Freescale Semiconductor
Application Note

Document Number: AN4475
Rev 0, 07/2012

MMA845x Driver: Quick Start Guide

by: Laura Salhuana

1 Introduction

This quick start guide demonstrates how to load the MMA845x driver and also outlines some of the elementary function commands available. For a more in-depth look at the function commands, please refer to AN4076, Data Manipulation and Basic Settings of the MMA8451, 2, 3Q. The purpose of the driver is to give the customer the capability to access the device registers and to be able to configure the driver with a Freescale microcontroller. For this particular driver, the following hardware is used: the Sensor Toolbox Board (RDDMA845x) and the Freescale 8-bit microcontroller (MC9S08QE8). The HyperTerminal program was used for the examples listed in this document, but any terminal emulation tool may be used. To make modifications to the program, the user will need a USB BDM multilink cable and Freescale's CodeWarrior HCS08.

Contents

2 MMA8451, 2, 3Q Consumer 3-axis Accelerometer 3 by 3 by 1 mm

The MMA8451, 2, 3Q has a selectable dynamic range of ±2g, ±4g, and ±8g. The device has eight different output data rates, selectable high-pass filter cutoff frequencies, and high-pass filtered data. The available resolution of the data and the embedded features are dependent on the specific device selected.

Note: The MMA8450Q has a different memory map and has a slightly different pinout configuration.

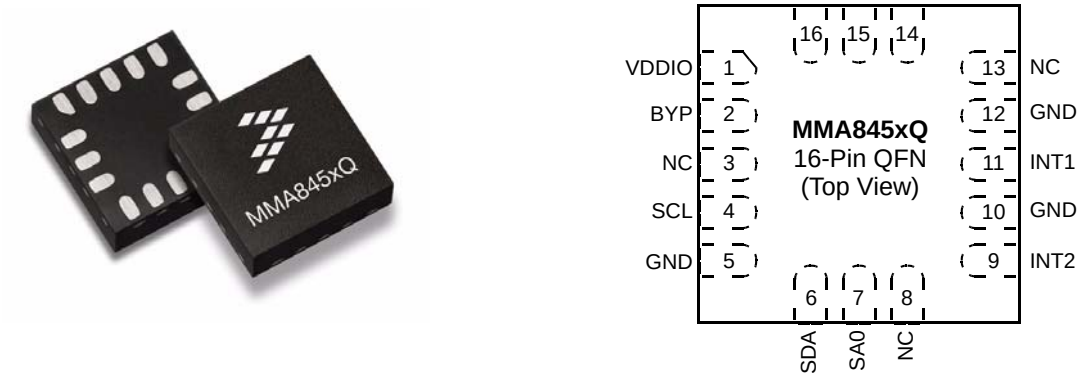


Figure 1. MMA8451, 2, 3Q Consumer 3-axis Accelerometer 3 by 3 by 1 mm

2.1 Key Features of the MMA845xQ

The key features of the MMA845xQ are:

- Current consumption:
  - — Standby Mode: 1.8 mA
  - — Low-power Mode (1.56 Hz - 800 Hz): 6 mA - 165 mA
  - — Normal Mode (1.56 Hz - 800 Hz): 24 mA - 165 mA
- I^2C digital output interface (operates to 2.25 MHz with 4.7 kΩ pullup)
- 14/12/10-bit and 8-bit data or high-pass filtered data
- ±2g/±4g/±8g dynamically selectable full-scale
- Noise: 99 mg/Hz
- 14-bit and 8-bit digital output
- Self-Test

2.2 Programmable Interrupt Pins for eight Interrupt Sources

1. Embedded four channels of Motion detection
   a) Freefall or Motion detection: two channels
   b) Tap detection: one channel
   c) Transient detection: one channel
2. Embedded orientation (Portrait/Landscape) detection with hysteresis compensation
3. Embedded automatic ODR change for auto-wakeup and return-to-sleep
4. Embedded 32-sample FIFO
5. Data-ready interrupt setup for example code and driver program

