Volume

1

A-WIT TECHNOLOGIES INC.

… a passion for execution …

CS425000 Accelerometer Reference Guide Manual

Version 1.0

A-WIT TECHNOLOGIES INC.

CS425000 Accelerometer Sensor Reference Manual

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Introduction to the CS425000 Accelerometer Sensor

The CS425000 is an accelerometer sensor module with a digital output. Application of industrial CMOS processes with a patented Micro-Electromechanical-System (MEMS) ensures the highest reliability and excellent long term stability. A 2-wire serial interface and internal voltage regulation allows easy and fast system integration with a C Stamp. The Sensor is compatible with the C Stamp microcomputer's supplies and signal levels.

Registering Your C Stamp or C Stamp Related Product

At A-WIT Technologies we respect your privacy; however, we do ask you to register your C Stamp or C Stamp related product, so you can receive free of charge product updates. The registration procedure is simple. Just send an e-mail to tech_support@a-wit.com with the word "REGISTRATION x" in the subject line, where "x" is the product number that you purchased. If you purchased more than one product, send an e-mail for each different product.

Introduction to the CS425000 Accelerometer Sensor

The CS425000 is an accelerometer sensor module with a digital output. It can sense gravitational (g) force of ±4g on all three axes (X, Y, and Z). Application of industrial CMOS processes with a patented Micro-Electromechanical-System (MEMS) ensures the highest reliability and excellent long term stability. A 2-wire serial interface and internal voltage regulation allows easy and fast system integration with a C Stamp. The Sensor is compatible with the C Stamp microcomputer's supplies and signal levels. The device includes a MEMS accelerometer that is seamlessly coupled to a 13-bit analog to

digital converter with a serial interface on the same module. This results in superior signal quality, a fast response time and insensitivity to external disturbances (EMC) at a very competitive price. The 2-wire serial interface and internal voltage regulation allows easy and fast system integration with a C Stamp. Its tiny size and low power consumption makes it the ultimate choice for even the most demanding applications. The Sensor is compatible with the C Stamp microcomputer's supplies and signal levels. Communicating with the Sensor is made easy with A-WIT's supplied software command ACCSIN. This simple one command interface is all that is required to setup and acquire from the sensor an acceleration vector in g's for each of the X, Y, and Z dimensions.

Technical Specifications

Measures ±4 g on any axis

High precision acceleration sensor with a resolution of 976 μg's

Uses MEMS (Micro Electro-Mechanical System) technology

Onboard regulator and high-resolution ADC for simple connection to the C Stamp

SPI communications and function driver ACCSIN command

Power Requirements: 5 VDC

Dimensions: 0.8 x 0.9 in (20.3 x 22.9 mm)

Operating Temperature: -40 to +185 °F (-40 to +85 °C)

Fully calibrated, digital output

Excellent long-term stability

No external components required

Fast response time

Ultra low power consumption

Small size

Automatic power down

Applications include any type of tilt, motion, and vibration sensing.

