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EXPANSION MODULE SPECIFICATIONS
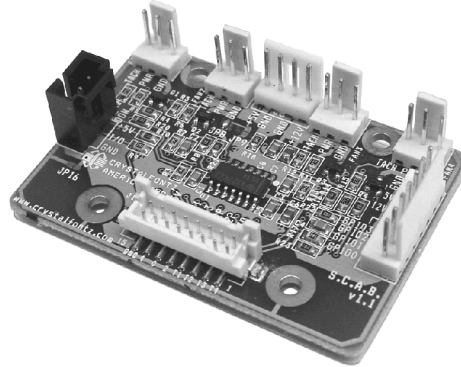
SYSTEM COOLING ACCESSORY BOARD (SCAB)

Crystalfontz Model Number	**CFA-SCAB**
Hardware Revision	**v1.1 August 2005**
Data Sheet Version	**v1.1 August 2005**
Product Pages	www.crystalfontz.com/products/SCAB

Customer Name	
Customer Part Number	

Crystalfontz America, Incorporated

12412 East Saltese Avenue
Spokane Valley, WA 99216-0357

Phone: (888) 206-9720
Fax: (509) 892-1203
Email: techinfo@crystalfontz.com
URL: www.crystalfontz.com

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REVISION HISTORY

HARDWARE	
2005/08/01	Start Public Version Tracking. Current hardware version: **v1.1**

DATA SHEET	
2005/08/01	Start Public Version Tracking. Current data sheet version: **v1.1**

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INTRODUCTION / FEATURES

In 2002, Crystalfontz released the CFA-633. The CFA-633 combined an LCD, keypad, fan control, and temperature monitoring integrated into a compact, low-cost module.

We have since released the CFA-631 and the CFA-635 modules, which pack more display area into smaller outlines. However, due to the compact size of the CFA-631 and CFA-635, we moved the fan control and temperature monitoring hardware onto a separate small circuit board, the System Cooling Accessory Board (SCAB). In this Data Sheet, the CFA-631 or CFA-635 combined with SCAB is described as "CFA-631/CFA-635+SCAB".

The SCAB allows the CFA-631 or CFA-635 to perform the same system cooling functions that are available on the CFA-633:

- Four fan connectors with RPM monitoring and variable PWM fan power control
- Temperature monitoring: up to 32 channels at up to 0.5 degree C absolute accuracy (using optional Crystalfontz WRDOWY17 cable with Dallas 1-Wire sensor)

The CFA-633's four GPIO lines are also duplicated on the SCAB, which allow:

- ATX power supply control functionality allows the buttons on the CFA-631 or CFA-635 to replace the "power" and "reset" buttons on your system, simplifying front panel design
- Hardware watchdog can reset host on host software failure
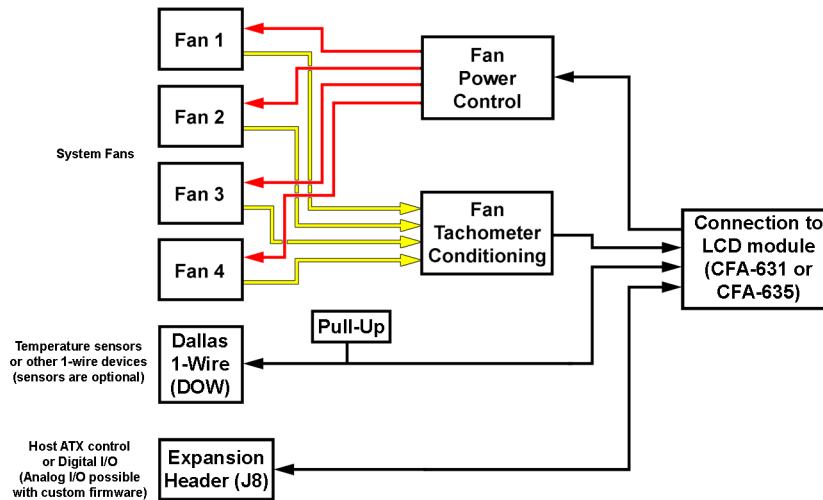- Advanced digital GPIO control with PWM output

SYSTEM BLOCK DIAGRAM

Figure 1. CFA-SCAB System Block Diagram

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MECHANICAL CHARACTERISTICS

ITEM	SIZE (mm)
PCB Outline Size	60 (W) x 40 (H)
Maximum Thickness (approximate)	15.5

GENERAL SPECIFICATIONS

ITEM	SPECIFICATION
Operating Temperature	0°C minimum, 50°C maximum
Storage Temperature	-10°C minimum, 60°C maximum
Weight	65 grams (typical)

ELECTRICAL SPECIFICATIONS

Required Voltage:

+5 v (logic): 4.75 v minimum, 5.0 v nominal, 5.25 v maximum
+12 v (fans): 4.75 v minimum, 12 v nominal, 13 v maximum (not required if the fan connectors are not used)

Current Consumption:

+12 v (fans): Draw on +12 v for fans will vary, depending on the user equipment connected to FAN1 through FAN4.

Maximum continuous current draw must be no more than 1.5 A per fan connector, no more than 4 A total. Pulsed current may be up to 5 A per connector, the pulse width must be less than 50 mS. This pulse specification allows for the fan's start-up current spike.

GPIO (inherited from LCD module):

Sink: 25 mA
Source: 10 mA

The SCAB circuitry is industry standard CMOS logic and is susceptible to ESD damage. Please use industry standard antistatic precautions as you would for any other PCBs such as expansion cards or motherboards.

