



# MAX1284 Evaluation System

Evaluates: MAX1284

## General Description

The MAX1284 evaluation system (EV system) is a complete data-acquisition system consisting of a MAX1284 evaluation kit (EV kit) and a Maxim 68HC16MODULE-DIP microcontroller ( $\mu$ C) module. The MAX1284 is a high-speed, 12-bit data acquisition system. Windows 95/98<sup>®</sup> software provides a handy user interface to exercise the MAX1284's features.

Order the complete EV system (MAX1284EVC16) for comprehensive evaluation of the MAX1284 using a PC. You can order the EV kit (MAX1284EVKIT) if the 68HC16MODULE-DIP module has already been purchased with a previous Maxim EV system, or for custom use in other  $\mu$ C-based systems.

## EV System Component List

PART	QTY	DESCRIPTION
MAX1284EVKIT	1	MAX1284 EV kit
68HC16MODULE-DIP	1	68HC16 $\mu$ C module

## EV Kit Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	0.01 $\mu$ F ceramic capacitor
C2, C3	2	0.1 $\mu$ F ceramic capacitors
C4	1	4.7 $\mu$ F tantalum capacitor
C5	1	10 $\mu$ F, 10V tantalum capacitor
J1	1	2x20 right-angle socket
JU1	1	2-pin header
JU2	1	3-pin header
R1	1	1k $\Omega$ $\pm$ 5% resistor
TP1	1	6-pin header
U1	1	MAX1284BCSA
None	1	MAX1284 EV kit PC board
None	1	3-1/2in software disk, MAX1284 EV kit
None	1	MAX1284 EV kit data sheet
None	1	MAX1284 data sheet

Windows 95/98 is a registered trademark of Microsoft Corp.



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## Features

- ◆ Proven PC Board Layout
- ◆ Convenient On-Board Test Points
- ◆ Data-Logging Software
- ◆ Fully Assembled and Tested

## Ordering Information

PART	TEMP. RANGE	INTERFACE TYPE
MAX1284EVKIT	0°C to +70°C	User supplied
MAX1284EVC16	0°C to +70°C	Windows software

**Note:** The MAX1284 software is designed for use with the complete MAX1284EVC16 EV system (includes 68HC16MODULE-DIP module together with MAX1284EVKIT). If the MAX1284 evaluation software will not be used, the MAX1284EVKIT board can be purchased by itself, without the  $\mu$ C.

## EV Kit Component List

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX1284.EXE	Application program
KIT1284.C16	Software loaded into 68HC16 $\mu$ C

## Recommended Equipment

Before you begin, you will need the following equipment:

- Maxim MAX1284EVC16 (contains MAX1284EVKIT board and 68HC16MODULE-DIP)
- A small DC power supply, such as a 12VDC 0.25A plug-in transformer or a 9V battery
- An IBM PC-compatible computer running Windows 95/98
- A spare serial communications port, preferably a 9-pin plug
- A serial cable to connect the computer's serial port to the 68HC16MODULE-DIP

# MAX1284 Evaluation System

## Quick Start

- 1) Carefully connect the boards by aligning the 40-pin header of the MAX1284 EV kit with the 40-pin connector of the 68HC16MODULE-DIP module, both boards component-side up. Gently press them together. The two boards should be flush against one another.
- 2) Ensure that JU1 is open and JU2 is in the 1-2 position.
- 3) Connect a +7VDC to +20VDC power source to the  $\mu$ C module at the terminal block located next to the on/off switch, along the top edge of the  $\mu$ C module. Observe the polarity marked on the board.
- 4) Connect a cable from the computer's serial port to the  $\mu$ C module. If using a 9-pin serial port, use a straight-through, 9-pin female-to-male cable. If the only available serial port uses a 25-pin connector, a standard 25-pin-to-9-pin adapter will be required. The EV kit software checks the modem status lines (CTS, DSR, DCD) to confirm that the correct port has been selected.
- 5) Install the MAX1284 EV kit software on your computer by running the INSTALL.EXE program on the floppy disk. The program files are copied and icons are created for them in the Windows Start menu.
- 6) Start the MAX1284 program by opening its icon in the Start menu.
- 7) The program will prompt you to connect the  $\mu$ C module and turn its power on. Slide SW1 to the ON position. Select the correct serial port and press OK. The program will automatically download KIT1284.C16 to the module.
- 8) Apply an input signal between AIN and GND. Observe the readout on the screen.

## Detailed Description

### MAX1284 Stand-Alone EV Kit

The MAX1284EVKIT provides a proven PC board layout to evaluate the MAX1284. It must be interfaced to appropriate timing signals for proper operation. Connect +5V to VDD, and connect the ground return to GND (Figure 1). Refer to the MAX1284 data sheet for timing requirements.

### MAX1284 EV System

The MAX1284EVC16 EV system operates from a user-supplied +7VDC to +20VDC power supply. Windows 95/98 software running on an IBM PC interfaces to the EV system board through the computer's serial communications port. See the *Quick Start* section for setup and operating instructions.

## Software Description

The evaluation software's main window controls the serial-clock speed and sample rate. It displays the voltage and output code as well as some statistics of the input signal. A separate graph window shows the data changing in real time. The update rate is limited to about 10 samples per second, due to COM port bandwidth limitations.

### Statistics

The **Minimum** and **Maximum** fields show the highest and lowest readings acquired. The **Average** field shows a running mean based on the equation  $a_i = (k)(x_i) + (1 - k)(a_i - 1)$ . The **Clear** button resets the statistics. To remove offset errors, first apply 0V to the active input channel, clear statistics, acquire some samples, and then check **Tare**. This average offset voltage will now be subtracted from all subsequent measurements.

### Sampling

Choose the desired sampling rate (QSPI™ Clock), sampling size (**Sample!** menu item), and press **Begin Sampling!** (in **Sample!** pop-up window). Sample size is restricted to a power of 2 to permit FFT processing once the data is saved to a file. After the samples have been collected, the data is automatically uploaded to the host and graphed. Once displayed, the data can be saved optionally to a file.

