MIC74 Evaluation Board

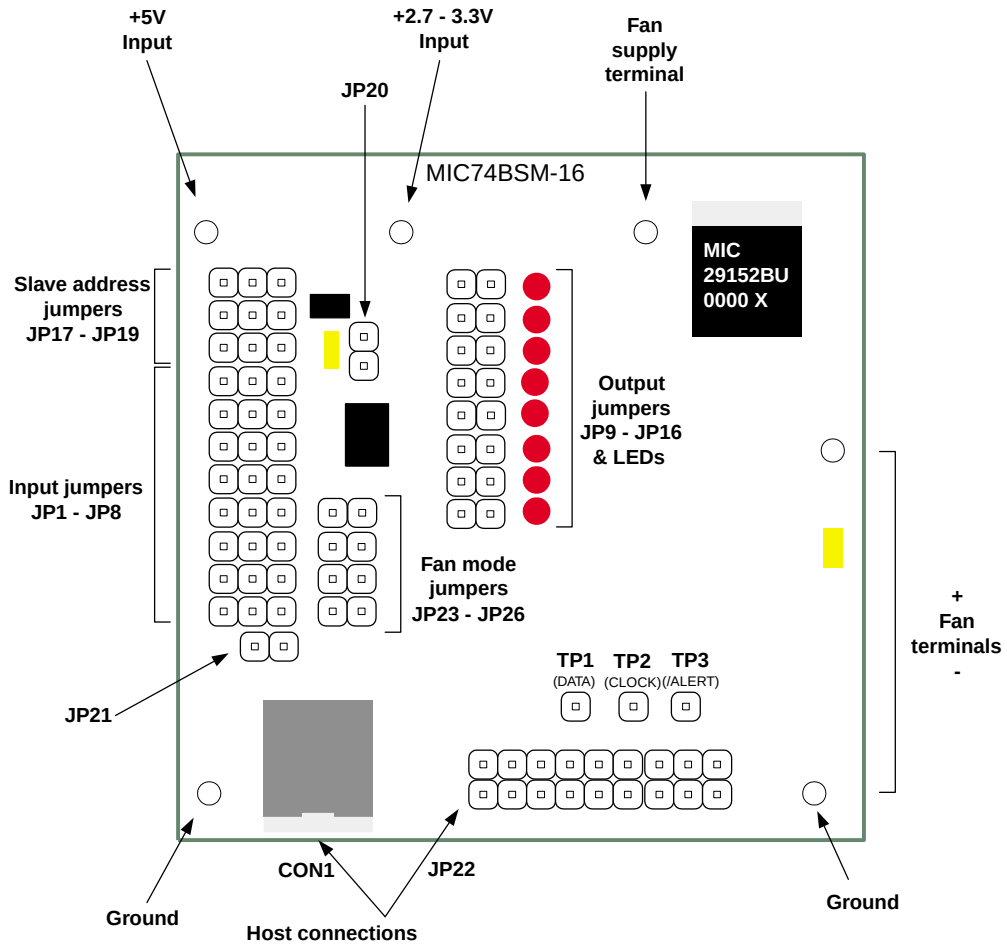
SMBus™ I/O Expander and Fan Controller Evaluation Board

General Description

This evaluation board demonstrates use of the MIC74 Serial I/O expander and fan controller. It is designed to support rapid prototyping of circuits employing the MIC74 as an I/O expander and/or a fan speed controller. Support is included for dual power supplies in order to demonstrate the 5V-tolerant I/O capabilities of the MIC74. An MIC5205 150mA LDO regulator can be configured to supply 3.3V to the MIC74 while the other circuitry is supplied from a single external 5V supply.

User configurable jumpers allow each of the MIC74's I/O lines to be used as an input or output, or the high-order lines can be configured for fan speed control. An MIC29152, a high-current low-dropout regulator, is included to drive common 12V brushless DC fans.

A 4-pin connector is provided to interface the evaluation board with a serial bus host such as the IPort™, an I²C™ Host Adapter from MCC Corp. This connector is commonly used for interoperability testing among SMBus™ or ACCESS.bus hosts and peripherals. For more information regarding the IPort™ I²C™ Host Adapter and the I²C™ Message Manager™ Software, see Appendix A.