Table 1. Features of the MMA845xQ devices

Feature List	MMA8451	MMA8452	MMA8453
Digital Resolution (Bits)	14	12	10
Digital Sensitivity (Counts/g)	4096	1024	256
Data-Ready Interrupt	Yes	Yes	Yes
Single-Pulse Interrupt	Yes	Yes	Yes
Double-Pulse Interrupt	Yes	Yes	Yes
Directional-Pulse Interrupt	Yes	Yes	Yes
Auto-WAKE	Yes	Yes	Yes
Auto-SLEEP	Yes	Yes	Yes
Freefall Interrupt	Yes	Yes	Yes
32 Level FIFO	Yes	No	No
High-Pass Filter	Yes	Yes	Yes
Low-Pass Filter	Yes	Yes	Yes
Orientation Detection Portrait/Landscape = 30°, Landscape to Portrait = 60°, and Fixed 45° Threshold	Yes	Yes	Yes
Programmable Orientation Detection	Yes	No	No
Motion Interrupt with Direction	Yes	Yes	Yes
Transient Detection with High-Pass Filter	Yes	Yes	Yes
Low-Power Mode	Yes	Yes	Yes

2.3 Necessary tools and software

To access the driver program with the HyperTerminal program, the user will need to have a RDMMA845X Sensor Toolbox kit, CodeWarrior version 6.3 and a USB BDM multilink cable. The RDMMA845X will need to be reprogrammed with the MMA845x driver.

http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MMA8451Q&fpsp=1&tab=Design_Tools_Tab

To purchase a USB BDM multilink cable:

http://www.pemicro.com/products/product_viewDetails.cfm?product_id=33&CFID=8416068&CFTOKEN=696e3eb1f8907b16-C474EE01-FD08-E31E-64D23BB70CDEA46

Figure 2. USB BDM multilink cable

To download CodeWarrior:

http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=CW-MICROCONTROLLERS

2.4 How to program the RDMMA845x with the driver program

Once the necessary tools are installed, the driver program will need to be programmed into the RDMMA845xQ Sensor Toolbox board:

1. Plug the BDM cable into the J1 of the RDMMA845X Sensor Toolbox board. Make sure that pin 1 is connected to the red part of the ribbon cable on the BDM connector.
2. Using CodeWarrrior
   a) Select Project > Debug (F5)
   b) The True-Time Simulator & Real-Time Debugger will appear with the PEMICRO Connection Manager. Select Connect (Reset)

