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Chapter 1

Hierarchical Index

1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 2

Data Structure Index

2.1 Data Structures

Here are the data structures with brief descriptions:

Chapter 3

File Index

3.1 File List

Here is a list of all files with brief descriptions:

Chapter 4

Data Structure Documentation

4.1 Communicative Class Reference

A class to manage communication with slave module.

`#include <Communicative.h>`

Public Member Functions

- Communicative (const int CS)

  Constructor.
- ~Communicative (void)

  Destructor.
- bool isPeripheralConnected (void)

  Checks whether Slave is connected.
- sCmd RequestReply (const mCmd)

  Performs a complete transaction; expects Slave to Reply with sCmd object.
- Identity RequestIdentity (const mCmd)

  Performs a complete transaction; expects Slave to Reply with Identity object.
- Data RequestData (const mCmd)

  Performs a complete transaction; expects Slave to Reply with a Data object.

4.1.1 Detailed Description

A class to manage communication with slave module.

This class is designed for SPI communication with a slave device. The class responsibilities include both SPI initialisation and fundamental transactions. The transaction protocol implemented follows the following flow: Clear SS -> Send '?' to slave -> recieve 'ACK' (0x06) from slave -> send request mCmd -> recieve sCmd/Data/Identity as expected -> set SS. Where mCmd, sCmd, Data and Identity are structures defined as types.

4.1.2 Constructor & Destructor Documentation

4.1.2.1 Communicative()

```
Communicative (
            const int CS )
```

Constructor.

Constructor initialises the SS pin to be used in communications and initialises SPI as Master.

Parameters

CS	is the Slave Select pin designation; most commonly PA4.

See also

SPISetup()

4.1.2.2 ~Communicative()

```
~Communicative (
            void  )
```

Destructor.

Executes SPI.end();

4.1.3 Member Function Documentation

4.1.3.1 isPeripheralConnected()

```
bool isPeripheralConnected (
            void  )
```

Checks whether Slave is connected.

Executes a nop transaction.

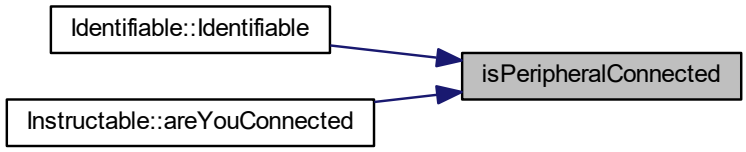
Returns

true if handshake is successful and Slave responds to '?' with 'ACK'

See also

areYouAlive()

Here is the caller graph for this function:



4.1.3.2 RequestData()

```
Data RequestData (
            const mCmd Request )
```

Performs a complete transaction; expects Slave to Reply with a Data object.

Executes a complete transaction: Clear SS -> Send '?' to slave -> recieve 'ACK' (0x06) from slave -> send request mCmd -> recieve Data -> set SS.

Parameters

mCmd	is the mCmd object which constitutes the Request made to the slave.

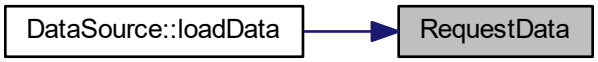
Returns

The Data object generated by the Slave containing a two dimensional array of data points and the length, headings and units of the data array rows.

See also

RequestReply(), RequestIdentity()

Here is the caller graph for this function:



4.1.3.3 RequestIdentity()

```
Identity RequestIdentity (
            const mCmd Request )
```

Performs a complete transaction; expects Slave to Reply with Identity object.

Executes a complete transaction: Clear SS -> Send '?' to slave -> recieve 'ACK' (0x06) from slave -> send request mCmd -> recieve Identity -> set SS.

Parameters

mCmd	is the mCmd object which constitutes the Request made to the slave.

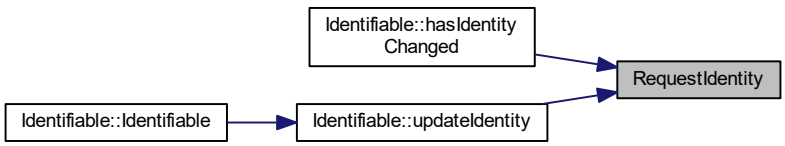
Returns

The Idenity object generated by the Slave containing the Slave ID and name.

See also

RequestReply(), RequestData()

Here is the caller graph for this function:



4.1.3.4 RequestReply()

```
sCmd RequestReply (
            const mCmd Request )
```

Performs a complete transaction; expects Slave to Reply with sCmd object.

Executes a complete transaction: Clear SS -> Send '?' to slave -> recieve 'ACK' (0x06) from slave -> send request mCmd -> recieve sCmd -> set SS.

Parameters

mCmd	is the mCmd object which constitutes the Request made to the slave.

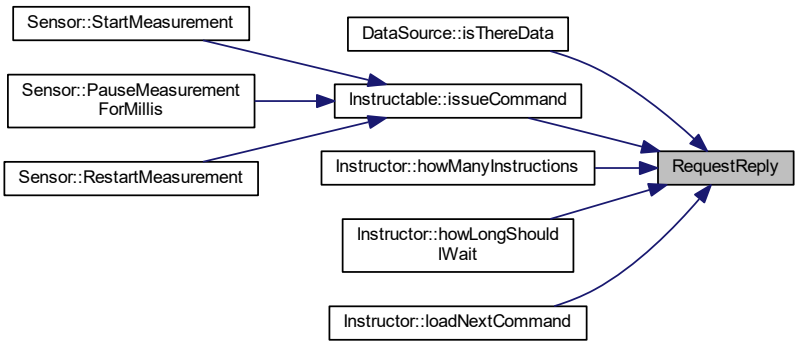
Returns

The sCmd object generated by the Slave as the reply to the request.

See also

RequestIdentity(), RequestData()

Here is the caller graph for this function:



The documentation for this class was generated from the following files:

- Communicative.h
- Communicative.cpp

4.2 Data Struct Reference

Type used to encapsulate the data collected by the slave.

`#include <SPI_InstructionSet.h>`

Public Member Functions

- Data & operator= (const volatile Data &rhs) volatile
- volatile Data & operator= (const Data &rhs) volatile

Data Fields

- int NumColumns [NUMBER_OF_DATA_ROWS]

  Number of data points currently stored in each row.
- int NumRows

  Number of rows. Defined at compilation.
- char RowHeadings [NUMBER_OF_DATA_ROWS][ROW_HEADING_LENGTH]

  String headings to describe the data in each row.
- char rowUnits [NUMBER_OF_DATA_ROWS][ROW_UNIT_LENGTH]

  String units to qualify the data in each row.
- float DataPoints [NUMBER_OF_DATA_ROWS][DATA_ROW_LENGTH]

  Two dimensional array of data. Each row generally treated as an independent vector.

4.2.1 Detailed Description

Type used to encapsulate the data collected by the slave.

Data is contained in a two dimensional array but generally modelled as a collection of 'vectors' or rows of data. Each row is allowed a variable number of data points, a string heading and a string unit.

4.2.2 Member Function Documentation

4.2.2.1 operator=() [1/2]

```
Data& operator= (
            const volatile Data & rhs ) volatile  [inline]
```

4.2.2.2 operator=() [2/2]

```
volatile Data& operator= (
            const Data & rhs ) volatile  [inline]
```

4.2.3 Field Documentation

4.2.3.1 DataPoints

```
float DataPoints[NUMBER_OF_DATA_ROWS][DATA_ROW_LENGTH]
```

Two dimensional array of data. Each row generally treated as an independent vector.

4.2.3.2 NumColumns

```
int NumColumns[NUMBER_OF_DATA_ROWS]
```

Number of data points currently stored in each row.

4.2.3.3 NumRows

```
int NumRows
```

Number of rows. Defined at compilation.

4.2.3.4 RowHeadings

```
char RowHeadings[NUMBER_OF_DATA_ROWS][ROW_HEADING_LENGTH]
```

String headings to describe the data in each row.

4.2.3.5 rowUnits

```
char rowUnits[NUMBER_OF_DATA_ROWS][ROW_UNIT_LENGTH]
```

String units to qualify the data in each row.

The documentation for this struct was generated from the following file:

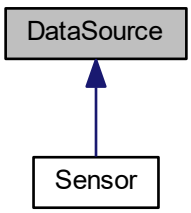
- SPI_InstructionSet.h

4.3 DataSource Class Reference

A class which models a Sensor/peripheral as an entity which is a source of data.

```
#include <DataSource.h>
```

Inheritance diagram for DataSource:



Public Member Functions

- DataSource (const int ChipSelect)

  Constructor.
- bool isThereData (void)

  Asks Sensor/peripheral whether there is Data ready to be collected.
- Data loadData (void)

  Loads Data from the Sensor.
- int getNumberOfDataColumns (const MeasurementVectors VectorNumber)

  Gets the number of data points along a particular row of the data array.
- int getNumberOfDataRows (void)

  Gets the number of rows used in the data array.
- void getRowHeadings (char[NUMBER_OF_DATA_ROWS][ROW_HEADING_LENGTH])

  Gets string headings of all the vectors in the data array.
- void getRowUnits (char[NUMBER_OF_DATA_ROWS][ROW_UNIT_LENGTH])

  Gets string units of all the vectors in the data array.
- void getDataArray (float[NUMBER_OF_DATA_ROWS][DATA_ROW_LENGTH])

  Gets the entire data array.
- void getDataVector (const MeasurementVectors VectorNumber, float[DATA_ROW_LENGTH])

  Gets the indicated data vector.
- int getVectorLength (const MeasurementVectors VectorNumber)

  Gets the indicated data vector length.
- void getVectorHeading (const MeasurementVectors VectorNumber, char[ROW_HEADING_LENGTH])

  Gets the string heading for the vector in question.
- void getVectorUnits (const MeasurementVectors VectorNumber, char[ROW_UNIT_LENGTH])

  Gets the string units for the vector in question.
- float getValueOne (void)

  Gets the first data point in the first vector.
- float getValueTwo (void)

  Gets the second data point in the first vector.
- float getValueThree (void)

  Gets the third data point in the first vector.

4.3.1 Detailed Description

A class which models a Sensor/peripheral as an entity which is a source of data.

This class models a Sensor as a source of data. The convention in use is that any Sensor can store data such that it occupies a two dimensional float array with maximum dimensions NUMBER_OF_DATA_ROWS x DATA_RO↩ W_LENGTH. The data can either be treated as a square array, the dimensions of which can be requested, or as a series of 'vectors', the length of which can be requested.

4.3.2 Constructor & Destructor Documentation

4.3.2.1 DataSource()

```
DataSource (
            const int ChipSelect )
```

Constructor.

Parameters

ChipSelect	is the Slave Select pin of the SPI peripheral in question.

4.3.3 Member Function Documentation

4.3.3.1 getDataArray()

```
void getDataArray (
            float DataVals[NUMBER_OF_DATA_ROWS][DATA_ROW_LENGTH] )
```

Gets the entire data array.

Retrieves the entire two dimensionsal data array, irrespective of which elements/vectors are actually in use.

Parameters

float	is the array into which the data is written.

See also

Data

4.3.3.2 getDataVector()

```
void getDataVector (
            const MeasurementVectors VectorNumber,
            float DataVect[DATA_ROW_LENGTH] )
```

Gets the indicated data vector.

Retrieves a singel row in the two dimesnional data array.