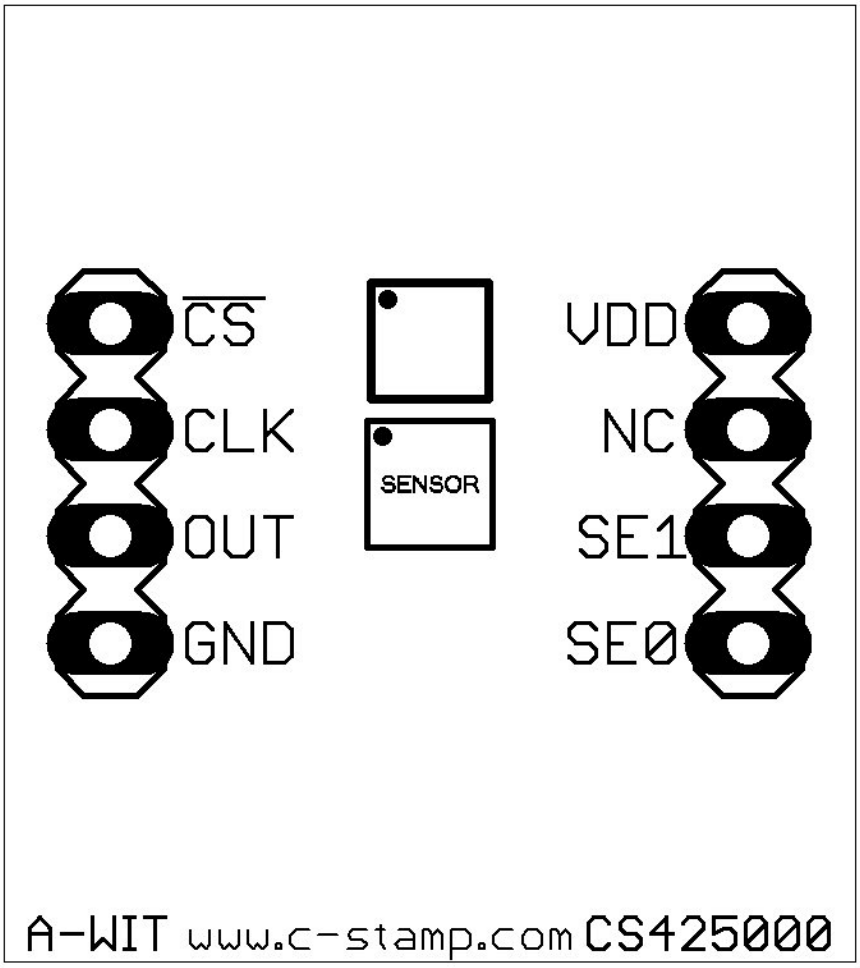
8-pin DIP package

Compact and breadboard-friendly

Compatible with C Stamp microcomputer

Detailed Pin Description

The figure below shows the pins arrangement of the CS425000, and the following table shown the Detailed Pin Description.



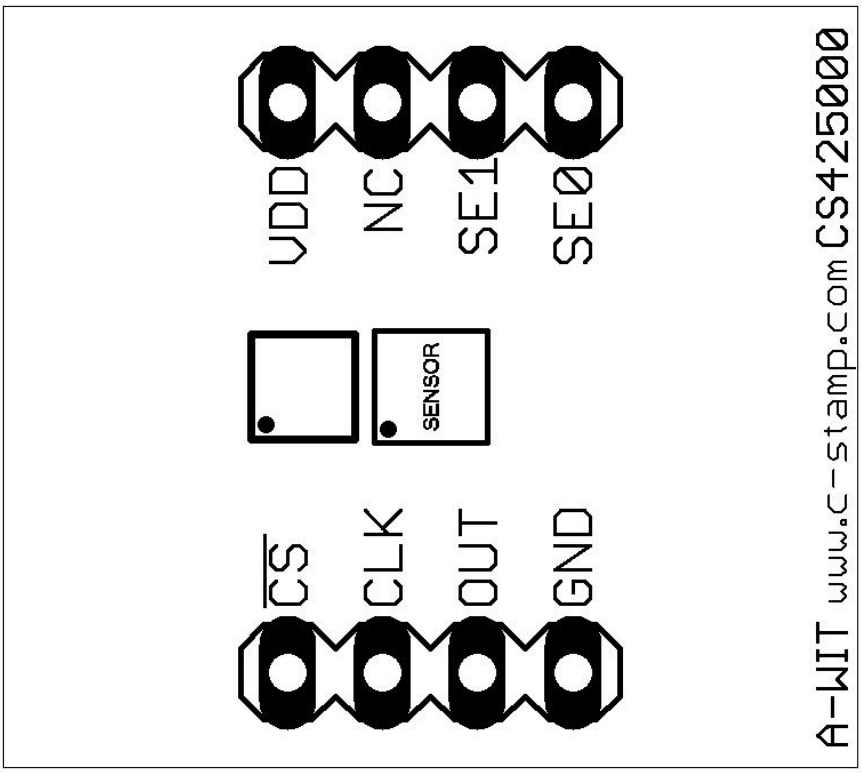
Accelerometer Sensor Pin-Out Connectivity		
Pin	***Symbol***	***Description***
1	$\overline{CS}$	Select input

Accelerometer Sensor Pin-Out Connectivity		
Pin	***Symbol***	***Description***
		Connect to any C Stamp I/O pin
2	CLK	Serial SPI clock input Connect to C Stamp pin 28
3	OUT	Serial SPI output data Connect to C Stamp pin 29
4	GND	Ground pin
5	SE0	Select input Connect to any C Stamp I/O pin
6	SE1	Select input Connect to any C Stamp I/O pin
7	NC	No Connect Do not connect
8	VDD	Supply 5 V

Polarity of the Acceleration Output

With the sensor module in the orientation shown in the figure below, the acceleration vector axes are as follows:

- x axis runs right to left with the left being the positive side
- y axis runs top to bottom with the bottom being the positive side
- z axis runs out of the page with the that direction being the positive side



If the sensor is accelerated into the indicated positive directions, the sensor will deliver a positive acceleration signal.

