

SPC

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# 1 SPC Programmer's Guide

October 10, 2011

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- [Introduction](#)
- [The SPC Language](#)

## 2 Introduction

SPC stands for SuperPro C.

It is a simple language for programming the HiTechnic SuperPro prototyping sensor board. The SuperPro has a bytecode interpreter which can be used to execute programs. The SPC compiler translates a source program into SuperPro bytecodes, which can then be executed on the target itself. Although the preprocessor and control structures of SPC are very similar to C, SPC is not a general-purpose programming language - there are many restrictions that stem from limitations of the SuperPro bytecode interpreter.

Logically, SPC is defined as two separate pieces. The SPC language describes the syntax to be used in writing programs. The SPC Application Programming Interface (API) describes the system functions, constants, and macros that can be used by programs. This API is defined in a special file known as a "header file" which is, by default, automatically included when compiling a program.

This document describes both the SPC language and the SPC API. In short, it provides the information needed to write SPC programs. Since there are different interfaces for SPC, this document does not describe how to use any specific SPC implementation

(such as the command-line compiler or Bricx Command Center). Refer to the documentation provided with the SPC tool, such as the SPC User Manual, for information specific to that implementation.

For up-to-date information and documentation for SPC, visit the SPC website at <http://bricxcc.sourceforge.net/spc/>.

## **3 The SPC Language**

This section describes the SPC language.

This includes the lexical rules used by the compiler, the structure of programs, statements and expressions, and the operation of the preprocessor.

SPC is a case-sensitive language, just like C and C++, which means the identifier "xYz" is not the same identifier as "Xyz". Similarly, the "if" statement begins with the keyword "if" but "iF", "If", or "IF" are all just valid identifiers - not keywords.

- [Lexical Rules](#)
- [Program Structure](#)
- [Statements](#)
- [Expressions](#)
- [The Preprocessor](#)

### **3.1 Lexical Rules**

The lexical rules describe how SPC breaks a source file into individual tokens.

This includes the way comments are written, the handling of whitespace, and valid characters for identifiers.

- [Comments](#)
- [Whitespace](#)
- [Numerical Constants](#)
- [String Constants](#)
- [Character Constants](#)
- [System Constants](#)
- [Identifiers and Keywords](#)

### 3.1.1 Comments

Two forms of comments are supported in SPC.

The first are traditional C comments. They begin with `/*` and end with `*/`. These comments are allowed to span multiple lines, but they cannot be nested.

```
/* this is a comment */

/* this is a two
   line comment */

/* another comment...
   /* trying to nest...
      ending the inner comment...*/
   this text is no longer a comment! */
```

The second form of comments supported in SPC begins with `//` and continues to the end of the current line. These are sometimes known as C++ style comments.

```
// a single line comment
```

As you might guess, the compiler ignores comments. Their only purpose is to allow the programmer to document the source code.

### 3.1.2 Whitespace

Whitespace consists of all spaces, tabs, and newlines.

It is used to separate tokens and to make a program more readable. As long as the tokens are distinguishable, adding or subtracting whitespace has no effect on the meaning of a program. For example, the following lines of code both have the same meaning:

```
x=2;
x = 2 ;
```

Some of the C++ operators consist of multiple characters. In order to preserve these tokens, whitespace cannot appear within them. In the example below, the first line uses a right shift operator (`>>`), but in the second line the added space causes the `>>` symbols to be interpreted as two separate tokens and thus results in a compiler error.

```
x = 1 >> 4; // set x to 1 right shifted by 4 bits
x = 1 > > 4; // error
```

### 3.1.3 Numerical Constants

Numerical constants may be written in either decimal or hexadecimal form.

Decimal constants consist of one or more decimal digits. Decimal constants may optionally include a decimal point along with one or more decimal digits following the decimal point. Hexadecimal constants start with `0x` or `0X` followed by one or more hexadecimal digits.

```
x = 10; // set x to 10
x = 0x10; // set x to 16 (10 hex)
f = 10.5; // set f to 10.5
```

### 3.1.4 String Constants

String constants in SPC, just as in C, are delimited with double quote characters.

String constants can only be used in a few API functions that require a const char \* input parameter.

```
puts("testing\n");
printf("testing %d\n", value);
```

### 3.1.5 Character Constants

Character constants in SPC are delimited with single quote characters and may contain a single ASCII character.

The value of a character constant is the numeric ASCII value of the character.

```
char ch = 'a'; // ch == 97
```

### 3.1.6 System Constants

In SPC you can define special system memory address constants that are treated like a variable with an absolute memory address.

A system address is simply a numeric constant preceded by the '@' symbol.

```
int volt = @0x00; // read the voltage from analog input A0.
@0x0C = 1000; // set countdown timer 0 to 1000.
```

### 3.1.7 Identifiers and Keywords

Identifiers are used for variable, task, function, and subroutine names.

The first character of an identifier must be an upper or lower case letter or the underscore ('\_'). Remaining characters may be letters, numbers, and underscores.

A number of tokens are reserved for use in the SPC language itself. These are called keywords and may not be used as identifiers. A complete list of keywords appears below:

- [The asm statement](#)
- [bool](#)

- The break statement
- The case label
- char
- const
- The continue statement
- The default label
- The do statement
- The if-else statement
- enum
- The false condition
- The for statement
- The goto statement
- The if statement
- The inline keyword
- int
- long
- The repeat statement
- The return statement
- The start statement
- static
- Structures
- The sub keyword
- The switch statement
- Tasks
- The true condition
- typedef
- The until statement
- The void keyword
- The while statement

### 3.1.7.1 const

The `const` keyword is used to alter a variable declaration so that the variable cannot have its value changed after it is initialized.

The initialization must occur at the point of the variable declaration.

```
const int myConst = 23; // declare and initialize constant integer
task main() {
    int x = myConst; // this works fine
    myConst++; // compiler error - you cannot modify a constant's value
}
```

### 3.1.7.2 enum

The `enum` keyword is used to create an enumerated type named name.

The syntax is show below.

```
enum [name] {name-list} var-list;
```

The enumerated type consists of the elements in name-list. The var-list argument is optional, and can be used to create instances of the type along with the declaration. For example, the following code creates an enumerated type for colors:

```
enum ColorT {red, orange, yellow, green, blue, indigo, violet};
```

In the above example, the effect of the enumeration is to introduce several new constants named red, orange, yellow, etc. By default, these constants are assigned consecutive integer values starting at zero. You can change the values of those constants, as shown by the next example:

```
enum ColorT { red = 10, blue = 15, green };
```

In the above example, green has a value of 16. Once you have defined an enumerated type you can use it to declare variables just like you use any native type. Here are a few examples of using the `enum` keyword:

```
// values start from 0 and increment upward by 1
enum { ONE, TWO, THREE };
// optional equal sign with constant expression for the value
enum { SMALL=10, MEDIUM=100, LARGE=1000 };
// names without equal sign increment by one from last name's value
enum { FRED=1, WILMA, BARNEY, BETTY };
// optional named type (like a typedef)
enum TheSeasons { SPRING, SUMMER, FALL, WINTER };
// optional variable at end
enum Days {
    saturday,           // saturday = 0 by default
    sunday = 0x0,       // sunday = 0 as well
    monday,             // monday = 1
    tuesday,           // tuesday = 2
}
```

```
wednesday,          // etc.
thursday,
friday
} today;            // Variable today has type Days

Days tomorrow;

task main()
{
    TheSeasons test = FALL;
    today = monday;
    tomorrow = today+1;
    printf("%d\n", THREE);
    printf("%d\n", MEDIUM);
    printf("%d\n", FRED);
    printf("%d\n", SPRING);
    printf("%d\n", friday);
    printf("%d\n", today);
    printf("%d\n", test);
    printf("%d\n", tomorrow);
    Wait(SEC_5);
}
```

### 3.1.7.3 static

The static keyword is used to alter a variable declaration so that the variable is allocated statically - the lifetime of the variable extends across the entire run of the program - while having the same scope as variables declared without the static keyword.