MIC74 Evaluation Board Jumper and Connector Layout

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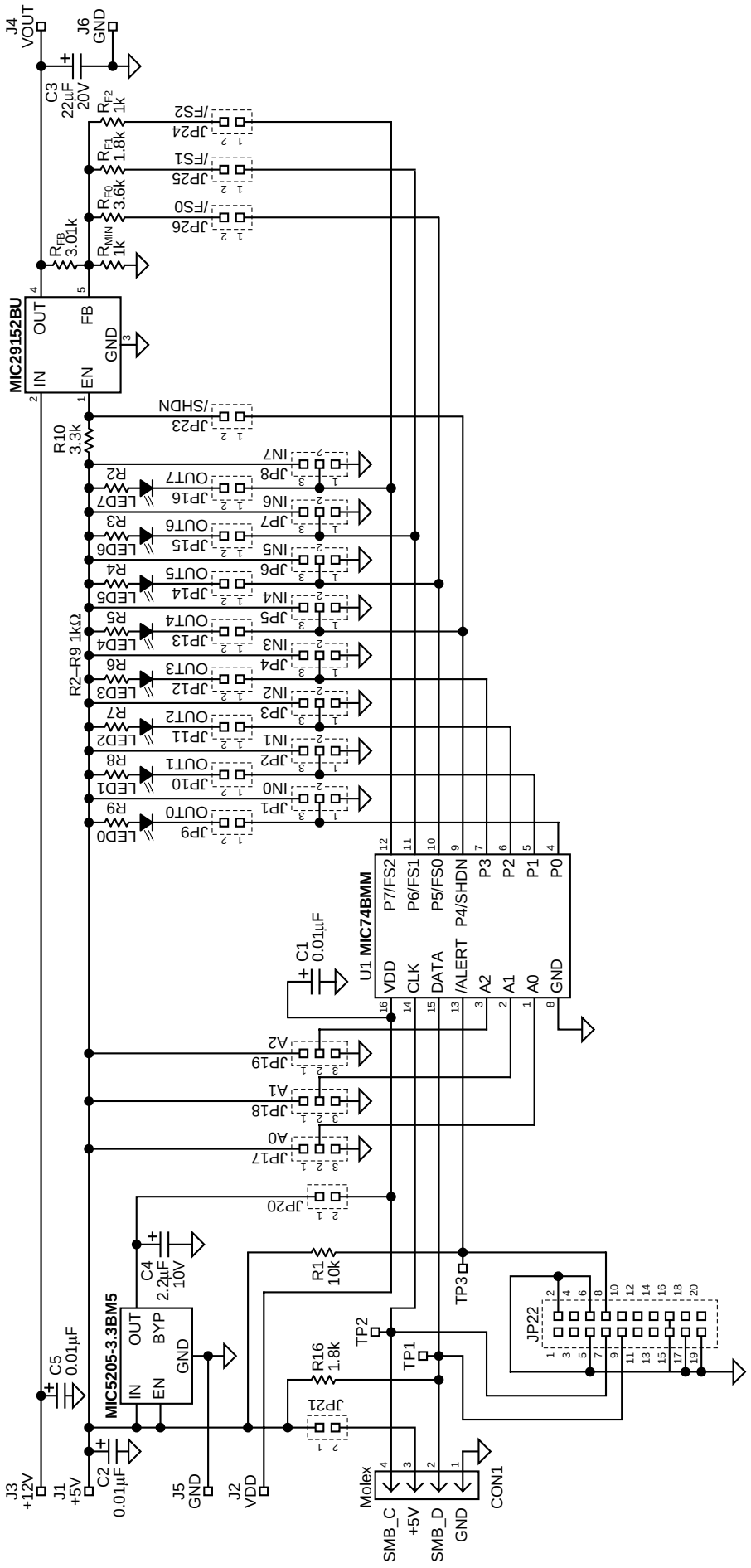


Figure 1. Evaluation Board Schematic

Getting Started

What's Included

Review the packing list in Table 1 to confirm that you received all listed items. If any of the items are missing or damaged, contact Micrel Semiconductor. The absolute latest version of all Micrel device datasheets may be obtained from our website at www.micrel.com.

Item	Qty	Description
1	1	MIC74 Evaluation Board with Jumpers Installed
2	1	MIC74 Evaluation Board User's Manual
3	1	MIC74 Data Sheet
4	2	MIC74BQS Samples
5	1	MIC29152 Data Sheet
6	2	MIC29152BU Samples
7	1	MIC5205 Data Sheet
8	2	MIC5205-3.3BM5 Samples

Table 1. Packing List

What You Must Provide

The following items are required for use with the MIC74 Evaluation Board:

- 5V, 100mA regulated power supply
- Power supply leads or cables
- SMBus/I2C compatible serial bus host for communication with the MIC74
- Cable for serial host connection
- 12V-power supply rated to deliver the required fan current*
- 12V brushless DC fan rated at no more than 1.5A maximum*

  * Required only for fan control applications

The following additional items are useful, but not required:

- Logic probe(s)
- Voltmeter(s)
- SMBus/I2C bus analyzer

Powering the Board

The MIC74 evaluation board supports the use of dual power supplies in order to demonstrate and make use of the MIC74's voltage-tolerant I/O capability. The LED indicators can be powered from a 5V supply while the MIC74 is powered from a lower voltage (2.7 to 3.6V). The MIC29152 linear regulator in the optional fan control section requires a third, higher voltage power supply. Three options are available for powering the digital section of the evaluation board. Note that in all cases, the pull-up resistors on /ALERT and the serial data line are connected to the supply voltage present at J1.