Chapter

2

Getting Started

This chapter is a quick start guide to using the CS425000 Accelerometer Sensor with the C Stamp. This assumes you have a C Stamp and an appropriate connection kit or development board with the RESET and START circuitry, and the Humidity Sensor properly connected to the C Stamp. You will also need a programming cable, power supply, PC running Windows® 2000/XP/Media, with a quantity of RAM recommended for the OS, sufficient free hard disk drive space for the software installations, CD-ROM drive, Internet access (recommended only), and available port compatible with your programming cable.

Notices

CONNECTION WITH THE SOFTWARE OR FIRMWARE OR THE USE OF OTHER DEALINGS IN THE SOFTWARE OR FIRMWARE.

Getting Support

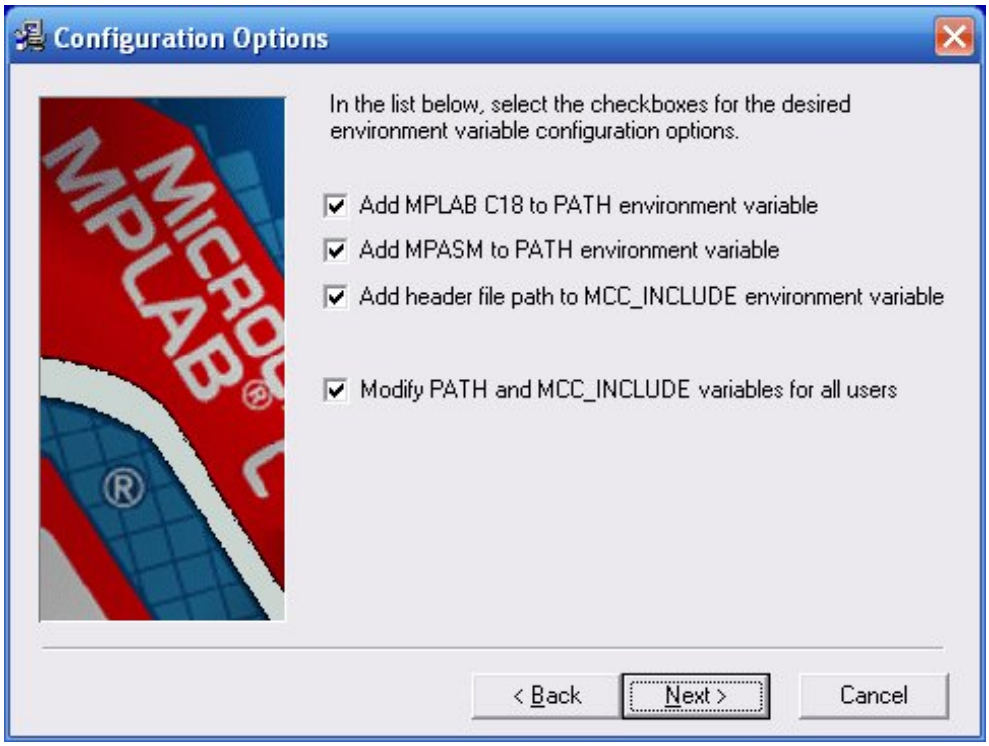
If possible, please check the C Stamp website www.c-stamp.com under SUPPORT for any updates to documentation, changes, or notices that may have become available since your Installation CD was produced. If you continue to have any issues for which a solution is not found in the aforementioned website, please e-mail tech_support@a-wit.com for help.

