Using the Sensing Triple Axis Reference Board (STAR)

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INTRODUCTION

The Sensing Triple Axis Reference Board (STAR) is a Freescale demonstration tool that is designed to allow visualization of key accelerometer applications in the consumer industry. In the past few years, accelerometers have changed dramatically during this entrance to the consumer market with increased sensitivity, reduced power consumption, and reduced package size. In addition, there has been development of accelerometer applications in many new markets. The MMA7260Q leaps forward in these requirements in addition to new functionality such as a g-Select feature and low power supply to allow system developer's more opportunities for integration of the five measurements of Freescale accelerometers (See AN1986).

MMA7260Q

The STAR board is a demonstration tool for the MMA7260Q, a 3-Axis Low-g accelerometer. The MMA7260Q has many unique features that make it an ideal solution for many consumer applications such as freefall protection for laptops and MP3 players, tilt detection for e-compass compensation and cell phone scrolling, motion detection for handheld games and game controllers, position sensing for g-mice, shock detection for warranty monitors, and vibration for out of balance detection.

Features such as low power, low current, and sleep mode with a quick turn on time allow the battery life to be extended in end applications. The 3-axis sensing in a small QFN package requires only 6 mm x 6 mm board space, with a profile of 1.45 mm, allowing for easy integration into many small handheld electronics.
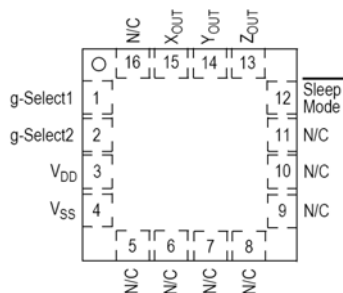

Figure 1. Pin Connections for the MMA7260Q

g-SELECT

The MMA7260Q has a unique feature that allows the range of g-force to be determined by changing inputs to the Quad Flat No-Lead (QFN). Table 1 below shows the configurable settings for the accelerometer, allowing multiple g-ranges.

Table 1. Configurable Setting for Accelerometer

g-Select2	g-Select1	g-Range	Sensitivity
0	0	1.5g	800 mV/g
0	1	2g	600 mV/g
1	0	4g	300 mV/g
1	1	6g	200 mV/g

The dipswitches located on the (STAR) Board allow for the manual setting of the g-range. The ON position indicates a logic "1" which is equal to Vdd of the MMA7260Q. The OFF position is a logic "0" or Vss of the MMA7260Q. For a final design, the g-Select is best configured to additional I/O of a chosen microcontroller. Therefore, the sensitivity of the device could be easily changed with a quick change in the software. In addition, the software can be configured so that different sensitivities can be used for several applications, where the MCU drives the g-Select during different modes of operation.

MICROCONTROLLER

The MC68HC908KX8, an 8-bit MCU with 8-bit ADCs, was selected to sample the MMA7260Q 3-axis signals. An SCI for the serial communication, four 8-bit ADC channels to process the 3 analog signals, and 8 Kbytes of FLASH memory to save calibration data and other software configuration data also make it a suitable solution.

The MCU sends data via RS232 port to a CPU for further processing and graphical display of the acceleration data. In stand alone operation, the MCU can store acceleration, motion, or position data to a set of external EEPROMs which can later be downloaded to an excel file through the serial connection using the demo software provided. During stand alone operation, there are Status LEDs and a Piezo-electric buzzer allowing the MCU to display program modes.

More information regarding the MCU can be found in the MC68HC908KX8, MC68HC908KX2 Technical Datasheet (Freescale document number MC68HC908KX8/D).

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REFERENCE BOARD

The goal of the Mini-TRIAX was to provide a small board with the capability to demonstrate and evaluate many accelerometer applications. Many design considerations were taken in effect to have a small and versatile tool (board size is 1.850" x 1.50").

Table 2 provides a brief description of the components on the STAR board and Figure 2 showing the location on the board.