Option 1: An MIC5205-3.3BM5 linear regulator, U2, permits powering the board from a single 5V power supply connected to J1 when a shorting block is installed at location JP20. The MIC5205 generates the lower voltage (3.3V) required by the MIC74 and feeds its V_{DD} input via JP20. The LED's indicators on the board are powered from the 5V supply connected to J1. JP21 should be removed or the 5V supply will be fed to pin 3 of the serial bus connector, CON1. Note that the pull-up resistors on /ALERT and the serial data line are connected to the supply voltage present at J1. The 3.3V output of U2 will be present at J2.

Option 2: The board can be powered via CON1 by a single 5V power supply connected to pin 3 when a shorting block is installed at locations JP20 and JP21. The MIC5205 generates the lower voltage (3.3V) required by the MIC74 and feeds its V_{DD} input via JP20. The supply voltage applied at CON1 will also be present at J1. The LED's indicators on the board are powered from the 5V supply connected to CON1. The pull-up resistors on /ALERT and the serial data line are connected to the supply voltage present at pin 3 of CON1. The 3.3V output of U2 will be present at J2.

Option 3: A single power supply between 2.7V and 3.6V can power the entire evaluation board via J1 and J2. J1 and J2 should be connected together and JP20 is removed. This isolates the MIC5205 from the circuit and ties both sections together. The LED indicators will be powered from the same supply as the MIC74. JP21 should be removed or the supply voltage will be fed to pin 3 of the serial bus connector, CON1. Note that the pull-up resistors on /ALERT and the serial data line are connected to the supply voltage present at J1.

These options are summarized in Table 2. For each case, the terminal used as the power supply input is highlighted in bold.

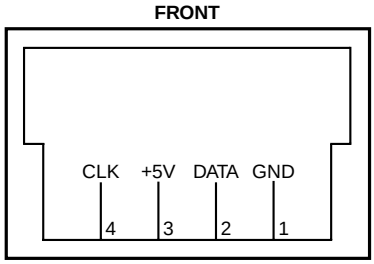
Option Description	J1	J2	CON1:3	JP20	JP21
Single 5V suppy via J1; supply fed to CON1:3	**5V Supply Input**	3.3V Present	5V Present	Shorted	Shorted
Single 5V suppy via J1; supply not fed to CON1:3	**5V Supply Input**	3.3V Present	Open	Shorted	Open
Single 5V suppy via CON1	5V Present	3.3V Present	**5V Supply Input**	Shorted	Shorted
Single 2.7 to 3.3V supply; supply fed to CON1:3	**3V Supply Input**	Connect to J1	Supply Voltage Present	Open	Shorted
Single 2.7 to 3.3V supply; supply not fed to CON1:3	**3V Supply Input**	Connect to J1	Open	Open	Open

Table 2. Options for Powering the Evaluation Board

For fan control applications, an additional power supply is connected to J3. This is nominally a 12V supply, but may be higher, limited only by the MIC29152's maximum input voltage of 26V. *Care must be taken, however, to insure that the maximum power dissipation of the regulator is not exceeded. If the regulator overheats, its internal thermal shutdown circuitry will deactivate it. See MIC29152 datasheet.* Any of the power supply arrangements listed in Table 2 may be used in conjunction with a fan power supply at J3.

Serial Bus Host

The connector provided for the serial bus host is a Molex part number 15-83-0064, 4-conductor shielded receptacle. The pinout of this connector is shown below. The mating connector is Molex part number 15-83-1564. See Appendix A for more information on these connectors. The serial bus signals are also present on dual-row header JP22 and at test points TP1 and TP2. One or more of these connection points can be used in lieu of the specialized connector. The various serial bus connection points are summarized in Table 3 below.



Molex 15-83-0064

Signal	Molex 15-83-0064 Pin#	JP22 Pin#	Test Point
Serial Data	2	9	TP1
Serial Clock	4	7	TP2
+5V	3	n/a	n/a
GND	1	2,5,6,15,17,19	J5,J6
/ALERT	n/a	8	TP3

Table 3. Serial Bus Connection Points

Personal computer based host adapters, cables, bus analyzers and other useful items can be obtained from the sources listed in *Appendix A.*

Slave Address Selection

Before communication between the serial bus host and the MIC74 can take place, the MIC74's slave address must be established. Jumpers JP17-19, marked "A0", "A1", and "A2" on the PCB establish the slave address by connecting the A0, A1, and A2 pins to 5V or ground. The address of the MIC74 is only registered at power-on and cannot be changed during operation. To change the MIC74's slave address, power must be removed and then reapplied once the new settings of JP17-19 have been established. The factory setting for the MIC74's slave address is 010 0**000**$_b$ (JP17 = JP18 = JP19 = GND).

There are eight possible slave addressess. Table 4 shows each of the jumper settings and resulting slave addresses.