Note that the initialization of automatic and static variables is quite different. Automatic variables (local variables are automatic by default, unless you explicitly use static keyword) are initialized during the run-time, so the initialization will be executed whenever it is encountered in the program. Static (and global) variables are initialized during the compile-time, so the initial values will simply be embedded in the executable file itself.

```
void func() {
    static int x = 0; // x is initialized only once across three calls of func()
    NumOut(0, LCD_LINE1, x); // outputs the value of x
    x = x + 1;
}

task main() {
    func(); // prints 0
    func(); // prints 1
    func(); // prints 2
}
```

### 3.1.7.4 typedef

A typedef declaration introduces a name that, within its scope, becomes a synonym for the type given by the type-declaration portion of the declaration.

```
typedef type-declaration synonym;
```

You can use typedef declarations to construct shorter or more meaningful names for types already defined by the language or for types that you have declared. Typedef names allow you to encapsulate implementation details that may change.

A typedef declaration does not introduce a new type - it introduces a new name for an existing type. Here are a few examples of how to use the typedef keyword:

```
typedef char FlagType;
const FlagType x;
typedef char CHAR;           // Character type.
CHAR ch;
```

## 3.2 Program Structure

An SPC program is composed of code blocks and variables.

There are two distinct types of code blocks: tasks and functions. Each type of code block has its own unique features, but they share a common structure.

- [Code Order](#)
- [Tasks](#)
- [Functions](#)
- [Variables](#)
- [Structures](#)
- [Arrays](#)

### 3.2.1 Code Order

Code order has two aspects: the order in which the code appears in the source code file and the order in which it is executed at runtime.

The first will be referred to as the lexical order and the second as the runtime order.

The lexical order is important to the SPC compiler, but not to the SuperPro brick. This means that the order in which you write your task and function definitions has no effect on the runtime order. The rules controlling runtime order are:

1. There must be a task called main and this task will always run first.
2. The time at which any other task will run is determined by the placement of API functions and keywords that start other tasks.

3. A function will run whenever it is called from another block of code.

This last rule may seem trivial, but it has important consequences when multiple tasks are running. If a task calls a function that is already in the midst of running because it was called first by another task, unpredictable behavior and results may ensue. Tasks can share functions by treating them as shared resources and using code to prevent one task from calling the function while another task is using it.

The rules for lexical ordering are:

1. Any identifier naming a task or function must be known to the compiler before it is used in a code block.
2. A task or function definition makes its naming identifier known to the compiler.
3. A task or function declaration also makes a naming identifier known to the compiler.
4. Once a task or function is defined it cannot be redefined or declared.
5. Once a task or function is declared it cannot be redeclared.

Sometimes you will run into situations where it is impossible or inconvenient to order the task and function definitions so the compiler knows every task or function name before it sees that name used in a code block. You can work around this by inserting task or function declarations of the form

```
task name ();  
return_type name(argument_list);
```

before the code block where the first usage occurs. The *argument\_list* must match the list of formal arguments given later in the function's actual definition.

### 3.2.2 Tasks

Since the SuperPro supports multi-threading, a task in SPC directly corresponds to a SuperPro thread or process.

Tasks are defined using the task keyword with the syntax shown in the code sample below.

```
task name ()  
{  
    // the task's code is placed here  
}
```

The name of the task may be any legal identifier. A program must always have at least one task - named "main" - which is started whenever the program is run. The body of a task consists of a list of statements.

You can start tasks with the start statement, which is discussed below.

The [StopAllTasks](#) API function stops all currently running tasks. You can also stop all tasks using the [Stop](#) function. A task can stop itself via the [ExitTo](#) function. Finally, a task will stop itself simply by reaching the end of its body.

### 3.2.3 Functions

It is often helpful to group a set of statements together into a single function, which your code can then call as needed.

SPC supports functions with arguments and return values. Functions are defined using the syntax below.

```
[inline] return_type name(argument_list)
{
    // body of the function
}
```

The return type is the type of data returned. In the C programming language, functions must specify the type of data they return. Functions that do not return data simply return void.

Additional details about the keywords inline, and void can be found below.

- [The inline keyword](#)
- [The void keyword](#)

The argument list of a function may be empty, or may contain one or more argument definitions. An argument is defined by a type followed by a name. Commas separate multiple arguments. All values are represented as bool, char, int, long, struct types, or arrays of any type.

SPC supports specifying a default value for function arguments that are not struct or array types. Simply add an equal sign followed by the default value. Specifying a default value makes the argument optional when you call the function. All optional arguments must be at the end of the argument list.

```
int foo(int x, int y = 20)
{
    return x*y;
}

task main()
{
    printf("%d\n", foo(10)); outputs 200
    printf("%d\n", foo(10, 5)); outputs 50
    Wait(SEC_10); // wait 10 seconds
}
```

SPC also supports passing arguments by value, by constant value, by reference, and by constant reference. These four modes for passing parameters into a function are discussed below.

When arguments are passed by value from the calling function or task to the called function the compiler must allocate a temporary variable to hold the argument. There are no restrictions on the type of value that may be used. However, since the function is working with a copy of the actual argument, the caller will not see any changes the called function makes to the value. In the example below, the function `foo` attempts to set the value of its argument to 2. This is perfectly legal, but since `foo` is working on a copy of the original argument, the variable `y` from the main task remains unchanged.

```
void foo(int x)
{
    x = 2;
}

task main()
{
    int y = 1;    // y is now equal to 1
    foo(y); // y is still equal to 1!
}
```

The second type of argument, `const arg_type`, is also passed by value. If the function is an inline function then arguments of this kind can sometimes be treated by the compiler as true constant values and can be evaluated at compile-time. If the function is not inline then the compiler treats the argument as if it were a constant reference, allowing you to pass either constants or variables. Being able to fully evaluate function arguments at compile-time can be important since some SPC API functions only work with true constant arguments.

```
void foo(const int x)
{
    x = 1; // error - cannot modify argument
    Wait(SEC_1);
}

task main()
{
    int x = 5;
    foo(5); // ok
    foo(4*5); // expression is still constant
    foo(x); // x is not a constant but is okay
}
```

The third type, `arg_type &`, passes arguments by reference rather than by value. This allows the called function to modify the value and have those changes be available in the calling function after the called function returns. However, only variables may be used when calling a function using `arg_type &` arguments:

```
void foo(int &x)
{
    x = 2;
}

task main()
```

```
{
    int y = 1;        // y is equal to 1

    foo(y); // y is now equal to 2
    foo(2); // error - only variables allowed
}
```

The fourth type, `const arg_type &`, is interesting. It is also passed by reference, but with the restriction that the called function is not allowed to modify the value. Because of this restriction, the compiler is able to pass anything, not just variables, to functions using this type of argument. Currently, passing an argument by reference in SPC is not as optimal as it is in C. A copy of the argument is still made but the compiler will enforce the restriction that the value may not be modified inside the called function.

