SW9-3, +5V_{IN} (pin 16) may be fed from the wiper of R28 and monitored at J3-1 pin 2, or fed from J3-1 pin 2, while +12V_{IN} may be fed from the wiper of R33 and monitored at J3-1 pin 3, or fed from J3-1 pin 3.

Position 4 of SW9 may be used to simulate a sensor open-circuit fault on Q4 by opening this switch.

TABLE 9. INDICATORS

LED	Colour	Function
D1	Green	Power indicator
D3	Red	Lights when CI input is high
D4	Red	Lights when $\overline{\text{THERM}}$ output is low
D5	Green	Lights when $\overline{\text{RESET}}$ input is low
D6	Ref	Lights when $\overline{\text{INT}}$ output is low

THE SOFTWARE

The Software allows the ADM1024's functions to be controlled from the PC via an easy to use interface operating under the Windows ™ environment. The contents of the device's internal registers can easily be read or altered through a user-friendly graphical interface, whileThe Control Center window allows graphing of temperature readings

INSTALLING THE SOFTWARE

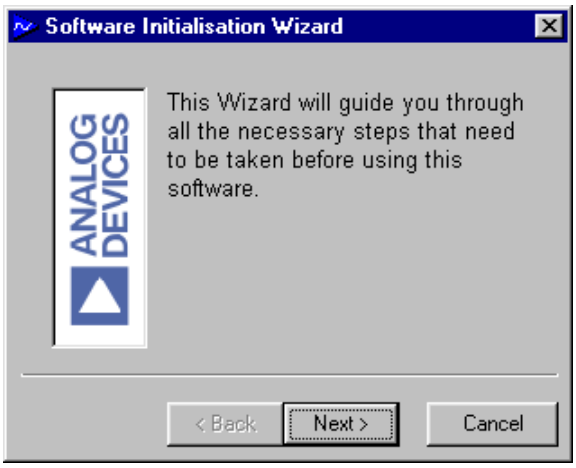
To install the software, insert the first disk of the program software into drive A, click on the Start icon, click on Run, then type A:setup.exe as the file name. If the 3.5-inch floppy disk drive is not drive "A", type "X" instead of "A", where "X" is the drive letter of the 3.5-inch floppy disk drive. Follow the instructions in the setup program to install the software to the drive and directory of your choice.

USING THE SOFTWARE

When using the software , first ensure the evaluation board is powered up and connected to the Parallel printer port, or to the PC's SMBus using the DIMM interface card.

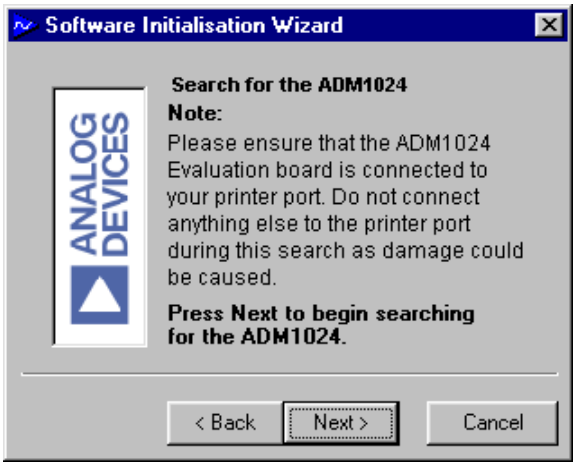
To start the software, select Start- Programs -ADM1024 Evaluation Software.

Press any key or mouse button to go on to the next step, which is the Software Initialisation Wizard.

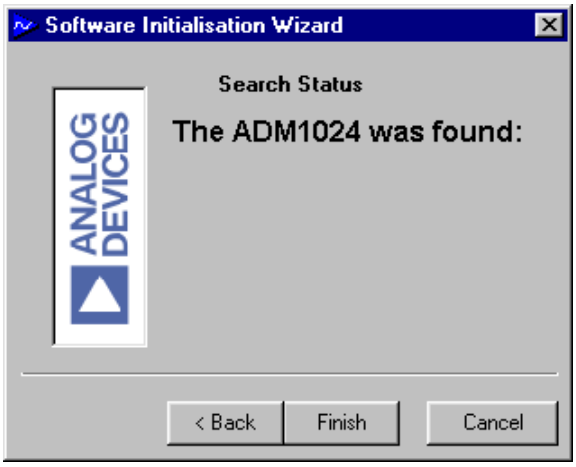


Click on "Next" to go on to the next screen, which allows the user to select between connection of the evalution board via the printer port or to the SMBus using the DIMM interface card.

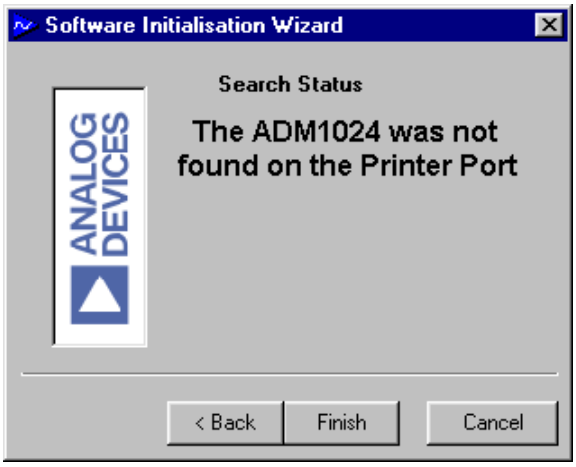
Once the communucations medium has been selected, click on "Next" to go to the next screen. When you are ready for the software to begin searching for the evaluation board on either the parallel port or the SMBus, click "Next".



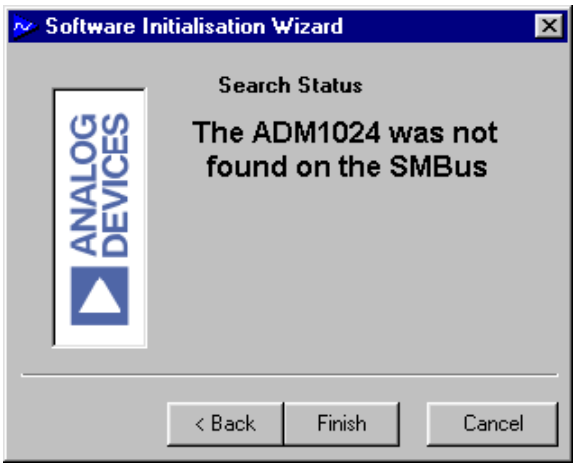
The software will search for the ADM1024, when it is found, the following screen will appear.



If the ADM1024 is not found on the printer port, the following message will appear.