Parameters

VectorNumber	is the row in the data array to be retrieved.
float	is the floating point array into which the data points will be written.

See also

Data, MeasurementVectors

4.3.3.3 getNumberOfDataColumns()

```
int getNumberOfDataColumns (
            const MeasurementVectors VectorNumber )
```

Gets the number of data points along a particular row of the data array.

Parameters

VectorNumber	is an enumerated type referring to the row in the two dimensional data array.

Returns

The number of data points along a particular row/vector.

See also

MeasurementVectors, Data

4.3.3.4 getNumberOfDataRows()

```
int getNumberOfDataRows (
            void  )
```

Gets the number of rows used in the data array.

Returns the number of 'vectors' (rows) which the sensor has used to store data. Ideally, one should utilise the result of this function to iterate through the vectors.

Returns

The number of vectors in use.

See also

Data

4.3.3.5 getRowHeadings()

```
void getRowHeadings (
            char Headings[NUMBER_OF_DATA_ROWS][ROW_HEADING_LENGTH] )
```

Gets string headings of all the vectors in the data array.

Each vector/row is assigned a heading to describe the nature of the data contained within that vector. Such as "Ambient Temperature".

Parameters

char	is the array of character arrays into which the headings are loaded.

See also

Data

4.3.3.6 getRowUnits()

```
void getRowUnits (
            char Units[NUMBER_OF_DATA_ROWS][ROW_UNIT_LENGTH] )
```

Gets string units of all the vectors in the data array.

Each vector/row is assigned a Units string to define the units of the data contained within that vector. Such as "V" or "Amperes".

Parameters

char	is the array of character arrays into which the units are loaded.

See also

Data

4.3.3.7 getValueOne()

```
float getValueOne (
            void  )
```

Gets the first data point in the first vector.

Returns

The first data point in the first vector. DataArray[0][0].

See also

Data, MeasurementVectors

4.3.3.8 getValueThree()

```
float getValueThree (
            void  )
```

Gets the third data point in the first vector.

Returns

The third data point in the first vector. DataArray[2][0].

See also

Data, MeasurementVectors

4.3.3.9 getValueTwo()

```
float getValueTwo (
            void  )
```

Gets the second data point in the first vector.

Returns

The second data point in the first vector. DataArray[1][0].

See also

Data, MeasurementVectors

4.3.3.10 getVectorHeading()

```
void getVectorHeading (
            const MeasurementVectors VectorNumber,
            char Heading[ROW_HEADING_LENGTH] )
```

Gets the string heading for the vector in question.

Parameters

VectorNumber	is the row in the data array to which the heading coresponds.

See also

getRowHeadings(), Data, MeasurementVectors

4.3.3.11 getVectorLength()

```
int getVectorLength (
            const MeasurementVectors VectorNumber )
```

Gets the indicated data vector length.

The data vectors (rows) have a max length of DATA_ROW_LENGTH and the Sensor will push data points into said vector. As the Sensor may not utilise the entire width of the data array, the length indicates the number of values which the Sensor has pushed into the vector in question.

Parameters

VectorNumber	is the row in the data array.

See also

Data, MeasurementVectors

4.3.3.12 getVectorUnits()

```
void getVectorUnits (
            const MeasurementVectors VectorNumber,
            char Units[ROW_UNIT_LENGTH] )
```

Gets the string units for the vector in question.

Parameters

VectorNumber	is the row in the data array to which the heading coresponds.

See also

getRowUnits(), Data, MeasurementVectors

4.3.3.13 isThereData()

```
bool isThereData (
            void  )
```

Asks Sensor/peripheral whether there is Data ready to be collected.

Asks the sensor whether the data is ready to be retrieved by the master. Slave's are, however, required to instantiate a Data object and so premature loads thereof will not fail.

Returns

True if the data is ready to be collected from the Sensor.

Here is the call graph for this function:

4.3.3.14 loadData()

```
Data loadData (
             void  )
```

Loads Data from the Sensor.

Loads the Data object from the Sensor into local memory.

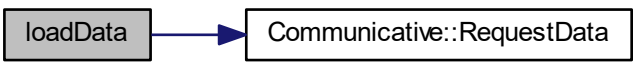
Returns

The Data object loaded into local memory. User of accessors preffered.

See also

getNumberOfDataColumns(), getNumberOfDataRows(), getRowHeadings(), getRowUnits(), getDataArray(), getDataVector(), getVectorLength(), getVectorHeading(),getVectorUnits(), getValueOne(),getValueTwo(),getValueThree()

Here is the call graph for this function:



The documentation for this class was generated from the following files:

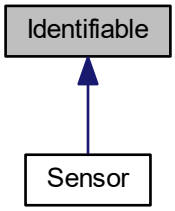
- DataSource.h
- DataSource.cpp

4.4 Identifiable Class Reference

A class which models a Sensor/peripheral as an identifiable entity.

`#include <Identifiable.h>`

Inheritance diagram for Identifiable:



Public Member Functions

- Identifiable (const int ChipSelect)
  A constructor.
- bool hasIdentityChanged (void)
  Checks to seee whether the Identity in local memory is different to the Identity advertised by peripheral.
- void updateIdentity (void)
  Loads the Identity advertised by the peripheral into local memory.
- int getIDNumber (void)
  Gets the identity number of the attached peripheral.
- void getSensorName (char name[IDENTITY_SENSOR_NAME_LENGTH])
  Gets the sensor name of the attached peripheral.

4.4.1 Detailed Description

A class which models a Sensor/peripheral as an identifiable entity.

This class models a peripheral as an identifiable entity with ID number and string name. The class allows for the identity to be loaded from the peripheral and interrogated.

4.4.2 Constructor & Destructor Documentation

4.4.2.1 Identifiable()

```
Identifiable (
            const int ChipSelect )
```

A constructor.

Constructor for class which loads the identity of any connected SPI peripheral into local memory.

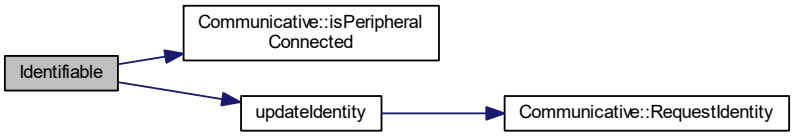
Parameters

The	Slave Select pin of the SPI peripheral in question.

See also

updateIdentity.

Here is the call graph for this function:



4.4.3 Member Function Documentation

4.4.3.1 getIDNumber()

```
int getIDNumber (
            void  )
```

Gets the identity number of the attached peripheral.

Reports the identity number of the peripheral currently stored in local memory.

Returns

The sensor ID number.

4.4.3.2 getSensorName()

```
void getSensorName (
            char name[IDENTITY_SENSOR_NAME_LENGTH] )
```

Gets the sensor name of the attached peripheral.

Reports the sensor name of the peripheral currently stored in local memory.

Parameters

name	is the character array into which the sensor name is loaded.

4.4.3.3 hasIdentityChanged()

```
bool hasIdentityChanged (
            void  )
```

Checks to seee whether the Identity in local memory is different to the Identity advertised by peripheral.

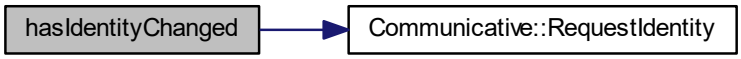
Returns

True if the stored Identity is different than the Identity advertised by the peripheral.

See also

Identity

Here is the call graph for this function:



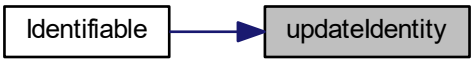
4.4.3.4 updateIdentity()

```
void updateIdentity (
            void  )
```

Loads the Identity advertised by the peripheral into local memory.

Here is the call graph for this function:

Here is the caller graph for this function:



The documentation for this class was generated from the following files:

- Identifiable.h
- Identifiable.cpp

4.5 Identity Struct Reference

Type used to convey the Slave identity.

`#include <SPI_InstructionSet.h>`

Public Member Functions

- Identity & operator= (const volatile Identity &rhs) volatile
- volatile Identity & operator= (const Identity &rhs) volatile

Data Fields

- char SensorName [IDENTITY_SENSOR_NAME_LENGTH]

  String name of the slave. Used for informative reporting to user.
- int sensorID

  Single byte identitfication number.
- int sensorChipSelect

  SPI chip select of the peripheral in question. Used by slave, but used by Master.

4.5.1 Detailed Description

Type used to convey the Slave identity.

4.5.2 Member Function Documentation

4.5.2.1 operator=() [1/2]

```
Identity& operator= (
            const volatile Identity & rhs ) volatile  [inline]
```

4.5.2.2 operator=() [2/2]

```
volatile Identity& operator= (
            const Identity & rhs ) volatile  [inline]
```

4.5.3 Field Documentation

4.5.3.1 sensorChipSelect

```
int sensorChipSelect
```

SPI chip select of the peripheral in question. Used by slave, but used by Master.

4.5.3.2 sensorID

```
int sensorID
```

Single byte identitfication number.

4.5.3.3 SensorName

```
char SensorName[IDENTITY_SENSOR_NAME_LENGTH]
```

String name of the slave. Used for informative reporting to user.

The documentation for this struct was generated from the following file:

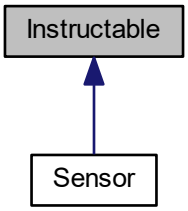
- SPI_InstructionSet.h

4.6 Instructable Class Reference

A class which models a Sensor/peripheral as entity which can recieve commands.

`#include <Instructable.h>`

Inheritance diagram for Instructable:



Public Member Functions

- Instructable (const int ChipSelect)
  A constructor.
- bool issueCommand (mInstruct)
  Issues a command to the peripheral.
- bool issueCommand (mInstruct, int)
  Issues a command to the peripheral.
- bool issueCommand (mInstruct, float)
  Issues a command to the peripheral.
- bool issueCommand (mInstruct, int, float)
  Issues a command to the peripheral.
- bool areYouConnected (void)
  Checks to see whether the peripheral is connected.

4.6.1 Detailed Description

A class which models a Sensor/peripheral as entity which can recieve commands.

This class models a peripheral as an entity which can be issued commands. The commands issued are elements of the set defined by the mInstruct type. Each instruction can be accompanied by and integer and/or float as required to act as parameters to qualify the command. For example, if the peripheral is commanded to pause for an interval, the integer parameter is used by the peripheral to determine the length of time for which to pause.

4.6.2 Constructor & Destructor Documentation

4.6.2.1 Instructable()

```
Instructable (
            const int ChipSelect )
```

A constructor.

Parameters

The	Slave Select pin of the SPI peripheral in question.

4.6.3 Member Function Documentation

4.6.3.1 areYouConnected()

```
bool areYouConnected (
            void  )
```

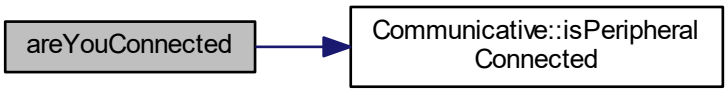
Checks to see whether the peripheral is connected.

Initiates handshake and nop transaction with the sensor to ensure that it is connected and responding appropriately.

Returns

True if the peripheral is connected and communicating effectively.

Here is the call graph for this function:



4.6.3.2 issueCommand() [1/4]

```
bool issueCommand (
            mInstruct Command )
```

Issues a command to the peripheral.

Sends a command which is an element of the mInstruct type.