### Saving Graphs to Disk

Data in the real-time graph and in sampled data graphs may be saved to a file. Only the raw output codes are saved, but voltages may be inferred, based on the reference voltage and the maximum code value.

### Evaluating Shutdown

The evaluation software configures the 68HC16's QSPI submodule to continuously read data from the MAX1284 into the 68HC16. The sample rate is controlled by the QSPI clock. To evaluate power-saving modes, these automatic updates must be stopped. First, set the QSPI clock control to **STOP**. This reconfigures the 68HC16's QSPI submodule to stop driving the serial clock. Second, in the evaluation software's main window, uncheck the "Read Every...msec" checkbox. If evaluating the hardware shutdown, move jumper JU2 to the 2-3 position.

### Reference Voltage

The evaluation software assumes a 2.5V reference voltage, unless otherwise specified. Refer to the MAX1284 data sheet for more information. To override this value, type the new reference voltage into the **Vref** edit box and press the **Set Vref** button.

*QSPI is a trademark of Motorola, Inc.*

# MAX1284 Evaluation System

Evaluates: MAX1284

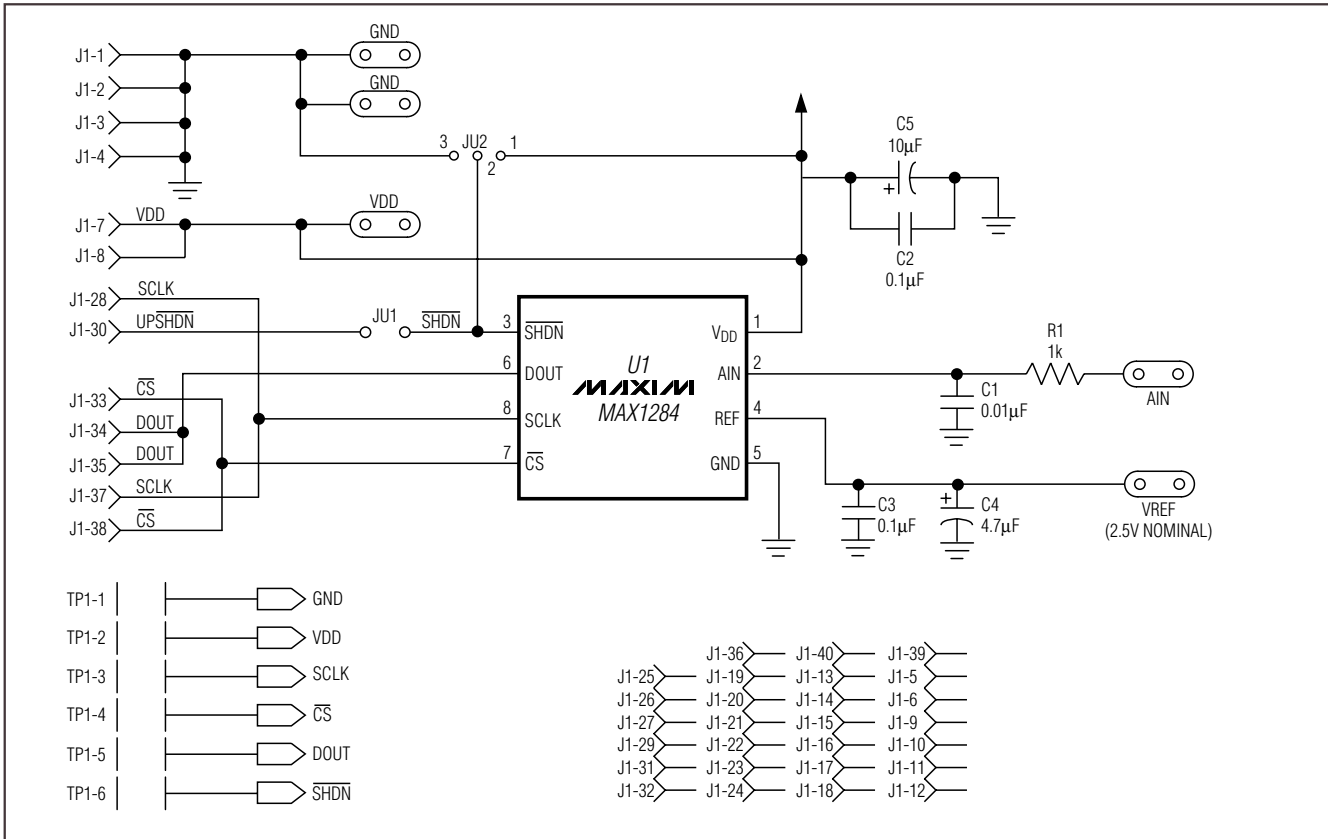


Figure 1. MAX1284 EV Kit Schematic Diagram

## Detailed Hardware Description

The MAX1284, U1, is a high-speed, 12-bit data-acquisition system. Resistor R1 (1kΩ) and capacitor C1 (0.01µF) form a single-pole, low-pass anti-aliasing filter with a nominal 10µs time constant and a corner frequency of approximately 16kHz. C3 and C4 bypass the analog-to-digital converter's (ADC's) voltage reference. When plugged into the 68HC16MODULE, the VDD circuit is powered by +5V (Figure 1; refer to the MAX1284 data sheet).

## Troubleshooting

**Problem:** No output measurement. System seems to report zero voltage or fails to make a measurement.

Check the VDD supply voltage. Check the reference voltage using a DVM. Use an oscilloscope to verify that the conversion-start signal is being strobed. Verify that SHDN is being driven high.

**Problem:** Measurements are erratic, unstable; poor accuracy.

Check the reference voltage using a DVM. Use an oscilloscope to check for noise. When probing for noise, keep the oscilloscope ground return lead as short as possible, preferably less than 1/2in (10mm).