RELIABILITY

The lifetime of the SCAB is 50,000 to 100,000 hours under normal operating conditions.

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HOST CONNECTIONS

The SCAB is designed to connect to a CFA-631 or CFA-635 LCD module. The LCD module will provide the correct signals to operate the SCAB.
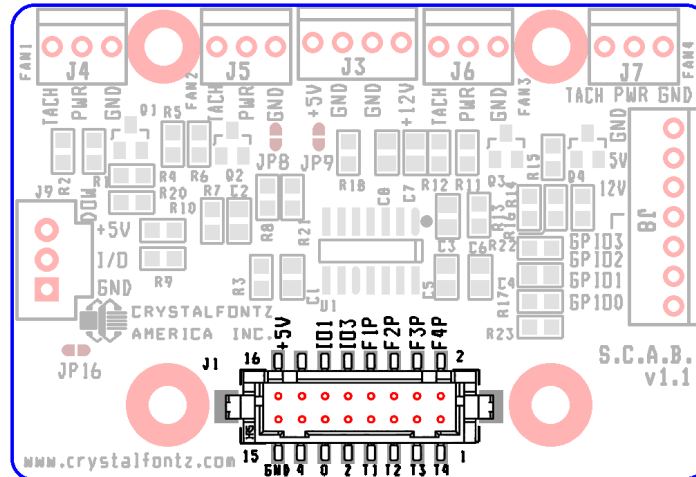

Figure 2. CFA-SCAB J1 connection to connect CFA-631 or CFA-635 LCD module

Two cables are available from Crystalfontz to make the connection between the SCAB and the CFA-631 or CFA-635 LCD module:

- WREXTY15: 18" SCAB connection cable
- WREXTY19: 3.5" SCAB connection cable

The WREXTY15 allows the SCAB to be mounted some distance away from the LCD module. For instance, the SCAB could be mounted in a central location within the PC's case. The WREXTY15 would connect from this central location to the LCD module that is mounted in a drive bay. Then the connections to the fans and temperature sensors would only need to be run to the SCAB, not all the way to the front panel where the LCD module is mounted.

The WREXTY19 is intended to be used when the SCAB is mounted in close proximity to the LCD module—as is the case when the SCAB is fastened directly to the LCD module's mounting bracket.

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The following image shows the SCAB connected to a CFA-631 using the WREXTY19 cable:
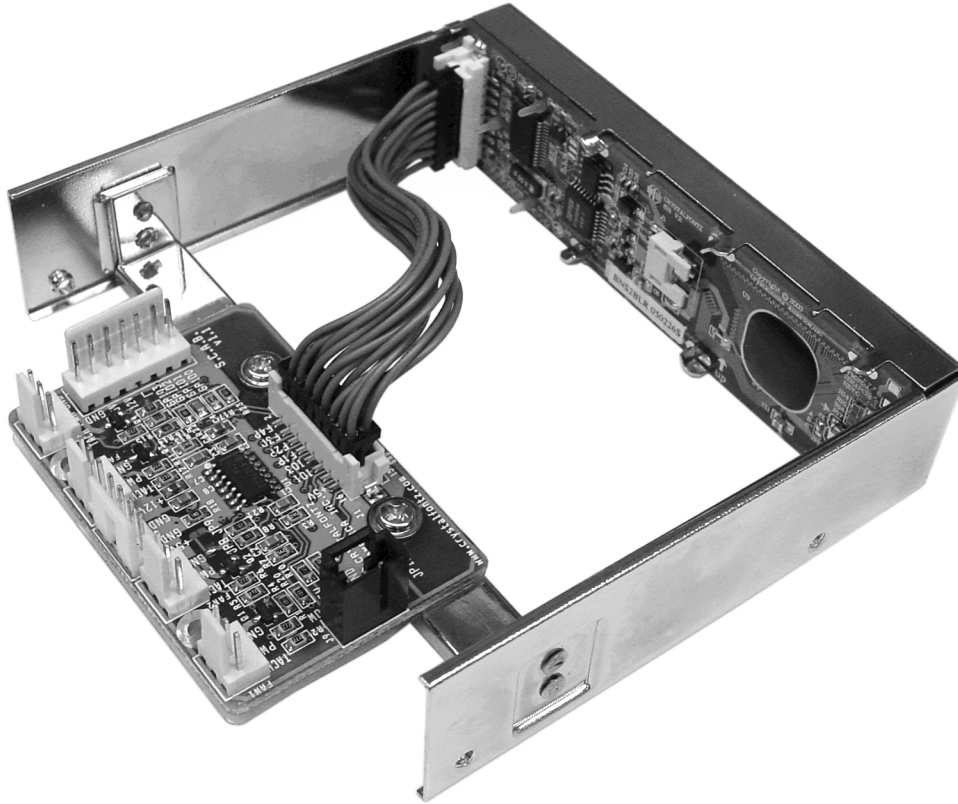

Figure 3. CFA-SCAB connected to a Crystalfontz CFA-631 LCD module using the WREXTY19 cable