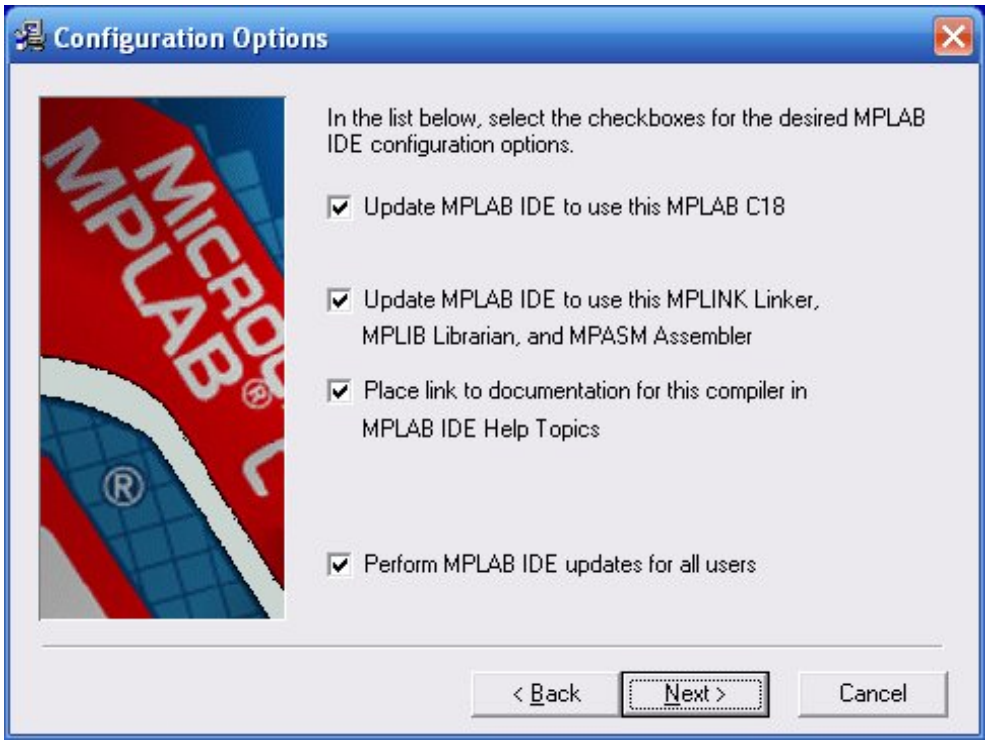
Installing the Microchip MPLAB and C Compiler Software

The first step is to install the Microchip MPLAB software that you will use to develop your programs.

Insert your A-WIT provided Installation CD in your CD drive. Go to the MPLAB directory in the CD and double click on the "MPLAB vX.XX Install" file in that directory. Follow the installation steps, prompts, and directions provided by the installer software, accepting all the default options.

After the MPLAB installation is complete, switch to the C18 directory in the CD, and double click on the file in that directory. Follow the installation steps, prompts, and directions provided by the installer software, accepting all the default options. The only exceptions to accepting all the default options is that on the 5th and 6th windows of the installation process for the C18 Compiler, you have to select everything as shown in the figures below. This will ensure that MPLAB is configured to use the C18 Compiler.


Configuration Options
In the list below, select the checkboxes for the desired environment variable configuration options.
Add MPLAB C18 to PATH environment variable
Add MPASM to PATH environment variable
Add header file path to MCC_INCLUDE environment variable
Modify PATH and MCC_INCLUDE variables for all users
< Back
Next >
Cancel


Configuration Options
In the list below, select the checkboxes for the desired MPLAB IDE configuration options.
Update MPLAB IDE to use this MPLAB C18
Update MPLAB IDE to use this MPLINK Linker, MPLIB Librarian, and MPASM Assembler
Place link to documentation for this compiler in MPLAB IDE Help Topics
Perform MPLAB IDE updates for all users
< Back
Next >
Cancel

Installing the A-WIT C Stamp Quick Programmer

To install the A-WIT C Stamp Quick Programmer, switch to the CSTAMPQP directory in the CD using Windows Explorer, and double click on the file in that directory. Follow the installation steps, prompts, and directions provided by the installer software, accepting all the default options.

Installing the USB Software

If you purchased a product with a USB download cable, make sure that the A-WIT provided CD is in the CD drive of your PC and insert the USB cable in the USB port of your PC. Windows auto detects the new USB device. If Windows prompts you to install drivers for the USB cable device, follow the installation steps, prompts, and directions provided by the installer software, accepting all the default options.

After the USB adapter has been installed, open a Windows Explorer window from the Accessories sub-menu in the Start menu, and right click on My Computer. Proceed to select Properties, and then select the Hardware tab. Click on the Device Manger button, and expand the Ports (COM & LPT) branch. Make a note of the COM port that has been assigned to the USB-to-Serial adapter. This is the port that should be selected in the C Stamp programmer software.

Setting Up the C Stamp Software Templates

To set up the C Stamp Software Templates, switch to the CSTAMP_Template directory in the CD using Windows Explorer, and double click on the file in that directory. Follow the installation steps, prompts, and directions provided by the installer software, accepting all the default options.