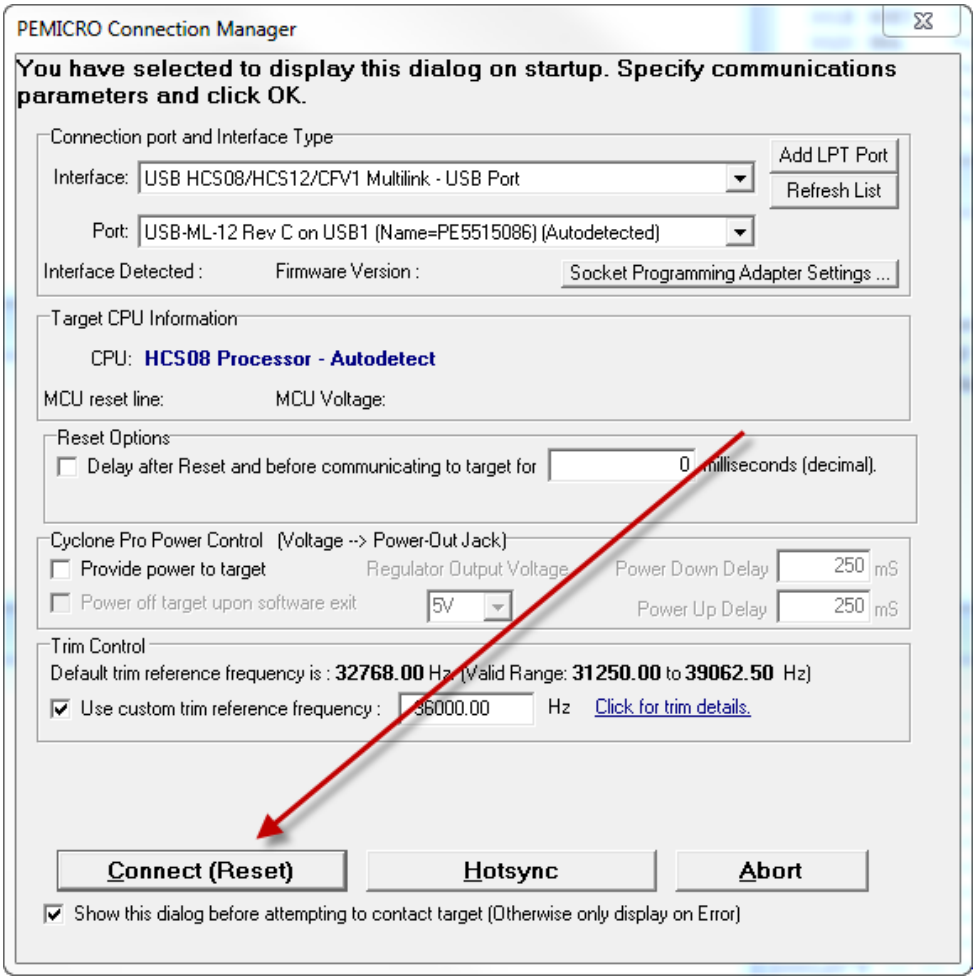


Figure 3. PEMICRO connection manager

c) Select Yes when prompted to Erase and Program flash?