The following image shows the SCAB connected to a CFA-635 using the WREXTY19 cable:
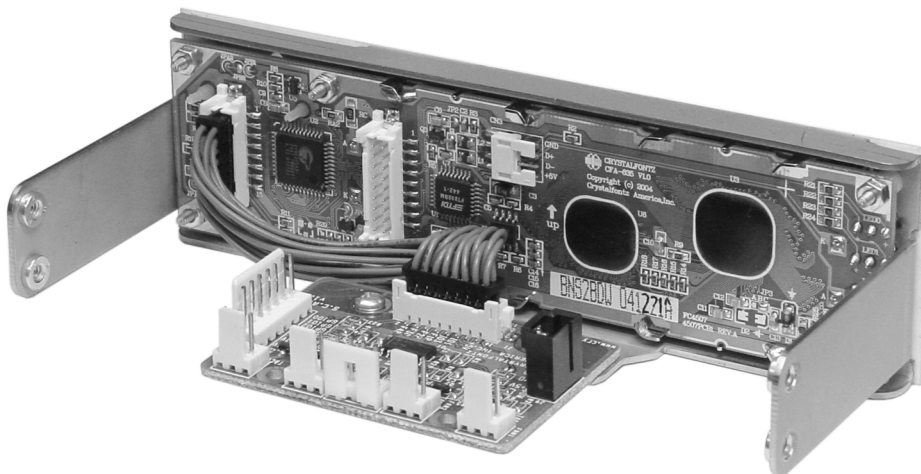

Figure 4. CFA-SCAB connected to a Crystalfontz CFA-635 LCD module using the WREXTY19 cable

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The following parts may be used to make a mating cable for J1:
- 16-position housing: Hirose DF11-16DS-2C / Digi-Key H2025-ND
- Terminal (tape & reel): Hirose DF11-2428SCF / Digi-Key H1504TR-ND
- Terminal (loose): Hirose DF11-2428SC / Digi-Key H1504-ND
- Pre-terminated interconnect wire: Hirose / Digi-Key H3BBT-10112-B4-ND is typical

HOST POWER CONNECTION

In most applications, power to the SCAB will be supplied by connecting a single standard "3½ inch floppy" power supply cable to J3 on the SCAB.
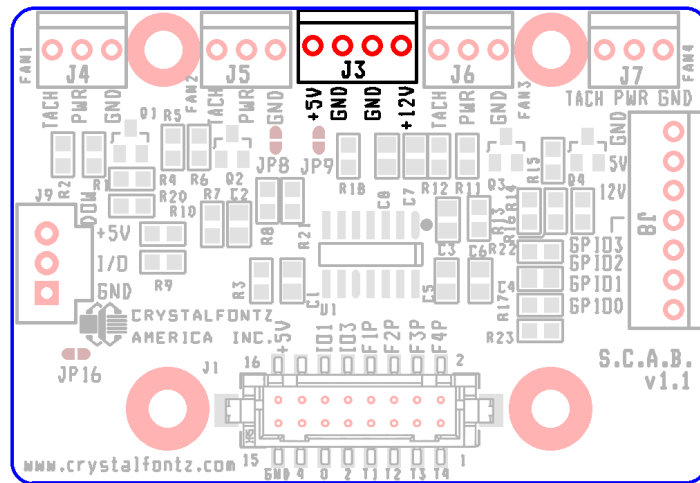

Figure 5. Host power connection using CFA-SCAB's J3 connector

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STANDARD (NON-ATX) POWER CONNECTION

Two typical power connection configurations are used in a standard PC containing a CFA-631/CFA-635+SCAB. The simplest connection scheme is shown here:
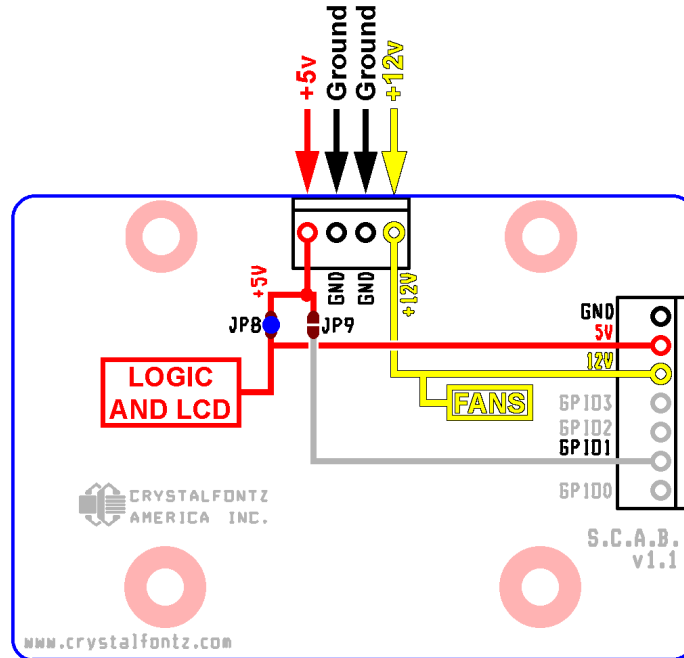

Figure 6. CFA-SCAB power connection used in a PC containing a CFA-631/CFA-635+SCAB

> **NOTE**
>
> If a SCAB is ordered at the same time as the CFA-631 or CFA-635 LCD module and no WRPWRY14 (ATX) cable is ordered, Crystalfontz will configure the SCAB and LCD module in this manner.

> **NOTE**
>
> Do not connect high power fans to the SCAB when +12 v is supplied through J8, Pin 3. Total fan current must be less than 500 mA if +12 v is supplied through J8, Pin 3. When using high power fans, supply the +12 v through the J3 the power connector.