Documentation

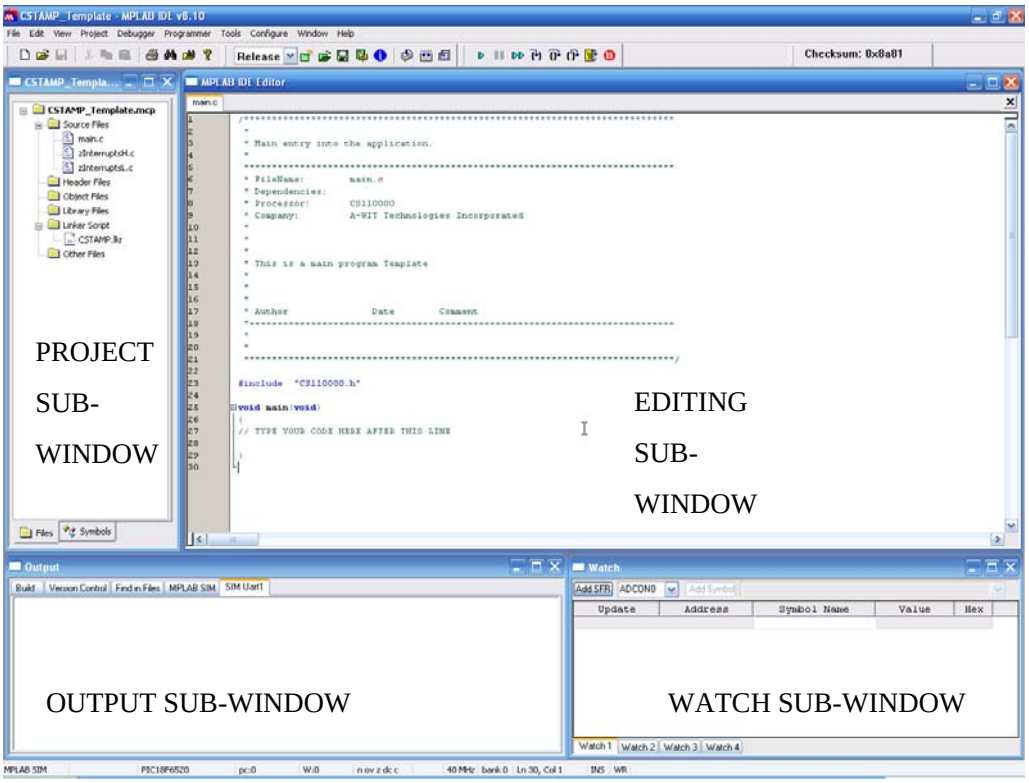
Copy the DOCS directory from the C Stamp Installation CD to your C:\A-WIT directory. This directory contains all the C Stamp related documentation in PDF format.

Creating your Accelerometer Sensor C Stamp Program

Create a directory where you want to have all the files for your program; for example ACCS_APP. We recommend making this directory under your C:\A-WIT directory, so you can have all your CSTAMP related files in one place.

Copy the all files in your C Stamp Software Templates directory C:\A-WIT\CSTAMP_Template to the directory you just made.

Open the Microchip MPLAB IDE application. As shown the following figure, the IDE has several sub-windows. Depending on the resolution of your screen, your sub-windows may have a different layout. However; you can move and resize these into the position that you want to fit your screen, and your layout for that particular project will get saved upon answering yes to the prompt of saving the workspace when you exit the software development environment.

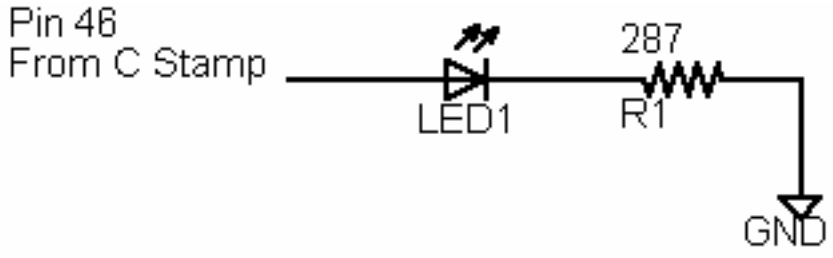


Go to the "File" menu to "Open Workspace…". Then navigate to your program directory, and open CSTAMP_Template.mcw.