Table 1. Jumper JU1 Functions

JUMPER	POSITION	FUNCTION
JU1	Closed	SHDN driven by µC; JU2 must be open
	Open*	SHDN set by JU2
JU2	1-2*	Operate
	2-3	Shutdown

\*Default configuration

# MAX1284 Evaluation System

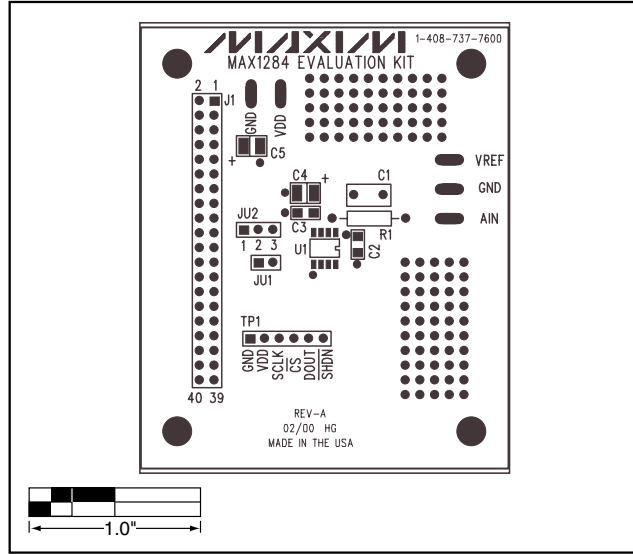


Figure 2. MAX1284 EV Kit Component Placement Guide—Component Side

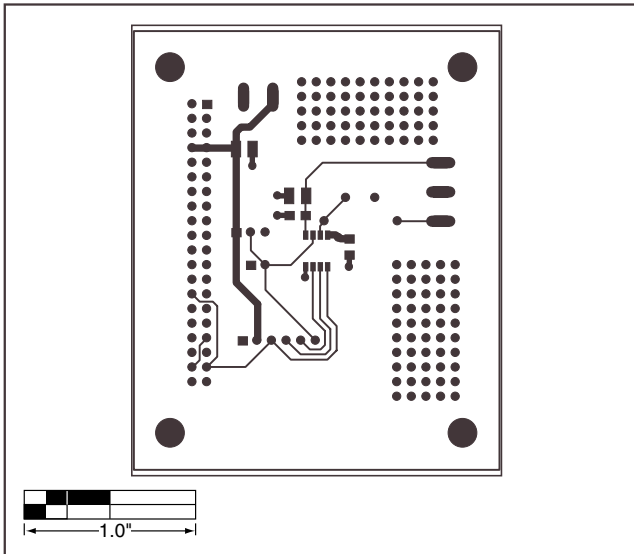


Figure 3. MAX1284 EV Kit PC Board Layout—Component Side

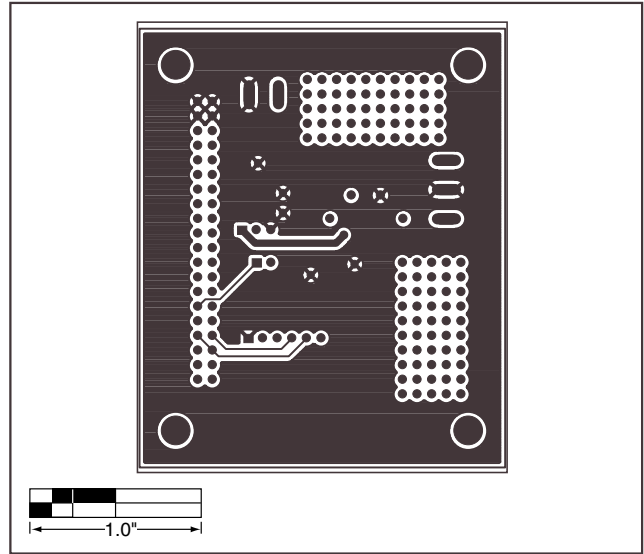


Figure 4. MAX1284 EV Kit PC Board Layout—Solder Side



## 68HC16 Module

68HC16 Module

### 68HC16 Module Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2, C3	3	1 $\mu$ F ceramic capacitors
C4, C5	2	22 $\mu$ F, 25V radial-lead electrolytic capacitors
C6, C7	2	22pF capacitors
C8	1	0.01 $\mu$ F capacitor
C9	0	Reference designator, not used
C10-C14	5	0.1 $\mu$ F capacitors
D1	1	1N4001 diode
J1	1	40-pin right-angle male connector
J2	1	2-circuit terminal block
J3	1	Right-angle printed circuit board mount, DB9 female socket
J4	0	Open
JU1	0	Open
JU2	0	Reference designator, not used
JU3	0	Open
JU4	0	Open
JU5	0	Open
L1	0	Open
L2	0	Open
LED1	1	Light-emitting diode
R1	1	10M $\Omega$ , 5% resistor

DESIGNATION	QTY	DESCRIPTION
R2	1	330k $\Omega$ , 5% resistor
R3, R4	2	10k $\Omega$ , 5% resistors
R5	1	470 $\Omega$ , 5% resistor
R6	1	10k $\Omega$ SIP resistor
SW1	1	Slide switch
SW2	1	Momentary pushbutton switch
U1	1	68HC16 $\mu$ C MC68HC16Z1CFC16 (132-pin plastic quad flat pack)
U2	1	Maxim MAX233CPP
U3	1	27C256 EPROM containing monitor program
U4	1	7805 regulator, TO-220 size
U5	1	62256 (32K x 8) static RAM
U6	1	74HCT245 bidirectional buffer
U7	1	Maxim MAX707CPA
Y1	1	32.768kHz watch crystal
None	4	Rubber feet
None	1	28-pin socket for U3
None	1	20-pin socket for U6
None	1	3" x 5" printed circuit board
None	1	Heatsink for U4, thermalloy # 6078

### 68HC16 Module General Description

The 68HC16 module is an assembled and tested printed-circuit board intended for use with Maxim's high-speed serial-interface evaluation kits (EV kits). The module uses an inexpensive 8-bit implementation of Motorola's MC68HC16Z1 microcontroller ( $\mu$ C) to collect data samples at high speed using the QSPI™ interface. It requires an IBM-compatible personal computer and an external DC power supply, typically 12V DC or as specified in EV kit manual.