In this connection configuration, power is supplied to the CFA-631 or CFA-635 LCD module from the "3½ inch floppy" power supply cable through JP8 on the SCAB. In order to prevent "back-powering" the +5 v on the USB from the +5 v supplied by "3½ inch floppy" power supply cable, the USB power disable jumper on the LCD module (JP2) should be opened. Please refer to the CFA-631 or the CFA-635 USB LCD Module Data Sheet for details.

By supplying power through the "3½ inch floppy" power supply cable, the LCD module, the SCAB. and the fans will all be powered "instantly" when the system is powered on. If power is supplied through the USB (JP8 open and JP2 on the LCD module closed) then power will not be supplied until the host operating system enumerates the USB.

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ATX POWER SUPPLY
POWER AND CONTROL CONNECTIONS

CFA-631/CFA-635+SCAB has the ability to control power on/off and reset functions of a standard ATX PC.
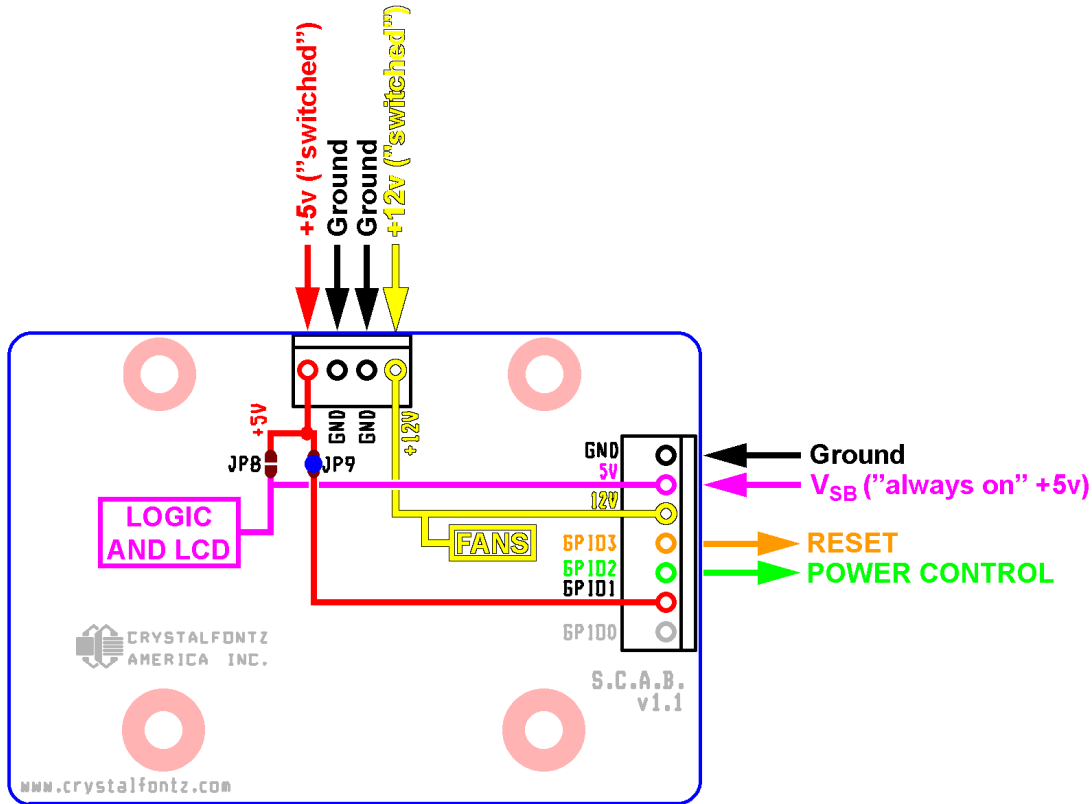

Figure 7. CFA-SCAB's ATX power supply and control connections

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NOTE

If a SCAB is ordered at the same time as the CFA-631 or the CFA-635 USB LCD module and a WRPWRY14 (ATX) cable is ordered, Crystalfontz will configure the SCAB and LCD module in this manner. In this case, power must be applied to both J8, Pin 1 (V_{SB}) and the +5v Pin of the J3 power connector.

NOTE

The GPIO pins of the CFA-631 or CFA-635 LCD module used for ATX control must not be configured as user GPIO, and must be configured to their default drive mode in order for the ATX functions to work correctly. These settings are factory default, but may be changed by the user. Please see command "34: Set or Set and Configure GPIO Pin" in the CFA-631 or the CFA-635 USB LCD Module Data Sheet).

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NOTE

Do not connect high power fans to the SCAB when +12 v is supplied through J8, Pin 3. Total fan current must be less than 500 mA if +12 v is supplied through J8, Pin 3. When using high power fans, supply the +12 v through the J3 the power connector.

The Crystalfontz WRPWRY14 cable simplifies ATX power control connections. When using this cable, please open jumper JP8 and close jumper JP9 in order to ensure correct operation.

For this functionality, the combination of the CFA-631/CFA-635+SCAB is powered from the PC's V_{SB} signal (the "standby" or "always-on" +5 v ATX power supply output).

By default, the pin labeled "+5 v" on the SCAB's connector J8 is electrically connected to the "+5 v" pin on the SCAB's J3 power connector. If you are using CFA-631/CFA-635+SCAB to do ATX power control, you will want to open jumper JP8, which will disconnect the "+5 v" of the "PWR" connector from the "+5 v" of connector J8.