Right click on CSTAMP_Template.mcp in the "Project" sub-window, and "Save as…" the name of your program project after you have navigated to your program directory. For example, your program project could be named "ACCS_APP". Now when you open the Microchip MPLAB IDE (Integrated Development Environment), and go to your program directory to open the workspace for your program, you will see a .mws file with the name of your program preceding it. This is the file that you should open any time you want to work on your program.

Double click on the main.c source and type the following code fragment where it is indicated. You can omit the comments for brevity, as they are written here to offer clarifications of what the code does. Do pay attention; however, to the indentation of the code blocks between curly brackets for loops, if statements, etc. Although indenting the code is not a requirement for the compiler to parse your code (i.e. any blank spaces are ignored by the compiler), it does help tremendously to make your code much more readable, and consequently, it makes finding any errors easier. Keywords and function names in the code fragment below are bolded.

After you START the C Stamp in user mode as explained in the "Downloading and Running Your Program" section (this will not be the RESET/BOOT/DOWNLOAD mode), the program will run. This program assumes that your Acceleration Sensor is correctly connected to the C Stamp with the clock pin connected to pin 28 and the data pin connected to pin 29, the $\overline{CS}$ pin connected to pin 1, SE0 connected to pin 4, and SE1 connected to pin 5. You will also need LEDs connected to the C Stamp at pins 46 through 39 each with a 287 Ω resistor as shown in the figure below for pin 46. If you are using the CS310X00 BOL, then the LED connections are available in the board already.



The table below shows the connections between the sensor and the C Stamp.

Accelerometer Sensor C Stamp Connectivity		
Pin	***Symbol***	***Description***

Accelerometer Sensor C Stamp Connectivity		
Pin	***Symbol***	***Description***
1	$\overline{CS}$	Select input Connect to pin 1
2	CLK	Serial SPI clock input Connect to C Stamp pin 28
3	OUT	Serial SPI output data Connect to C Stamp pin 29
4	GND	Ground pin
5	SE0	Select input Connect to pin 4
6	SE1	Select input Connect to pin 5
7	NC	No Connect Do not connect
8	VDD	Supply 5 V

If you hold the BOL upright in front of you, you will see the following LEDs turning on in response to the following motion or lack thereof, as shown in the table below.

BOL LEDs Response to Tilt/Position per the Example Program	
Tilt	***LEDs Response***
None BOL is straight and upright in front of you	All light up

BOL LEDs Response to Tilt/Position per the Example Program	
Tilt	***LEDs Response***
Rotate left (counter-clock-wise)	LEDs on, except 1 and 5
Rotate right (clock-wise)	LEDs on, except 4 and 8
Tilt forward (away from you)	LEDs on, except 2 and 3
Tilt backward (toward you)	LEDs on, except 6 and 7

The program executes indefinitely until you restart it by pushing and releasing the RESET button while holding the START button and then letting go of the latter.

```
// interface pins

  BYTE pins[] = {4, 8, 1};

  float acc[3];

// rotation and tilt thresholds in g's
  float GTL = -0.33; float GTR = 0.33;
  float GTB =  0.00; float GTF = 0.67;

  while(TRUE){
    ACCSIN_CS425000(acc, pins);

    if(acc[0] < GTL)
      {STPIND(43, HIGH); STPIND(39, HIGH);
       STPIND(46, LOW); STPIND(42, LOW);}
    else if(acc[0] > GTR)
      {STPIND(43, LOW); STPIND(39, LOW);
       STPIND(46, HIGH); STPIND(42, HIGH);}
    else
      {STPIND(43, HIGH); STPIND(39, HIGH);
       STPIND(46, HIGH); STPIND(42, HIGH);}

    if(acc[2] < GTB)
      {STPIND(45, HIGH); STPIND(44, HIGH);
       STPIND(41, LOW); STPIND(40, LOW);}
    else if(acc[2] > GTF)
      {STPIND(45, LOW); STPIND(44, LOW);
```

```
      STPIND(41, HIGH); STPIND(40, HIGH);}
  else
    {STPIND(45, HIGH); STPIND(44, HIGH);
     STPIND(41, HIGH); STPIND(40, HIGH);}
}
```