Jumper Settings			MIC74 Slave Address	
JP19	**JP18**	**JP17**		
A2	A0	A1	**Binary**	**Hex**
GND	GND	GND	010 0**000**$_b$	20$_h$
GND	GND	5V	010 0**001**$_b$	21$_h$
GND	5V	GND	010 0**010**$_b$	22$_h$
GND	5V	5V	010 0**011**$_b$	23$_h$
5V	GND	GND	010 0**100**$_b$	24$_h$
5V	GND	5V	010 0**101**$_b$	25$_h$
5V	5V	GND	010 0**110**$_b$	26$_h$
5V	5V	5V	010 0**111**$_b$	27$_h$

Table 4. Selecting the MIC74 Slave Address

Pull-up Resistors

The MIC74 evaluation board includes a pull-up resistor on the serial data line and the MIC74's /ALERT output, resistors R16 and R1, respectively. The serial clock line also requires a pull-up resistor or current source somewhere in the system. If the host does not have a provision for this pull-up, a pull-up resistor will have to be added somewhere on the board, such as between TP2 and J1. Guidelines for sizing this pull-up resistor can be found in the SMBus specification. *See source in Appendix A.*

Checkout

Proper operation of all of the MIC74's various functions can be demonstrated and tested by a series of short exercises. Each I/O pin is tested in its output mode and its input mode, including the generation of interrupts. Lastly, the MIC74's fan mode operation is verified. If fan mode operation is not desired, this section can be skipped.

Input Mode

The following steps will configure all I/O pins as inputs and verify that the MIC74 is detecting and passing valid data.

1. Verify that jumpers JP1 - JP8 are adjusted so that all MIC74 inputs will be grounded. *See Figure 2.*
2. Verify that the address selection jumpers are set to match the slave address that will be used by the host to communicate with the MIC74.
3. Apply power to the MIC74 evaluation board. The MIC74 will be initialized to its default state, all I/Os will be configured as inputs.
4. Read the data register, DATA. The value returned should be 00h = 0000 0000b.
5. Connect any one of the input pins to 5V by moving one of jumpers JP1-JP8. For example, move JP3 to connect input I3 to 5V (logic high).
6. Read the data register, DATA. The value returned should be 08h = 0000 1000b.

7. Repeat steps 5 through 6 for each input in turn.
8. Confirm that the correct values were returned.

The following additional steps will verify that interrupts are operating properly:

9. Configure jumpers JP1 - JP8 so that all inputs are low.
10. Clear any pending interrupts by reading STATUS
11. Enable interrupts by setting the interrupt enable bit, IE, in the configuration register.
12. Enable interrupts on all inputs by setting all bits in the interrupt mask register.
13. Connect a logic probe or voltmeter to TP3 to monitor the /ALERT output. /ALERT should be in its high state.
14. Read DATA. The data returned should be 0000 0000b.
15. Connect any of the input pins to 5V by moving one of JP1 - JP8. For example, move JP4 to connect input I3 to 5V (logic high).
16. Confirm that /ALERT goes low and remains low indefinitely.
17. Clear the interrupt by reading STATUS. The value returned should match the input pattern. (For example: 08h = 0000 1000b)
18. Verify that /ALERT returns high
19. Read DATA and verify that the value returned matches the input data. (For example: 0000 1000b)
20. Repeat steps 15 through 19 for each input in turn.
21. Remove all power from the MIC74 evaluation board. Wait a few seconds for C4 to discharge.

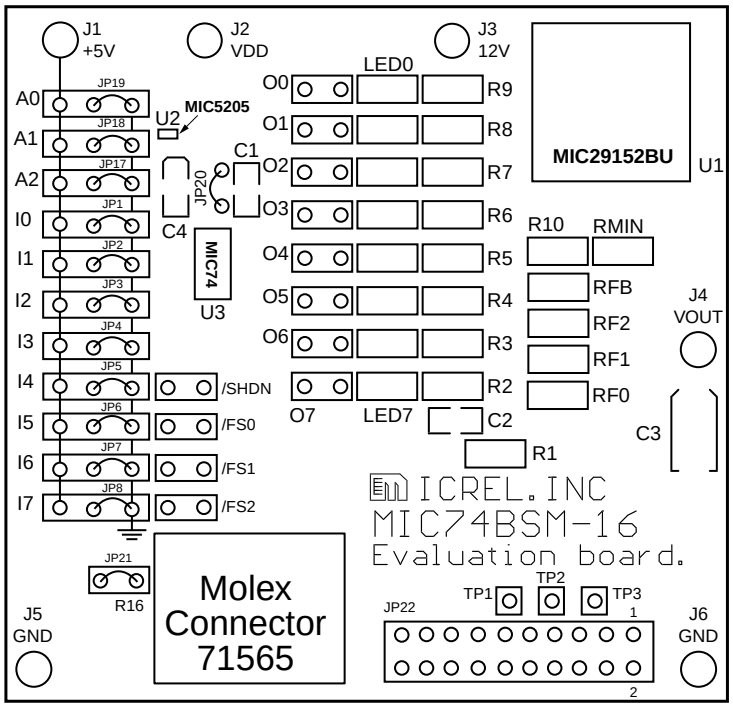


Figure 2. Input Configuration

Output Mode

The following steps will configure all I/O pins as outputs and verify that the MIC74 is passing valid data.