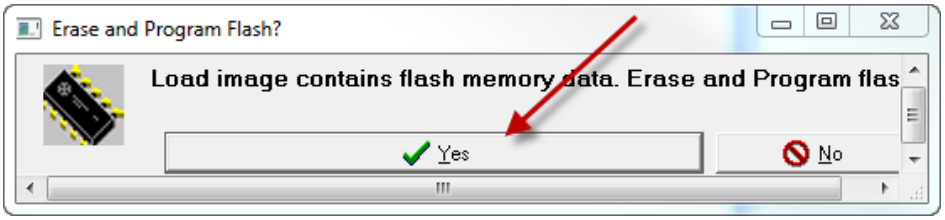


Figure 4. Erase and Program flash

d) Once programmed, select the green arrow to run the program

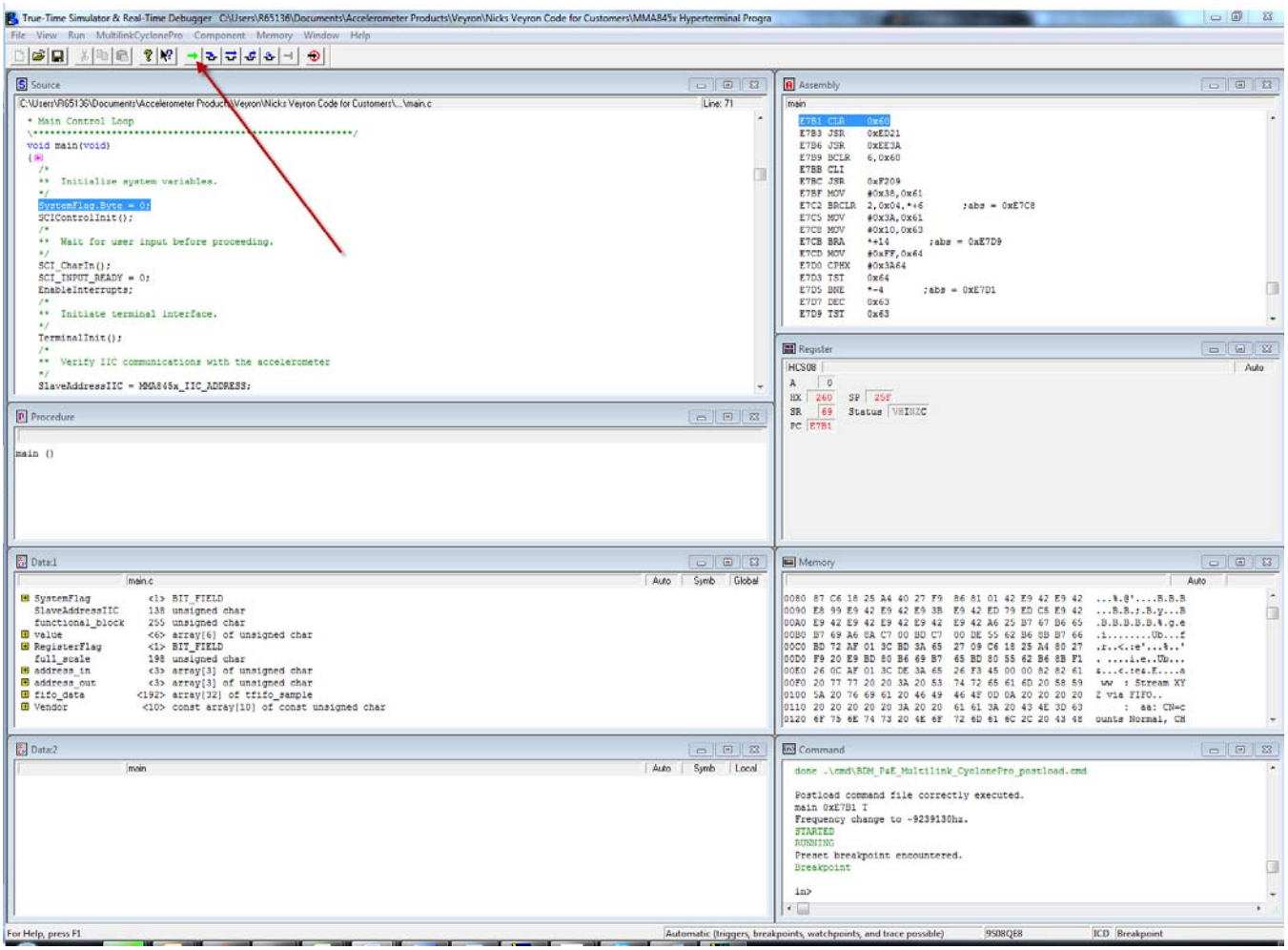


Figure 5. True-Time Simulator & Real-Time Debugger

2.5 Setting up the Terminal Emulator

A terminal emulator such as HyperTerminal, will be used for the driver program examples.

1. Connect to the COM port being used by the RDMMA845x Sensor Toolbox board. To check the COM port being used, go to the Device Manager and check the Ports. The port being used will be “USB Serial Port”.