Parameters

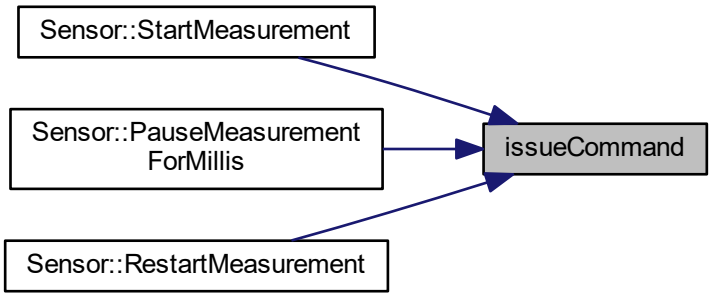
mInstruct	is the command issued to the peripheral.

Returns

True if the peripheral acknowledges the command.

Here is the call graph for this function:

Here is the caller graph for this function:



4.6.3.3 issueCommand() [2/4]

```
bool issueCommand (
            mInstruct Command,
            int intParam )
```

Issues a command to the peripheral.

Sends a command which is an element of the mInstruct type qualified by an integer parameter (generally used to instruct on wait time or similar).

Parameters

mInstruct	is the command issued to the peripheral and int is the integer qualifier.

Returns

True if the peripheral acknowledges the command.

Here is the call graph for this function:

4.6.3.4 issueCommand() [3/4]

```
bool issueCommand (
            mInstruct Command,
            float floatParam )
```

Issues a command to the peripheral.

Sends a command which is an element of the mInstruct type qualified by a float parameter.

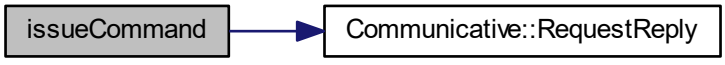
Parameters

mInstruct	is the command issued to the peripheral and float is the floating point qualifier.

Returns

True if the peripheral acknowledges the command.

Here is the call graph for this function:



4.6.3.5 issueCommand() [4/4]

```
bool issueCommand (
              mInstruct Command,
              int intParam,
              float floatParam )
```

Issues a command to the peripheral.

Sends a command which is an element of the mInstruct type qualified by an integer parameter (generally used to instruct on wait time or similar) and a floating point parameter.

Parameters

mInstruct	is the command issued to the peripheral, int is the integer qualifier and float is the floating point qualifier.

Returns

True if the peripheral acknowledges the command.

Here is the call graph for this function:

The documentation for this class was generated from the following files:

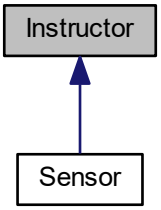
- Instructable.h
- Instructable.cpp

4.7 Instructor Class Reference

A class which models a Sensor/peripheral as entity which can issue instructions to the master.

```
#include <Instructor.h>
```

Inheritance diagram for Instructor:



Public Member Functions

- Instructor (const int ChipSelect)

  Constructor.
- int howManyInstructions (void)

  Asks the Sensor how many instructions there are in a measurement cycle.
- int howLongShouldIWait (void)

  Asks the sensor how long the master should pause for. Deprecated.
- void loadNextCommand (void)

  Fetches the next instruction issued by the sensor in its instruction cycle.
- void getCurrentCommandString (char[SLAVE_COMMMAND_STRING_LENGTH])

  Returns the character array which qualifies the instruction currently loaded into local memory as issued by the Sensor.
- int getCurrentCommandInt (void)

  Returns the integer which qualifies the instruction currently loaded into local memory as issued by the Sensor.
- float getCurrentCommandFloat (void)

  Returns the float which qualifies the instruction currently loaded into local memory as issued by the Sensor.
- sInstruct getCurrentCommandInstruction (void)

  Returns the sinstruct object which defines the instruction currently loaded into local memory as issued by the Sensor.

4.7.1 Detailed Description

A class which models a Sensor/peripheral as entity which can issue instructions to the master.

This class models a peripheral as an entity which can issue commands to the master. The premise is that a sensor peripheral will conduct a measurement by cycling through a number of steps. At each step the sensor may wish for the Master to perform certain actions, such as display a message to the user, pause for a certain period of time or wait until the user has acknowledged an instruction by button press. In general, the master is expected to iterate through the instruction set, loading an instruction each iteration and repsonding appropriately. i.e. follow the procedure: howManyInstructions()->start loop->loadNextCommand()->React to command->repeat until all instructions have been processed.

4.7.2 Constructor & Destructor Documentation

4.7.2.1 Instructor()

```
Instructor (
            const int ChipSelect )
```

Constructor.

Parameters

ChipSelect	is the Slave Select pin of the SPI peripheral in question.

4.7.3 Member Function Documentation

4.7.3.1 getCurrentCommandFloat()

```
float getCurrentCommandFloat (
            void  )
```

Returns the float which qualifies the instruction currently loaded into local memory as issued by the Sensor.

The float which qualifies the instruction issued by the sensor is generally used to either augment the information displayed to the user to instruct the master as to how it should carry out the request of the slave.

4.7.3.2 getCurrentCommandInstruction()

```
sInstruct getCurrentCommandInstruction (
            void  )
```

Returns the sinstruct object which defines the instruction currently loaded into local memory as issued by the Sensor.

Elements of the sInstruct type define all the potential instructions which can be issued by a Slave.

Returns

The instruction issued by the slave.

4.7.3.3 getCurrentCommandInt()

```
int getCurrentCommandInt (
            void  )
```

Returns the integer which qualifies the instruction currently loaded into local memory as issued by the Sensor.

The integer which qualifies the instruction issued by the sensor is generally used to either augment the information displayed to the user to instruct the master as to how it should carry out the request of the slave, such as how long to pasue for.

Returns

The integer which qualifies the instruction.

4.7.3.4 getCurrentCommandString()

```
void getCurrentCommandString (
            char Instruction[SLAVE_COMMMAND_STRING_LENGTH] )
```

Returns the character array which qualifies the instruction currently loaded into local memory as issued by the Sensor.

The character array (string) issued by the Sensor is generally intended to be displayed to the user, to update the user on the progress of the measurement procedure or instruct the user on the next step in the measurement procedure, such as inserting the probe into the measurement environment.

Parameters

char	is the character array into which the instruction string is loaded.

4.7.3.5 howLongShouldIWait()

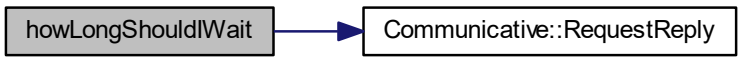
```
int howLongShouldIWait (
            void  )
```

Asks the sensor how long the master should pause for. Deprecated.

Returns

The duration, in milliseconds, the master should pause for.

Here is the call graph for this function:



4.7.3.6 howManyInstructions()

```
int howManyInstructions (
            void  )
```

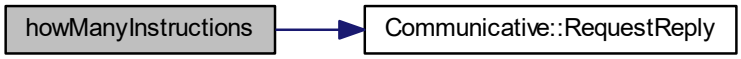
Asks the Sensor how many instructions there are in a measurement cycle.

In general, the master is expected to iterate through the instrcution set.

Returns

The number of instructions in a measurement cycle.

Here is the call graph for this function:

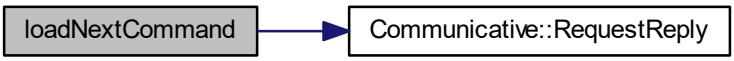


4.7.3.7 loadNextCommand()

```
void loadNextCommand (
             void  )
```

Fetches the next instruction issued by the sensor in its instruction cycle.

Fetches the next instruction from the Sensor and loads it into local memory. Instructions are issued in the sCmd type and are therefore consititute an element of the sInstruct instruction set, qualified by a character array (string), integer and float. Here is the call graph for this function:



The documentation for this class was generated from the following files:

- Instructor.h
- Instructor.cpp

4.8 Master Class Reference

A monolithic class to encapsulate and abstract the slave's communication with the master.

```
#include <Master.h>
```

Public Member Functions

- Master (const int SensorIDNumber, const char SensorName[ ], const char InstructionSet[ ][SLAVE_COMMMAND_STRING_LEN const int NumberOfInstructions, const sInstruct MasterInstructionSet[ ], const int intParams[ ], const float floatParams[ ])
- Master (void)
- ~Master (void)
- Master (volatile const Master &)
- volatile Master & operator= (const Master &rhs) volatile
- volatile Master & operator= (volatile const Master &rhs) volatile
- void SETUP (const int SensorIDNumber, volatile char SensorName[ ], volatile char Instruction↩ Set[ ][SLAVE_COMMMAND_STRING_LENGTH], const int NumberOfInstructions, volatile sInstruct Master↩ InstructionSet[ ], volatile int intParams[ ], volatile float floatParams[ ]) volatile

  Set up of the commuication mechanism.
- void SPISetup (void) volatile

  Sets up SPI and attaches interrupt.
- bool Handshake (void) volatile

  Manages the handshake component of any transaction.
- mCmd loadRequest (void) volatile

  Retrieve the request sent by the master.
- mInstruct getCurrentInstruction (void) volatile

  Returns the mInstruct component of the most recently loaded request sent by the master.
- int getCurrentInstructionIntParameter (void) volatile

  Returns the integer parameter of the most recently loaded request sent by the master.
- float getCurrentInstructionFloatParameter (void) volatile

  Returns the floating point parameter of the most recently loaded request sent by the master.
- void sendReply (const sCmd Reply) volatile

  Send an sCmd object in reply to the request recieved from Master.
- void sendReply (const sInstruct Instruction) volatile

  Send a reply to the request recieved from master.
- void sendReply (const sInstruct Instruction, volatile char InstructionString[SLAVE_COMMMAND_STRING_LENGTH]) volatile

  Send a reply to the request recieved from master.
- void sendReply (const sInstruct Instruction, const int iParam) volatile

  Send a reply to the request recieved from master.
- void sendReply (const sInstruct Instruction, const float fParam) volatile

  Send a reply to the request recieved from master.
- void sendReply (const sInstruct Instruction, const int iParam, const int fParam) volatile

  Send a reply to the request recieved from master.
- void sendReply (sInstruct Instruction, int iParam, volatile char InstructionString[SLAVE_COMMMAND_STRING_LENGTH]) volatile

  Send a reply to the request recieved from master.
- void sendReply (sInstruct Instruction, float fParam, volatile char InstructionString[SLAVE_COMMMAND_STRING_LENGTH]) volatile

  Send a reply to the request recieved from master.
- void sendReply (sInstruct Instruction, int iParam, float fParam, volatile char InstructionString[SLAVE_COMMMAND_STRING_LE volatile

  Send a reply to the request recieved from master.
- void sendData (void) volatile

  Sends the local Data object to the master in reply to appropriate request.
- void sendIdentity (void) volatile

  Sends slave Identity object to the master in reply to appropriate request.