1. Completely remove the jumpers from JP1 to JP8 and connect them to JP9 - JP16 to configure all I/Os to drive the LED's. See Figure 3 below.
2. Apply power to the board. The MIC74 will be initialized to its power-up state.
3. Verify that all the LEDs are off at this point.
4. Configure all I/Os as outputs by setting all bits in the data direction register, i.e., write DIR with FFh.
5. Set all I/Os to their high (open-drain) state by setting all bits in DATA, i.e., write DATA with FFh
6. Verify that all the LEDs are off at this point.
7. Clear any bit in the data register. For example, write DATA with F7h = 1111 0111b to clear output #3.
8. Verify that LED #3 turns on and all other LED's are off.
9. Repeat steps 7 and 8 for each output bit.
10. Remove all power from the MIC74 evaluation board. Wait a few seconds for C4 to discharge.

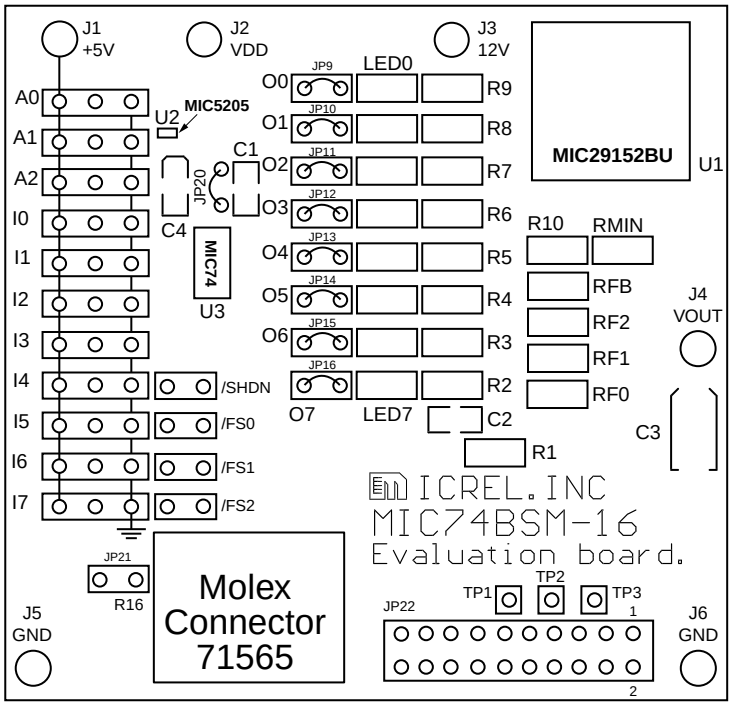


Figure 3. Output Configuration

Fan Mode

The following steps will configure the board for fan speed control and verify proper operation.

1. Remove the eight jumpers from JP1 - JP8 and use four of the jumpers to short JP23 - JP26. See Figure 4 below.
2. Connect the positive lead of the 12V fan to J4 (MIC29152's output) and the negative wire of the 12V fan to J6 (Ground).
3. Apply power to the board. The MIC74 will be initialized to its power-up state. See the datasheet Applications section.
4. Connect the 12V power supply to the MIC29152's input at J3.
5. Verify that the fan comes on at its minimum speed. (It will remain in this state while the MIC74 is programmed for fan mode.)
6. Enable fan mode by setting the fan bit in DEV_CFG, i.e., write DEV_CFG with 02h.
7. Select the desired speed by writing to FAN_SPEED. (Table 3 shows the output voltage for the seven available speeds.)
8. Verify by observation that the fan speed changes.
9. Verify that the output voltage of the MIC29152 is close to the value given in Table 3 (This voltage will vary slightly due to resistor tolerances, component accuracy, etc.)
10. Repeat steps six and seven for each possible fan speed value.
11. Remove all power from the MIC74 evaluation board. Wait a few seconds for C4 to discharge.