Since the CFA-631/CFA-635+SCAB must act differently depending on if the host's power supply is "on" or "off", you must also connect the host's "switched +5 v" to GPIO1 (Pin 6 of the SCAB's connector J8). This pin functions as POWER-ON SENSE. The POWER-ON SENSE pin is configured as an input with a pull-down (5 KΩ nominal). To simplify this connection, JP9 is closed to make a connection between the "+5v" Pin on the CFA-631/CFA-635+SCAB's "PWR" connector and the POWER-ON SENSE pin.

The motherboard's "power switch" input is connected to Pin 5 of the SCAB's connector J8 (labeled as "GPIO[2]"). This pin functions as POWER CONTROL. The POWER CONTROL pin is configured as a high-impedance input until the LCD module wants to turn the host on or off, then it will change momentarily to low impedance output, driving either low or high depending on the setting of POWER_INVERT. (See command "28: Set ATX Power Switch Functionality" in the CFA-631 or the CFA-635 USB LCD Module Data Sheet.)

The motherboard's "reset switch" input is connected to Pin 4 of the SCAB's connector J8 (labeled as "GPIO[3]"). This pin functions as RESET. The RESET pin is configured as a high-impedance input until the LCD module wants to reset the host. Then it will change momentarily to low impedance output, driving either low or high depending on the setting of RESET_INVERT (see command "28: Set ATX Power Switch Functionality" in the CFA-631 or the CFA-635 USB LCD Module Data Sheet). This connection is also used for the hardware watchdog.

Once configured by the host software (see command "28: Set ATX Power Switch Functionality" in the CFA-631 or the CFA-635 USB LCD Module Data Sheet), the following functions may be individually enabled:

- System power on. If POWER-ON SENSE is low (0 v), pressing the green check key on a CFA-635 or the upper right key on a CFA-631 for 0.25 seconds will turn the unit on by driving POWER CONTROL line for the pulse width set by command "28: Set ATX Power Switch Functionality" (1.0 seconds default). (See the CFA-631 or the CFA-635 USB LCD Module Data Sheet.)
- System hard power off. If POWER-ON SENSE is high (+5 v) pressing the red "X" key on a CFA-635+SCAB or the upper right key on a CFA-631+SCAB for 4 seconds will turn the system off by driving the POWER CONTROL line. The line will be driven for a minimum of the pulse width set by command "28: Set ATX Power Switch Functionality" (1.0 seconds default). (See the CFA-631 or the CFA-635 USB LCD Module Data Sheet.) If the user continues to press the key, the LCD module will continue to drive the line for up to an additional 5 seconds.
- If POWER-ON SENSE is high (+5 v) pressing the green check key on a CFA-635+SCAB or the lower right key on a CFA-631+SCAB for 4 seconds will reset the system off by driving the RESET line for 1 second. The LCD module will reboot itself immediately after resetting the host.

Since the computer and LCD module must look "off" if the computer's power is "off", the LCD module can be configured to monitor the POWER-ON SENSE line and blank its display any time the POWER-ON SENSE line is low. If +12 v remains active (which would not be expected, since the host is "off"), the fans will remain on at their previous settings.

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GPIO/GPO CONNECTIONS

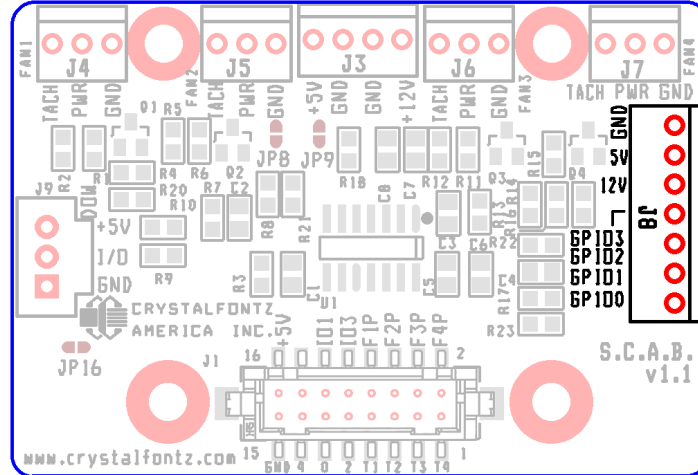The CFA-SCAB has 4 GPIOs available on header "J8":

Figure 8. CFA-SCAB GPIO/GPO connections

The GPIO pins can be set as inputs, outputs, pull-high or pull-low. In output mode they can be PWM'd (Pulse Width Modulated) to change the brightness of a connected LED.

Please see the commands "34: Set or Set and Configure GPIO Pin", and "35: Read GPIO Pin Levels and Configuration State" in the CFA-631 or the CFA-635 USB LCD Module Data Sheet for details on how to control the GPIO.

FAN CONNECTIONS

The SCAB supports up to 4 standard "3-pin" fans. The fan connectors are compatible with industry standard "3-pin" fans.
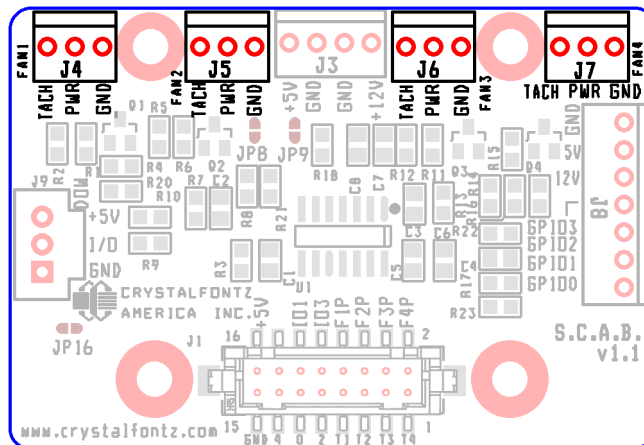

Figure 9. CFA-SCAB's four fan connections

The average power delivered to each fan may be set to any level between 0% and 100% through firmware command of the connected LCD module. The power setting controls the PWM duty cycle of a high-performance open-drain FET connected between the system ground and the GND pin of each fan connector. The CFA PWM frequency is nominally 18 Hz.