If the ADM1024 is not found on the SMBus, the following message will appear.



In this case check the connections to the evaluation board, click on "Back" and try again. If this does not work then try re-booting the PC and and re-running the software.

When the software has successfully found the ADM1024, click on "Finish". An index-card type display with four tabs will appear.

MAIN TAB

The Main tab shows the software version. Additional information about the software may be obtained by clicking on About. Help can be obtained at any time by pressing F1.

READ/WRITE

This tab displays information about the ADM1024's internal registers allows their contents of be read and/or altered. The registers are arranged in three functional groups. The "Measured" group contains all the registers for measured values. The "Other Settings" group contains the registers for controal and configuration of the ADM1024, whilst the "Limits" group contains the registers for high and low limits.

Each register has a button associated with it. Clicking on a button will display the contents of the selected register in the register contents box and the name of each register bit. The register contents are also displayed in hexadecimal and decimal.

Clicking on a register button causes its contents to be read once if continuous reading is off. If continuous reading is on, the register continuous will be updated continuously. Click the button to toggle between Continuous Reading is Off and Continuous Reading is On.

The type of register selected, its hexadecimal address, its current value in hexadecimal and decimal and the previous value written to the register, are also displayed.

Data may be written to all registers that are Read/Write ,(refer to data sheet for more information). When the Read/Write tab is first selected, none of the registers have been written to, and they contain their default values.

Registers may be written to in two ways. Clicking on a bit in the Read/Write display will toggle its value between 0 and 1. This is useful where a function is controlled by setting or clearing a bit, for example starting monitoring by setting bit 0 of Configuration Register 1.

The entire contents of a register may be changed by typing a Hex or decimal value in the text boxes of the Write display. The button will change from green to red and the new value can be written to the register by clicking on the button.