- bool PushMeasurementVector (const MeasurementVectors VectorNumber, const float Measurement) volatile

  Pushes a data point onto one of the data vectors.
- bool PopMeasurementVector (MeasurementVectors VectorNumber) volatile

  Pops a data point from the tail end of a designated vector.
- void ClearMeasurementVector (MeasurementVectors VectorNumber) volatile

  Clears all data points from a particular vector.
- void setMeasurementVectorHeading (MeasurementVectors VectorNumber, volatile char Heading[ROW_HEADING_LENGTH]) volatile

  Sets the string heading assigned to a paritcular data vector.
- void setMeasurementVectorUnits (MeasurementVectors VectorNumber, volatile char Units[ROW_UNIT_LENGTH]) volatile

  Sets the string Units assigned to a paritcular data vector.
- bool isThereData (void) volatile

  Checks to see whether any data has been pushed to any of the data vectors locally.
- void sendTotalNumOfInstructions (void) volatile

  Sends a reply to Master specifiying the total number of instructions in a measurement procedure.
- int getCurrentInstructionNumber (void) volatile

  Gets the value of the counter which tracks the current instruction number throughout the measurement procedure.
- bool sendNextUserInstruction (void) volatile

  Sends the next instruction in the measurement cycle to the master.
- void resendCurrentUserInstruction (void) volatile

  Resends the cuurent instruction in the measurement procedure to the master.
- void restartUserInstructionCycle (void) volatile

  Restarts the measurement prcedure.
- void beginMeasurement (void) volatile

  Updates state to indicate that Master has requested the intitiation of the measurement procedure.
- bool shallIStart (void) volatile

  Checks whether the beginMeasurement() method has been called.

4.8.1 Detailed Description

A monolithic class to encapsulate and abstract the slave's communication with the master.

A single transaction is characterised by the following flow of control: Clear SS -> Enter IRQ -> Recieve '?' from master -> send 'ACK' (0x06) to master -> recieve request mCmd -> send sCmd/Data/Identity as expected -> exit IRQ. Where mCmd, sCmd, Data and Identity are structures defined as types. The intial Recieve '?' -> send 'ACK' is known as the handshake. This class' responsibilities include intitialising and handling the SPI, attaching the interrupt and providing the IRQ, managing the handshake and encapsulating the reponse mechanism. Note the use of a volatile interface to allow for safe use of the interrupt.

4.8.2 Constructor & Destructor Documentation

4.8.2.1 Master() [1/3]

```
Master (
            const int SensorIDNumber,
            const char SensorName[],
            const char InstructionSet[][SLAVE_COMMMAND_STRING_LENGTH],
            const int NumberOfInstructions,
            const sInstruct MasterInstructionSet[],
            const int intParams[],
            const float floatParams[] )
```

4.8.2.2 Master() [2/3]

```
Master (
            void  )
```

4.8.2.3 ~Master()

```
~Master (
            void  )
```

4.8.2.4 Master() [3/3]

```
Master (
            volatile const Master & rhs )
```

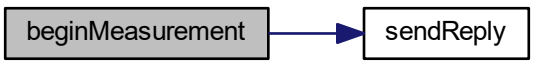
4.8.3 Member Function Documentation

4.8.3.1 beginMeasurement()

```
void beginMeasurement (
            void  ) volatile
```

Updates state to indicate that Master has requested the intitiation of the measurement procedure.

Designed to allow the IRQ to update the slave state so that the procedural code in main() can initiate the measurement procedure. Here is the call graph for this function:



4.8.3.2 ClearMeasurementVector()

```
void ClearMeasurementVector (
            MeasurementVectors VectorNumber ) volatile
```

Clears all data points from a particular vector.

Parameters

VectorNumber	is the enumerated reference to the row/vector in the data array being accessed.

4.8.3.3 getCurrentInstruction()

```
mInstruct getCurrentInstruction (
            void  ) volatile
```

Returns the mInstruct component of the most recently loaded request sent by the master.

4.8.3.4 getCurrentInstructionFloatParameter()

```
float getCurrentInstructionFloatParameter (
            void  ) volatile
```

Returns the floating point parameter of the most recently loaded request sent by the master.

4.8.3.5 getCurrentInstructionIntParameter()

```
int getCurrentInstructionIntParameter (
            void  ) volatile
```

Returns the integer parameter of the most recently loaded request sent by the master.

4.8.3.6 getCurrentInstructionNumber()

```
int getCurrentInstructionNumber (
            void  ) volatile
```

Gets the value of the counter which tracks the current instruction number throughout the measurement procedure.

4.8.3.7 Handshake()

```
bool Handshake (
            void  ) volatile
```

Manages the handshake component of any transaction.

Manages the handshake between master and slave; defined by: Recieve '?' -> send 'ACK' (0x06).

Returns

True if the handshake was successful.

Here is the caller graph for this function:

4.8.3.8 isThereData()

```
bool isThereData (
            void  ) volatile
```

Checks to see whether any data has been pushed to any of the data vectors locally.

Returns

True if any data points exist in the data vectors locally.

4.8.3.9 loadRequest()

```
mCmd loadRequest (
            void  ) volatile
```

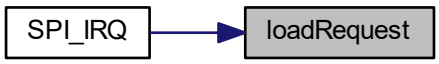
Retrieve the request sent by the master.

After each handshake, the master will proceed to send a request, defined by an mCmd object. This function must runafter each handshake. This function reassembles the mCmd request sent by the master, byte by byte and stores it in local memory.

Returns

the mCmd object sent by the master.

Here is the caller graph for this function:



4.8.3.10 operator=() [1/2]

```
volatile Master& operator= (
            const Master & rhs ) volatile  [inline]
```

4.8.3.11 operator=() [2/2]

```
volatile Master& operator= (
            volatile const Master & rhs ) volatile  [inline]
```

4.8.3.12 PopMeasurementVector()

```
bool PopMeasurementVector (
            MeasurementVectors VectorNumber ) volatile
```

Pops a data point from the tail end of a designated vector.

Removes the most recent data point from the vector in question by marking said data slot writeable to be the next PushMeasurementVector().

Parameters

VectorNumber	is the enumerated reference to the row/vector in the data array being accessed.

Returns

False if the vector/row in question is empty.

4.8.3.13 PushMeasurementVector()

```
bool PushMeasurementVector (
            const MeasurementVectors VectorNumber,
            const float Measurement ) volatile
```

Pushes a data point onto one of the data vectors.

Adds a data point to the next available slot in a particular vector until the vector (row) in the data array is full.

Parameters

VectorNumber	is the enumerated reference to the row/vector in the data array being accessed.
Measurement	is the data point to be stored.

Returns

False if the vector/row in question is full. (See DATA_ROW_LENGTH).

4.8.3.14 resendCurrentUserInstruction()

```
void resendCurrentUserInstruction (
            void  ) volatile
```

Resends the cuurent instruction in the measurement procedure to the master.

This method will NOT advance the measurement cycle. Here is the call graph for this function:

4.8.3.15 restartUserInstructionCycle()

```
void restartUserInstructionCycle (
            void  ) volatile
```

Restarts the measurement prcedure.

Restarts the measuement procedure such that the next instruction sent will be the first instruction in the measurement cycle.

4.8.3.16 sendData()

```
void sendData (
             void  ) volatile
```

Sends the local Data object to the master in reply to appropriate request.

Sends Data object to the master in reponse to a request made by the master for Data. NOTE: This must be used as the response to the appropriate mInstruct request. In paricular, (mInstruct)SendDataPlease

4.8.3.17 sendIdentity()

```
void sendIdentity (
             void  ) volatile
```

Sends slave Identity object to the master in reply to appropriate request.

Sends the slave Identity object in response to an appropriate request made by master. NOTE: This must be used as the response to the appropriate mInstruct request. In paricular, (mInstruct)WhoAreYou

4.8.3.18 sendNextUserInstruction()

```
bool sendNextUserInstruction (
             void  ) volatile
```

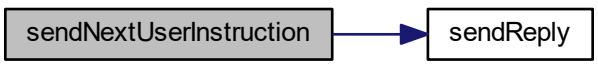
Sends the next instruction in the measurement cycle to the master.

Sends the next instruction in the measurement cycle array in reponse to the appropriate request from master. Specifically, (mInstruct)NextCommandPlease. This method will auto-advance the measurement cycle to the next instruction and re-define the 'current instruction'.

Returns

False if the final instruction in the measurement procedure has already been sent and the measurement procedure is now complete.

Here is the call graph for this function:

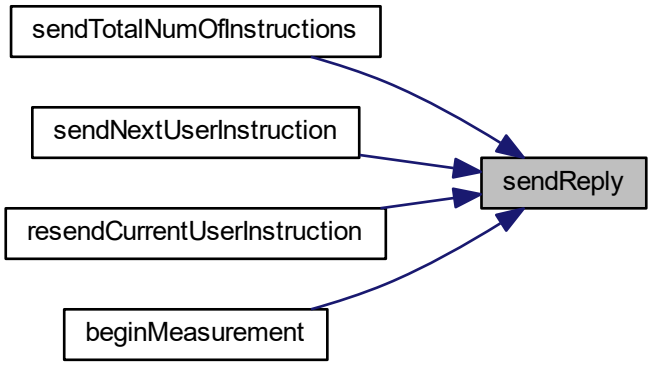


4.8.3.19 sendReply() [1/9]

```
void sendReply (
            const sCmd Reply ) volatile
```

Send an sCmd object in reply to the request recieved from Master.

Here is the caller graph for this function:



4.8.3.20 sendReply() [2/9]

```
void sendReply (
            const sInstruct Instruction ) volatile
```

Send a reply to the request recieved from master.

Assembles the sCmd object from the supplied parameters. Overloaded.

4.8.3.21 sendReply() [3/9]

```
void sendReply (
            const sInstruct Instruction,
            volatile char InstructionString[SLAVE_COMMMAND_STRING_LENGTH] ) volatile
```

Send a reply to the request recieved from master.

Assembles the sCmd object from the supplied parameters. Overloaded. Note the need for the char* to be defined locally as volatile char[]. Cannot pass string literals.

4.8.3.22 sendReply() [4/9]

```
void sendReply (
            const sInstruct Instruction,
            const int iParam ) volatile
```

Send a reply to the request recieved from master.

Assembles the sCmd object from the supplied parameters. Overloaded.

4.8.3.23 sendReply() [5/9]

```
void sendReply (
            const sInstruct Instruction,
            const float fParam ) volatile
```

Send a reply to the request recieved from master.

Assembles the sCmd object from the supplied parameters. Overloaded.

4.8.3.24 sendReply() [6/9]

```
void sendReply (
            const sInstruct Instruction,
            const int iParam,
            const int fParam ) volatile
```

Send a reply to the request recieved from master.

Assembles the sCmd object from the supplied parameters. Overloaded.

4.8.3.25 sendReply() [7/9]

```
void sendReply (
            sInstruct Instruction,
            int iParam,
            volatile char InstructionString[SLAVE_COMMMAND_STRING_LENGTH] ) volatile
```

Send a reply to the request recieved from master.

Assembles the sCmd object from the supplied parameters. Overloaded. Note the need for the char* to be defined locally as volatile char[]. Cannot pass string literals.

4.8.3.26 sendReply() [8/9]

```
void sendReply (
            sInstruct Instruction,
            float fParam,
            volatile char InstructionString[SLAVE_COMMMAND_STRING_LENGTH] ) volatile
```

Send a reply to the request recieved from master.

Assembles the sCmd object from the supplied parameters. Overloaded. Note the need for the char* to be defined locally as volatile char[]. Cannot pass string literals.

4.8.3.27 sendReply() [9/9]

```
void sendReply (
            sInstruct Instruction,
            int iParam,
            float fParam,
            volatile char InstructionString[SLAVE_COMMMAND_STRING_LENGTH] ) volatile
```

Send a reply to the request recieved from master.

