

1.2 MC13192 Sensor Applications Reference Design (SARD) Components

The MC13192 Sensor Applications Reference Design (SARD) introduces users to the MC13192 2.4 GHz wireless data transceiver. It includes an RS232 port, background debug module for in-circuit hardware debug, switches, LEDs, and a host MCU and allows the user flexibility in establishing wireless data networks.

Features of the MC13192 SARD include:

- Provides all hardware required for a complete 2.4 GHz wireless node using IEEE 802.15.4 packet structure.
- One MC13192 2.4 GHz transceiver RF reference design with printed circuit antenna.
- One MC9S08GT60 low-power, low-voltage MCU with 60KB of on-chip Flash.
- Background Debug Module (BDM) programming port for support of Metrowerks CodeWarrior™ Development Studio.
- Provides IEEE 802.15.4 modem.
- Two Accelerometers: MMA6261Q (X and Y axis), MMA1260D (Z axis)
- RS-232 port for interface with a personal computer.
- Four switches and LEDs for control and monitoring.
- Reset switch for program reset.
- Scalable software support:
 - Proprietary point-to-point or star networking using Freescale's Simple Medium Access Control (SMAC) software
 - IEEE 802.15.4 Standard compliant networking using Freescale's MAC/PHY
 - ZigBee™ networking using Freescale's Z-stack software

1.3 Hardware Description

As previously stated, the MC13192 Sensor Applications Reference Design (SARD) provides the hardware required to establish a wireless node using a variety of protocols. [Figure 1-1](#) shows a simplified block diagram of two SARDs connected in a simple point-to-point network. Optional personal computers are shown for control and monitoring.

The SARD is a 2 inch x 3 inch module that comprises a complete network node containing the MC13192, crystal, printed circuit antenna and MCU. Also included are jumper-selectable X-Y and Z Axis Accelerometers, four switches, and four LEDs for monitoring purposes. The SARD derives its power from a 9V battery.

NOTE

Do not use a Lithium battery.