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The CFA-631/CFA-635+SCAB can measure the frequency of the fan's tachometer signal and report the information needed to calculate the RPM to the host. If a fan's power is set to 100%, then the average frequency of each fan's tachometer signal is measured over a 1/8 second (125 mS) period of time. Each fan is measured in sequence, so updated fan speed information is available every 1/2 second (500 mS) for each fan.

The power to a fan must be on in order for the fan's tachometer signal to be valid. If a fan is configured to report its speed to the host, the power of the fan will be unconditionally set to 100% at the start of the 1/8 second period of time when the CFA-631/CFA-635+SCAB is measuring the frequency of the tachometer signal—overriding the PWM. The CFA-631/ CFA-635+SCAB will leave the power to the fan on until the glitch delay (see command "26: Set Fan Tachometer Glitch Delay" in the CFA-631 or the CFA-635 USB LCD Module Data Sheet) has expired and two tachometer edges have been detected. The normal PWM cycle will then resume.

This technique allows the fan speed to be measured with a very minimal effect on the speed of the fan. If the fan power is set to 100% or if the speed of the fan and length of the PWM on time are such that the speed can be measured without stretching the PWM, then this override will not change the speed of the fan at all. If the fan power is set to some level other than 100% and the PWM on time is short compared to the tachometer signal frequency, then the fan speed will "pulse" slightly every 1/2 second due to the stretching of the PWM on time. During tachometer measuring, the maximum width of a stretched on pulse is 1/8 second. For some fans, the result is not very noticeable, and this technique will allow you to monitor the average speed of the fan while controlling the average power of the fan. For other fans (particularly high torque, high RPM models) the pulsing effect may be undesirable.

Since the on-time is dynamically stretched by the CFA-631/CFA-635+SCAB to force the fan to produce two tachometer edges, the result is that the fan will resist stalling as power is reduced towards 0% and the RPM is being measured. Here is a graph of fan RPM vs. the fan power setting for a typical high-performance 80 mm fan (Delta FFB0812SHE):
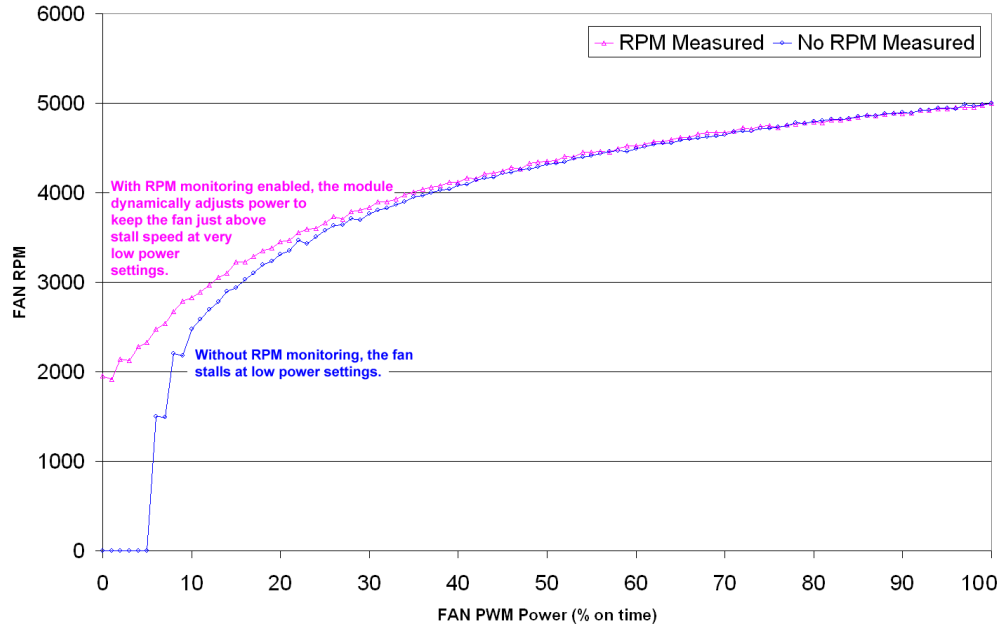

Figure 10. Graph showing fan PWM power (% on time) for various fan RPM

Typically if the fan speed is not at 100% then it is being controlled by the host software to drive a temperature sensor to a given reading in a closed-loop arrangement. In this case, the temperature, rather than the fan speed would be monitored for out-of-range conditions. If the temperature is within specification, you really do not care how fast the fan is turning. In an unattended system, it may be a good idea to set each fan to 100% for a few seconds during a test cycle—perhaps once a day or once a week—and log the steady-state RPM attained by the fan. If that steady state RPM were

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higher (this can be caused by a blocked airflow) or lower than expected (perhaps the fan's bearings are failing), a maintenance warning would be generated by the host software.