Maxim's 68HC16 module is provided to allow customers to evaluate selected Maxim products. It is not intended to be used as a microprocessor development platform, and such use is not supported by Maxim.

QSPI is a trademark of Motorola Corp.

### 68HC16 Module Detailed Description

#### Power Input Connector J2

The 68HC16 module draws its power from a user-supplied power source connected to terminal block J2. Be sure to note the positive and negative markings on the board. A three-terminal 5V regulator allows input voltages between 8V and an absolute maximum of 20V. The 68HC16 module typically requires 200mA of input current.

#### 68HC16 Microcontroller

U1 is Motorola's 68HC16Z1  $\mu$ C. Contact Motorola for  $\mu$ C information, development, and support. Maxim EV kits use the high-speed queued serial peripheral interface (QSPI) and the internal chip-select generation.

A MAX707 on the module monitors the 5V logic supply, generates the power-on reset, and produces a reset pulse whenever the reset button is pressed.



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## 68HC16 Module

The 68HC16 uses a phase-locked loop (PLL) to set its bus speed. Crystal Y1 is a 32.768kHz frequency reference. The internal oscillator runs 256 times faster than the external crystal. When the 68HC16 is reset, it waits for the PLL to lock before it executes any software. After the PLL locks onto the reference frequency, the software doubles the clock speed by writing to the clock synthesizer control register, selecting a bus speed of 16.78MHz.

U5, the user RAM area, is a 32kbyte CMOS static RAM.

The 74HCT245 octal buffer lets the 68HC16 module access an 8-bit port on the 40-pin interface connector. This memory-mapped port consists of separate read and write strobes, four chip selects, four address LSBs, and eight data bits.

### Serial Communications

J3 is an RS-232 serial port, designed to be compatible with the IBM PC 9-pin serial port. Use a straight-through DB9 male-to-female cable to connect J3 to this port. If the only available serial port has a 25-pin connector, you may use a standard 25-pin to 9-pin adapter. Table 1 shows the pinout of J3.

The MAX233 is an RS-232 interface voltage level shifter with two transmitters and two receivers. It includes a built-in charge pump with internal capacitors that generates the output voltages necessary to drive RS-232 lines.

### 40-Pin Data Connector J1

The 20 x 2 pin header connects the 68HC16 module to a Maxim EV kit. Table 2 lists the function of each pin. Note that 68HC16 object code is not compatible with 68HC11 object code. Use the 68HC16 module only with those modules that are designed to support it, and only download code that is targeted for the 68HC16 module. Downloading incorrect object code into the 68HC16 module will have unpredictable results.

### Address Ranges

The 68HC16  $\mu$ C generates various enable signals for different address ranges. The ROM and RAM enable signals are fed directly to the respective chips. Several additional signals (J1.11–J1.14) are available on the data connector to be used by Maxim EV kits. Table 3 outlines the address ranges for each of the elements found on the 68HC16 module, and Table 4 is a truth table that describes the logic for each of the 68HC16's chip-select outputs. Because the addresses are not completely decoded, the boot ROM and user RAM have shadows.

**Table 1. Serial Communications Port J3**

PIN	NAME	FUNCTION
1	DCD	Handshake; hard-wired to DTR and DSR
2	RXD	RS-232-compatible data output from 68HC16 module
3	TXD	RS-232-compatible data input to 68HC16 module
4	DTR	Handshake; hard-wired to DCD and DSR
5	GND	Signal ground connection
6	DSR	Handshake; hard-wired to DCD and DTR
7	RTS	Handshake; hard-wired to CTS
8	CTS	Handshake; hard-wired to RTS
9	None	Unused

**Table 2. 40-Pin Data-Connector Signals**

PIN	NAME	FUNCTION
1–4	GND	Ground
5, 6	VPREREG	Unregulated input voltage
7, 8	VCC	+5V from on-board regulator
9	RD	Read strobe
10	WR	Write strobe
11	7E000	Chip select for 7E000–7E7FF
12	7E800	Chip select for 7E800–7EFFF
13	7F000	Chip select for 7F000–7F7FF
14	7F800	Chip select for 7F800–7FFFF
15	A00	Address bit 0 (LSB)
16	A01	Address bit 1
17	A02	Address bit 2
18	A03	Address bit 3
19	EXTD0	Buffered data bus 0 (LSB)
20–26	EXTD1–7	Buffered data bus bits 1–7
27	IC1	General I/O port bit 0 (LSB)
28	IC2	General I/O port bit 1
29	IC3	General I/O port bit 2
30	OC1	General I/O port bit 3
31	OC2	General I/O port bit 4
32	OC3	General I/O port bit 5
33	OC4	General I/O port bit 6
34	IC4	General I/O port bit 7
35	MISO	QSPI master-in, slave-out
36	MOSI	QSPI master-out, slave-in
37	SCK	QSPI serial clock
38	PCS0/SS	QSPI chip-select output
39	CLKOUT	System clock output
40	PWMA	Pulse-width-modulator output