Assembles the sCmd object from the supplied parameters. Overloaded. Note the need for the char* to be defined locally as volatile char[]. Cannot pass string literals.

4.8.3.28 sendTotalNumOfInstructions()

```
void sendTotalNumOfInstructions (
            void  ) volatile
```

Sends a reply to Master specifiying the total number of instructions in a measurement procedure.

Here is the call graph for this function:

4.8.3.29 setMeasurementVectorHeading()

```
void setMeasurementVectorHeading (
            MeasurementVectors VectorNumber,
            volatile char Heading[ROW_HEADING_LENGTH] ) volatile
```

Sets the string heading assigned to a paritcular data vector.

NOTE: The Heading parameter must be declared locally as volatile char[]. Literal strings cannot be passed to this function.

Parameters

VectorNumber	is the enumerated reference to the row/vector in the data array in question.
Heading[]	is the character array containing the string heading.

4.8.3.30 setMeasurementVectorUnits()

```
void setMeasurementVectorUnits (
            MeasurementVectors VectorNumber,
            volatile char Units[ROW_UNIT_LENGTH] ) volatile
```

Sets the string Units assigned to a paritcular data vector.

NOTE: The Units parameter must be declared locally as volatile char[]. Literal strings cannot be passed to this function.

Parameters

VectorNumber	is the enumerated reference to the row/vector in the data array in question.
Units[ ]	is the character array containing the string heading.

4.8.3.31 SETUP()

```
void SETUP (
            const int SensorIDNumber,
            volatile char SensorName[],
            volatile char InstructionSet[][SLAVE_COMMMAND_STRING_LENGTH],
            const int NumberOfInstructions,
            volatile sInstruct MasterInstructionSet[],
            volatile int intParams[],
            volatile float floatParams[] ) volatile
```

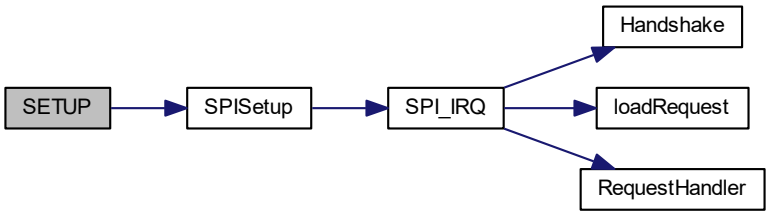
Set up of the commuication mechanism.

Intialised the auto-instantiated Master object, attaches the IRQ and sets up SPI communications.

Parameters

SensorIDNumber	is the identity number of th slave.
SensorName	is the string name of the slave.
InstructionSet	is the array of strings associated with each instruction in the measuremnt cycle. Generally to be displayed to the user.
NumberOfInstructions	is the number of instructions in a single measurement cycle/procedure.
MasterInstructionSet	is the array of sInstruct objects associated with each instruction in the measurement cycle. Defines the required action by the master for each step of the measurement procedure.
IntParams	is the array of integer parameter associated with each instruction.
FloatParams	is the array of floating point parameters accosiated with each instruction.

Here is the call graph for this function:



4.8.3.32 shallIStart()

```
bool shallIStart (
            void  ) volatile
```

Checks whether the beginMeasurement() method has been called.

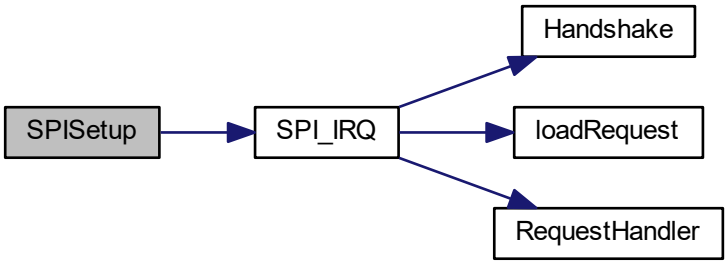
Allows procedural code in main() to determine whether the system state has changed during an interrupt in response to a request by the master to initiate the measurement procedure.

4.8.3.33 SPISetup()

```
void SPISetup (
            void  ) volatile
```

Sets up SPI and attaches interrupt.

Here is the call graph for this function:



Here is the caller graph for this function:

The documentation for this class was generated from the following files:

- Master.h
- Master.cpp

4.9 mCmd Struct Reference

Type used by master to send requests to slave.

`#include <SPI_InstructionSet.h>`

Public Member Functions

- mCmd (mInstruct Instruct, int i, float f)
- mCmd ()
- mCmd (volatile mCmd &rhs)
- mCmd & operator= (const volatile mCmd &rhs) volatile
- volatile mCmd & operator= (const mCmd &rhs) volatile

Data Fields

- mInstruct Instruction

  Instruction to slave.
- int iParam

  Integer paramter which qualifies the instruction.
- float fParam

  Floating point parameter which wualifies the instruction.

4.9.1 Detailed Description

Type used by master to send requests to slave.

Each transaction, following the initial handshake, the master will send a request and the slave will send a reply. Requests made by the master will always take the form of an mCmd object, which contains a parameterised instance of the instruction set, mInstruct, which defines the class of repsonse expected by the slave.

4.9.2 Constructor & Destructor Documentation

4.9.2.1 mCmd() [1/3]

```
mCmd (
            mInstruct Instruct,
            int i,
            float f )  [inline]
```

4.9.2.2 mCmd() [2/3]

```
mCmd ( )  [inline]
```

4.9.2.3 mCmd() [3/3]

```
mCmd (
            volatile mCmd & rhs )  [inline]
```

4.9.3 Member Function Documentation

4.9.3.1 operator=() [1/2]

```
mCmd& operator= (
            const volatile mCmd & rhs ) volatile  [inline]
```

4.9.3.2 operator=() [2/2]

```
volatile mCmd& operator= (
            const mCmd & rhs ) volatile  [inline]
```

4.9.4 Field Documentation

4.9.4.1 fParam

```
float fParam
```

Floating point parameter which wualifies the instruction.

4.9.4.2 Instruction

```
mInstruct Instruction
```

Instruction to slave.

Defines the request made of the slave by the master during any transacion. mInstruct defines a finite set of requests which the master can make of the slave.

4.9.4.3 iParam

```
int iParam
```

Integer paramter which qualifies the instruction.

The documentation for this struct was generated from the following file:

- SPI_InstructionSet.h

4.10 sCmd Struct Reference

Type used by slave to send reply to master,.

```
#include <SPI_InstructionSet.h>
```

Public Member Functions

- sCmd & operator= (const volatile sCmd &rhs) volatile
- volatile sCmd & operator= (const sCmd &rhs) volatile

Data Fields

- sInstruct Instruction

  Instruction to master.
- char sParam [SLAVE_COMMMAND_STRING_LENGTH]

  String parameter which qualifies the instruction. Often used to convey instructions which are to be displayed to the user.
- int iParam

  Integer parameter which qualifies the instruction.
- float fParam

  Floating point parameter which qualifies the instruction.

4.10.1 Detailed Description

Type used by slave to send reply to master,.

Each transaction, following the initial handshake, the master will send a request and the slave will send a reply. Replied made by the slave are generally in the form of an sCmd object, which contains a parameterised instance of the slave instruction set, sInstruct, which defines the action which the slave requires the master to carry out. Other acceptable replies to particular requests from the master are Data and Identity objects.

4.10.2 Member Function Documentation

4.10.2.1 operator=() [1/2]

```
sCmd& operator= (
            const volatile sCmd & rhs ) volatile  [inline]
```

4.10.2.2 operator=() [2/2]

```
volatile sCmd& operator= (
            const sCmd & rhs ) volatile  [inline]
```

4.10.3 Field Documentation

4.10.3.1 fParam

```
float fParam
```

Floating point parameter which qualifies the instruction.

4.10.3.2 Instruction

```
sInstruct Instruction
```

Instruction to master.

Defines the reply made by the slave in repsonse to the request posed by the master during a single transaction. Used to confirm commands issued by the master or issue commands to the master.

4.10.3.3 iParam

```
int iParam
```

Integer parameter which qualifies the instruction.

4.10.3.4 sParam

```
char sParam[SLAVE_COMMMAND_STRING_LENGTH]
```

String parameter which qualifies the instruction. Often used to convey instructions which are to be displayed to the user.

The documentation for this struct was generated from the following file:

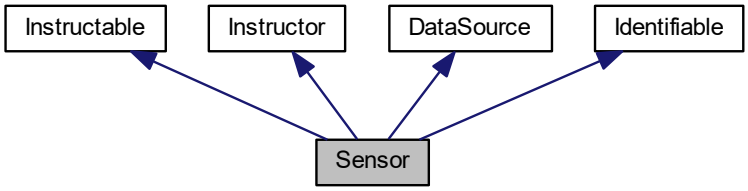
- SPI_InstructionSet.h

4.11 Sensor Class Reference

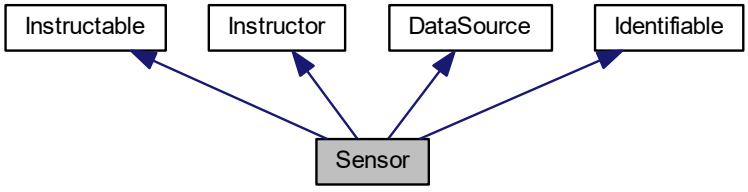
A class which models a Sensor/peripheral.

```
#include <Sensor.h>
```

Inheritance diagram for Sensor:



Collaboration diagram for Sensor:



Public Member Functions

- Sensor (const int ChipSelect)

  Constructor.
- int StartMeasurement (void)

  Instruct the sensor to initiate the measurement procedure.
- int PauseMeasurementForMillis (int)

  Instruct the sensor to pause the measurement procedure for a brief period.
- int RestartMeasurement (void)

  Instruct the sensor to restart the measurement procedure.

4.11.1 Detailed Description

A class which models a Sensor/peripheral.

This class models a sensor peripheral as an entity which has a queriable Identity, is a source of Data, can be issued commands and can issue a series of instructions in turn. In particular, a sensor is considered to perform a measurement procedure consisting of a series of steps; at each step, the sensor will issue instructions to the master to be acted upon and/or displayed to the user. The sensor may also require feedback from the user such as confirmation of the completion of an instruction, before proceeding to the next instruction in the measurement procedure. While the sensor dictates the flow of the measurement procedure, a master reserves the right to initiate the procedure, pause the procedure and restart the procedure.

4.11.2 Constructor & Destructor Documentation

4.11.2.1 Sensor()

```
Sensor (
            const int ChipSelect )
```

Constructor.

Parameters

ChipSelect	is the Slave Select pin of the SPI peripheral in question.

4.11.3 Member Function Documentation

4.11.3.1 PauseMeasurementForMillis()

```
int PauseMeasurementForMillis (
            int PauseTime )
```

Instruct the sensor to pause the measurement procedure for a brief period.

Instructs the sensor to temporarily pause the measurement procedure for a period defined in milliseconds.

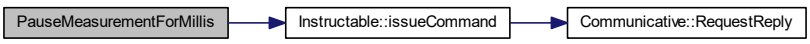
Parameters

int	is the number of milliseconds for which the sensor is to pause.

Returns

True if the sensor acknowledges the request.

Here is the call graph for this function:



4.11.3.2 RestartMeasurement()

```
int RestartMeasurement (
            void  )
```

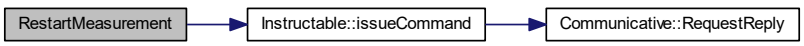
Instruct the sensor to restart the measurement procedure.