Table 2. Components on the Mini-TRIAX Board

| Component	Component Function
MMA7260Q	3 axis Accelerometer part to give vibration and inertial readings to the board
MC68HC908KX8	8-Bit processor used on the board. It is featured in a dip socket rather than SMT so it can be removed by a user for reprogramming for final solution designing.
LM317-L	Adjustable Voltage regulator. This part allows for the regulation of power to all the components on the board. 3.6 V
LM2765M6	Charge pump. This allows the use of a small 3 V battery to provide power at a higher voltage to the necessary level for the other components. With this, a standard 3V, 2/3A battery can easily be purchased. It keeps the size small rather than using a large 9V battery & holder.
2/3A battery Holder	The power of the board is supplied by a 3 V 2/3 A or 123 battery. It is commercially available at any consumer battery stand. This is the holder.
DB9 Serial Connector	The Mini-TRIAX communicates using a RS232 port, and this is the connector used for the cable.
MAX3316CAE	RS232 Chipset. This part allows the interface between the MCU and the standard RS232 communications port.
CTX690CT-ND	This is the external canned clock oscillator that allows the MCU to communicate with the RS232 port. This clock is set for 14.7456 MHz
25LC640	This is one of two EEPROMs. They are used via SCI to store accelerometer values at 200 times a second to memory.
Dip Switch	The STAR contains a set of 2 dip switches that allow the user to use the function defined as 'g-select' on the MMA7260Q accelerometer. This enables the user to define the g-force range, from a 1.5 g device to a 2 g, 4 g, and 6 g device with two simple buttons.
Momentary switch	This enables the MCU to detect inputs to the STAR from the user during standalone mode, when the board is not connected via RS232.
Buzzer & LEDs	These provide status/outputs for the STAR. It notifies the user if the board is on, if a certain condition is satisfied, etc.
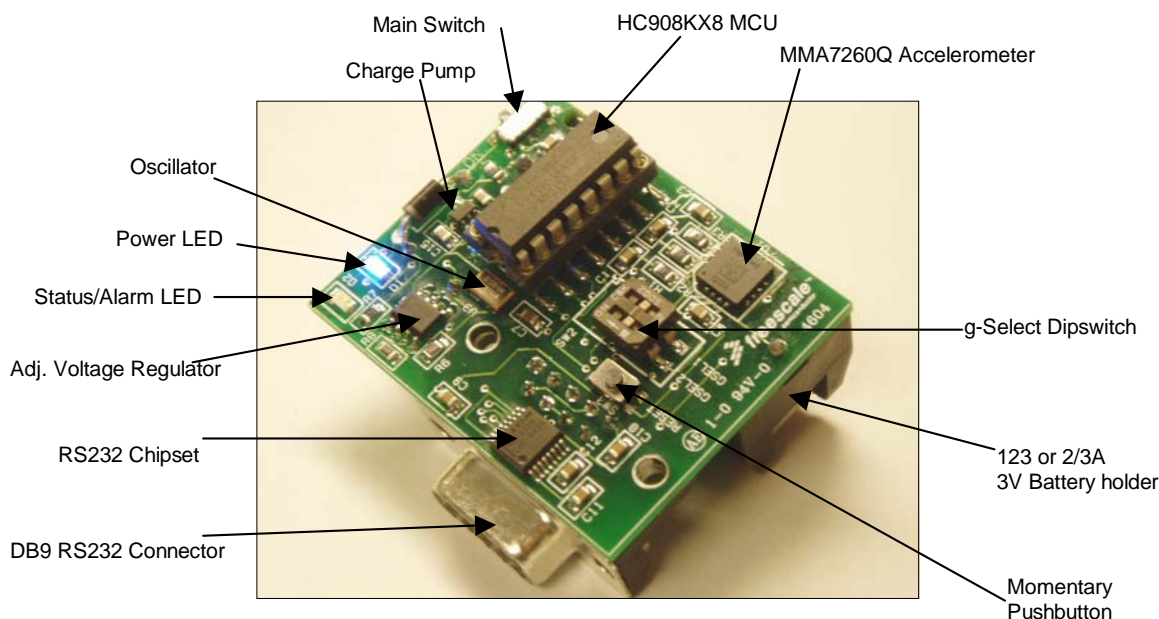
Figure 2. Location of Components on Board

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VOLTAGE/POWER

A 2/3 A battery was chosen as a power supply with its ability to supply 1400 mAH for the STAR. It was also a design consideration to reduce the size of the demonstration board. The 2/3 A battery is available at any commercial battery stand. The other options were two AA batteries or a 9 V battery, significantly larger in size when coupled with battery holders. As can be seen in Figure 2, a number of the components are driven at a 3.6 V supply. The MMA7260Q is optimal at 3.3 V so a slightly higher voltage was used to compensate for any small drop in voltage. The RS232 chipset was driven directly from the 3 V source due to the logic level thresholds of that particular device.