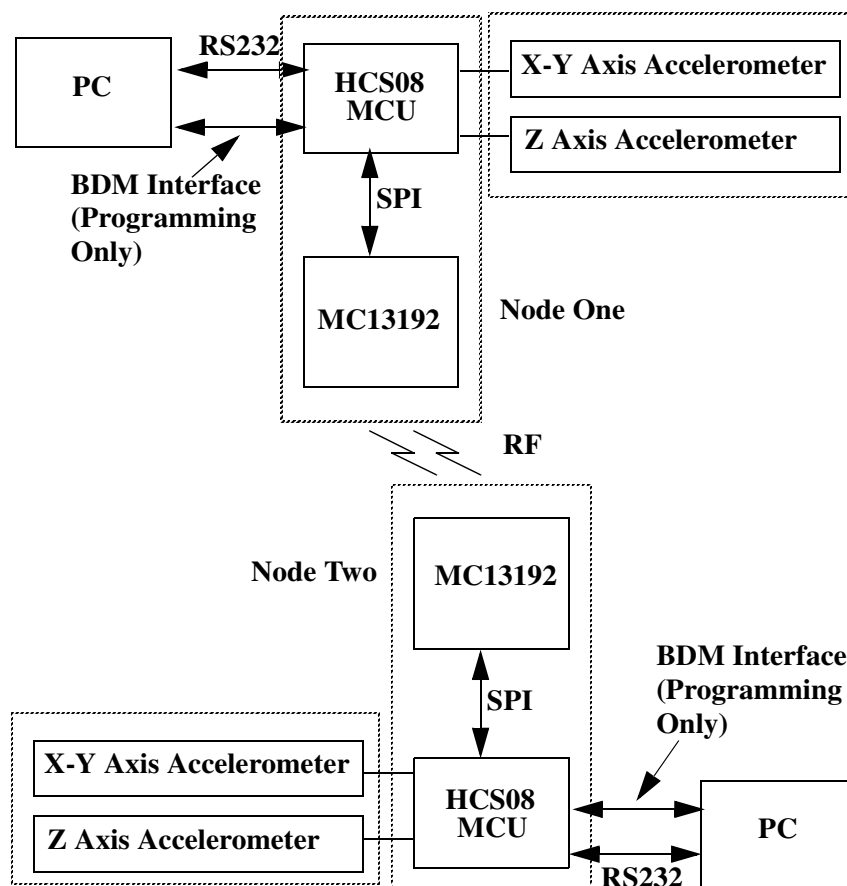


Figure 1-1. Point to Point MC13192 SARD Block Diagram

1.3.1 MC13192 SARD Circuit Description

Figure 1-2 shows the MC13192 SARD schematic. Appendix A includes board layout, including the printed dipole receive and transmit antennas, and Bill of Material information. All circuitry required for a 2.4 GHz wireless node is provided. The heart of the design is the MC13192 2.4 GHz transceiver and the MC9S08GT60 microcontroller. All connections for control of the transceiver by the MCU are provided. Peripherally, four LEDs and switches interfacing with the MCU are provided for control and demonstration purposes.

Three accelerometers are provided. An MMA6261Q (X and Y axis) and an MMA1260D (Z axis) for demonstration purposes. A Background Debug Module (BDM) port is provided for programming using the CodeWarrior™ Development Studio to develop and in-circuit debug code and program the MCU. An RS-232 interface is provided to allow monitoring or programming.