Instructs the sensor to restart the measurement procedure. The sensor will wait revert to its initial state, waiting for a StartMeasurement() command before proceeding to the first instruction in the procedure.

Returns

True if the sensor acknowledges the request.

Here is the call graph for this function:



4.11.3.3 StartMeasurement()

```
int StartMeasurement (
            void  )
```

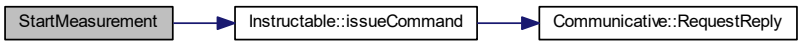
Instruct the sensor to initiate the measurement procedure.

Informs the sensor to start the measurement procedure and proceed to the first instruction step.

Returns

True if the sensor acknowledges the request.

Here is the call graph for this function:



The documentation for this class was generated from the following files:

- Sensor.h
- Sensor.cpp

4.12 UserInstructions Struct Reference

```
#include <Master.h>
```

Public Member Functions

- UserInstructions & operator= (const volatile UserInstructions &rhs) volatile
- volatile UserInstructions & operator= (const UserInstructions &rhs) volatile

Data Fields

- int NumOfInstructions
- int InstructionCounter
- char InstructionSet [MAX_USER_INSTRUCTION_NUMBER][SLAVE_COMMMAND_STRING_LENGTH]
- sInstruct MasterInstructionSet [MAX_USER_INSTRUCTION_NUMBER]
- int iParams [MAX_USER_INSTRUCTION_NUMBER]
- float fParams [MAX_USER_INSTRUCTION_NUMBER]

4.12.1 Member Function Documentation

4.12.1.1 operator=() [1/2]

```
UserInstructions& operator= (
            const volatile UserInstructions & rhs ) volatile  [inline]
```

4.12.1.2 operator=() [2/2]

```
volatile UserInstructions& operator= (
            const UserInstructions & rhs ) volatile  [inline]
```

4.12.2 Field Documentation

4.12.2.1 fParams

```
float fParams[MAX_USER_INSTRUCTION_NUMBER]
```

4.12.2.2 InstructionCounter

```
int InstructionCounter
```

4.12.2.3 InstructionSet

```
char InstructionSet[MAX_USER_INSTRUCTION_NUMBER][SLAVE_COMMMAND_STRING_LENGTH]
```

4.12.2.4 iParams

```
int iParams[MAX_USER_INSTRUCTION_NUMBER]
```

4.12.2.5 MasterInstructionSet

```
sInstruct MasterInstructionSet[MAX_USER_INSTRUCTION_NUMBER]
```

4.12.2.6 NumOfInstructions

```
int NumOfInstructions
```

The documentation for this struct was generated from the following file:

- Master.h

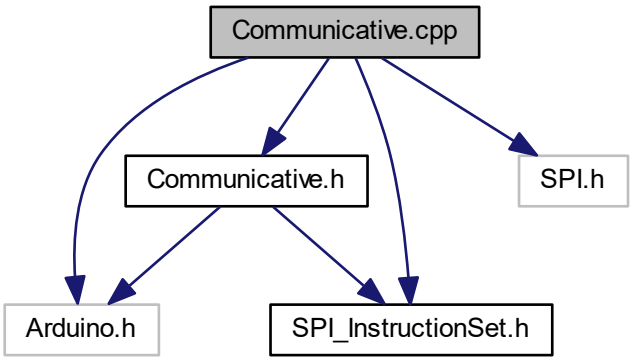
Chapter 5

File Documentation

5.1 Communicative.cpp File Reference

```
#include <Arduino.h>
#include "Communicative.h"
#include "SPI_InstructionSet.h"
#include <SPI.h>
```

Include dependency graph for Communicative.cpp:



Variables

- const int REQUEST_DELAY_MICROS = 100

5.1.1 Variable Documentation

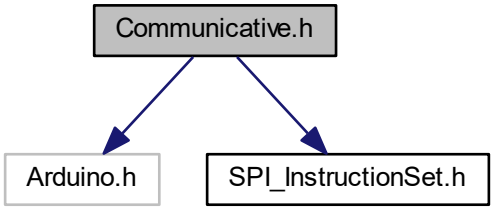
5.1.1.1 REQUEST_DELAY_MICROS

```
const int REQUEST_DELAY_MICROS = 100
```

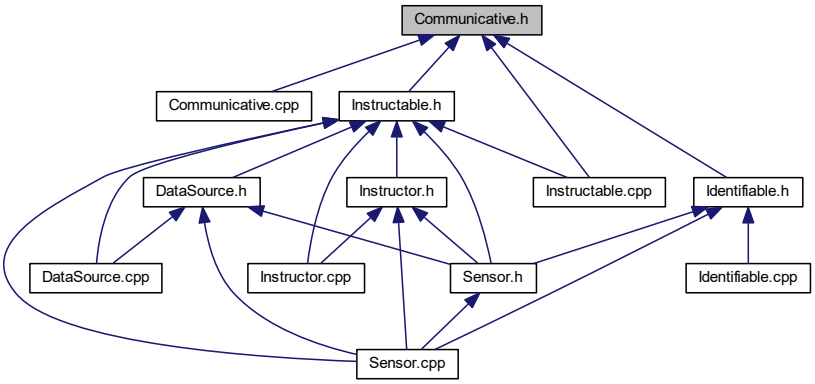
5.2 Communicative.h File Reference

```
#include <Arduino.h>
#include "SPI_InstructionSet.h"
```

Include dependency graph for Communicative.h:



This graph shows which files directly or indirectly include this file:



Data Structures

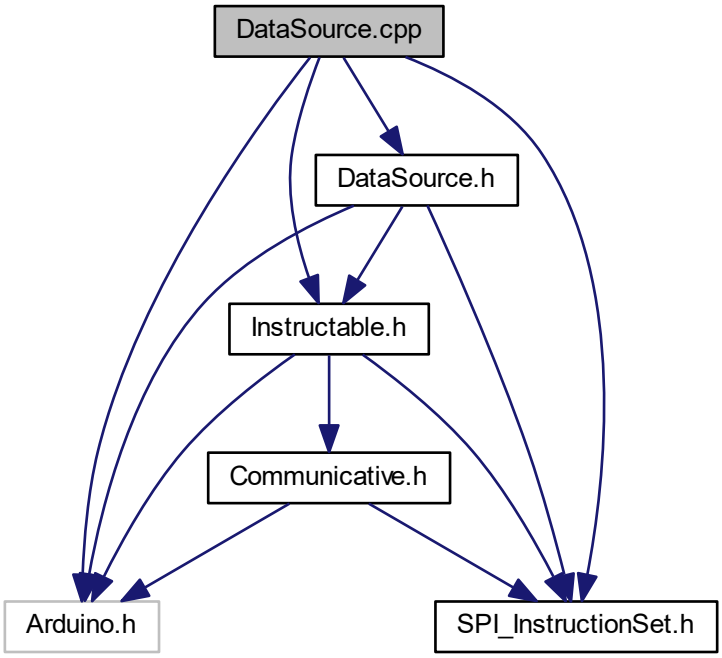
- class Communicative

  A class to manage communication with slave module.

5.3 DataSource.cpp File Reference

```
#include <Arduino.h>
#include "Instructable.h"
#include "DataSource.h"
#include "SPI_InstructionSet.h"
```

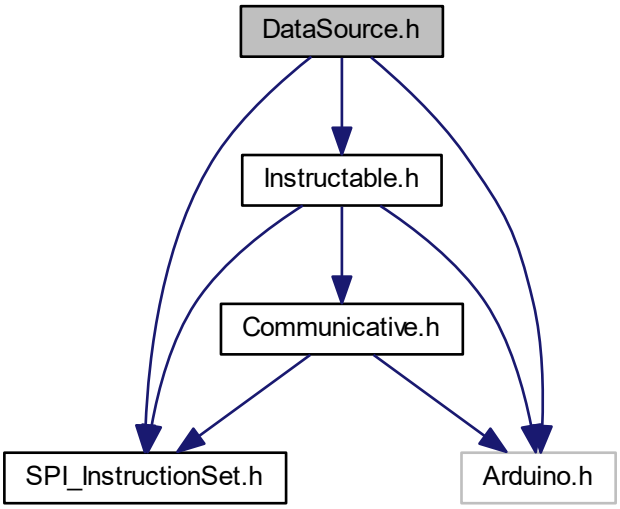
Include dependency graph for DataSource.cpp:



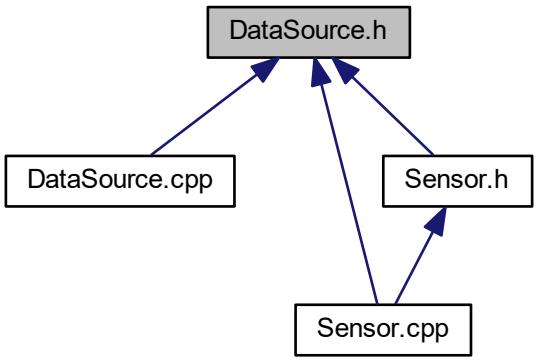
5.4 DataSource.h File Reference

```
#include <Arduino.h>
#include "SPI_InstructionSet.h"
#include "Instructable.h"
```

Include dependency graph for DataSource.h:



This graph shows which files directly or indirectly include this file:



Data Structures

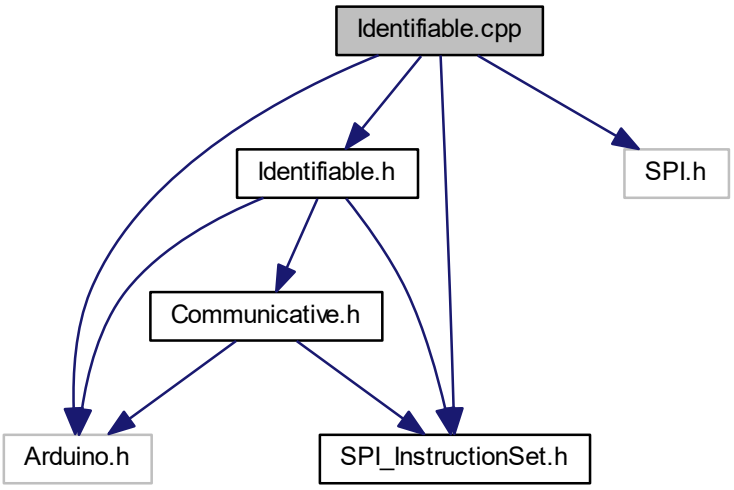
- class DataSource

  A class which models a Sensor/peripheral as an entity which is a source of data.