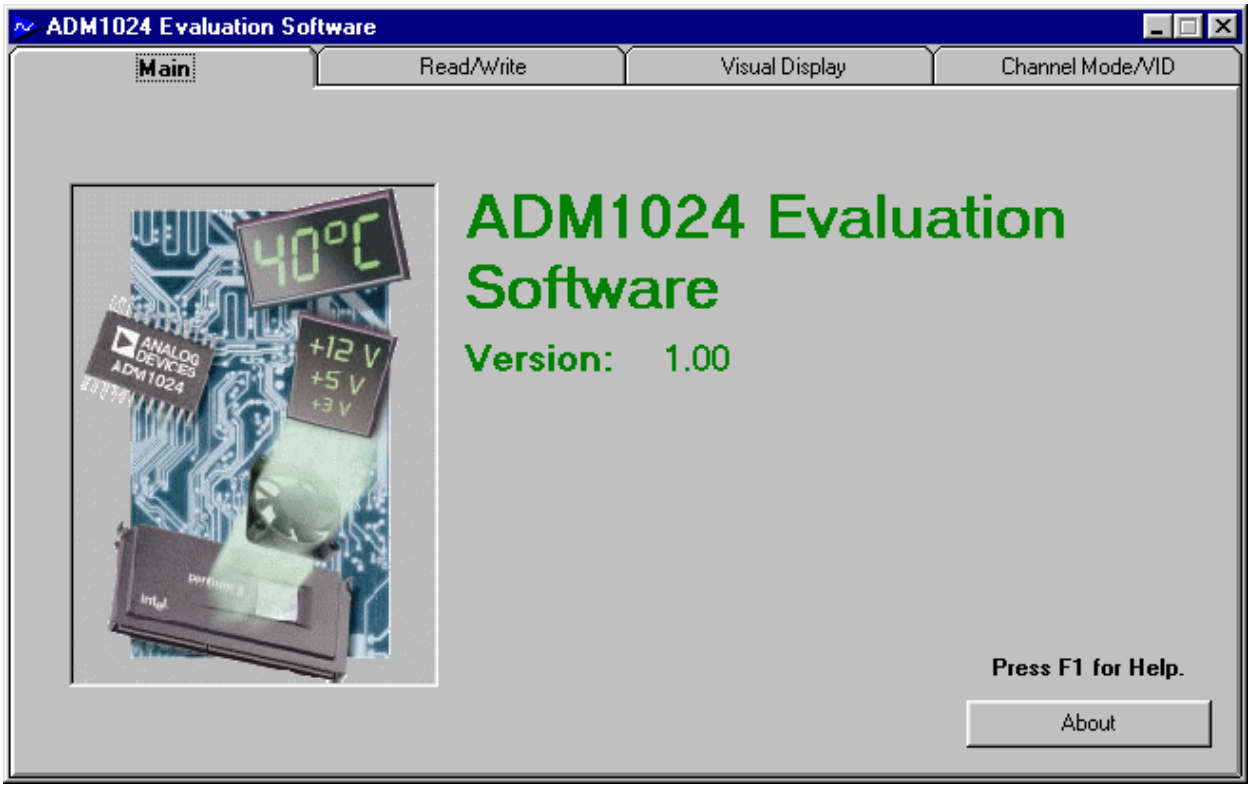


Figure 4 Main Program Tab

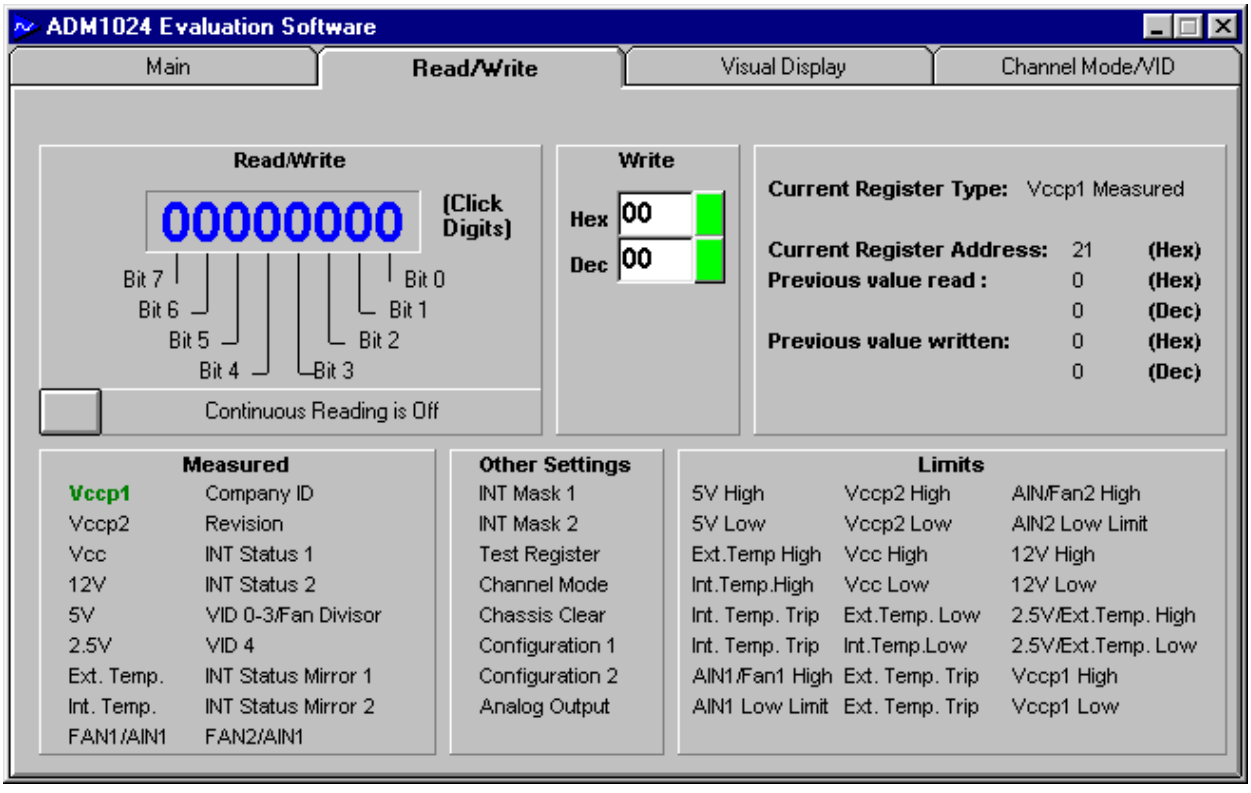


Figure 5. Read/Write Program Tab

This is useful where a register contains a numeric value such as a temperature limit.

Two extremely important functions avaliable from the Read/Write tab are starting the ADM1024, which is achieved by setting bit 0 of Configuration Register 1, and configuring the input channels, which is done by setting or clearing bits 0 through 3 of the Channel Mode Register. The input channels should be set up to suit the type of inouts being measured. Refer to Tables 2 through 8 for more details.

CHANNEL MODE/VID TAB

The input channels can also be set up in graphical format using the Channel Mode/VID tab.This tab allows the user to update the contents of the channel mode register using a graphical interface and to view the VID bits. Clicking on any of the switches graphically displayed in this tab will toggle the switch. This allows the user to configure the following inputs.

- FAN1 or AIN1
- FAN2 or AIN2
- 2.5V_{IN} and V_{CCP2} or D2+/D2-
- Internal V_{CC} channel set to monitor 3.3V or 5V V_{CC}

Changing the switches in the Channel Mode/VID tab will change the corresponding bit in the Channel Mode Register. Conversely, changes to bits 0 though 3 of the Channel Mode Register made in the Read/Write tab will be reflected in the Channel Mode/VID tab.

The processor voltage ID bits VID0 to VID4 are displayed in the VID window. Changing the value of the VID bits with SW8 will be reflected in this window.

VISUAL DISPLAY TAB

The Visual Display Tab allows the measured values of several channels to be displayed as line graphs vs. time, or the values and limits for a single channel to be displayed as a bargraph.

When the Visual Display tab is selected, the line graph will default to displaying the measured voltages of all those channels that are configured as analog inputs.

By selecting another option in the Graph box, the line graph can be made to display the measured value of the internal and external temperature sensors, or the fan speed of those channels configured as fan inputs. At least one input must be configured for fan speed measurement for the Fan Revs option to be available. The speed of the on-board fan may be controlled by the slider at the left of the Visual Display tab, which sets trhe analog output and hence the fan speed.

In temperature mode the line graph will display either two or three temperature channels, depending on whether the second external temperature channel is enabled.

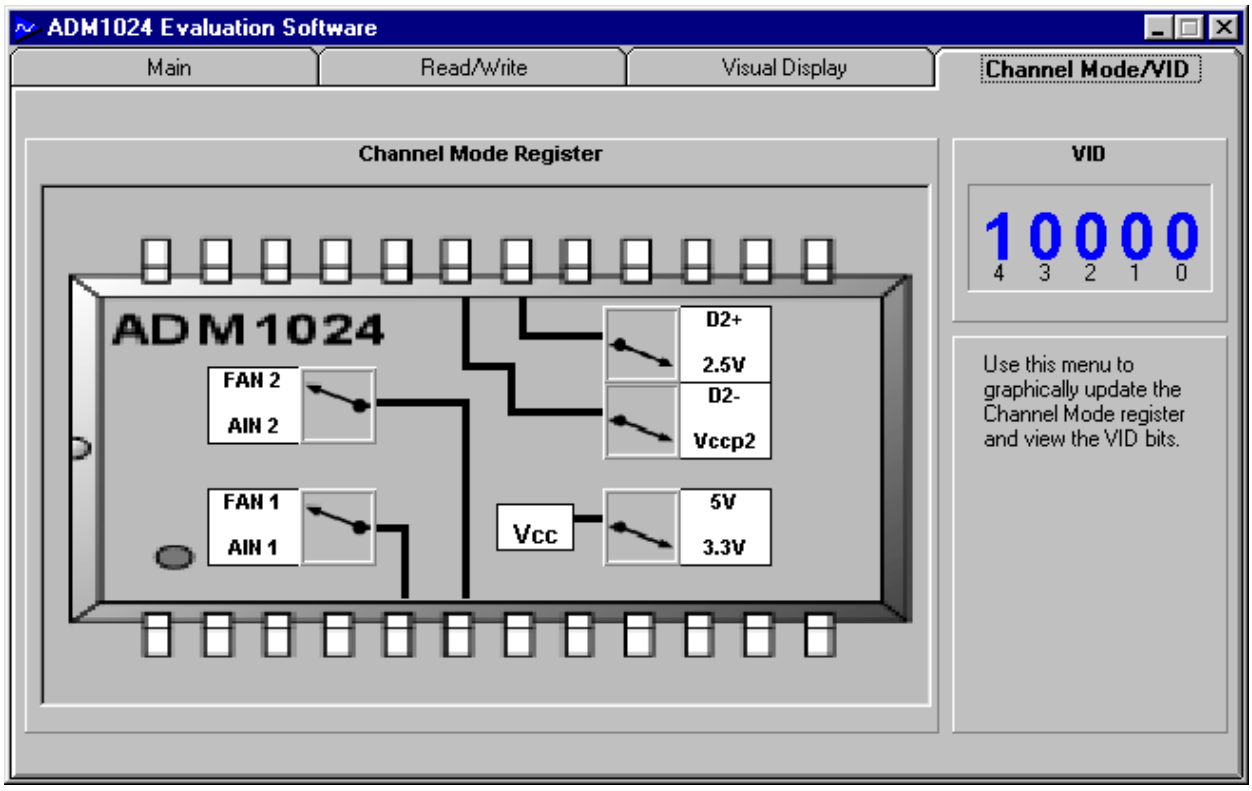


Figure 6. Channel Mode/VID Tab

The input channels may be configured from the Read/Write tab using bits 0 through 3 of the Channel Mode Register, or may be configured graphically from the Channel Mode/VID Tab.