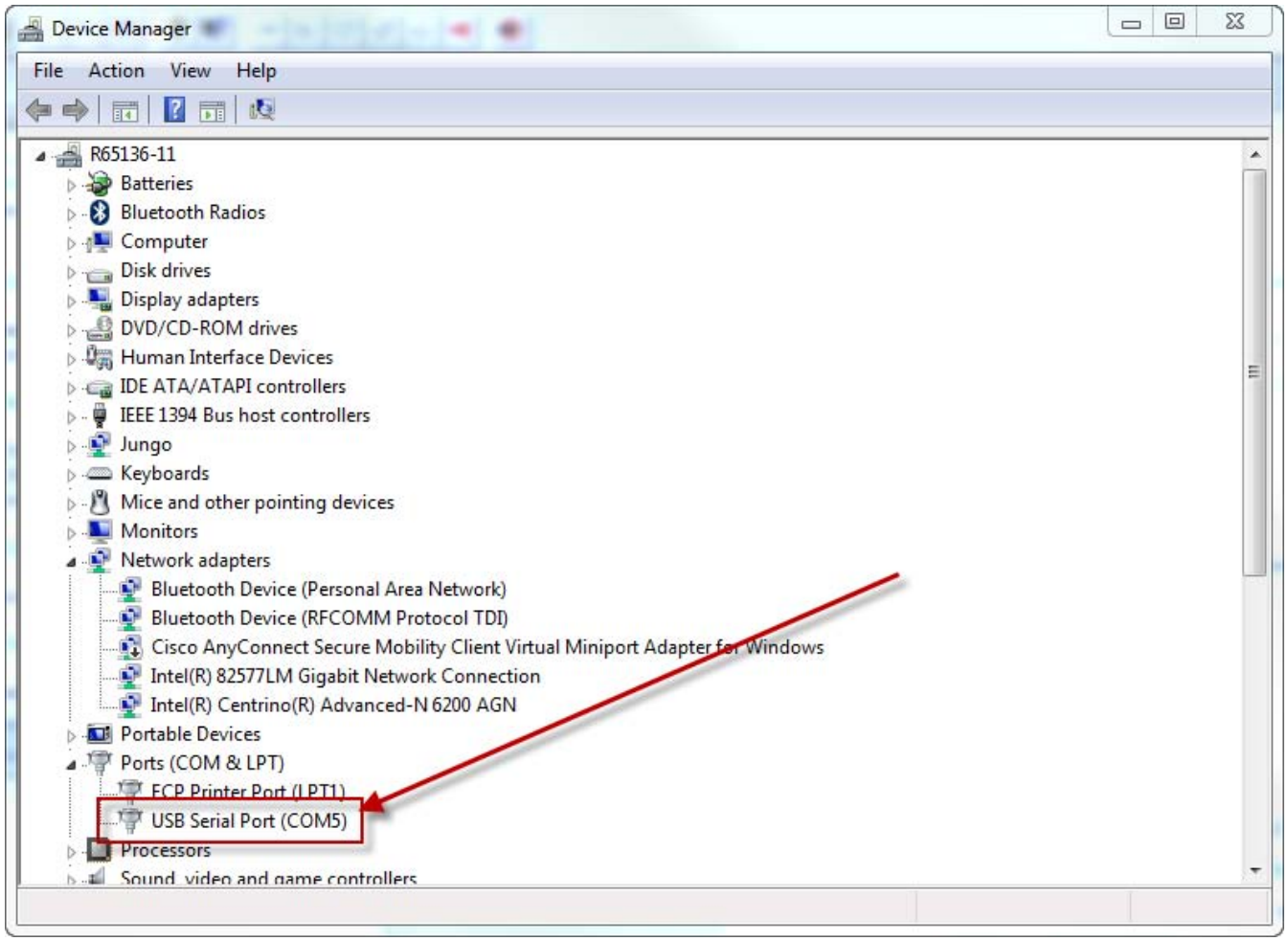


Figure 6. Device Manager

2. For the Port Settings, the following should be selected: Bits per second = 115200, Data bits = 8, Parity = None, Stop bits = 1, Flow control = None. Select Apply and then OK.

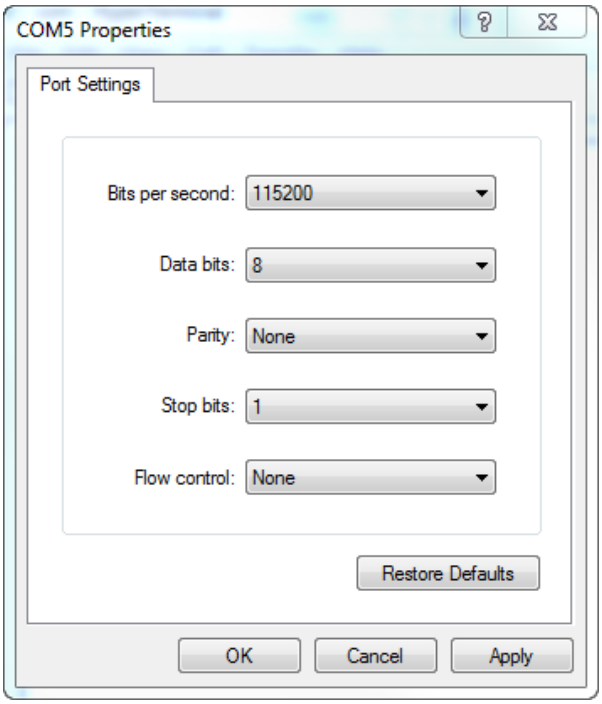


Figure 7. Port Settings configuration

3. In the terminal window, type any key. This will start the program. A message will appear if everything is configured correctly.

```
I

**  Freescale Semiconductor  **
**  MMA845xQ Driver          **
**  Using the MC9S08QE8      **
**                           **
**  Mar 28 2012    11:29:17  **

Data Flash JEDEC ID : Manf=BF Type=25 Capacity=4A : SST25VF032B

MMA8451Q :  OverSample = High Res    ODR = 12.5Hz    HP = 16Hz    Mode = 2g

MMA8451Q>
```