5.5 Identifiable.cpp File Reference

```
#include <Arduino.h>
#include "Identifiable.h"
#include "SPI_InstructionSet.h"
#include <SPI.h>
```

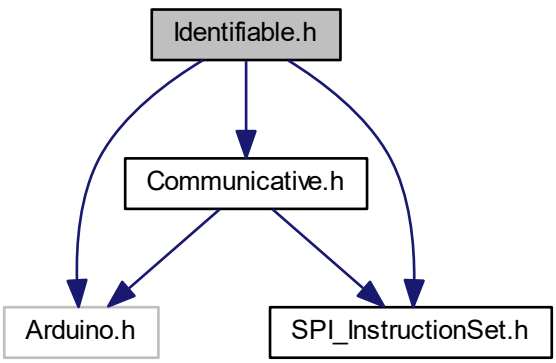
Include dependency graph for Identifiable.cpp:



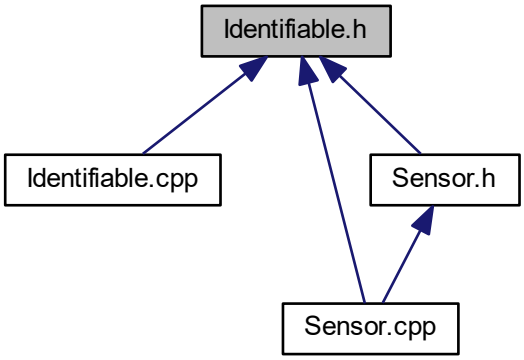
5.6 Identifiable.h File Reference

```
#include <Arduino.h>
#include "SPI_InstructionSet.h"
#include "Communicative.h"
```

Include dependency graph for Identifiable.h:



This graph shows which files directly or indirectly include this file:



Data Structures

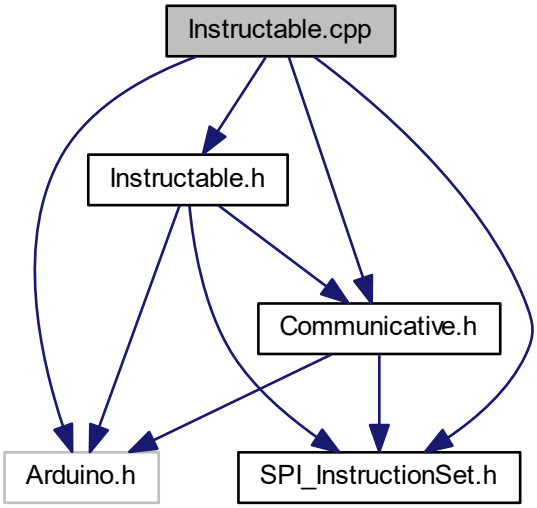
- class Identifiable

  A class which models a Sensor/peripheral as an identifiable entity.

5.7 Instructable.cpp File Reference

```
#include <Arduino.h>
#include "Communicative.h"
#include "Instructable.h"
#include "SPI_InstructionSet.h"
```

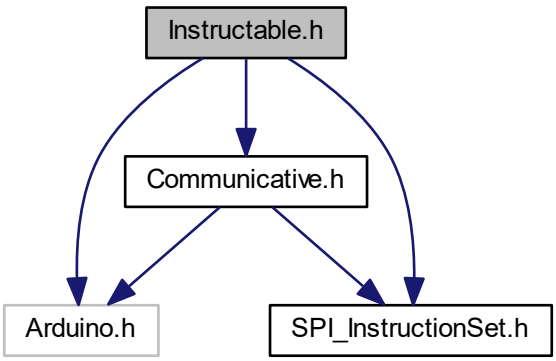
Include dependency graph for Instructable.cpp:



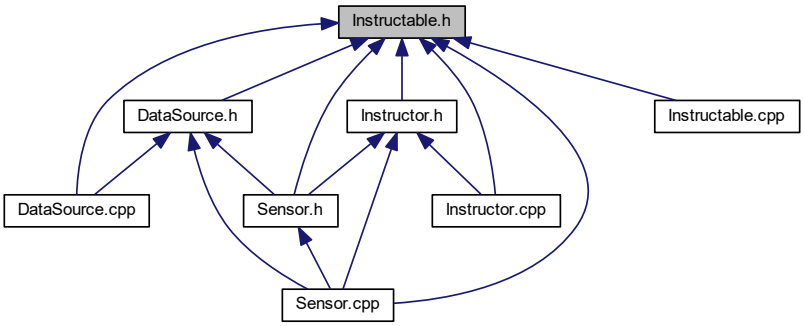
5.8 Instructable.h File Reference

```
#include <Arduino.h>
#include "SPI_InstructionSet.h"
#include "Communicative.h"
```

Include dependency graph for Instructable.h:



This graph shows which files directly or indirectly include this file:



Data Structures

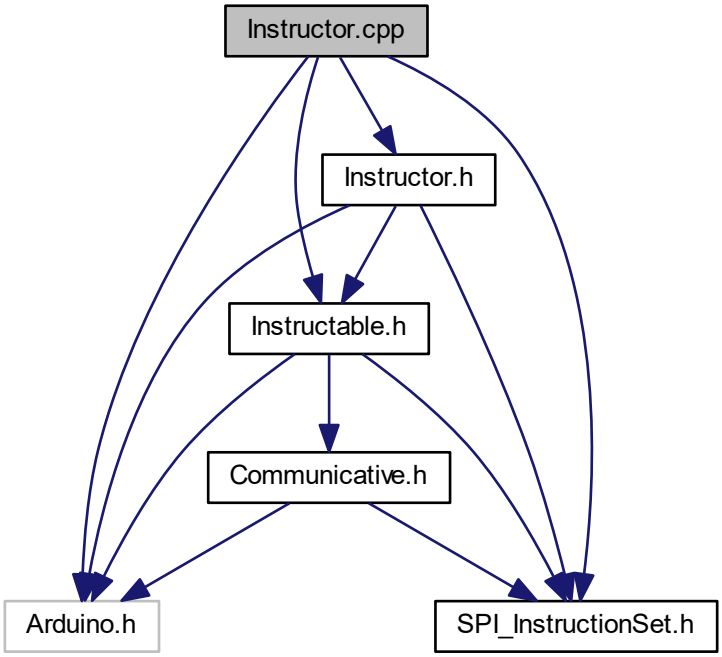
- class Instructable

  A class which models a Sensor/peripheral as entity which can recieve commands.

5.9 Instructor.cpp File Reference

```
#include <Arduino.h>
#include "Instructable.h"
#include "Instructor.h"
#include "SPI_InstructionSet.h"
```

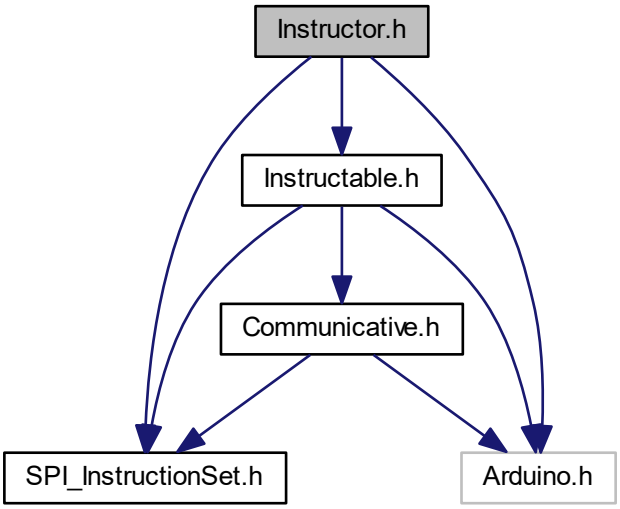
Include dependency graph for Instructor.cpp:



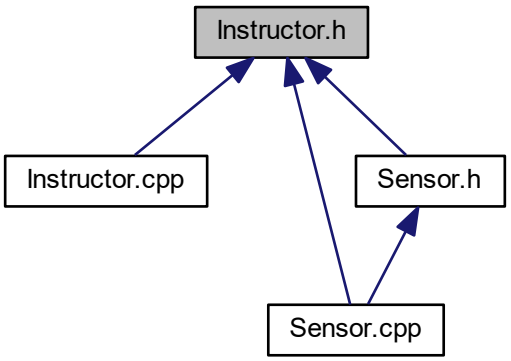
5.10 Instructor.h File Reference

```
#include <Arduino.h>
#include "SPI_InstructionSet.h"
#include "Instructable.h"
```

Include dependency graph for Instructor.h:



This graph shows which files directly or indirectly include this file:



Data Structures

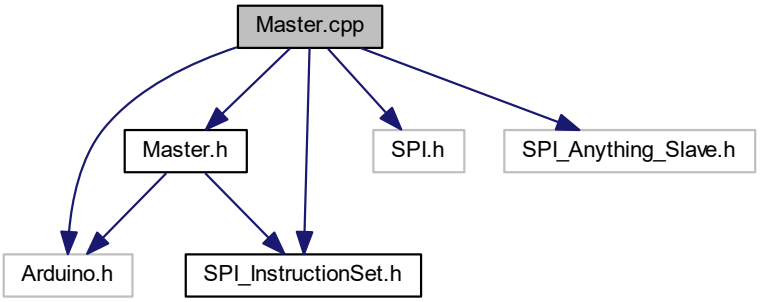
- class Instructor

  A class which models a Sensor/peripheral as entity which can issue instructions to the master.

5.11 Master.cpp File Reference

```
#include <Arduino.h>
#include "Master.h"
#include "SPI_InstructionSet.h"
#include <SPI.h>
#include "SPI_Anything_Slave.h"
```

Include dependency graph for Master.cpp:



Functions

- void SPI_IRQ (void)

  Innaccesible IRQ, called on SS falling.

Variables

- volatile Master SensorMaster

  Auto-instantiated instance of Master class, called during the privately implemented IRQ routine and accessible externally by main code.

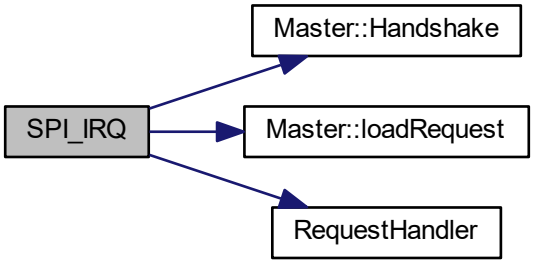
5.11.1 Function Documentation

5.11.1.1 SPI_IRQ()

```
void SPI_IRQ (
            void  )
```

Innaccesible IRQ, called on SS falling.

Here is the call graph for this function:



5.11.2 Variable Documentation

5.11.2.1 SensorMaster

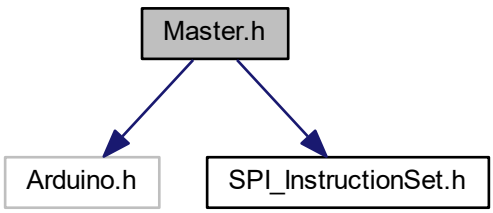
```
volatile Master SensorMaster
```

Auto-instantiated instance of Master class, called during the privately implemented IRQ routine and accessible externally by main code.

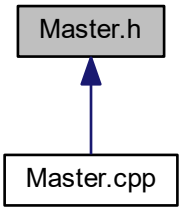
5.12 Master.h File Reference

```
#include <Arduino.h>
#include "SPI_InstructionSet.h"
```

Include dependency graph for Master.h:



This graph shows which files directly or indirectly include this file:



Data Structures

- struct UserInstructions
- class Master

  A monolithic class to encapsulate and abstract the slave's communication with the master.

Macros

- #define SPI1_NSS_PIN PA4

Functions

- void SPI_IRQ (void)

  Innaccesible IRQ, called on SS falling.
- void RequestHandler (mCmd &Request)

  Function prototype for user-implemented IRQ method; called after handshake and the reconstruction of the request from the master.

Variables

- const int MAX_USER_INSTRUCTION_NUMBER = 5
- volatile Master SensorMaster

  Auto-instantiated instance of Master class, called during the privately implemented IRQ routine and accessible externally by main code.