To see a portion of the graph in more detail, use the arrowheads on the axes(⌂⛉⛢⛣) to zoom in on the section of interest from the left, right, top or bottom.

BARGRAPH

The bargraph allows the user to display the measured value of any one input channel and the limits for that channel in a bargraph format. The limits may also easily be changed. To select a channel for bargraph display, click on the name of the channel in the bargraph box. Which channels are displayed in this box and how they are labelled depends on the setting of bits 0 through 3 of the Channel Mode register. The measured value of the channel will be displayed as a bargraph and also in decimal digits in the window below the bargraph. The limits for the channel are displayed in the limit buttons, which can be slid up and down the bargraph. As the limit buttons are moved, the values in them will change and the corresponding limit registers will be updated automatically. When a channel is within limits, the indicator at the side of it will be green. When it is out of limits, the indicator will flash red and D5 on the evaluation board will also flash. In the event of a thermal interrupt, D4 on the evaluation board will flash.

EASY SETUP

The line and bargraphs can be started with a single click by clicking on the Easy Setup button. This starts the ADM1024 monitoring, sets the input channels to their default values, puts nominal limits in the high and low limit registers and starts the line graph. If the Visual Display tab is selected when the ADM1024 is stopped (bit 1 of Configuration Register 1 cleraed), then the use will be prompted to select Easy Setup, as shown in Figure 8, overleaf. When Easy Setup is selected, the following defaults are selected.

- Pin 5 FAN1
- Pin 6 FAN2
- Pin 17 $+2.5_{VIN}$
- Pin 18 $+V_{CCP2}$
- Internal V_{CC} channel +3.3V
- Line Graph Displays temperature
- Bargraph Displays $+12V_{IN}$ channel

Once Easy Setup has been selected, the line and bargraph selections may be changed to display other parameters.

Before selecting Easy Setup, check that all inputs are configured correctly to suit the above defaults.

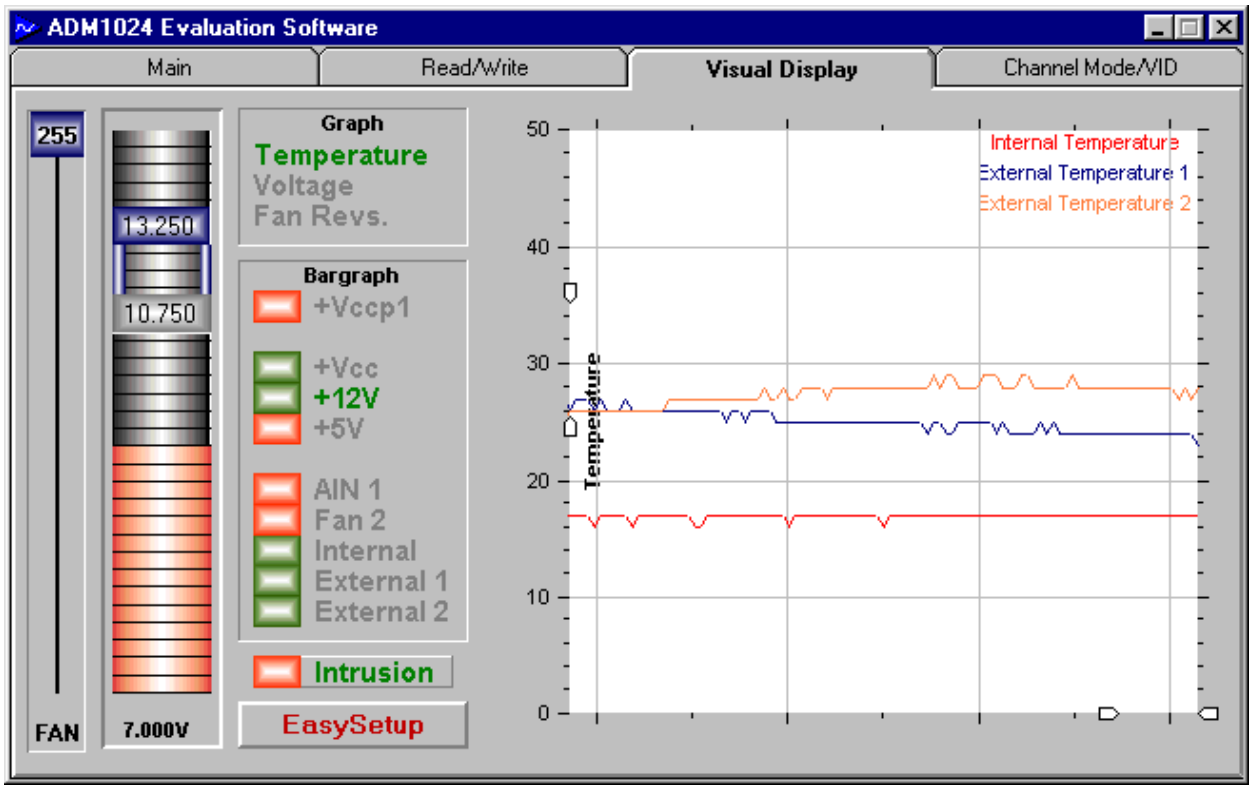


Figure 7. Visual Display Tab Showing Temperature

CHASSIS INTRUSION

A chassis intrusion event may be simulated by pressing SW6 on the evaluation board, which sets the chassis intrusion latch U5. The chassis intrusion is displayed on the Visual Display Tab by the Intrusion indicator turning from green to red. The chassis intrusion latch may be reset by clicking on the word Intrusion .