# 68HC16 Module

**Table 3. 68HC16 Module Memory Map (all address values are in 20-bit hex)**

PIN	FUNCTION
00000–07FFF	Boot ROM (U3, strobed by CSBOOT)
08000–0FFFF	Shadow of boot ROM
10000–17FFF	User RAM (U5, strobed by CS0 and CS2)
18000–1FFFF	Shadow of user RAM
20000–203FF	Internal standby RAM; 1kbyte
20400–7DFFF	Unused
7E000–7E7FF	External chip select (J1 pin 11) (CS7)
7E800–7EFFF	External chip select (J1 pin 12) (CS8)
7F000–7F7FF	External chip select (J1 pin 13) (CS9)
7F800–7FFFF	External chip select (J1 pin 14) (CS10)
80000–F7FFF	Not accessed by the 68HC16
F8000–FF6FF	Unused
FF700–FF73F	68HC16's built-in ADC (not used)
FF740–FF8FF	Unused
FF900–FF93F	General-purpose timer module (GPT)
FF940–FF9FF	Unused
FFA00–FFA7F	System integration module (SIM)
FFA80–FFAFF	Unused
FFB00–FFB07	Internal standby RAM (SRAM) control registers
FFB08–FFBFF	Unused
FFC00–FFDFF	Queued serial module (QSM)
FFE00–FFFFF	Unused

### Boot ROM

The boot ROM, U3, is configured as an 8-bit memory device. Resistor R4 pulls data bit 0 low during system reset, forcing the  $\mu$ C to fetch instructions using only the upper eight data bits. The boot ROM checks the system and waits for commands from the host. Refer to the EV kit manual for specific start-up procedures.

### Software

All software is supplied on a disk with the EV kit. Instructions for operating the software are included in the EV kit manual. Refer to the EV kit manual for more information.

### 68HC16 Module Self Check

To test the 68HC16 module's integrity, connect the power supply to the power terminals (J2). Do not connect anything to J1 or J3. Slide the power switch SW1 to the "ON" position. The LED will light up, and will flash within 5 seconds.

If the LED flashes with a 50%-on/50%-off duty cycle, then it passed its self check. Note that this test does not exercise the RS-232 port or the EV kit 40-pin interface, but it does confirm that the power supply, microprocessor, ROM, and RAM passed the self test.

If the LED flashes with a 10%-on/90%-off duty cycle, then it failed its self check. Most likely, the RAM chip (U5) is bad.

If the LED remains on and does not flash, then the problem is either U3 (the EPROM), U1 (the microprocessor), U4 (the regulator), the MAX707 reset generator, or the power supply. Use a voltmeter to verify that the power supplies are good. Check the power-supply input and the +5V output from the regulator. Use an oscilloscope to see if the 32.768kHz reference oscillator is running.

# 68HC16 Module

Table 4. 68HC16 Chip-Select Outputs Truth Table

ADDRESS RANGE	CSBOOT	CS0	CS1	CS2	CS5	CS6	CS7	CS8	CS9	CS10
0xxx read	L	H	H	H	H	H	H	H	H	H
1xxx read	H	H	H	L	H	H	H	H	H	H
1xxx write	H	L	H	H	H	H	H	H	H	H
7E0xx read	H	H	L	H	H	L	L	H	H	H
7E0xx write	H	H	H	H	L	L	L	H	H	H
7E8xx read	H	H	L	H	H	L	H	L	H	H
7E8xx write	H	H	H	H	L	L	H	L	H	H
7F0xx read	H	H	L	H	H	L	H	H	L	H
7F0xx write	H	H	H	H	L	L	H	H	L	H
7F8xx read	H	H	L	H	H	L	H	H	H	L
7F8xx write	H	H	H	H	L	L	H	H	H	L