Figure 8. Driver program message

4. To get the menu of commands type in “? [Enter]”

```
Data Flash JEDEC ID : Manf=BF Type=25 Capacity=4A : SST25VF032B

MMA8451Q :  OverSample = High Res    ODR = 12.5Hz    HP = 16Hz    Mode = 2g

MMA8451Q>? List of MMA845x commands:
Mn        : Mode 1=Standby; 2=2g; 4=4g; 8=8g
On        : Oversampling 0=Normal; 1=LNLP; 2=HighRes; 3=LP
RO n      : ODR Hz 0=800; 1=400; 2=200; 3=100; 4=50; 5=12.5; 6=6.25; 7=1.56
RR xx     : Register xx Read
RW xx=nn  : Register xx Write value nn
RH n      : High Pass Filter  0 - 3, 4=off
RF        : Report ODR speed, HP Filter freq and Mode
C a       : XYZ data as signed counts: a=N Normal data; a=H HPF data
G a       : XYZ data as signed g's: a=N Normal data; a=H HPF data
S aa      : Stream XYZ:
          :  aa: CN=counts Normal, CH=counts HPF, GN=g's Normal, GH=g's HPF
I aa n    : Stream XYZ via Interrups
          :  aa: CN=counts Normal, CH=counts HPF, GN=g's Normal, GH=g's HPF
          :  n:  1=INT1; 2=INT2
F aa ww   : Stream XYZ via FIFO
          :  aa: CN=counts Normal, CH=counts HPF, GN=g's Normal, GH=g's HPF
          :  ww: Watermark= 1 to 31

MMA8451Q>
```

Figure 9. Menu Command List

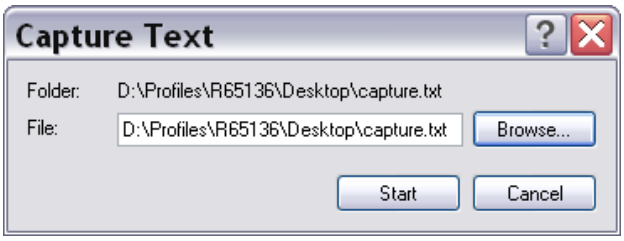
Table 2. Menu commands

Function:	PC to S08	S08 to PC	Notes/comments
Read XYZ as signed counts	CN (Normal Data) or CH (High-Pass Filter Data)	X = nn Y = nn Z = nn	Example of response: X = -250 Y = -126 Z = +968
Read XYZ as signed g's	GN (Normal Data) or GH (High-Pass Filter Data)	X = nng Y = nng Z = nng	Example of response: X = -0.1992g Y = -0.0577g Z = +0.9473g
Stream XYZ, polling	S aa: (aa: CN = counts Normal, CH = counts HPF, GN = g's Normal, GH = g's HPF)	X = nn Y = nn Z = nn, repeated	Example of response: X = -250 Y = -126 Z = +968, repeated.
Stream XYZ, interrupts	I aa n (aa: CN = counts Normal, CH = counts HPF, GN = g's Normal, GH = g's HPF n: 1 = INT1; 2 = INT2)	X = nn Y = nn Z = nn, repeated	Example of response: X = -250 Y = -126 Z = +968, repeated.
Stream XYZ, FIFO	F aa ww: (aa: CN = counts Normal, CH = counts HPF, GN = g's Normal, GH = g's HPF, ww: Watermark = 1 to 31)	FIFO Watermark Samples = x group = xx X = xx Y = xx Z = xx	Example of response: FIFO Watermark Samples = 3 group = 3B, repeated. X = -214 Y = -39 Z = +968 X = -216 Y = -40 Z = +967 X = -212 Y = -37 Z = +970