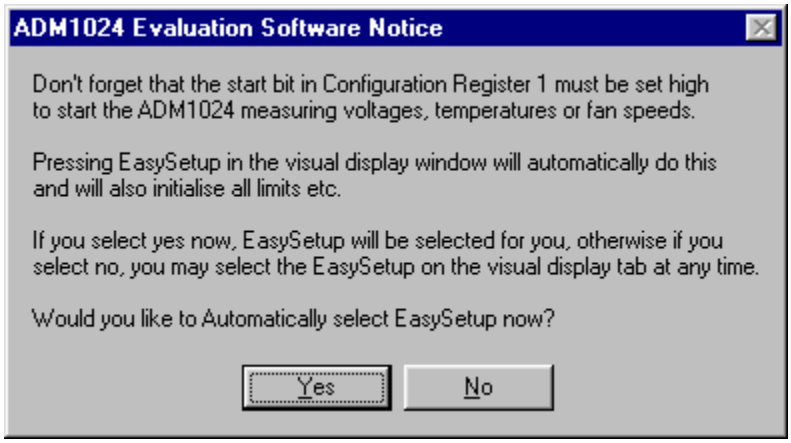


Figure 8. Visual Display Tab Showing Temperature

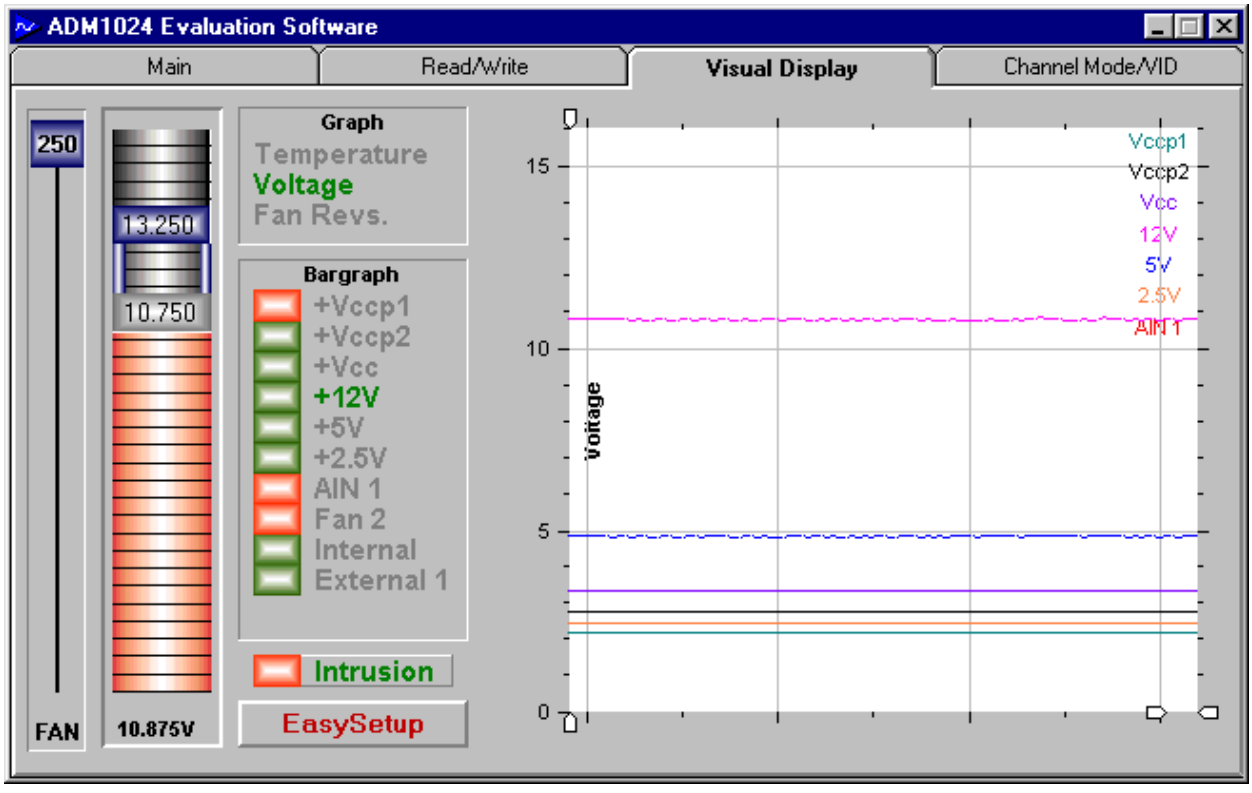


Figure9. Visual Display Tab Showing Voltage

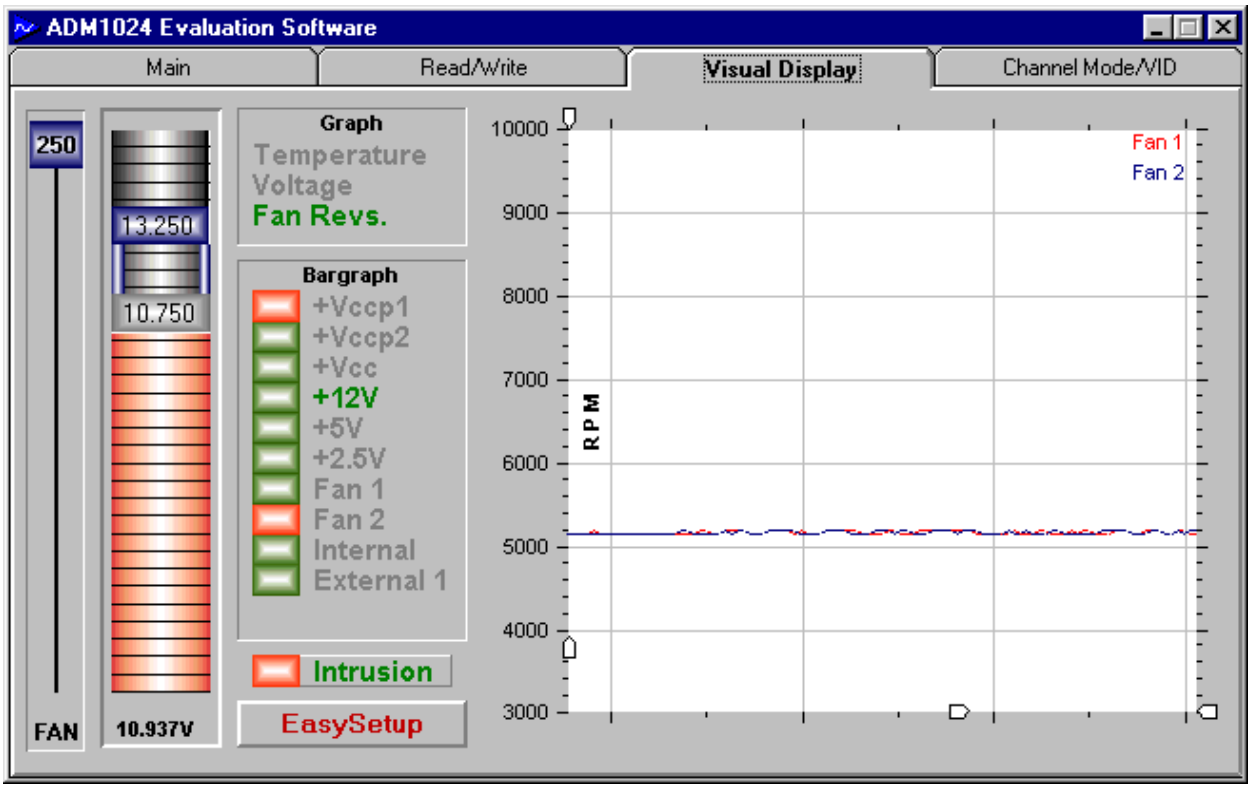


Figure 10. Visual Display Tab Showing Fan RPM

APPENDIX A. ADM1024 REGISTERS

For additional details, please refer to the ADM1024 data sheet

TABLE 10. ADDRESS POINTER REGISTER

Bit	Name	R/W	Description
7-0	Address Pointer	Write	Address of ADM1024 Registers. See the tables below for detail.