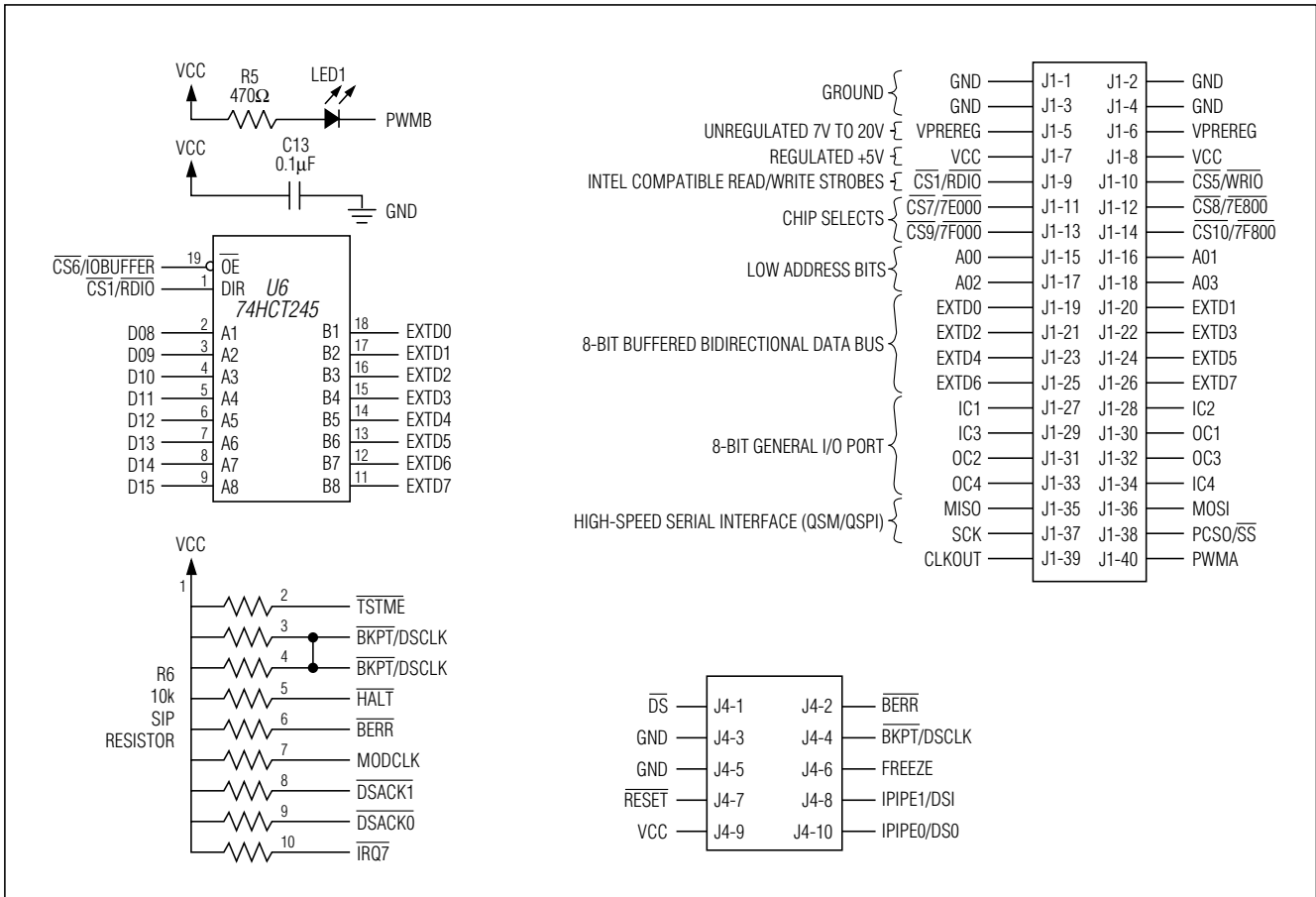


Figure 1. 68HC16 Module Schematic



# 68HC16 Module

# 68HC16 Module

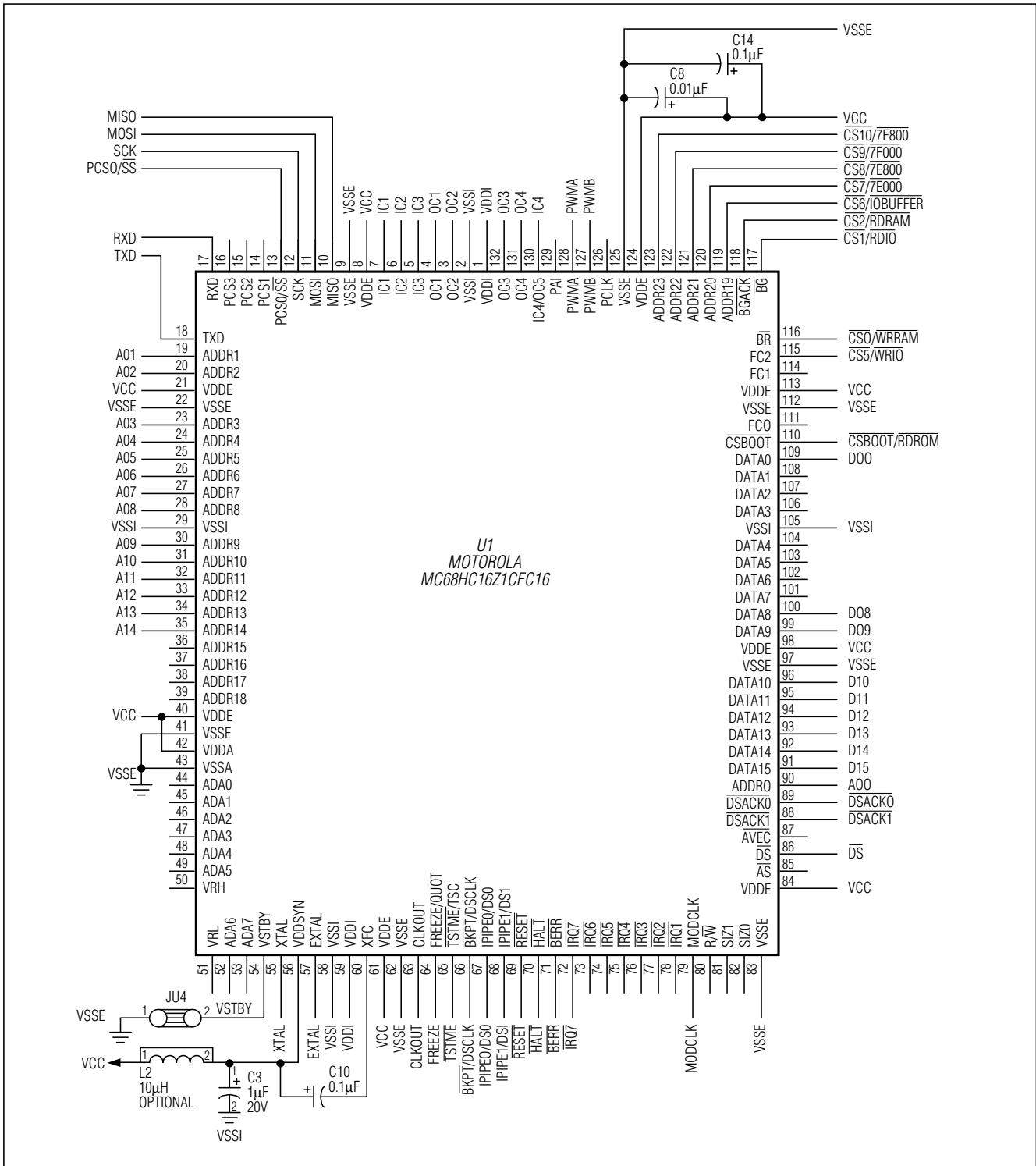


Figure 1. 68HC16 Module Schematic (continued)