Functions must be invoked with the correct number and type of arguments. The code example below shows several different legal and illegal calls to function `foo`.

```
void foo(int bar, const int baz)
{
    // do something here...
}

task main()
{
    int x; // declare variable x
    foo(1, 2); // ok
    foo(x, 2); // ok
    foo(2); // error - wrong number of arguments!
}
```

### 3.2.3.1 The inline keyword

You can optionally mark SPC functions as inline functions.

This means that each call to the function will create another copy of the function's code. Unless used judiciously, inline functions can lead to excessive code size.

If a function is not marked as inline then an actual SuperPro subroutine is created and the call to the function in SPC code will result in a subroutine call to the SuperPro subroutine. The total number of non-inline functions (aka subroutines) and tasks must not exceed 256.

The code example below shows how you can use the inline keyword to make a function emit its code at the point where it is called rather than requiring a subroutine call.

```
inline void foo(int value)
{
    Wait(value);
}

task main()
{
    foo(MS_100);
}
```

```
foo( MS_10 );  
foo( SEC_1 );  
foo( MS_50 );  
}
```

In this case task main will contain 4 Wait calls rather than 4 calls to the foo subroutine since it was expanded inline.

### 3.2.3.2 The void keyword

The void keyword allows you to define a function that returns no data.

Functions that do not return any value are sometimes referred to as procedures or sub-routines. The sub keyword is an alias for void. Both of these keywords can only be used when declaring or defining a function. Unlike C you cannot use void when declaring a variable type.

In NQC the void keyword was used to declare inline functions that could have arguments but could not return a value. In SPC void functions are not automatically inline as they were in NQC. To make a function inline you have to use the inline keyword prior to the function return type as described in the [Functions](#) section above.

- [The sub keyword](#)

**3.2.3.2.1 The sub keyword** The sub keyword allows you to define a function that returns no data.

Functions that do not return any value are sometimes referred to as procedures or sub-routines. The sub keyword is an alias for void. Both of these keywords can only be used when declaring or defining a function.

In NQC you used this keyword to define a true subroutine which could have no arguments and return no value. For the sake of C compatibility it is preferable to use the void keyword if you want to define a function that does not return a value.

## 3.2.4 Variables

All variables in SPC are defined using one of the types listed below:

- [bool](#)
- [char](#)
- [int](#)
- [long](#)

- Structures
- Arrays

Variables are declared using the keyword(s) for the desired type, followed by a comma-separated list of variable names and terminated by a semicolon (;). Optionally, an initial value for each variable may be specified using an equals sign (=) after the variable name. Several examples appear below:

```
int x;           // declare x
bool y,z;       // declare y and z
long a=1,b;     // declare a and b, initialize a to 1
int data[10];  // an array of 10 zeros in data
bool flags[] = {true, true, false, false};
```

Global variables are declared at the program scope (outside of any code block). Once declared, they may be used within all tasks, functions, and subroutines. Their scope begins at declaration and ends at the end of the program.

Local variables may be declared within tasks and functions. Such variables are only accessible within the code block in which they are defined. Specifically, their scope begins with their declaration and ends at the end of their code block. In the case of local variables, a compound statement (a group of statements bracketed by '{' and '}') is considered a block:

```
int x; // x is global

task main()
{
    int y; // y is local to task main
    x = y; // ok
    {
        // begin compound statement
        int z; // local z declared
        y = z; // ok
    }
    y = z; // error - z no longer in scope
}

task foo()
{
    x = 1; // ok
    y = 2; // error - y is not global
}
```

### 3.2.4.1 bool

In SPC the bool type is a signed 32-bit value.

Normally you would only store a zero or one in a variable of this type.

```
bool flag=true;
```

### 3.2.4.2 char

In SPC the char type is a signed 32-bit value.

The char type is often used to store the ASCII value of a single character. Use [Character Constants](#) page has more details about this usage.

```
char ch=12;
char test = 'A';
```

### 3.2.4.3 int

In SPC the int type is a signed 32-bit value.

This type can store values from [INT\\_MIN](#) to [INT\\_MAX](#).

```
int x = 0xffff;
int y = -23;
```

### 3.2.4.4 long

In SPC the long type is a signed 32-bit value.

This type can store values from [LONG\\_MIN](#) to [LONG\\_MAX](#).

```
long x = 2147000000;
long y = -88235;
```

## 3.2.5 Structures

SPC supports user-defined aggregate types known as structs.

These are declared very much like you declare structs in a C program.

```
struct car
{
    int car_type;
    int manu_year;
};

struct person
{
    int age;
    car vehicle;
};

person myPerson;
```

After you have defined the structure type you can use the new type to declare a variable or nested within another structure type declaration. Members (or fields) within the struct are accessed using a dot notation.

```
myPerson.age = 40;
anotherPerson = myPerson;
fooBar.car_type = honda;
fooBar.manu_year = anotherPerson.age;
```

You can assign structs of the same type but the compiler will complain if the types do not match.

### 3.2.6 Arrays

SPC also support arrays.

Arrays are declared the same way as ordinary variables, but with an open and close bracket following the variable name. Arrays must either have a non-empty size declaration or an initializer following the declaration.

```
int my_array[3]; // declare an array with 3 elements
```

To declare arrays with more than one dimension simply add more pairs of square brackets. The maximum number of dimensions supported in SPC is 4.

```
bool my_array[3][3]; // declare a 2-dimensional array
```

Arrays of up to two dimensions may be initialized at the point of declaration using the following syntax:

```
int X[] = {1, 2, 3, 4}, Y[]={10, 10}; // 2 arrays
int matrix[][] = {{1, 2, 3}, {4, 5, 6}};
```

The elements of an array are identified by their position within the array (called an index). The first element has an index of 0, the second has index 1, and so on. For example:

```
my_array[0] = 123; // set first element to 123
my_array[1] = my_array[2]; // copy third into second
```

SPC also supports specifying an initial size for both global and local arrays. The compiler automatically generates the required code to correctly initialize the array to zeros. If an array declaration includes both a size and a set of initial values the size is ignored in favor of the specified values.

```
task main()
{
    int myArray[10][10];
    int myVector[10];
}
```

## 3.3 Statements

The body of a code block (task or function) is composed of statements.

Statements are terminated with a semi-colon (;), as you have seen in the example code above.

- [Variable Declaration](#)
- [Assignment](#)
- [Control Structures](#)
- [The asm statement](#)
- [Other SPC Statements](#)

### 3.3.1 Variable Declaration

Variable declaration, which has already been discussed, is one type of statement.