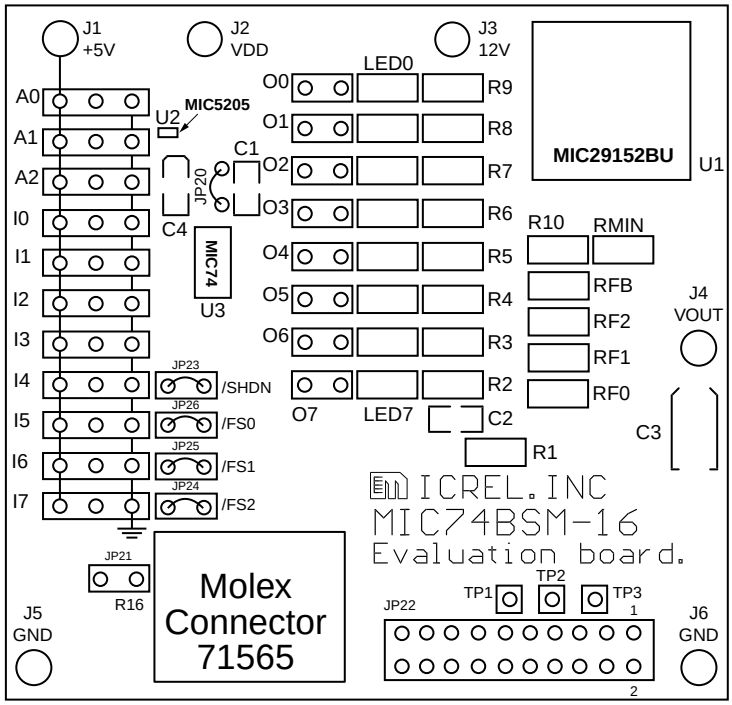


Figure 4. Fan Configuration

Table 5 lists the fan speed and MIC29152 output voltage produced by a given value written into FAN_SPEED. The actual measured voltage may vary slightly from the values shown in the table due to resistor tolerances, component accuracy, etc. R_{EQ} in the table is the equivalent feedback resistance that results from the parallel combination of R_{F0}, R_{F1}, R_{F2}, R_{MIN}, as applicable for each speed setting. Refer to the Applications section of the MIC74 datasheet for a detailed explanation of fan mode and how to select resistors for a given application.

FAN_SPEED Value	Fan Speed Selected	R_{FB}	R_{MN}	R_{F2}	R_{F1}	R_{F0}	R_{EQ}	V_{OUT}
0000 0000_b	power-up	3k	1k	open	open	open	1k	4.96V
0000 0000_b	fan off	3k	1k	open	open	open	1k	0V
0000 0001_b	lowest	3k	1k	open	open	3.6k	783	5.99V
0000 0010_b	2nd lowest	3k	1k	open	1.8k	open	643	7.03V
0000 0011_b	3rd lowest	3k	1k	open	1.8k	3.6k	545	8.06V
0000 0100_b	medium	3k	1k	1k	open	open	500	8.68V
0000 0101_b	3rd highest	3k	1k	1k	open	3.6k	439	9.71V
0000 0110_b	2nd highest	3k	1k	1k	1.8k	open	391	10.75V
0000 0111_b	highest	3k	1k	1k	1.8k	3.6k	353	11.78V

Table 5. Fan Drive Voltages vs. Value in FAN_SPEED

Hardware Reference

Designator	Description
J1	5V Power Supply Input
J2	MIC74's V_{DD} Input
J3	12V Power Supply Input
J4	Fan Drive Voltage (MIC29152 V_{OUT})
J5	Ground
J6	Ground

Table 6. Terminals

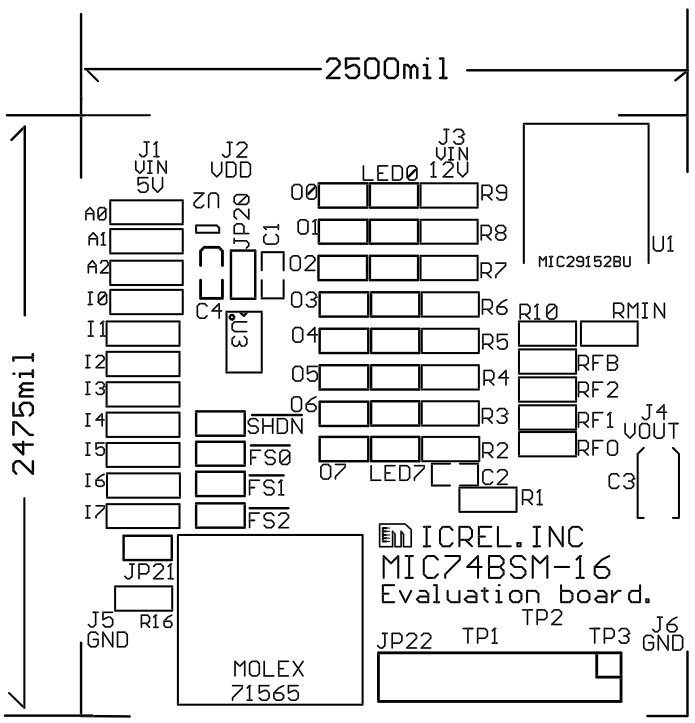
Designator	Description
TP1	DATA
TP2	CLOCK
TP3	/ALERT