The 3.6 V supply is obtained from the 3 V battery by the use of a charge pump, the LM2765M6. This allows the doubling of voltage to 6 V. This is regulated back down to 3.6 V via the adjustable regulator LM317-L and supplied to the other ICs.
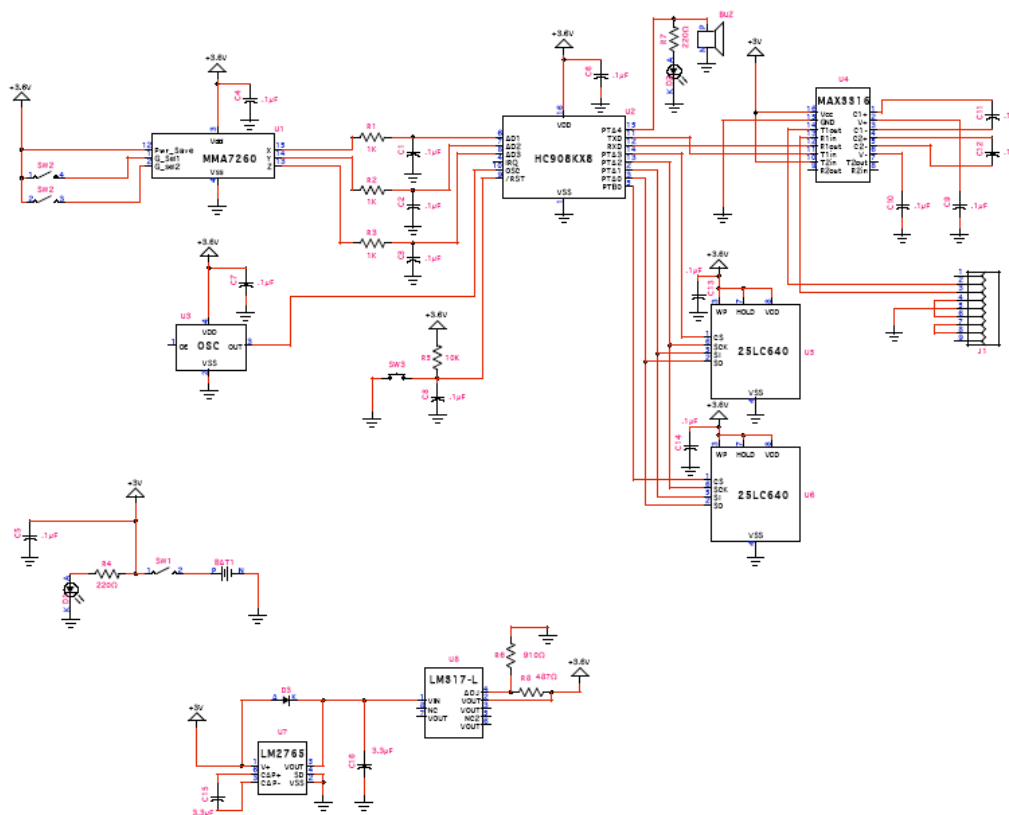
Figure 3. Schematic of Board

SOFTWARE

A software program was developed to provide an interface as well as a development system. The software can be used for displaying the 8-bit ADC values sent through the RS232 connection, or utilized for analyzing accelerometer data to demonstrate end applications. The software is sorted by various modules that showcase these possible end-applications for the MMA7260Q. This allows for developmental ideas for the MMA7260Q as a user can sample possible final products with a single reference/development tool. Some software modules such as free fall and battery saver can be initiated without the use of the PC connection, activated by a push button. The software available for the STAR board can be found on the Freescale Web site.

MODES OF OPERATION

The STAR board has three modes of operation - sending data to the PC for analysis or display, saving data to external memory (2 EEPROMs), or running a stand alone module. The stand alone modules contain demonstration tools such as freefall, battery saver, or shock alarm. The operation mode can be selected via the STAR's push button or by selecting a stand alone module on the PC software. In the push button operation mode, a user can push the STAR's tactile switch to select the most recent stand alone module. If the user depresses the same button for 20 seconds, it will cause the STAR to run the freefall stand alone module.

SUMMARY

The MMA7260Q has many unique features such as low power, low current, a quick turn on time, and 3-axis sensing with g-select all in a small QFN package. The STAR enables the user to quickly see many capabilities of the device along with application ideas to pursue. In addition, with data download capability, the STAR provides a quick way to prototype a software solution to gain a better understanding for the capability of the device.
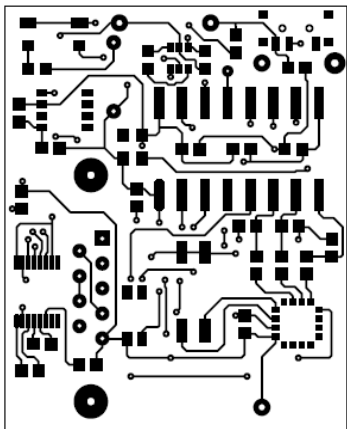
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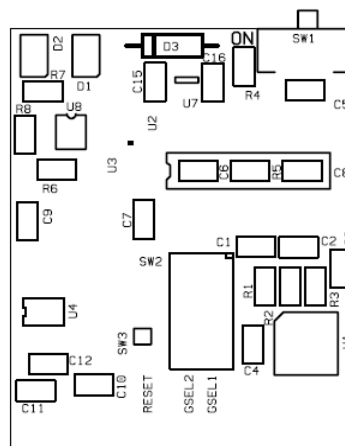
Figure 4. Component Layer of STAR Board
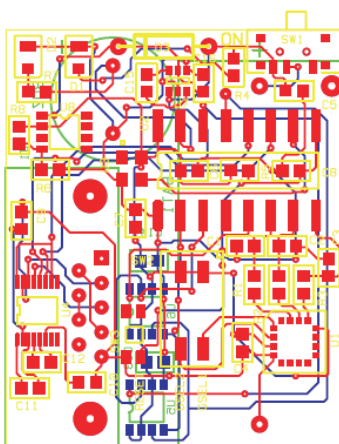

Figure 5. Component Silkscreen

Figure 6. All Layers

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