Its purpose is to declare a local variable (with optional initialization) for use within the code block. The syntax for a variable declaration is shown below.

```
arg_type variables;
```

Here `arg_type` must be one of the types supported by SPC. Following the type are variable names, which must be a comma-separated list of identifiers with optional initial values as shown in the code fragment below.

```
name[=expression]
```

Arrays of variables may also be declared:

```
int array[n][=initializer];
```

You can also define variables using user-defined aggregate structure types.

```
struct TPerson {  
    int age;  
    string name;  
};  
TPerson bob; // cannot be initialized at declaration
```

### 3.3.2 Assignment

Once declared, variables may be assigned the value of an expression using the syntax shown in the code sample below.

```
variable assign_operator expression;
```

There are eleven different assignment operators. The most basic operator, '=', simply assigns the value of the expression to the variable. The other operators modify the variable's value in some other way as shown in the table below.

| Operator | Action   |
|----------|--|
| =        | Set variable to expression                             |
| +=       | Add expression to variable                             |
| -=       | Subtract expression from variable                      |
| *=       | Multiple variable by expression                        |
| /=       | Divide variable by expression                          |
| %=       | Set variable to remainder after dividing by expression |
| &=       | Bitwise AND expression into variable                   |
| =        | Bitwise OR expression into variable                    |
| ^=       | Bitwise exclusive OR into variable                     |
| >>=      | Right shift variable by expression                     |
| <<=      | Left shift variable by expression                      |

### Operators

The code sample below shows a few of the different types of operators that you can use in SPC expressions.

```
x = 2; // set x to 2
y = 7; // set y to 7
x += y; // x is 9, y is still 7
```

#### 3.3.3 Control Structures

An SPC task or function usually contains a collection of nested control structures.

There are several types described below.

- [The compound statement](#)
- [The if statement](#)
- [The if-else statement](#)
- [The while statement](#)
- [The do statement](#)
- [The for statement](#)
- [The repeat statement](#)
- [The switch statement](#)
- [The goto statement](#)
- [The until statement](#)

### 3.3.3.1 The compound statement

The simplest control structure is a compound statement.

This is a list of statements enclosed within curly braces ('{' and '}'):

```
{
    x = 1;
    y = 2;
}
```

Although this may not seem very significant, it plays a crucial role in building more complicated control structures. Many control structures expect a single statement as their body. By using a compound statement, the same control structure can be used to control multiple statements.

### 3.3.3.2 The if statement

The if statement evaluates a condition.

If the condition is true, it executes one statement (the consequence). The value of a condition is considered to be false only when it evaluates to zero. If it evaluates to any non-zero value, it is true. The syntax for an if statement is shown below.

```
if (condition) consequence
```

The condition of an if-statement must be enclosed in parentheses, as shown in the code sample below. The compound statement in the last example allows two statements to execute as a consequence of the condition being true.

```
if (x==1) y = 2;
if (x==1) { y = 1; z = 2; }
```

### 3.3.3.3 The if-else statement

The if-else statement evaluates a condition.

If the condition is true, it executes one statement (the consequence). A second statement (the alternative), preceded by the keyword else, is executed if the condition is false. The value of a condition is considered to be false only when it evaluates to zero. If it evaluates to any non-zero value, it is true. The syntax for an if-else statement is shown below.

```
if (condition) consequence else alternative
```

The condition of an if-statement must be enclosed in parentheses, as shown in the code sample below. The compound statement in the last example allows two statements to execute as a consequence of the condition being true as well as two which execute when the condition is false.

```
if (x==1)
  y = 3;
else
  y = 4;
if (x==1) {
  y = 1;
  z = 2;
}
else {
  y = 3;
  z = 5;
}
```

### 3.3.3.4 The while statement

The while statement is used to construct a conditional loop.

The condition is evaluated, and if true the body of the loop is executed, then the condition is tested again. This process continues until the condition becomes false (or a break statement is executed). The syntax for a while loop appears in the code fragment below.

```
while (condition) body
```

Because the body of a while statement must be a single statement, it is very common to use a compound statement as the body. The sample below illustrates this usage pattern.

```
while(x < 10)
{
    x = x+1;
    y = y*2;
}
```

### 3.3.3.5 The do statement

A variant of the while loop is the do-while loop.

The syntax for this control structure is shown below.

```
do body while (condition)
```

The difference between a while loop and a do-while loop is that the do-while loop always executes the body at least once, whereas the while loop may not execute it at all.

```
do
{
    x = x+1;
    y = y*2;
} while(x < 10);
```

### 3.3.3.6 The for statement

Another kind of loop is the for loop.

This type of loop allows automatic initialization and incrementation of a counter variable. It uses the syntax shown below.

```
for(statement1 ; condition ; statement2) body
```

A for loop always executes statement1, and then it repeatedly checks the condition. While the condition remains true, it executes the body followed by statement2. The for loop is equivalent to the code shown below.

```
statement1;
while(condition)
{
    body
    statement2;
}
```

Frequently, statement1 sets a loop counter variable to its starting value. The condition is generally a relational statement that checks the counter variable against a termination value, and statement2 increments or decrements the counter value.

Here is an example of how to use the for loop:

```
for (int i=0; i<8; i++)
{
    NumOut (0, LCD_LINE1-i*8, i);
}
```

### 3.3.3.7 The repeat statement

The repeat statement executes a loop a specified number of times.

This control structure is not included in the set of Standard C looping constructs. SPC inherits this statement from NQC. The syntax is shown below.

```
repeat (expression) body
```

The expression determines how many times the body will be executed. Note: the expression following the repeat keyword is evaluated a single time and then the body is repeated that number of times. This is different from both the while and do-while loops which evaluate their condition each time through the loop.

Here is an example of how to use the repeat loop:

```
int i=0;
repeat (8)
{
    printf("%d\n", i++);
}
```

### 3.3.3.8 The switch statement

A switch statement executes one of several different code sections depending on the value of an expression.

One or more case labels precede each code section. Each case must be a constant and unique within the switch statement. The switch statement evaluates the expression, and then looks for a matching case label. It will execute any statements following the matching case until either a break statement or the end of the switch is reached. A single default label may also be used - it will match any value not already appearing in a case label. A switch statement uses the syntax shown below.

```
switch (expression) body
```

Additional information about the case and default labels and the break statement can be found below.

- [The case label](#)
- [The default label](#)
- [The break statement](#)

A typical switch statement might look like this:

```
switch(x)
{
    case 1:
        // do something when x is 1
        break;
    case 2:
    case 3:
        // do something else when x is 2 or 3
        break;
    default:
        // do this when x is not 1, 2, or 3
        break;
}
```

**3.3.3.8.1 The case label** The case label in a switch statement is not a statement in itself.

It is a label that precedes a list of statements. Multiple case labels can precede the same statement. The case label has the syntax shown below.

```
case constant_expression :
```

[The switch statement](#) page contains an example of how to use the case label.

**3.3.3.8.2 The default label** The default label in a switch statement is not a statement in itself.

It is a label that precedes a list of statements. There can be only one default label within a switch statement. The default label has the syntax shown below.

```
default :
```

The [switch statement](#) page contains an example of how to use the default label.

### 3.3.3.9 The goto statement

The goto statement forces a program to jump to the specified location.

Statements in a program can be labeled by preceding them with an identifier and a colon. A goto statement then specifies the label that the program should jump to. You can only branch to a label within the current function or task, not from one function or task to another.

Here is an example of an infinite loop that increments a variable:

```
my_loop:
    x++;
    goto my_loop;
```

The goto statement should be used sparingly and cautiously. In almost every case, control structures such as if, while, and switch make a program much more readable and maintainable than using goto.

### 3.3.3.10 The until statement

SPC also defines an until macro for compatibility with NQC.