# 68HC16 Module

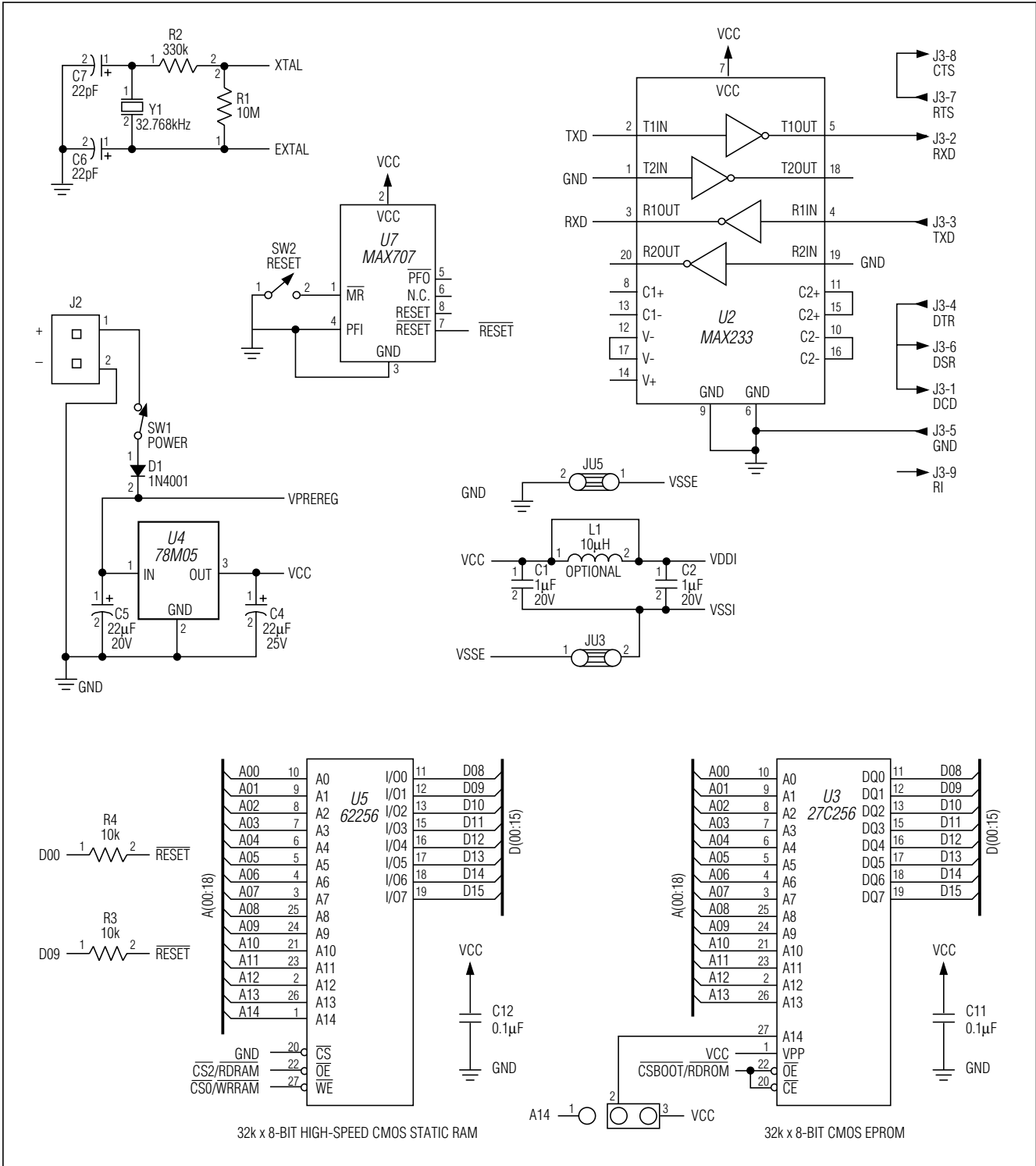


Figure 1. 68HC16 Module Schematic (continued)

# 68HC16 Module

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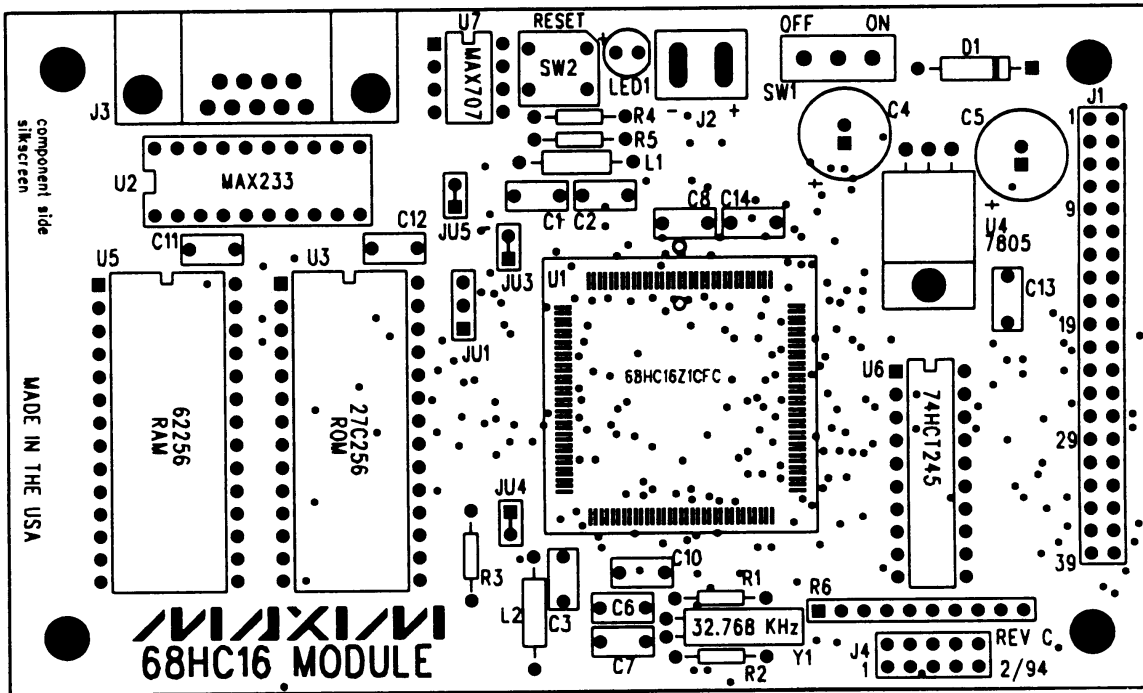