Table 7. Test Points

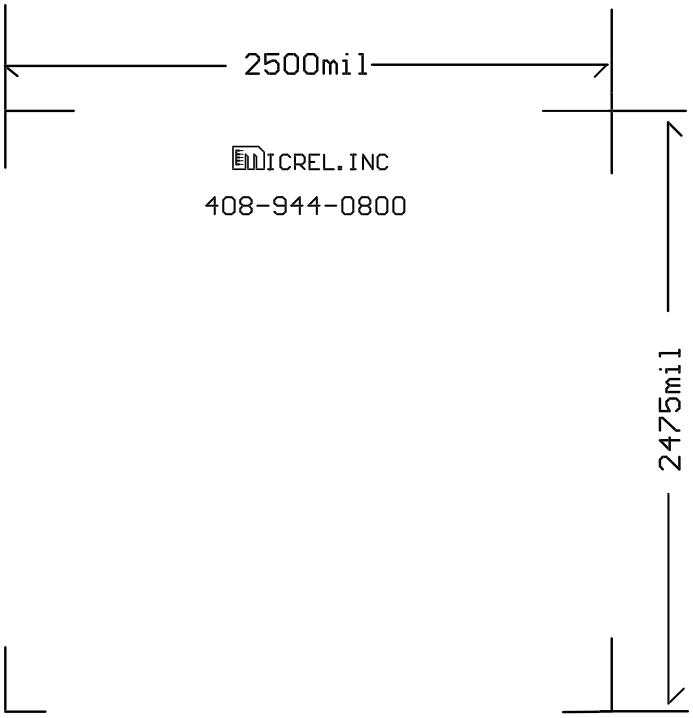
Jumper	Position	Function	Factory Setting
JP1	1 to 2 2 to 3	Connect P0 to Ground in the input mode Connect P0 to 5V in the input mode	Shorted Open
JP2	1 to 2 2 to 3	Connect P1 to Ground in the input mode Connect P1 to 5V in the input mode	Shorted Open
JP3	1 to 2 2 to 3	Connect P2 to Ground in the input mode Connect P2 to 5V in the input mode	Shorted Open
JP4	1 to 2 2 to 3	Connect P3 to Ground in the input mode Connect P3 to 5V in the input mode	Shorted Open
JP5	1 to 2 2 to 3	Connect P4 to Ground in the input mode Connect P4 to 5V in the input mode	Shorted Open
JP6	1 to 2 2 to 3	Connect P5 to Ground in the input mode Connect P5 to 5V in the input mode	Shorted Open
JP7	1 to 2 2 to 3	Connect P6 to Ground in the input mode Connect P6 to 5V in the input mode	Shorted Open
JP8	1 to 2 2 to 3	Connect P7 to Ground in the input mode Connect P7 to 5V in the input mode	Shorted Open
JP9	1 to 2	Connect LED0 to P0 in open-drain output mode	Open
JP10	1 to 2	Connect LED1 to P1 in open-drain output mode	Open
JP11	1 to 2	Connect LED2 to P2 in open-drain output mode	Open
JP12	1 to 2	Connect LED3 to P3 in open-drain output mode	Open
JP13	1 to 2	Connect LED4 to P4 in open-drain output mode	Open
JP14	1 to 2	Connect LED5 to P5 in open-drain output mode	Open
JP15	1 to 2	Connect LED6 to P6 in open-drain output mode	Open
JP16	1 to 2	Connect LED7 to P7 in open-drain output mode	Open
JP17	1 to 2 2 to 3	Connect A0 to 5V Connect A0 to Ground	Open Shorted
JP18	1 to 2 2 to 3	Connect A1 to 5V Connect A1 to Ground	Open Shorted
JP19	1 to 2 2 to 3	Connect A2 to 5V Connect A2 to Ground	Open Shorted
JP20	1 to 2	Provide 3.3V to the MIC74	Open
JP21	1 to 2	Use 5V from the Molex Connector	Open
JP23	1 to 2	Connect MIC29152's enable pin to /SHDN pin in fan mode	Open
JP24	1 to 2	Connect RF2 to /FS2 pin in fan mode	Open
JP25	1 to 2	Connect RF1 to /FS1 pin in fan mode	Open
JP26	1 to 2	Connect RF0 to /FS0 pin in fan mode	Open