This construct provides a convenient alternative to the while loop. The actual definition of until is shown below.

```
#define until(c)      while(!(c))
```

In other words, until will continue looping until the condition becomes true. It is most often used in conjunction with an empty body statement or a body which simply yields to other tasks:

```
until(EVENT_OCCURS); // wait for some event to occur
```

## 3.3.4 The asm statement

The asm statement is used to define many of the SPC API calls.

The syntax of the statement is shown below.

```
asm {  
    one or more lines of SPRO assembly language  
}
```

The statement simply emits the body of the statement as SuperPro ASM code and passes it directly to the compiler's backend. The asm statement can often be used to optimize code so that it executes as fast as possible on the SuperPro firmware. The following example shows an asm block containing variable declarations, labels, and basic SPRO ASM statements as well as comments.

```
asm {  
    MVI WORK2, 12  
    MOV PTR, WORK2  
    MOV (PTR), WORK1  
    INC PTR  
}
```

The asm block statement and these special ASM keywords are used throughout the SPC API. You can have a look at the [SPCDefs.h](#) header file for several examples of how they are used. To keep the main SPC code as "C-like" as possible and for the sake of better readability SPC asm block statements can be wrapped in preprocessor macros and placed in custom header files which are included using `#include`.

### 3.3.5 Other SPC Statements

SPC supports a few other statement types.

The other SPC statements are described below.

- [The function call statement](#)
- [The start statement](#)
- [The break statement](#)
- [The continue statement](#)
- [The return statement](#)

Many expressions are not legal statements. A notable exception are expressions using increment (++) or decrement (--) operators.

```
x++;
```

The empty statement (just a bare semicolon) is also a legal statement.

### 3.3.5.1 The function call statement

A function call can also be a statement of the following form:

```
name (arguments) ;
```

The arguments list is a comma-separated list of expressions. The number and type of arguments supplied must match the definition of the function itself. Optionally, the return value may be assigned to a variable.

### 3.3.5.2 The start statement

You can start a task with the start statement.

This statement can be used with both the standard and enhanced NBC/SPC firmwares. The resulting operation is a native opcode in the enhanced firmware but it requires special compiler-generated subroutines in order to work with the standard firmware.

```
start task_name;
```

### 3.3.5.3 The break statement

Within loops (such as a while loop) you can use the break statement to exit the loop immediately.

It only exits out of the innermost loop

```
break;
```

The break statement is also a critical component of most switch statements. It prevents code in subsequent code sections from being executed, which is usually a programmer's intent, by immediately exiting the switch statement. Missing break statements in a switch are a frequent source of hard-to-find bugs.

Here is an example of how to use the break statement:

```
while (x<100) {  
    x = get_new_x();  
    if (button_pressed())  
        break;  
    process(x);  
}
```

### 3.3.5.4 The continue statement

Within loops you can use the continue statement to skip to the top of the next iteration of the loop without executing any of the code in the loop that follows the continue statement.

```
continue;
```

Here is an example of how to use the continue statement:

```
while (x<100) {
  ch = get_char();
  if (ch != 's')
    continue;
  process(ch);
}
```

### 3.3.5.5 The return statement

If you want a function to return a value or to return before it reaches the end of its code, use a return statement.

An expression may optionally follow the return keyword and, when present, is the value returned by the function. The type of the expression must be compatible with the return type of the function.

```
return [expression];
```

## 3.4 Expressions

Values are the most primitive type of expressions.

More complicated expressions are formed from values using various operators.

Numerical constants in the SuperPro are represented as integer values. SPC internally uses 32 bit floating point math for constant expression evaluation. Numeric constants are written as either decimal (e.g. 123, 3.14) or hexadecimal (e.g. 0xABC). Presently, there is very little range checking on constants, so using a value larger than expected may produce unusual results.

Two special values are predefined: true and false. The value of false is zero (0), while the value of true is one (1). The same values hold for relational operators (e.g. <): when the relation is false the value is 0, otherwise the value is 1.

Values may be combined using operators. SPC operators are listed here in order of precedence from highest to lowest.

| Operator                              | Description                       | Associativity | Restriction    | Example                     |
|---------------------------------------|-----------------------------------|---------------|----------------|-----------------------------|
| <code>abs()</code>                    | Absolute value                    | n/a           |                | <code>abs(x)</code>         |
| <code>sign()</code>                   | Sign of operand                   | n/a           |                | <code>sign(x)</code>        |
| <code>++, --</code>                   | Postfix increment/decrement       | left          | variables only | <code>x++</code>            |
| <code>++, --</code>                   | Prefix increment/decrement        | right         | variables only | <code>++x</code>            |
| <code>-</code>                        | Unary minus                       | right         |                | <code>-x</code>             |
| <code>~</code>                        | Bitwise negation (unary)          | right         |                | <code>~123</code>           |
| <code>!</code>                        | Logical negation                  | right         |                | <code>!x</code>             |
| <code>*, /, %</code>                  | Multiplication, division, modulus | left          |                | <code>x * y</code>          |
| <code>+, -</code>                     | Addition, subtraction             | left          |                | <code>x + y</code>          |
| <code>&lt;&lt;, &gt;&gt;</code>       | Bitwise shift left and right      | left          |                | <code>x &lt;&lt; 4</code>   |
| <code>&lt;, &gt;, &lt;=, &gt;=</code> | relational operators              | left          |                | <code>x &lt; y</code>       |
| <code>==, !=</code>                   | equal to, not equal to            | left          |                | <code>x == 1</code>         |
| <code>&amp;</code>                    | Bitwise AND                       | left          |                | <code>x &amp; y</code>      |
| <code>^</code>                        | Bitwise exclusive OR              | left          |                | <code>x ^ y</code>          |
| <code> </code>                        | Bitwise inclusive OR              | left          |                | <code>x   y</code>          |
| <code>&amp;&amp;</code>               | Logical AND                       | left          |                | <code>x &amp;&amp; y</code> |
| <code>  </code>                       | Logical OR                        | left          |                | <code>x    y</code>         |
| <code>?:</code>                       | Ternary conditional value         | right         |                | <code>x==1 ? y : z</code>   |

#### Expression Operators

Where needed, parentheses are used to change the order of evaluation:

```
x = 2 + 3 * 4; // set x to 14
y = (2 + 3) * 4; // set y to 20
```

- [Conditions](#)

### 3.4.1 Conditions

Comparing two expressions forms a condition.

A condition may be negated with the logical negation operator, or two conditions combined with the logical AND and logical OR operators. Like most modern computer languages, SPC supports something called "short-circuit" evaluation of conditions. This means that if the entire value of the conditional can be logically determined by only evaluating the left hand term of the condition, then the right hand term will not be evaluated.

The table below summarizes the different types of conditions.

| Condition      | Meaning  |
|----------------|--|
| Expr           | true if expr is not equal to 0   |
| Expr1 == expr2 | true if expr1 equals expr2   |
| Expr1 != expr2 | true if expr1 is not equal to expr2  |
| Expr1 < expr2  | true if one expr1 is less than expr2   |
| Expr1 <= expr2 | true if expr1 is less than or equal to expr2   |
| Expr1 > expr2  | true if expr1 is greater than expr2  |
| Expr1 >= expr2 | true if expr1 is greater than or equal to expr2  |
| ! condition    | logical negation of a condition - true if condition is false                               |
| Cond1 && cond2 | logical AND of two conditions (true if and only if both conditions are true)               |
| Cond1    cond2 | logical OR of two conditions (true if and only if at least one of the conditions are true) |

#### Conditions

There are also two special constant conditions which can be used anywhere that the above conditions are allowed. They are listed below.