TABLE 11. LIST OF REGISTERS

Hex Address	Description	Power on Value (Binary Bit 7 - 0)	Notes
13h	Internal Temp. HardwareTrip Point	= 70°C	Cannot be written to a higher value. Can be written to a lower value, but only if write once bit in Config. Reg. 2 has not been set.
14h	External Temp Hardware Trip Point	= 85°C	Cannot be written to a higher value. Can be written to a lower value, but only if write once bit in Config. Reg. 2 has not been set.
15h	Test Register	0000 0000	Setting Bit 0 of this register to 1 selects shutdown mode. **Caution**: Do Not write to any other bits in this register
16h	Channel Mode Register	0000 0000	This register configures the input channels and configures VID0 to VID as processor voltage ID or interrupt inputs
17h	Internal Temp Hardware Trip Point	= 70°C	Read Only. Cannot be changed.
18h	External Temp Hardware Trip Point	= 85°C	Read-Only. Cannot be changed.
19h	Programmed Value of A_{OUT}	1111 1111	
1Ah	AIN1 Low Limit	Indeterminate	
1Bh	AIN2 Low Limit	Indeterminate	
20h	+2.5V Measured Value/EXT Temp2	Indeterminate	Read Only
21h	$+V_{CCP1}$ Measured Value	Indeterminate	Read Only
22h	V_{CC} Measured Value	Indeterminate	Read Only
23h	+5V Value	Indeterminate	Read Only. Stores +5V input reading
24h	+12V Measured Value	Indeterminate	Read Only.
25h	V_{CCP2} Measured Value	Indeterminate	Read Only
26h	Ext. Temp1Value	Indeterminate	Read Only. Stores the measurement from a diode sensor connected to pins 13 and 14
27h	Internal Temp Value	Indeterminate	Read Only. This register is used to store 8 bits of the internal temperature reading.
28h	FAN1/AIN1 Value	Indeterminate	Read Only. Stores FAN1 or AIN1 reading depending on the configuration of pin 5
29h	FAN2/AIN1 Value	Indeterminate	Read Only. Stores FAN2 or AIN2 reading depending on the configuration of pin 6
2Ah	Reserved	Indeterminate	

TABLE 11. list of REGISTERS (continued)

Hex Address	Description	Power on Value (Binary Bit 7 - 0)	Notes
2Bh	+2.5V/Ext. Temp2 High Limit	Indeterminate	Stores high limit for +2.5V input or, in temperature mode, this register stores the high limit for a diode sensor connected to pins 17 and 18
2Ch	+2.5V/Ext. Temp2 Low Limit	Indeterminate	Stores high limit for +2.5V input or, in temperature mode, this register stores the low limit for a diode sensor connected to pins 17 and 18
2Dh	$+V_{CCP1}$ High Limit	Indeterminate	Stores V_{CCP1} high limit
2Eh	$+V_{CCP1}$ Low Limit	Indeterminate	
2Fh	V_{CC} High Limit	Indeterminate	
30h	V_{CC} Low Limit	Indeterminate	
31h	+5V High Limit	Indeterminate	Stores high limit for 5V
32h	+5V Low Limit	Indeterminate	Stores low limit for 5V input
33h	+12V High Limit	Indeterminate	
34h	+12V Low Limit	Indeterminate	
35h	V_{CCP2} High Limit	Indeterminate	
36h	V_{CCP2} Low Limit	Indeterminate	
37h	Ext.Temp1. High Limit	Indeterminate	Stores high limit for a diode sensor connected to pins 13 and 14
38h	Ext Temp1. Low Limit	Indeterminate	Stores low limit for a diode sensor connected to pins 13 and 14
39h	Internal Temp. High Limit	Indeterminate	Stores the high limit for the internal temperature reading.
3Ah	Internal Temp. Low Limit	Indeterminate	Stores the low limit for the internal temperature reading.
3Bh	AIN1/FAN1 High Limit	Indeterminate	Stores high limit for AIN1 or FAN1, depending on the configuration of pin 5
3Ch	AIN2/FAN2 High Limit	Indeterminate	Stores high limit for AIN2 or FAN2, depending on the configuration of pin 6
3Dh	Reserved	Indeterminate	
3Eh	Company ID number	0100 0001	This location will contain the company identification number (Read Only)
3Fh	Revision number	0001 nnnn	Last four bits of this location will contain the revision number of the part. (Read Only)
40h	Configuration Register 1	0000 1000	See Table 12
41h	Interrupt $\overline{INT}$ Status Register 1	0000 0000	See Table 14
42h	Interrupt $\overline{INT}$ Status Register 2	0000 0000	See Table 15
43h	$\overline{INT}$ Mask Register 1	0000 0000	See Table 16

TABLE 11. LIST OF REGISTERS (CONTINUED)

Hex Address	Description	Power on Value (Binary Bit 7 - 0)	Notes
44h	$\overline{\text{INT}}$ Mask Register 2	0000 0000	See Table 17
46h	Chassis Intrusion Clear Register	0000 0000	See Table 18
47h	VID 0-3/Fan Divisor Register	0101 (VID3-VID0)	See Table 19
49h	VID 4 Register	1000 000(VID 4)	See Table 20
4Ah	Configuration Register 2	0000 0000	See Table 21
4Ch	Interrupt Status Register Mirror No. 1	0000 0000	See Table 22
4Dh	Interrupt Status Register Mirror No.2	0000 0000	SeeTable 23

TABLE 12. REGISTER 16H, CHANNEL MODE REGISTER (POWER ON DEFAULT = 00H)