Figure 2. 68HC16 Module Component Placement Guide

# 68HC16 Module

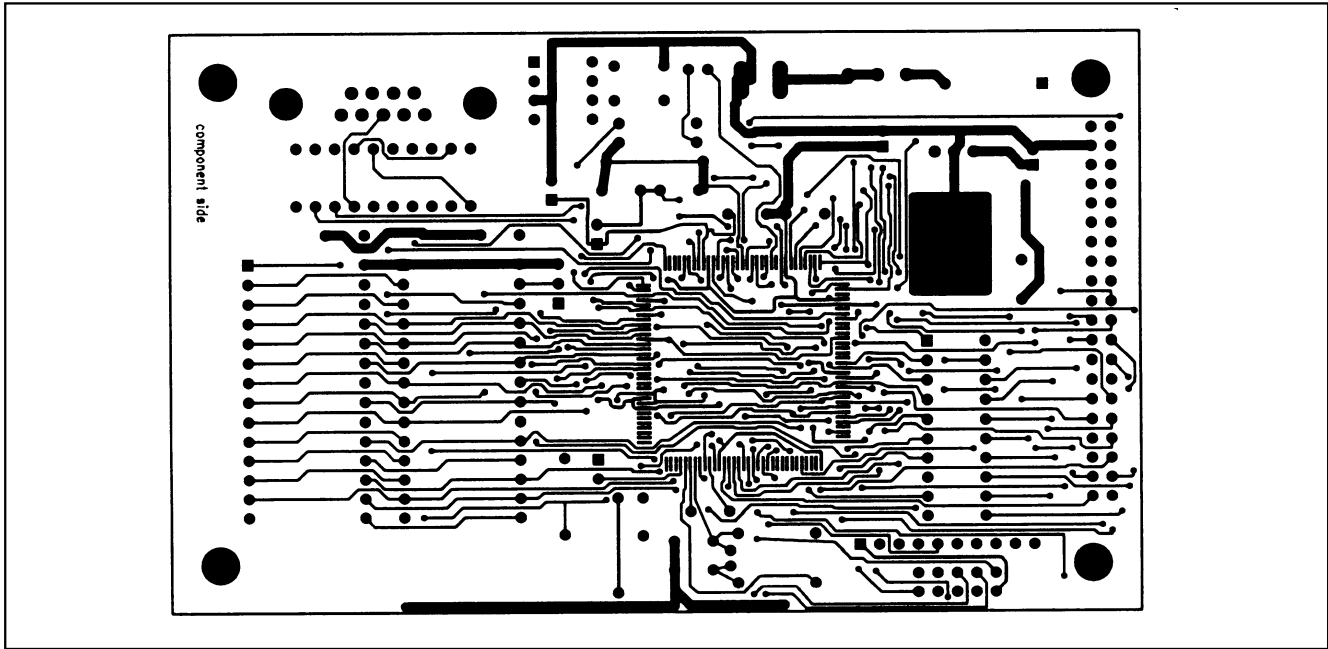


Figure 3. 68HC16 Module PC Board Layout—Component Side

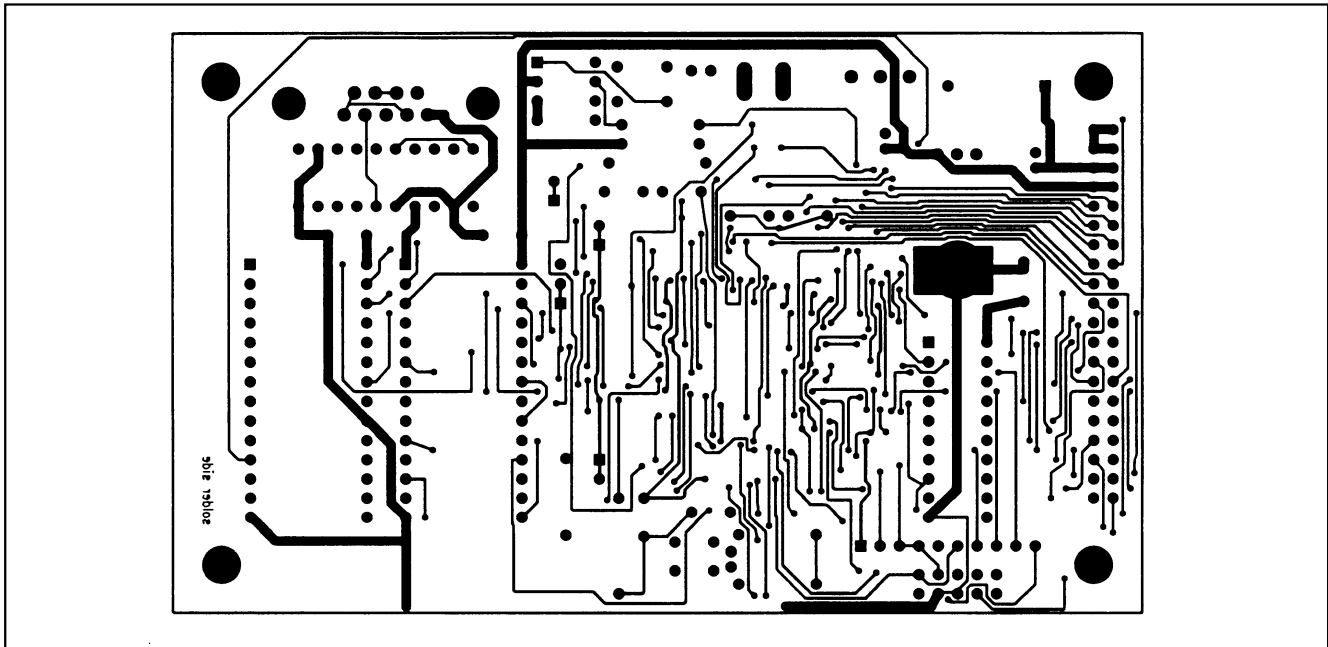


Figure 4. 68HC16 Module PC Board Layout—Solder Side

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