- [The true condition](#)
- [The false condition](#)

You can use conditions in SPC control structures, such as the if-statement and the while or until statements, to specify exactly how you want your program to behave.

#### 3.4.1.1 The true condition

The keyword true has a value of one.

It represents a condition that is always true.

### 3.4.1.2 The false condition

The keyword `false` has a value of zero.

It represents a condition that is always false.

## 3.5 The Preprocessor

SPC also includes a preprocessor that is modeled after the Standard C preprocessor.

The C preprocessor processes a source code file before the compiler does. It handles such tasks as including code from other files, conditionally including or excluding blocks of code, stripping comments, defining simple and parameterized macros, and expanding macros wherever they are encountered in the source code.

The SPC preprocessor implements the following standard preprocessor directives: `#include`, `#define`, `#ifdef`, `#ifndef`, `#endif`, `#if`, `#elif`, `#undef`, `##`, `#line`, `#error`, and `#pragma`. Its implementation is close to a standard C preprocessor's, so most preprocessor directives should work as C programmers expect in SPC. Any significant deviations are explained below.

- [include](#)
- [define](#)
- [## \(Concatenation\)](#)
- [Conditional Compilation](#)

### 3.5.1 #include

The `#include` command works as in Standard C, with the caveat that the filename must be enclosed in double quotes.

There is no notion of a system include path, so enclosing a filename in angle brackets is forbidden.

```
#include "foo.h" // ok
#include <foo.h> // error!
```

SPC programs can begin with `#include "NXCDefs.h"` but they don't need to. This standard header file includes many important constants and macros, which form the core SPC API. SPC no longer require that you manually include the `NXCDefs.h` header file. Unless you specifically tell the compiler to ignore the standard system files, this header file is included automatically.

### 3.5.2 #define

The `#define` command is used for macro substitution.

Redefinition of a macro will result in a compiler warning. Macros are normally restricted to one line because the newline character at the end of the line acts as a terminator. However, you can write multiline macros by instructing the preprocessor to ignore the newline character. This is accomplished by escaping the newline character with a backslash (`'\'`). The backslash character must be the very last character in the line or it will not extend the macro definition to the next line. The code sample below shows how to write a multi-line preprocessor macro.

```
#define foo(x) do { bar(x); \
                baz(x); } while(false)
```

The `#undef` directive may be used to remove a macro's definition.

### 3.5.3 ## (Concatenation)

The `##` directive works similar to the C preprocessor.

It is replaced by nothing, which causes tokens on either side to be concatenated together. Because it acts as a separator initially, it can be used within macro functions to produce identifiers via combination with parameter values.

### 3.5.4 Conditional Compilation

Conditional compilation works similar to the C preprocessor's conditional compilation.

The following preprocessor directives may be used:

| Directive                   | Meaning  |
|-----------------------------|--|
| <code>#ifdef symbol</code>  | If symbol is defined then compile the following code               |
| <code>#ifndef symbol</code> | If symbol is not defined then compile the following code           |
| <code>#else</code>          | Switch from compiling to not compiling and vice versa              |
| <code>#endif</code>         | Return to previous compiling state                                 |
| <code>#if condition</code>  | If the condition evaluates to true then compile the following code |
| <code>#elif</code>          | Same as <code>#else</code> but used with <code>#if</code>          |

#### Conditional compilation directives

See the [SPCDefs.h](#) header files for many examples of how to use conditional compilation.

## 4 SuperPro pre-defined system constants

Pre-defined system constants for directly interacting with the SuperPro hardware.

The `spmем.h` header file uses system constants to define names for the I/O mapped memory addresses of the SuperPro board you are targetting. A complete list of these system constants appears below:

- `ADChannel0/1/2/3`
- `DigitalIn`
- `DigitalOut`
- `DigitalControl`
- `StrobeControl`
- `Timer0/1/2/3`
- `SerialInCount`
- `SerialInByte`
- `SerialOutCount`
- `SerialOutByte`
- `DAC0Mode/DAC1Mode`
- `DAC0Frequency/DAC1Frequency`
- `DAC0Voltage/DAC1Voltage`
- `LEDControl`
- `SystemClock`

### 4.1 `ADChannel0/1/2/3`

These variables return the voltage on pins A0/1/2/3 as a value in the range 0 - 1023.

This range of values represents a voltage range of 0 - 3.3 volts, or  $\sim 3.222$  mV per step.

```
//convert channel 0 reading to millivolts
int voltage = ( ADChannel0 * 3222 ) / 1000 ;
```

## 4.2 DigitalIn

This variable returns the current state of the 8 digital lines, B0 - B7.

This includes the state of any of the lines which are configured as outputs.

```
if ( DigitalIn & DIGI_PIN7 == DIGI_PIN7 ) //check if bit 7 set
{
    // do something here
}
```

## 4.3 DigitalOut

This variable sets the current state of any of the 8 digital lines, B0 - B7 which are set as outputs.

See [SuperPro digital pin constants](#).

```
DigitalOut = DIGI_PIN0 ; //set B0
```

## 4.4 DigitalControl

This variable defines which of the 8 digital lines, B0 - B7, are set as outputs.

If the corresponding bit in 1, the line is configured as an output, else it will be an input. See [SuperPro digital pin constants](#).

```
DigitalControl = 0x0F ; //set DIGI_PIN0 - DIGI_PIN3 as outputs
```

## 4.5 StrobeControl

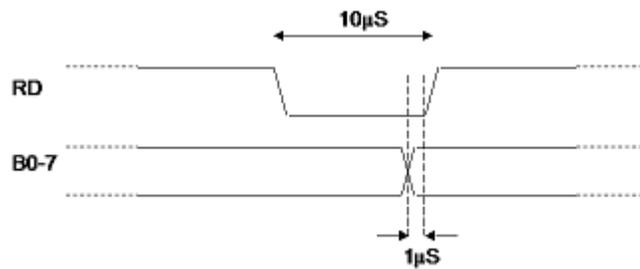
This variable allows control over the 6 strobe lines.

See [SuperPro Strobe control constants](#).

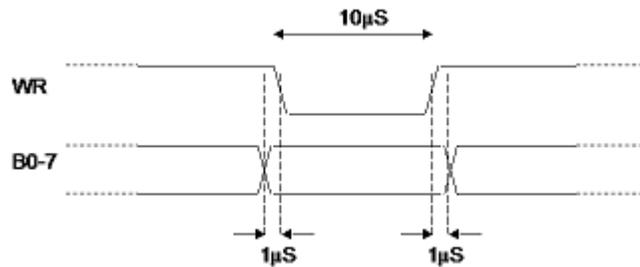
| D31-D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|--------|----|----|----|----|----|----|
| -      | WR | RD | S3 | S2 | S1 | S0 |

### Strobe Lines

There are 4 general purpose outputs, S0 - S3. These 4 lines may be used as digital outputs. There are 2 special purpose outputs, RD and WR. These lines are automatically activated when DigitalIn is read or DigitalOut is written. When DigitalIn is read, the RD output will pulse for about 10 S. If the StrobeControl RD bit is 0, the RD output will pulse high, if the bit is 1, the output will pulse low.