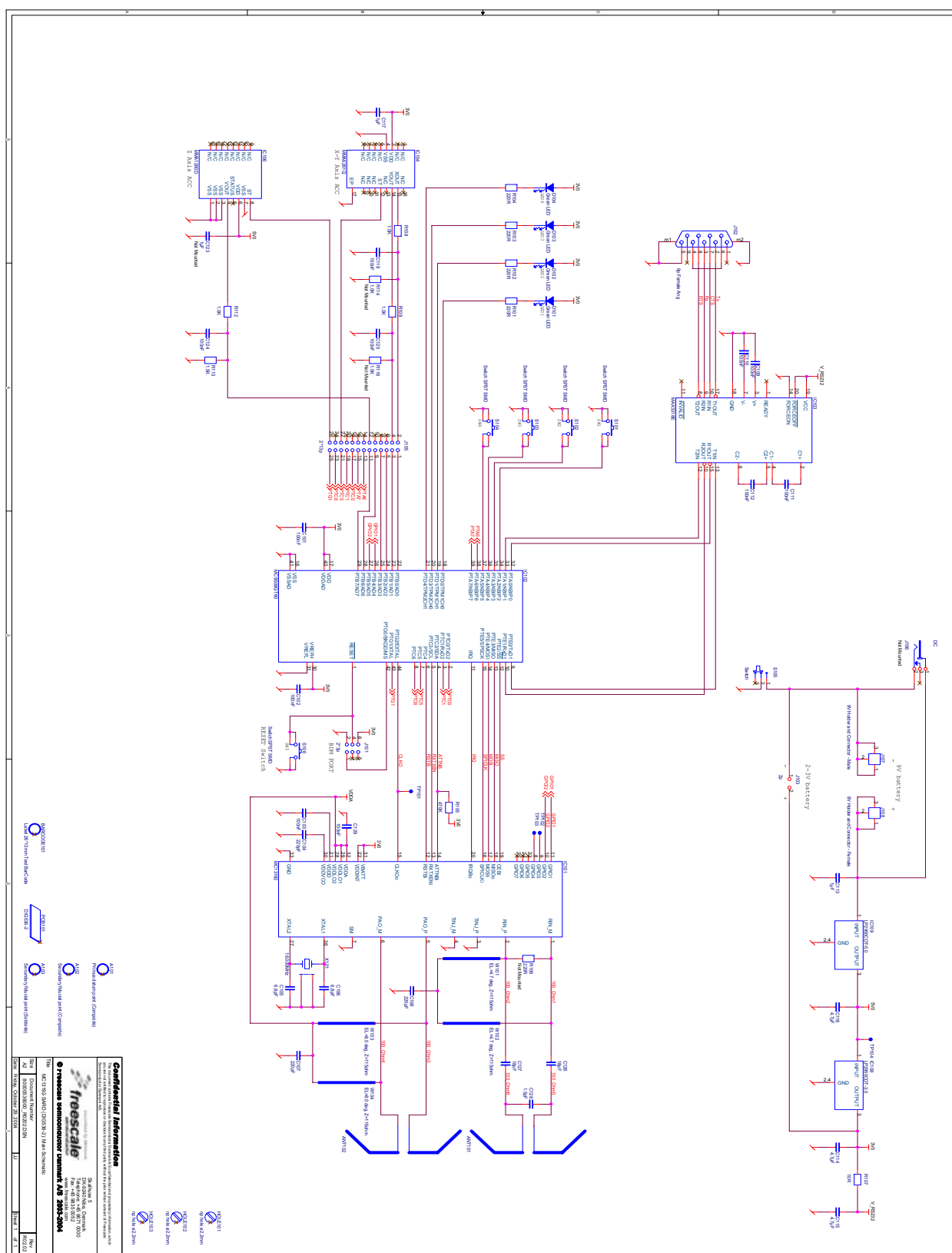


Figure 1-2. MC13192 SARD Schematic

1.3.2 RS232 Connector J102

The RS232 port is J102, a DB9 connector. A standard straight-through DB9 serial cable can be used with a PC. The port follows the standard RS232 DCE DB9 convention as shown in [Figure 1-3](#). The RS232 is normally used to connect the SARD to a PC. With an installed bootloader program such as the Sensor Applications Reference Design (SARD) Embedded Bootloader program, described in document number 802154EBRM/D, it can also be used to program the MCU.

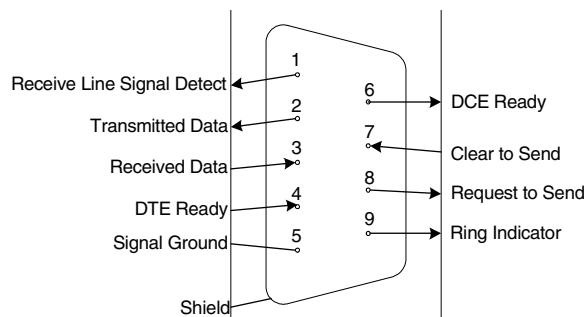


Figure 1-3. DCE-DB9 Female Connector (Looking into the SARD Connector)