> **NOTE**
>
> For safety, enable the fan power fail-safe (see command "25: Set Fan Power Fail-Safe" in the CFA-631 or the CFA-635 USB LCD Module Data Sheet) on any fans involved in host-based speed control. By enabling the fail-safe on a fan that is being used in closed-loop control through host software, the CFA-631/CFA-635+SCAB will turn that fan to 100% if the host fails to update the power of the fans within a given time interval. For instance, if the communications cable is dislodged, the host operating system hangs, or cooling control process is terminated, the CFA-631/CFA-635+SCAB will automatically force those fans to 100%, preventing potential equipment damage due to lack of cooling.

We tested the CFA-631 and CFA-635 LCD modules in conjunction with the SCAB with a large range of fans and had good results. However, you are responsible for determining if the control and monitoring methods employed by the LCD module are acceptable for your application. In particular, if a fan's power is set too low, it may stall or fail to start, providing no cooling. Using a PWM to control fan speed is generally accepted; however we make no claims that it is compatible with any particular fan or that it does not affect the lifetime of the fans. Some higher torque fans (especially the ball-bearing models) may click, buzz, or growl at low power settings due to the torque in the fan going from positive to negative in each PWM cycle. If you limit the power setting to 0% or 100% there should be no compatibility issues. We do not recommend operating a fan below 20% PWM duty cycle for an extended period of time. Limiting the minimum PWM duty cycle to 30% or 40% should reduce the mechanical and electrical stresses in the fan, avoiding premature failure.

When power is applied to the CFA-631/CFA-635+SCAB, the LCD module will set each fan's power to the factory default value of 100% or to the value that is stored in the boot state. To minimize peak current loading on the +12 v supply during start-up, the fans are started in sequence with a 0.5 second delay between any fans that are on.

If the cable that connects the CFA-631 or CFA-635 LCD module to the SCAB is disconnected (assuming that power is still supplied to the SCAB), the fans will all default to 100% on.

DALLAS SEMICONDUCTOR 1-WIRE DEVICE CONNECTIONS

TEMPERATURE SENSORS

The CFA-631/CFA-635+SCAB supports Dallas Semiconductor 1-Wire (DOW) temperature sensors. Any combination of up to 32 DS1822 Econo 1-Wire Digital Thermometer (2°C absolute accuracy) or DS18B20 High Precision 1-Wire Digital Thermometer (0.5°C absolute accuracy) temperature sensors or other DOW compatible devices are directly supported. (See CFA-SCAB's DOW connection location in Figure 11. on Pg. 15.)

Crystalfontz supplies the WRDOWY17 cable, which contains a DS18B20 attached to a "daisy chain" cable. For reference, the mating connector for the WRDOWY17 is Molex 70543-0002 available from Digi-Key.

Any temperature sensor can be configured to report to the host (see command "19: Set Up Temperature Reporting" in the CFA-631 or the CFA-635 USB LCD Module Data Sheet). Any sensors configured to be reported are updated once each second.

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OTHER 1-WIRE DEVICES

Any other Dallas Semiconductor 1-Wire devices may be connected to the 1-Wire bus, with the CFA-631/CFA-635+SCAB acting as a bridge between USB and the 1-Wire bus (see command "20: Arbitrary DOW Transaction" in the CFA-631 or the CFA-635 USB LCD Module Data Sheet). The total number of 1-Wire devices supported is 32, including directly supported temperature sensors and any other user-provided 1-Wire devices. (See CFA-SCAB's DOW connection location in Figure 11. on Pg. 15.)

The SCAB has a 1 KΩ hardware pull-up on the DOW connector's I/O line.

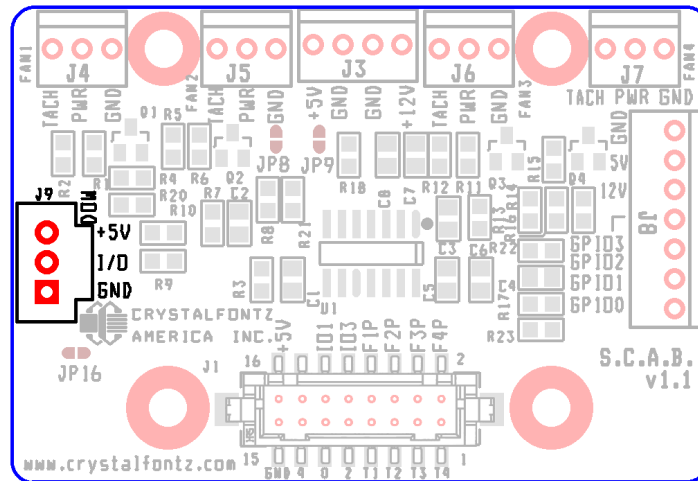Connect the 1-Wire sensors as detailed in the sensor's data sheet.