5.12.1 Macro Definition Documentation

5.12.1.1 SPI1_NSS_PIN

```
#define SPI1_NSS_PIN PA4
```

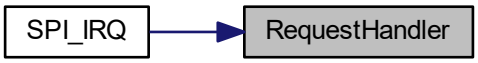
5.12.2 Function Documentation

5.12.2.1 RequestHandler()

```
void RequestHandler (
             mCmd & Request )
```

Function prototype for user-implemented IRQ method; called after handshake and the reconstruction of the request from the master.

Here is the caller graph for this function:

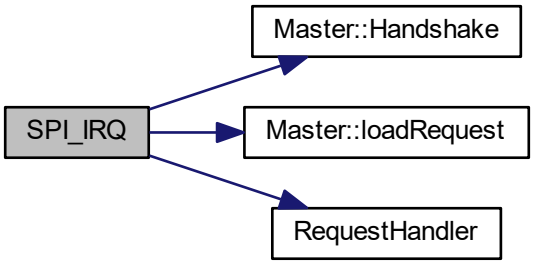


5.12.2.2 SPI_IRQ()

```
void SPI_IRQ (
             void  )
```

Innaccesible IRQ, called on SS falling.

Here is the call graph for this function:



5.12.3 Variable Documentation

5.12.3.1 MAX_USER_INSTRUCTION_NUMBER

```
const int MAX_USER_INSTRUCTION_NUMBER = 5
```

5.12.3.2 SensorMaster

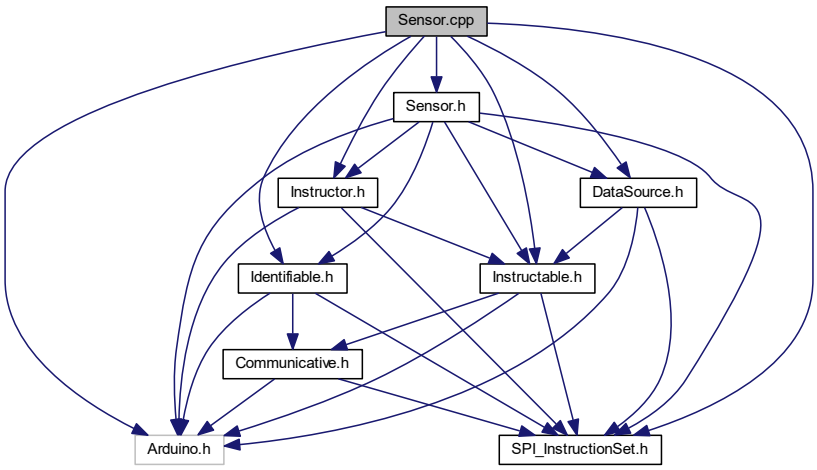
```
volatile Master SensorMaster
```

Auto-instantiated instance of Master class, called during the privately implemented IRQ routine and accessible externally by main code.

5.13 Sensor.cpp File Reference

```
#include <Arduino.h>
#include "DataSource.h"
#include "Instructor.h"
#include "Instructable.h"
#include "Identifiable.h"
#include "Sensor.h"
#include "SPI_InstructionSet.h"
```

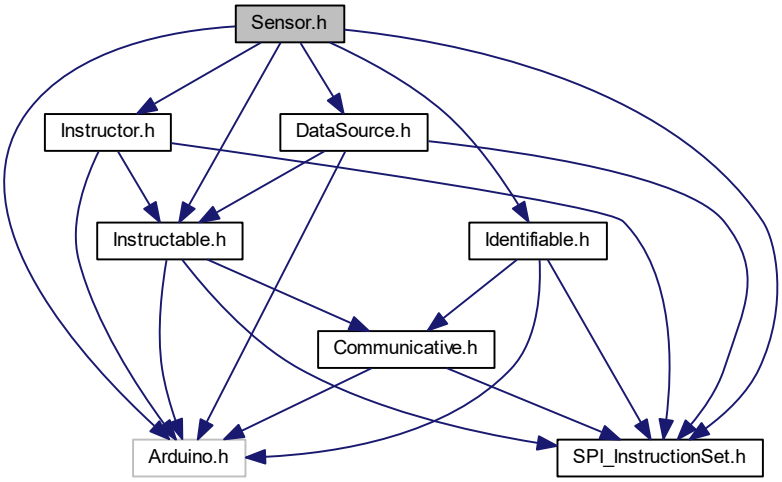
Include dependency graph for Sensor.cpp:



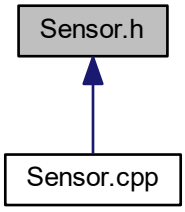
5.14 Sensor.h File Reference

```
#include <Arduino.h>
#include "SPI_InstructionSet.h"
#include "Instructor.h"
#include "DataSource.h"
#include "Instructable.h"
#include "Identifiable.h"
```

Include dependency graph for Sensor.h:



This graph shows which files directly or indirectly include this file:



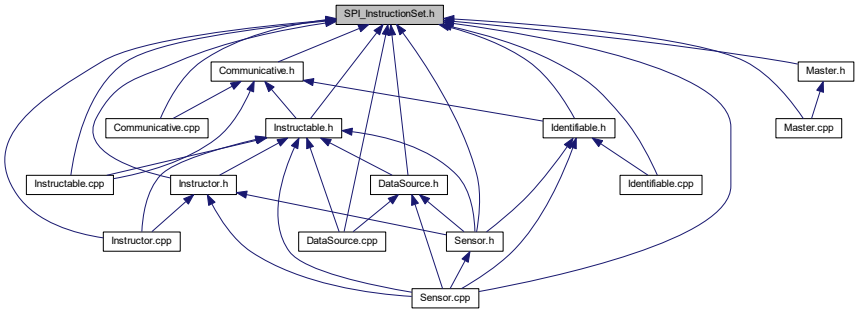
Data Structures

- class Sensor

  A class which models a Sensor/peripheral.

5.15 SPI_InstructionSet.h File Reference

This graph shows which files directly or indirectly include this file:



Data Structures

- struct sCmd

  Type used by slave to send reply to master,.
- struct mCmd

  Type used by master to send requests to slave.
- struct Identity

  Type used to convey the Slave identity.
- struct Data

  Type used to encapsulate the data collected by the slave.

Enumerations

- enum sInstruct {
  DisplayInstructionAndWait, DisplayInstructionAndWaitForUser, DontDisplayAndWait, DontDisplayAndContinue,
  ACK, Yes, No, NAK,
  ReferToInt, ReferToFloat, ReferToString }

  Instruction set used by slave to instruct master.
- enum mInstruct {
  PauseMeasurementForiParam, RestartMeasurementProcedure, ResetDevice, HowManyInstructions,
  NextCommandPlease, IsThereData, SendDataPlease, WhoAreYou,
  HowLongShouldIWait, BeginMeasurement, SitRep }

  Instruction set used by Master to instruct/request responses from Slave.
- enum MeasurementVectors { First, Second, Third }

  Enumeration to provide human-readable references to different rows in the Data array.

Variables

- const int SLAVE_COMMMAND_STRING_LENGTH = 40
- const int IDENTITY_SENSOR_NAME_LENGTH = 25
- const int NUMBER_OF_DATA_ROWS = 3
- const int ROW_HEADING_LENGTH = 10
- const int ROW_UNIT_LENGTH = 5
- const int DATA_ROW_LENGTH = 64

5.15.1 Enumeration Type Documentation

5.15.1.1 MeasurementVectors

`enum MeasurementVectors`

Enumeration to provide human-readable references to different rows in the Data array.

Enumerator

First	
Second	
Third	

5.15.1.2 mInstruct

`enum mInstruct`

Instruction set used by Master to instruct/request responses from Slave.

During a single transaction, the Master will send a request, characterised by an mCmd object, which contains an mInstruct object, integer and float. The mInstruct object will determine how the request is processed by the slave and will define the object type which the master must expect in reply. In general, the master will expect replies in the form of sCmd objects. However, the slave may also send Data and Identity objects in repsonse to specific mInstruct instances; in particular: SendDataPlease and WhoAreYou.

Enumerator

PauseMeasurementForiParam	Require Slave to pause for a duration specified by the integer parameter of mCmd. Expects sCmd{ACK or NAK} in response.
RestartMeasurementProcedure	Require Slave to restart the measurement procedure from the first instruction. Expects sCmd{ACK or NAK} in response.
ResetDevice	Require Slave to reset. Expects sCmd{ACK or NAK} in response.
HowManyInstructions	Request the slave to confirm the number of instructions in a measurement cycle. Expects sCmd{ReferToInt, int NumberOfInstructions} in response.
NextCommandPlease	Request the next instrction in the measurement cycle from the slave. Expects sCmd{sInstruct SomeInstruction, int PotentialIntParam, float PotentialFloatParam, char* PotentialStringParam} or sCmd{No} in response.
IsThereData	Requests slave to confirm that Data is ready for collection by master. Expects sCmd{Yes or No}.
SendDataPlease	Require slave to send the data object. Expects Data object in response.
WhoAreYou	Require the slave to send its Identity object; contains char* Name and int SensorID. Expects Identity object in response.
HowLongShouldIWait	Ask the slave whether the Master should pause before calling for the next instruction. Unused. Expects sCmd{ReferToInt, int PauseDuration} in reply.
BeginMeasurement	Instruct the slave to initiate its measurement cycle and expect the first instruction to be called for. Expects sCmd{ACK or NAK}.
SitRep	Request good/bad status from slave. Unused. Expects sCmd{} in reply.

5.15.1.3 sInstruct

```
enum sInstruct
```

Instruction set used by slave to instruct master.

During a single transaction, the master will request a reply, Data or Identity. Replies are characterised by an sCmd object, which contains an sInstruct object, which defines the action which the slave requires of the master.

Enumerator

DisplayInstructionAndWait	Require the master to display the string contained within the sCmd object and pause for a duration defined by the integer parameter of the sCmd object
DisplayInstructionAndWaitForUser	Require the master to display the string contained within the sCmd object and pause until the user has confirmed adherence to the instruction.
DontDisplayAndWait	Require the master to pause for a duration defined by the integer parameter of the sCmd object
DontDisplayAndContinue	Require the master to take no action. Essentially a nop.
ACK	Slave acknowleges the master's command/response.
Yes	Respond affirmative.
No	Respond negative.
NAK	Slave unable to adhere to Master's command or understand it.
ReferToInt	Points master to the integer parameter of sCmd.
ReferToFloat	Points master to the float parameter of sCmd
ReferToString	Points master to the string parameter of sCmd

5.15.2 Variable Documentation

5.15.2.1 DATA_ROW_LENGTH

```
const int DATA_ROW_LENGTH = 64
```

5.15.2.2 IDENTITY_SENSOR_NAME_LENGTH

```
const int IDENTITY_SENSOR_NAME_LENGTH = 25
```

5.15.2.3 NUMBER_OF_DATA_ROWS

```
const int NUMBER_OF_DATA_ROWS = 3
```

5.15.2.4 ROW_HEADING_LENGTH

```
const int ROW_HEADING_LENGTH = 10
```

5.15.2.5 ROW_UNIT_LENGTH

```
const int ROW_UNIT_LENGTH = 5
```

5.15.2.6 SLAVE_COMMMAND_STRING_LENGTH

```
const int SLAVE_COMMMAND_STRING_LENGTH = 40
```

Index