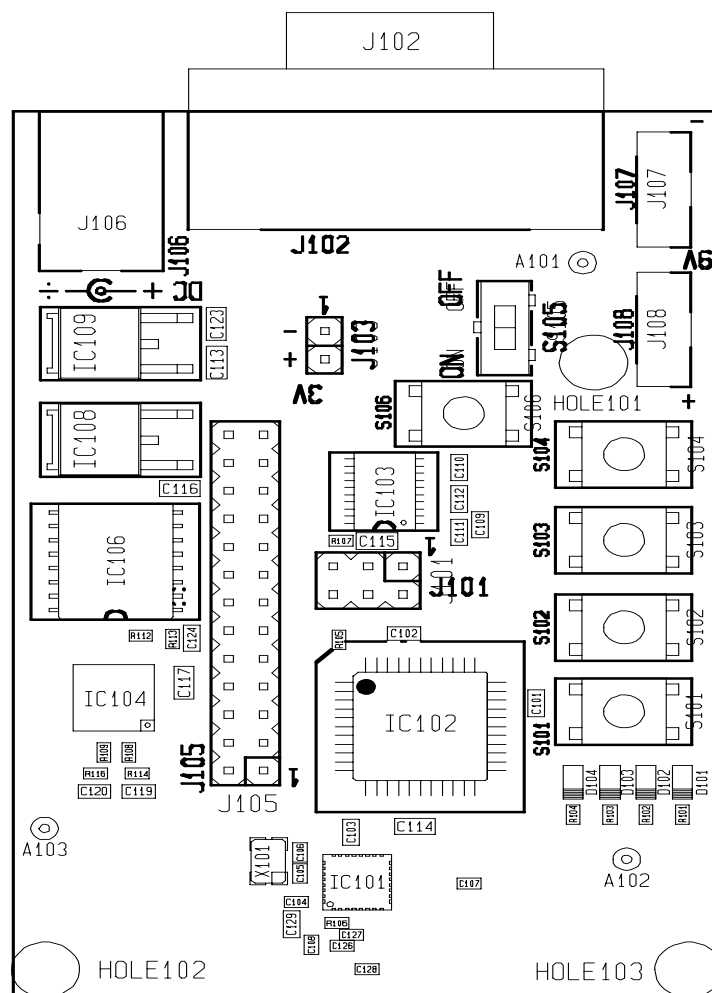


Figure 1-4. SARD Component Layout

1.3.3 Power Capability

The SARD can be powered from a 9 V battery connected to the board-mounted battery terminals. See [Figure 1-4](#) for battery terminal placement. If the accelerometers are not used, 2.0-3.4V can be supplied on J103. In this configuration, the accelerometer outputs are indeterminate.

NOTE

Do not use a Lithium battery.

1.3.4 LEDs and Switches

D101 through D104 and Switches S101 through S104 are connected to I/O as shown on the SARD schematic and in [Figure 1-4](#). These are useful as indicators and control in applications. Connections to MCU ports are listed in [Table 1-1](#). The on-off switch, S105 is labeled on the board.

Table 1-1. LED and Switch Port Connection

LED/Switch	MCU Port	I/O
LED 1, D101	PTD0	Output
LED 2, D102	PTD1	Output
LED 3, D103	PTD3	Output
LED 4, D104	PTD4	Output
RESET, S106	RESET	----
S101	PTA2	Input
S102	PTA3	Input
S103	PTA4	Input
S104	PTA5	Input

1.3.5 Board Reset Function

A hardware reset can be performed on the SARD in two ways:

- The Reset push button.
- The MCU resets the SARD as part of its startup sequence when power is applied and the On/Off switch is turned on.

In both cases, the reset sequence resets the MCU which, in turn, resets the MC13192.

1.3.6 MCU General Purpose Input/Output (GPIO)

[Figure 1-4](#) shows the MCU GPIO that can be interfaced with external hardware such as sensors. When using the on-board accelerometers, shunts must be installed at PTB0, PTB1, and PTB7, which corresponds to pins 1 and 2, 3 and 4, 11 and 12, of J105, to connect the accelerometer ICs to the MCU. For user defined applications, these shunts can be removed and other hardware attached to the GPIO pins.

1.3.7 BDM Port

Header J101 is a BDM port for use with a P&E BDM-Multilink cable which is available from Metrowerks. The BDM cable is used with CodeWarrior™ Development Studio for the HCS08 to program the MCU flash memory as well as performing in-circuit debugging. See [Figure 1-4](#) for the position of pin 1. The red lead of the BDM cable must align to pin 1 of J101.

When using the parallel port version of the BDM cable, the BDM pod should be powered with a 2 - 5 V negative center contact power supply. A 9 V battery is not capable of sourcing the current required by the parallel BDM pod during programming and debug.

1.4 Applications and Programming Information

1.4.1 Accelerometer Application Demo

The SARD comes pre-programmed with the accelerometer demo software. See the *Accelerometer Demonstration Quick Start Guide*, document number AN2762/D for installation and startup instructions. The receiver is connected to a PC COM port via an RS232 cable. The 9 V battery needs to be installed on the battery terminals and the on/off switch turned on. Start the accelerometer GUI software, available from our website, and choose the COM port you are using in the dialog box. Install the 9 V battery on the transmitter and turn it on. On the PC screen you can select various ways to display the accelerometer data. One popular way is the cursor mode where you can watch the cursor position move as the transmitter is moved.

1.4.2 Programming the SARD (User Defined Software)

A BDM programmer is used to load the MCU flash memory. Alternatively, the Embedded Bootloader software, described in the, *Embedded Bootloader Reference Manual*, document number 802154EBRM/D, can be installed and the SARD can be programmed through the RS-232 port.