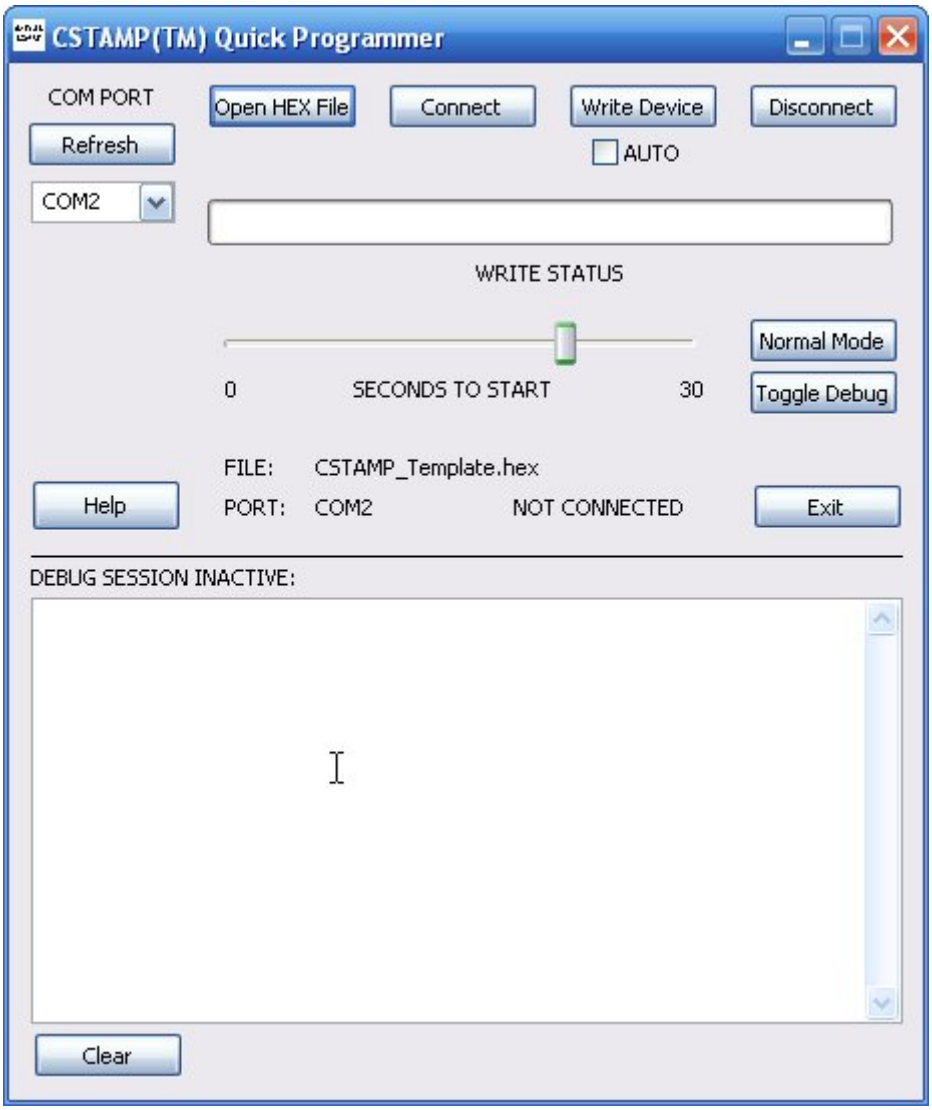
Save your program from the "File" menu or by clicking on the appropriate icon in the tool bar. Then "Build All" from the "Project" menu or from the tool bar.

If the code was typed correctly, you will have a file in your program directory with the name of your program project and a .HEX extension. An example is ACCS_APP.HEX. This is the file that you will download to the C Stamp, as explained up ahead.

If you get an error message or an indication that your program did not build successfully in the "Output" sub-window of the IDE, you probably have one or more syntax error(s). Double click on the line of the "Output" sub-window that mentions the error, and the program line that most likely contains the error will be indicated in the sub-window where you were editing your program. Correct as necessary, and "Build All" again until you get a successful .HEX file output.

Downloading and Running Your Program

Power up your KIT, and connect the KIT to the PC with the provided cable. Upon power up, the C Stamp will be in RESET/BOOT/DOWNLOAD mode. To go back to this mode at any time, just push and let go of the RESET button. Then open the A-WIT C Stamp Quick Programmer application shown in the next figure.