3 Capturing XYZ data

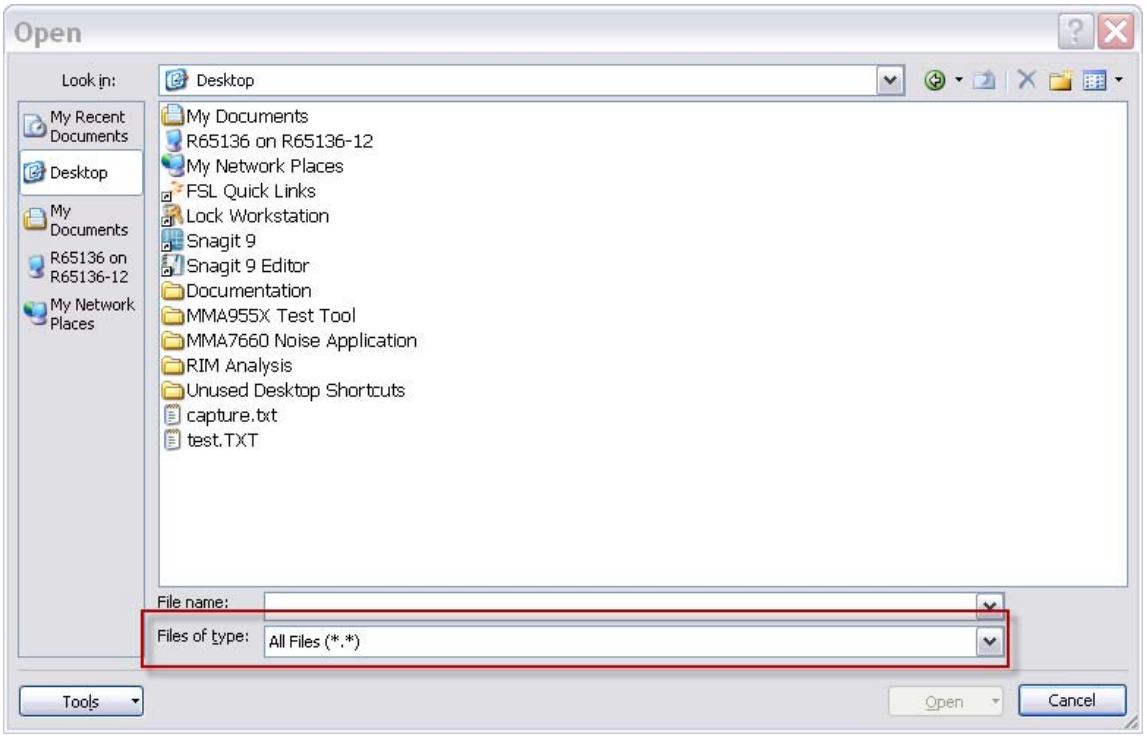
To assist in algorithm development or to check parameters of the sensor, the driver has the capability to stream XYZ data in both counts/g's. In order to capture the data for post processing, HyperTerminal has a "Capture Text" feature and Microsoft Excel can be used to view the data.

1. In HyperTerminal, select Transfer > Capture Text.
   The Capture Text box appears.
2. Select the Browse button and save the file to a known location. Then click the Start button.



3. Select one of the stream commands. The data will log.
4. Once a satisfactory amount of data has been collected, select Transfer > Capture Text > Stop
5. Open Microsoft Excel and locate and open the log file.

Note: If the file does not appear select the Files Of Type drop down menu and select All Files (*.*)



6. The Text Import Wizard will appear, select the Delimited option and select Next.
7. Select the Semicolon option and in Other type in "=". Then select Finish.
8. The data set will have 6 columns: X, X data, Y, Y data, Z, Z data

Table 3. X, X data, Y, Y data, Z, Z data

X	X data	Y	Y data	Z	Z data
X	-20	Y	181	Z	970
X	-22	Y	185	Z	972
X	-23	Y	183	Z	975
X	-22	Y	187	Z	970
X	-25	Y	181	Z	972
X	-21	Y	185	Z	969
X	-19	Y	183	Z	972
X	-19	Y	180	Z	968
X	-21	Y	186	Z	973
X	-22	Y	182	Z	970
X	-23	Y	183	Z	971
X	-17	Y	183	Z	969
X	-22	Y	181	Z	970
X	-19	Y	183	Z	971
X	-25	Y	183	Z	969
X	-20	Y	183	Z	968
X	-24	Y	184	Z	969
X	-23	Y	184	Z	969
X	-23	Y	183	Z	970
X	-22	Y	185	Z	969
X	-20	Y	184	Z	970
X	-24	Y	182	Z	968
X	-21	Y	180	Z	970
X	-22	Y	182	Z	973
X	-20	Y	183	Z	973
X	-22	Y	183	Z	972
X	-22	Y	184	Z	972
X	-21	Y	181	Z	970
X	-20	Y	181	Z	969
X	-25	Y	184	Z	971
X	-20	Y	182	Z	971
X	-23	Y	184	Z	970
X	-22	Y	181	Z	971
X	-21	Y	181	Z	969
X	-21	Y	184	Z	971
X	-20	Y	181	Z	971
X	-22	Y	184	Z	972
X	-24	Y	182	Z	970
X	-22	Y	181	Z	970
X	-22	Y	182	Z	971
X	-20	Y	183	Z	969
X	-26	Y	184	Z	970
X	-23	Y	182	Z	970

How to Reach Us:

Home Page:
www.freescale.com

Web Support:
http://www.freescale.com/support

AN4475
Rev 0
07/2012