Bit	Name	R/W	Description
0	FAN1/AIN1	R/W	Clearing this bit to 0 configures pin 5 as FAN1 input. Setting this bit to 1 configures pin 5 as AIN1. Power-on default = 0.
1	FAN2/AIN2	R/W	Clearing this bit to 0 configures pin 6 as FAN2 input. Setting this bit to 1 configures pin 6 as AIN2. Power-on default = 0.
2	2.5V,V_{CCP}/D2	R/W	Clearing this bit to 0 configures pins 18 and 19 to measure +2.5V and V_{CCP2}. Setting this bit to 1 configures pins 18 and 19 as an input for a second remote temperature-sensing diode. Power-on default = 0
3	Int V_{CC}	R/W	Clearing this bit to 0 sets the measurement range for the internal V_{CC} measurement to 3.3V. Setting this bit to 1 sets the internal VCC measurement range to 5V. Power-on default = 0
4	IRQ0 EN	R/W	Setting this bit to 1 enables pin 24 as an active high interrupt input, provided pins 20 to 24 have been configured as interrupts by setting bit 7 of the Channel Mode Register. Power-on default = 0
5	IRQ1 EN	R/W	Setting this bit to 1 enables pin 23 as an active high interrupt input, provided pins 20 to 24 have been configured as interrupts by setting bit 7 of the Channel Mode Register. Power-on default = 0
6	IRQ2 EN	R/W	Setting this bit to 1 enables pin 22 as an active high interrupt input, provided pins 20 to 24 have been configured as interrupts by setting bit 7 of the Channel Mode Register. Power-on default = 0
7	VID/IRQ	R/W	Clearing this bit to 0 configures pins 20 to 24 as processor voltage ID inputs. Setting this bit to 1 configures pins 20 to 24 as interrupt inputs. Power-on default = 0.

TABLE 13. REGISTER 40H, CONFIGURATION REGISTER 1 (POWER ON DEFAULT = 08H)

Bit	Name	R/W	Description
0	START	R/W	Logic 1 enables startup of ADM1024, logic 0 places it in standby mode.Caution: The outputs of the Interrupt pins will not be cleared if the user writes a zero to this location after an interrupt has occurred (see "$\overline{\text{INT}}$ Clear" bit). At startup, limit checking functions and scanning begins. Note, all high and low limits should be set into the ADM1024 prior to turning on this bit. (Powerup default=0)
1	$\overline{\text{INT}}$_Enable	R/W	Logic 1 enables the $\overline{\text{INT}}$ output. 1=Enabled 0=Disabled (Powerup Default = 0)
2	$\overline{\text{THERM}}$ Enable	R/W	0 = $\overline{\text{THERM}}$ disabled 1 = $\overline{\text{THERM}}$ enabled
3	$\overline{\text{INT}}$_Clear	R/W	During Interrupt Service Routine (ISR) this bit is asserted logic 1 to clear $\overline{\text{INT}}$ output without affecting the contents of the Interrupt Status Register. The device will stop monitoring. It will resume upon clearing of this bit. (Powerup default=1)
4	$\overline{\text{RESET}}$	R/W	Setting this bit generates a low-going 45ms reset pulse at pin 12. This bit is self-clearing and power-up default is 0
5	Reserved	R/W	Default = 0
6	$\overline{\text{THERM}}$ CLR	R/W	A one clears the $\overline{\text{THERM}}$ output without changing the Status Register contents.
7	Initialization	R/W	Logic 1 restores powerup default values to the Configuration register, Interrupt status registers, Interrupt Mask Registers, Fan Divisor Register, and the Temperature Configuration Register. This bit automatically clears itself since the power on default is zero.

TABLE 14. REGISTER 41H, INTERRUPT STATUS REGISTER 1 (POWER ON DEFAULT = 00 H)

BIT	Name	R/W	Description
0	+2.5V/Ext. Temp2 Error	Read Only	A one indicates that a High or Low limit has been exceeded
1	V_{CCP1} Error	Read Only	A one indicates that a High or Low limit has been exceeded
2	V_{CC} Error	Read Only	A one indicates that a High or Low limit has been exceeded
3	+5V Error	Read Only	A one indicates that a High or Low limit has been exceeded
4	Int. Temp Error	Read Only	A one indicates that a temperature interrupt has been set, or that a High or Low limit has been exceeded.
5	Ext. Temp1 Error	Read Only	A one indicates that a temperature interrupt has been set, or that a High or Low limit has been exceeded
6	FAN1/AIN1 Error	Read Only	A one indicates that a High or Low limit has been exceeded.
7	FAN2/AIN2 Error	Read Only	A one indicates that a High or Low limit has been exceeded.

TABLE 15. REGISTER 42H, INTERRUPT STATUS REGISTER 2 (POWER ON DEFAULT= 00H)

BIT	Name	R/W	Description
0	+12V Error	Read Only	A one indicates a High or Low limit has been exceeded,
1	V_{CCP2} Error	Read Only	A one indicates a High or Low limit has been exceeded
2	Reserved	Read Only	Undefined
3	Reserved	Read Only	Undefined
4	Chassis Error	Read Only	A one indicates Chassis Intrusion has gone high.
5	$\overline{\text{THERM}}$ Interrupt	Read Only	Indicates that $\overline{\text{THERM}}$ pin has been pulled low by an external source
6	D1 Fault	Read Only	Short or open-circuit sensor diode D1
7	D2 Fault	Read Only	Short or open-circuit sensor diode D2

Note: Anytime the STATUS Register is read out, the conditions (i.e. Register) that are read are automatically reset. In the case of the channel priority indication, if two or more channels were out of limits, then another indication would automatically be generated if it was not handled during the ISR.

In the Mask Register, the errant voltage interrupt may be disabled, until the operator has time to clear the errant condition or set the limit higher/lower.

TABLE 16. REGISTER 43H, INTERRUPT MASK REGISTER 1 (POWER ON DEFAULT = 00H)

BIT	Name	R/W	Description
0	+2.5V/Ext. Temp2	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt.
1	$+V_{CCP1}$	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt.
2	V_{CC}	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt.
3	+5V	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt.
4	Int. Temp	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt.
5	Ext. Temp1	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt.
6	FAN1/AIN1	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt.
7	FAN2/AIN2	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt.

TABLE 17. REGISTER 44H, INTERRUPT MASK REGISTER 2 (POWER ON DEFAULT= 00H)

Bit	Name	R/W	Description
0	+12V	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt
1	V_{CCP2}	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt
2	Reserved	Read/Write	Power up default set to Low.
3	Reserved	Read/Write	Power up default set to Low.
4	CI	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt.
5	$\overline{\text{THERM}}$ (input)	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt
6	D1 Fault	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt
7	D2 Fault	Read/Write	A one disables the corresponding interrupt status bit for $\overline{\text{INT}}$ interrupt

TABLE 18. REGISTER 46H, CHASSIS INTRUSION CLEAR (POWER ON DEFAULT = 00H)

Bit	Name	R/W	Description
0-6	Reserved	Read Only	Undefined , always reads as 00h
7	Chassis Int. Clear.	Read/Write	A one outputs a minimum 20 ms active low pulse on the Chassis Intrusion pin. The register bit clears itself after the pulse has been output.