The first step is to choose the serial port that you are using from the drop-down menu. Then click on "Refresh", so that the program registers your selection. Your selection should show in the status area of the program next to "PORT:". Then click on "Open HEX File" and load/select the HEX file that you had previously created during the

development of your program. The status are should indicate that the file has been loaded successfully. This is what will be downloaded to the C Stamp. Then click on "Connect", and the PC will be connected to the KIT, and the status area should indicate so. To download the HEX file to the C Stamp, just click on "Write Device", and you should see the progress bar after a few seconds, as the HEX file is downloaded. At this point, you can click on "Disconnect" to disconnect the PC from the KIT, disconnect the serial cable from both the PC and the KIT, and start your program manually at the KIT. To do this just push and let go of the RESET button while pushing the START button. Then you can let go of the START button. Alternatively, you can click on "Normal Mode" to start your program from the PC. This will also disconnect the program/PC from the KIT. Then you can disconnect the serial cable from the PC and the KIT. You can also instruct the CSTAMP™ Quick Programmer to wait several seconds before starting your program from the PC and disconnecting by adjusting the "SECONDS TO START" slide. This feature is useful in case you want to keep the PC connected with the serial cable, but need time to manually set up something in a circuit that you have built. If this is not the case it can just be left at the default of "0", and your program will started from the PC right away. After you click "Normal Mode" and your program is started, the CSTAMP™ Quick Programmer will not be communicating with the C Stamp any longer, so if you want to reconnect, you must click on "Connect" again.

Chapter 3

Accessory Specific Functions and Commands Reference

This chapter describes the functions and commands that are specific to the software support of different types of accessories that are available from A-WIT Technologies to complement the function and projects developed with the C Stamp. The user should consult the manual for a specific accessory for full information on connectivity and usage.

ACCSIN_CS425000

`void ACCSIN_CS425000(float acc[], BYTE Spins[]);`

The **`ACCSIN`** function populates the **`acc`** array with the X, Y, and Z acceleration vector in g's sensed by the A-WIT accelerometer sensor CS425000. The clock and data lines of the sensor connect to the SPI clock and data in pins of the C Stamp. The select pins of the sensor can be connected to any C Stamp pins, and they are passed to the function in the **`Spins`** array. The **`acc`** array has the following order: **`acc[0]`** = X acceleration, **`acc[1]`** = Y acceleration, and **`acc[2]`** = Z acceleration. The select pins in the **`Spins`** array are expressed in this order: **`Spins[0]`** = SE0, **`Spins[1]`** = SE1, and **`Spins[2]`** = $\overline{CS}$.

`acc` is the name of the array of **`floats`** that the function will use as storage to return the acceleration vector to the calling function. This array must have three elements.

`Spins` is an array that defines the C Stamp pin numbers that connect to the select pins of the sensor. These pins are defined from the perspective of the sensor in this order: SE0, SE1, and $\overline{CS}$. The select pins can be connected to any C Stamp I/O pins. These pins will be set to output mode.

Terms & Conditions

Quality Assurance

A-WIT has stringent quality control procedures in place to insure the best quality products.

90-Day Limited Warranty

A-WIT Technologies, Inc warrants its products against defects in materials and workmanship for a period of 90 days. If you discover a defect, A-WIT Technologies, Inc. will, at its option, repair, replace, or refund the purchase price. After 90 days, products can still be sent in for repair or replacement, but there will be a $10.00USD minimum inspection/labor/repair fee (not including return shipping and handling charges).

14-Day Money-Back Guarantee

If, within 14 days of having received your product, you find that it does not suit your needs, you may return it for a refund. A-WIT will refund the purchase price of the product in the form of a check, excluding shipping/handling costs, once the product is received. This refund does not apply if the product has been altered or damaged. If you decide to return the products after the 14-day evaluation period, a 20% restocking fee will be charged against a credit.

Disclaimer

Warranty does not apply if the product has been altered, modified, or damaged. A-WIT makes no other warranty of any kind, expressed or implied, including any warranty of merchantability, fitness of the product for any particular purpose even if that purpose is known to A-WIT, or any warranty relating to patents, trademarks, copyrights or other intellectual property. A-WIT shall not be liable for any injury, loss, damage, or loss of profits resulting from the handling or use of the product shipped.

How to Return a Product

When returning, you must first e-mail sales@a-wit.com for a Return Merchandise Authorization number. No packages will be accepted without the RMA number clearly marked on the outside of the package. After inspecting and testing, we will return your product, or its replacement using the same shipping method used to ship the product to A-WIT within 30 days. In your package, please include a daytime telephone number and a brief explanation of the problem.

Please contact our Sales Department at sales@a-wit.com if you have any questions regarding our warranty policy or if you are requesting an RMA number.