Figure 11. CFA-SCAB connection for Dallas Semiconductor 1-Wire (DOW) devices

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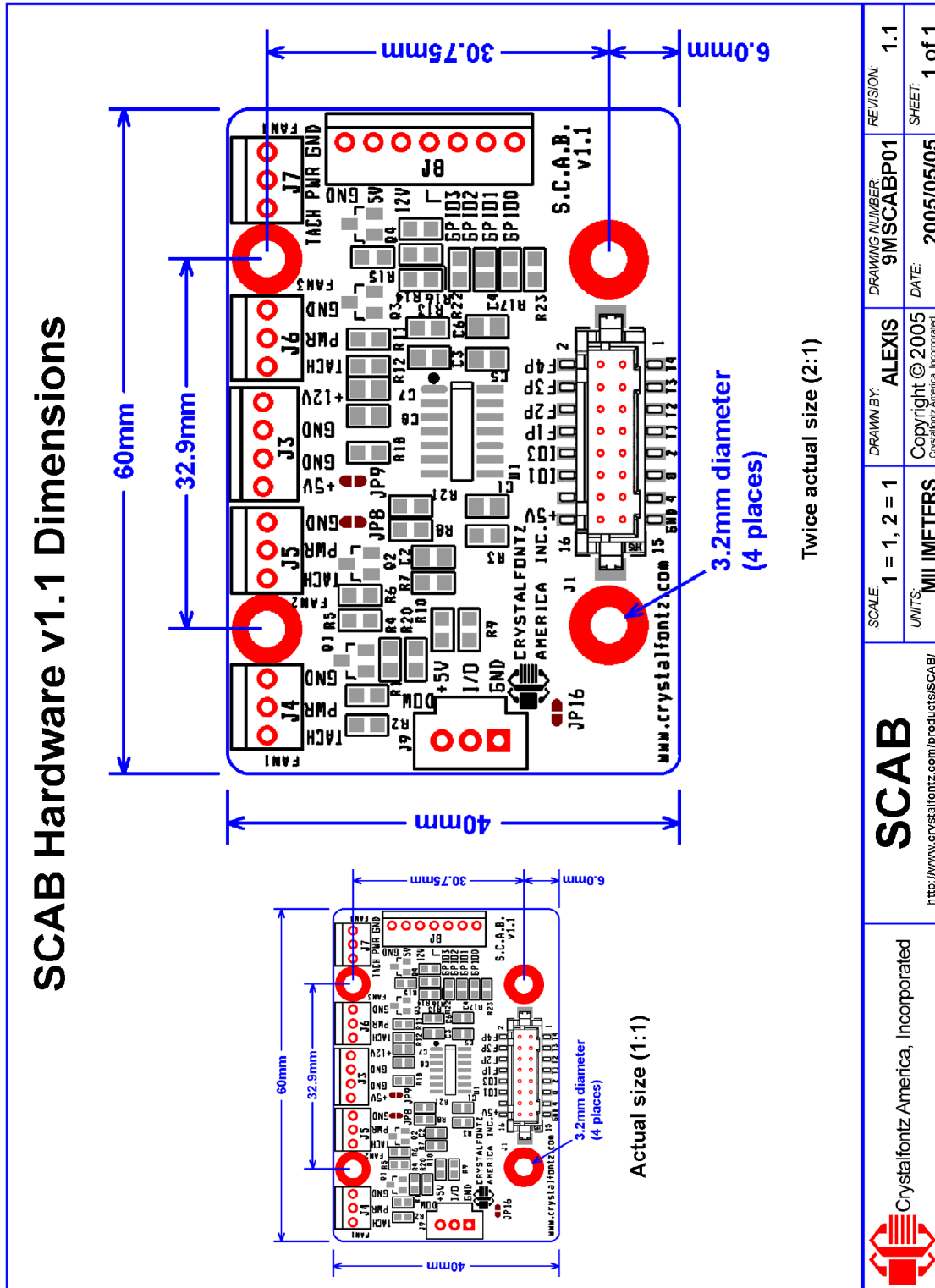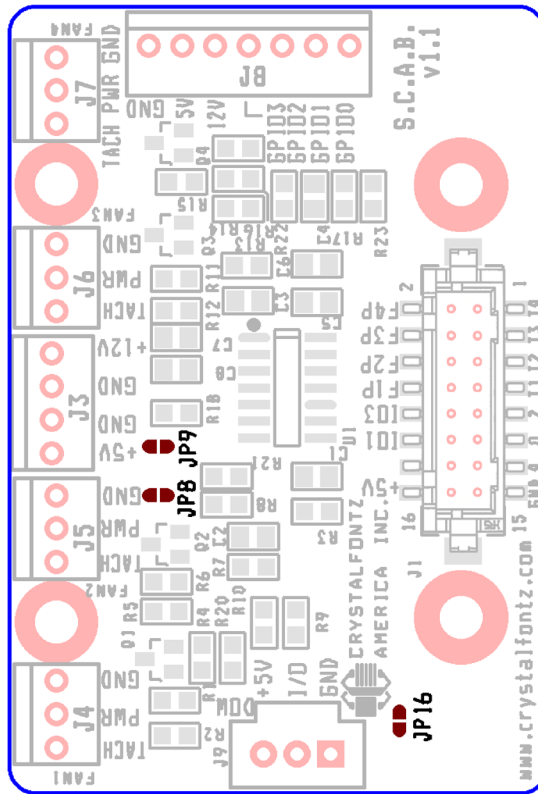www.crystalfontz.com
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MODULE OUTLINE DRAWING

Figure 12. CFA-SCAB outline drawing with dimensions

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JUMPER REFERENCE

JP8	open	Power is not supplied through J3 +5v pin
	closed	Power is supplied through J3 +5v pin
JP9	open	GPOI1 (Power Sense) is not connected to J3 +5v pin
	closed	GPOI1 (Power Sense) is connected to J3 +5v pin
JP16	**open**	Frame ground is isolated from logic ground
	closed	Frame ground is connected to logic ground

SCAB	SCALE:	2 = 1	DRAWN BY: **ALEXIS**	DRAWING NUMBER: **9MSCABP02**	REVISION: **1.1**
http://www.crystalfontz.com/products/SCAB/	UNITS: **MILIMETERS**		Copyright © 2005 Crystalfontz America, Incorporated	DATE: **2005/05/05**	SHEET: **1 of 1**

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Figure 13. CFA-SCAB jumper locations and functions