Table 8. Jumper Options

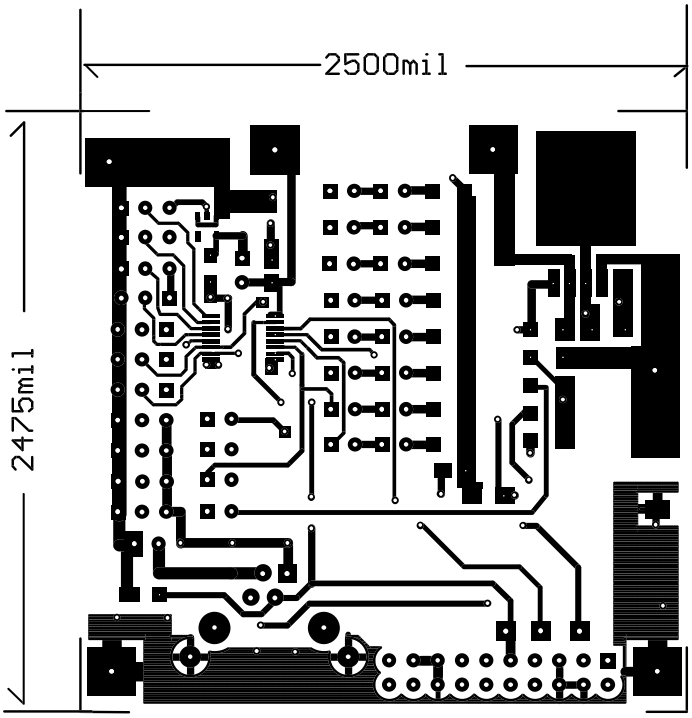
Printed Circuit Layouts



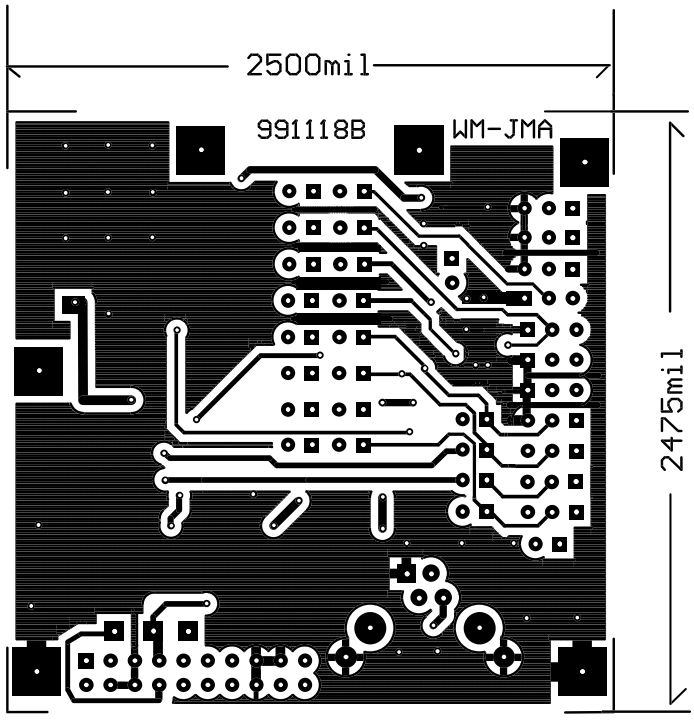
Top-Side Silk Screen



Bottom-Side Silk Screen



Top-Side Copper



Bottom-Side Copper

Bill of Materials

Item	Part Number	Manufacturer	Description	Qty.
C1, C2, C5	08055C103MAT2	AVX	0.01µF 50V	3
C3	TPSC226M016R0375	AVX	22µF 16V	1
C4	TAJA225M010R	AVX	2.2µF 10V	1
LED0–LED7	LTC-16KE	Vishay Lite-On	LED	8
R1	CRCW08051002FRT1	Vishay-Dale	10k ±1%, size 0805 or 1206	1
R10	CRCW08053301FRT1	Vishay-Dale	3.3k ±1%, size 0805 or 1206	1
R_{F0}	CRCW08053601FRT1	Vishay-Dale	3.6k ±1%, size 0805 or 1206	1
R_{F1}, R16	CRCW08051801FRT1	Vishay-Dale	1.8k ±1%, size 0805 or 1206	2
R_{MIN}, R_{F2}, R2–R9	CRCW08051001FRT1	Vishay-Dale	1k ±1%, size 0805 or 1206	10
R_{FB}	CRCW08053011FRT1	Vishay-Dale	3.01k ±1%, size 0805 or 1206	1
U1	**MIC29152-BU**	Micrel	High-Current LDO Regulator	1
U2	**MIC5205-3.3BM5**	Micrel	150mA Low-Noise LDO Regulator	1
U3	**MIC74BMM**	Micrel	SMBus™ I/O Expander and Fan Controller	1
CON1	15-83-0064	Molex	4-position female connector	1

Appendix A: SMBus Resources*

PC host adapters and software, bus analyzers, cables, and other items can be purchased from:

Micro Computer Control Corporation

PO Box 275/ 17 Model Ave

Hopewell, New Jersey 08525 USA

Telephone: 609-466-1751

Email: info@mcc-us.com

http://www.mcc-us.com

The 4-conductor serial bus connector is available from Molex as part number 15-83-0064. Mating plugs for constructing cable assemblies are also available. A list of distributors is available on the Molex website.

Molex Incorporated

2222 Wellington Court

Lisle, IL 60532-1682

Tel: 800/78MOLEX,

630/969-4550 (Outside USA)

Fax: 630/968-8356

Telex: 254069

E-mail: amerinfo@molex.com

http://www.molex.com

The current SMBus specification and other information regarding SMBus may be obtained from the SMBus website

SMBus Forum (website)

http://www.smbus.org.

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MICREL INC. 1849 FORTUNE DRIVE SAN JOSE, CA 95131 USA

TEL + 1 (408) 944-0800 FAX + 1 (408) 944-0970 WEB http://www.micrel.com

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