The timing for a read. An external device which is relying on the RD strobe output for synchronizing with the SuperPro hardware may use the leading edge of the RD strobe to present data on B0 - B7. The device must have the data ready within 9 microseconds of the start (leading edge) of the RD strobe. The timing for a write.

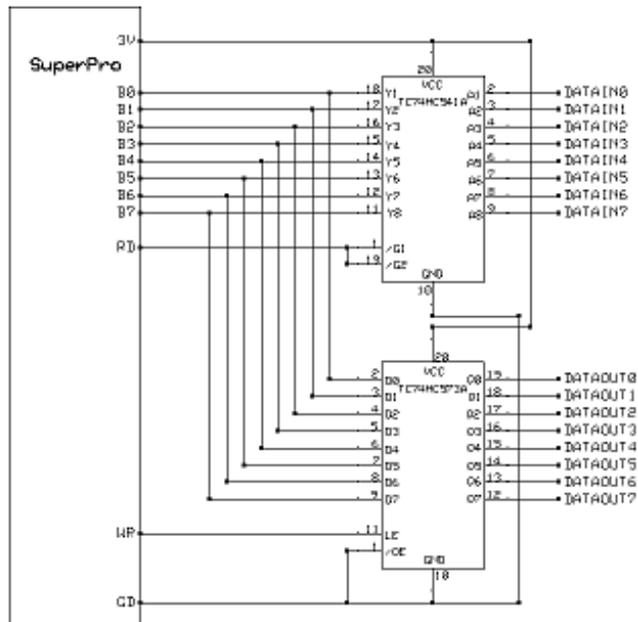


An external device which is relying on the WR strobe output for synchronizing with the SuperPro hardware may use the leading edge of the WR strobe as either an edge type clock or a latch type due to the data being presented on B0 - B7 at least 1 microsecond before the strobe is active until 1 microsecond after.

```

DigitalControl = 0xFF ; //set B0 - B7 as outputs
DigitalOut = outputbyte ;
DigitalControl = 0x00 ; //reset B0 - B7 to inputs

```



In a typical example of using the strobes to use the B0-7 bus bi-directionally:

```

StrobeControl = 0x10 ; //set RD active low and WR active high
DigitalControl = 0x00 ; //ensure outputs are inactive
// ...
datain = DigitalIn ; //read DATAIN byte
// ...
DigitalControl = 0xFF ; //set B0 - B7 as outputs
DigitalOut = dataout ; //write DATAOUT byte
DigitalControl = 0x00 ; //reset B0 - B7 to inputs

```

## 4.6 Timer0/1/2/3

The timers are count-down and halt at zero types.

They count down at the rate of 1000 counts per second, i.e., one count per millisecond.

```

Timer1 = 1000 ; //set timer1 to run for 1 second
while ( Timer1 != 0 ) ; //wait for timer1 to expire

```

## 4.7 SerialInCount

The SerialInCount returns the number of characters waiting in an input FIFO (First In, First Out) buffer of up to 255 entries.

Characters can be transferred from the host PC to the SuperPro via a terminal emulation program running at 115200bps, 8 bits, no parity. A program can wait for a character to become available using this value.

```
while ( SerialInCount == 0 ) ; //wait for a character
```

## 4.8 SerialInByte

The SerialInByte returns the character waiting in the input FIFO receive queue.

A program should wait for a character to become available before performing a read from SerialInByte. The result of reading from an empty FIFO receive queue is unpredictable.

```
while ( SerialInCount == 0 ) ; //wait for a character
kbchar = SerialInByte ; //get it
```

## 4.9 SerialOutCount

The SerialOutCount returns the number of characters waiting in an output FIFO send queue of 255 entries.

Characters from the output FIFO are transferred to the host PC at approximately 10,000 per second. If the program is generating characters at a rate greater than this, the output FIFO will start to fill up. This state can be checked by the program by comparing the count with SERIAL\_BUFFER\_SIZE. In the event that this check is not performed, no data will be lost since the program will stall waiting for space to become available in the FIFO.

```
while ( SerialOutCount > 254 ) ; //wait for space for a character
```

## 4.10 SerialOutByte

The SerialOutByte sends a character to the output FIFO send queue.

The result of writing to a full FIFO send queue is to cause the program to stall. The send queue can hold up to 255 bytes.

```
while ( SerialOutCount > 254 ) ; //wait for space for a character
SerialOutByte = 'C' ; //send a byte
```

## 4.11 DAC0Mode/DAC1Mode

The DACnMode controls the operation of the analog output pins O0/O1.

The following modes are available for use:

| Mode                   | Value | Function                       |
|------------------------|-------|--------------------------------|
| DAC_MODE_DCOUT         | 0     | Steady (DC) voltage output     |
| DAC_MODE_-SINEWAVE     | 1     | Sine wave output               |
| DAC_MODE_-SQUAREWAVE   | 2     | Square wave output             |
| DAC_MODE_-SAWPOSWAVE   | 3     | Positive going sawtooth output |
| DAC_MODE_-SAWNEGWAVE   | 4     | Negative going sawtooth output |
| DAC_MODE_-TRIANGLEWAVE | 5     | Triangle wave output           |
| DAC_MODE_-PWMVOLTAGE   | 6     | PWM square wave output         |

#### Analog Output Modes

Mode DAC\_MODE\_DCOUT uses the DACnVoltage to control the output voltage between 0 and 3.3 volts in steps of 3.222 mV.

The waveforms associated with modes DAC\_MODE\_SINEWAVE, DAC\_MODE\_-SQUAREWAVE, DAC\_MODE\_SAWPOSWAVE, DAC\_MODE\_SAWNEGWAVE, and DAC\_MODE\_TRIANGLEWAVE are centered around a DC offset of 1.65 volts. The DACnVoltage controls the amplitude from +/- 0 to +/- 1.65 volts.

The waveform associated with mode DAC\_MODE\_PWMVOLTAGE is a rectangular waveform switching between 0 and 3.3 volts. The DACnVoltage controls the mark to space ratio between 0% and 100%. The average DC value of this waveform thus varies from 0 to 3.3 volts.

```
DAC0Mode = DAC_MODE_PWMVOLTAGE; // use PWM output
DAC0Frequency = 4000; // 4khz frequency.
DAC0Voltage = 512; // mark/space ratio = 50%
```

#### 4.12 DAC0Frequency/DAC1Frequency

The DACnFrequency controls the generator frequency for the analog output pins O0/O1 for DACnModes DAC\_MODE\_SINEWAVE, DAC\_MODE\_-SQUAREWAVE, DAC\_MODE\_SAWPOSWAVE, DAC\_MODE\_SAWNEGWAVE, DAC\_MODE\_TRIANGLEWAVE, and DAC\_MODE\_PWMVOLTAGE.

The available frequency range is 1 - 8000 Hz.

```
DAC0Mode = DAC_MODE_SINEWAVE; // use sine wave output
DAC0Frequency = 4000; // 4khz frequency.
DAC0Voltage = 1024; // full range amplitude
```

### 4.13 DAC0Voltage/DAC1Voltage

The DACnVoltage controls the output voltage levels for the analog output pins O0/O1.

DACnMode DAC\_MODE\_DCOUT uses the DACnVoltage to control the output voltage between 0 and 3.3 volts in steps of 3.222 mV.