TABLE 19. REGISTER 47H, VID0-3/FAN DIVISOR REGISTER (POWER ON DEFAULT 0101(VID 3-0))

Bit	Name	R/W	Description
0-3	VID	Read	The VID[3:0] inputs from processor core power supplies to indicate the operating voltage (e.g. 1.3V to 3.5V)
4-5	FAN1 Divisor	Read/Write	Sets counter prescaler for fan1 speed measurement <5:4> = 00 - divide by 1 <5:4> = 01 - divide by 2 <5:4> = 10 - divide by 4 <5:4> = 11 - divide by 8.
6-7	FAN2 Divisor	Read/Write	Sets counter prescaler for fan 2 speed measurement <7:6> = 00 - divide by 1 <7:6> = 01 - divide by 2 <7:6> = 10 - divide by 4 <7:6> = 11 - divide by 8

TABLE 20. REGISTER 49H, VID 4 / DEVICE ID REGISTER (POWER ON DEFAULT 1000000(VID4))

Bit	Name	R/W	Description
0	VID 4	Read Only	VID 4 Input from Pentium
1-7	Reserved	Read Only	Undfined, always reads as 1000 000(VID4)

TABLE 21. REGISTER 4AH, CONFIGURATION REGISTER 2 (POWER ON DEFAULTS [7:0] = 0X00H)

Bit	Name	R/W	Description
0	Thermal $\overline{\text{INT}}$ Mask	Read / Write	Setting this bit masks the thermal interrupts for the $\overline{\text{INT}}$ output ONLY. The $\overline{\text{THERM}}$ output will still be generated, regardless of the setting of this bit.
1	Ambient Temp Fan Control RegisterWrite Once Bit	Read/Write Once	Writing a one to this bit will lock in the values set into the ambient temperature automatic fan control register 13h. This register will not be able to be written again until a power on reset is performed.
2	Remote Temp Fan Control Register Write Once Bit	Read/Write Once	Writing a one to this bit will lock in the values set into the remote temperature automatic fan control register 14h. This register will not be able to be written again until a power on reset is performed.
3	$\overline{\text{THERM}}$ Interrupt Mode	Read/Write	If this bit is 0 the $\overline{\text{THERM}}$ output operates in default mode. If this bit is 1, the $\overline{\text{THERM}}$ output operates in ACPI mode.
4,5	Reserved	Read Only	Reserved
6	IRQ3 EN	Read/Write	Setting this bit to 1 enables pin 21 as an active high interrupt input, provided pins 20 to 24 have been configured as interrupts by setting bit 7 of the Channel Mode Register. Power-on default = 0.
7	IRQ4 EN	Read/Write	Setting this bit to 1 enables pin 20 as an active high interrupt input, provided pins 20 to 24 have been configured as interrupts by setting bit 7 of the Channel Mode Register. Power-on default = 0.

TABLE 22. REGISTER 4CH, INTERRUPT STATUS REGISTER 1 MIRROR (POWER ON DEFAULT <7:0> = 00 H)

Bit	Name	Read/Write	Description
0	2.5V/Ext.Temp2 Err.	Read Only	A one indicates that a High or Low limit has been exceeded
1	V_{CCP1} Error	Read Only	A one indicates that a High or Low limit has been exceeded
2	V_{CC} Error	Read Only	A one indicates that a High or Low limit has been exceeded
3	+5V Error	Read Only	A one indicates that a High or Low limit has been exceeded
4	Int. Temp Error	Read Only	A one indicates that a temperature interrupt has been set, or that a High or Low limit has been exceeded .
5	Ext. Temp1 Error	Read Only	A one indicates that a temperature interrupt has been set, or that a High or Low limit has been exceeded
6	FAN1/AIN1 Error	Read Only	A one indicates that a High or Low limit has been exceeded.
7	FAN2/AIN2 Error	Read Only	A one indicates that a High or Low limit has been exceeded.

TABLE 23. REGISTER 4DH, INTERRUPT STATUS REGISTER 2 MIRROR (POWER ON DEFAULT <7:0> = 00 H)

Bit	Name	Read/Write	Description
0	+12V Error	Read Only	A one indicates a High or Low limit has been exceeded,
1	V_{CCP2} Error	Read Only	A one indicates a High or Low limit has been exceeded
2	Reserved	Read Only	Undefined
3	Reserved	Read Only	Undefined
4	Chassis Error	Read Only	A one indicates Chassis Intrusion has gone high.
5	$\overline{\text{THERM}}$ Interrupt	Read Only	Indicates that THERM pin has been pulled low by an external source
6	D1 Fault	Read Only	Short or open-circuit sensor diode D1
7	D2 Fault	Read Only	Short or open-circuit sensor diode D2

Note: An error that causes continuous interrupts to be generated may be masked in its respective mask register, until the error can be alleviated.

APPENDIX B. EVALUATION BOARD PARTS LIST

Reference	Description
C1 - C4	10uF Tantalum 16v
C5 - C8	0.1uF Multilayer Ceramic
D1, D6	3mm Green LED
D2	1N4001
D3, D4, D5	3mm Red LED
F1	Fan Connector 3-way screw terminal
Fan	12v brushless fan with Tacho o/p Typ 412 F/2H Manufacturer: Papst - Motoren, D-78106 St.Georgen, Germany
J1	DC Barrel Socket
J2	36-way Centronics Socket pcb R/A
J3	13-way header (use 8-way + 5-way)
J4	10-way male PCB r/a IDC header
J5	2-way screw terminal
Q1 - Q4	2N3904
R1 - R6	10k
R7 - R9	1k
R10	680R
R11	120R
R12	470R
R13	470k
R14	10k
R15, R16	680R
R17, R18	10k
R19, R20	100k
R21	470R
R22	100k
R23	10k
R24	47k
R25	2k2
R26	10k
R27	100k
R28 - R34	10k Vertical multi-turn pot
SKT1	*Unused*
SW1 - SW5	3-way slide switch
SW6, SW7	Push button switch SPNO
SW8	6-way DIL
SW9	4-way DIL
U1	*Unused*
U2	MC33171
U3	74HC05
U4	78L033 3.3V regulator
U5	74HC132