For DACnModes DAC\_MODE\_SINEWAVE, DAC\_MODE\_SQUAREWAVE, DAC\_MODE\_SAWPOSWAVE, DAC\_MODE\_SAWNEGWAVE, and DAC\_MODE\_TRIANGLEWAVE, the DACnVoltage controls the amplitude from +/- 0 to +/- 1.65 volts.

For DACnMode DAC\_MODE\_PWMVOLTAGE, DACnVoltage controls the mark to space ratio between 0% and 100%. The average DC value of this waveform thus varies from 0 to 3.3 volts.

```
DAC0Mode = DAC_MODE_DCOUT; // DC output voltage
DAC0Voltage = 500; // set voltage level of O0 to 500*3.222 mV
```

### 4.14 LEDControl

The LEDControl location can be used to turn two on-board LEDs on and off.

Bit 0 controls the state of a red LED, while bit 1 controls a blue LED.

```
LEDControl = LED_BLUE | LED_RED; // turn on both the blue and red LEDs
```

### 4.15 SystemClock

The SystemClock returns the number of milliseconds since power was applied to the SuperPro board.

```
long x = SystemClock;
```

## 5 Module Documentation

### 5.1 Miscellaneous SPC constants

Miscellaneous constants for use in SPC.

#### Modules

- [Data type limits](#)

*Constants that define various data type limits.*

### Defines

- #define TRUE 1
- #define FALSE 0
- #define SERIAL\_BUFFER\_SIZE 255

#### 5.1.1 Detailed Description

Miscellaneous constants for use in SPC.

#### 5.1.2 Define Documentation

##### 5.1.2.1 #define FALSE 0

A false value

##### 5.1.2.2 #define SERIAL\_BUFFER\_SIZE 255

Serial port receive and send buffer size

##### 5.1.2.3 #define TRUE 1

A true value

## 5.2 SuperPro analog output mode constants

Constants for controlling the 2 analog output modes.

### Defines

- #define DAC\_MODE\_DCOUT 0
- #define DAC\_MODE\_SINEWAVE 1
- #define DAC\_MODE\_SQUAREWAVE 2
- #define DAC\_MODE\_SAWPOSWAVE 3
- #define DAC\_MODE\_SAWNEGWAVE 4
- #define DAC\_MODE\_TRIANGLEWAVE 5
- #define DAC\_MODE\_PWMVOLTAGE 6

### 5.2.1 Detailed Description

Constants for controlling the 2 analog output modes. Two analog outputs, which can span 0 to 3.3 volts, can be programmed to output a steady voltage or can be programmed to output a selection of waveforms over a range of frequencies.

In the DC output mode, the DAC0/DAC1 voltage fields control the voltage on the two analog outputs in increments of  $\sim 3.2\text{mV}$  from 0 - 1023 giving 0 - 3.3v.

In waveform modes, the channel outputs will center on 1.65 volts when generating waveforms. The DAC0/DAC1 voltage fields control the signal levels of the waveforms by adjusting the peak to peak signal levels from 0 - 3.3v.

In PWFm voltage mode, the channel outputs will create a variable mark:space ratio square wave at 3.3v signal level. The average output voltage is set by the O0/O1 voltage fields.

### 5.2.2 Define Documentation

#### 5.2.2.1 #define DAC\_MODE\_DCOUT 0

Steady (DC) voltage output.

#### 5.2.2.2 #define DAC\_MODE\_PWMVOLTAGE 6

PWM square wave output.

#### 5.2.2.3 #define DAC\_MODE\_SAWNEGWAVE 4

Negative going sawtooth output.

#### 5.2.2.4 #define DAC\_MODE\_SAWPOSWAVE 3

Positive going sawtooth output.

#### 5.2.2.5 #define DAC\_MODE\_SINEWAVE 1

Sine wave output.

#### 5.2.2.6 #define DAC\_MODE\_SQUAREWAVE 2

Square wave output.

#### 5.2.2.7 #define DAC\_MODE\_TRIANGLEWAVE 5

Triangle wave output.

### 5.3 SuperPro LED control constants

Constants for controlling the 2 onboard LEDs.

#### Defines

- #define LED\_BLUE 0x02
- #define LED\_RED 0x01

#### 5.3.1 Detailed Description

Constants for controlling the 2 onboard LEDs.

#### 5.3.2 Define Documentation

##### 5.3.2.1 #define LED\_BLUE 0x02

Turn on the blue onboard LED.

##### 5.3.2.2 #define LED\_RED 0x01

Turn on the red onboard LED.

### 5.4 SuperPro digital pin constants

Constants for controlling the 8 digital pins.

#### Defines

- #define DIGI\_PIN0 0x01
- #define DIGI\_PIN1 0x02
- #define DIGI\_PIN2 0x04
- #define DIGI\_PIN3 0x08
- #define DIGI\_PIN4 0x10
- #define DIGI\_PIN5 0x20
- #define DIGI\_PIN6 0x40
- #define DIGI\_PIN7 0x80

### 5.4.1 Detailed Description

Constants for controlling the 8 digital pins. The eight digital inputs are returned as a byte representing the state of the eight inputs. The eight digital outputs are controlled by two bytes, the first of which sets the state of any of the signals which have been defined as outputs and the second of which controls the input/output state of each signal.

### 5.4.2 Define Documentation

#### 5.4.2.1 `#define DIGI_PIN0 0x01`

Access digital pin 0 (B0)

#### 5.4.2.2 `#define DIGI_PIN1 0x02`

Access digital pin 1 (B1)

#### 5.4.2.3 `#define DIGI_PIN2 0x04`

Access digital pin 2 (B2)

#### 5.4.2.4 `#define DIGI_PIN3 0x08`

Access digital pin 3 (B3)

#### 5.4.2.5 `#define DIGI_PIN4 0x10`

Access digital pin 4 (B4)

#### 5.4.2.6 `#define DIGI_PIN5 0x20`

Access digital pin 5 (B5)

#### 5.4.2.7 `#define DIGI_PIN6 0x40`

Access digital pin 6 (B6)

#### 5.4.2.8 `#define DIGI_PIN7 0x80`

Access digital pin 7 (B7)

## 5.5 SuperPro Strobe control constants

Constants for manipulating the six digital strobe outputs.

### Defines

- #define `STROBE_S0` 0x01
- #define `STROBE_S1` 0x02
- #define `STROBE_S2` 0x04
- #define `STROBE_S3` 0x08
- #define `STROBE_READ` 0x10
- #define `STROBE_WRITE` 0x20

### 5.5.1 Detailed Description

Constants for manipulating the six digital strobe outputs. Six digital strobe outputs are available. One is pre-configured as a read strobe, another is pre-configured as a write strobe while the other four can be set to a high or low logic level. These strobe lines enable external devices to synchronize with the digital data port and multiplex the eight digital input/output bits to wider bit widths.

The RD and WR bits set the inactive state of the read and write strobe outputs. Thus, if these bits are set to 0, the strobe outputs will pulse high.

### 5.5.2 Define Documentation

#### 5.5.2.1 #define `STROBE_READ` 0x10

Access read pin (RD)

#### 5.5.2.2 #define `STROBE_S0` 0x01

Access strobe 0 pin (S0)

#### 5.5.2.3 #define `STROBE_S1` 0x02

Access strobe 1 pin (S1)

#### 5.5.2.4 #define `STROBE_S2` 0x04

Access strobe 2 pin (S2)

**5.5.2.5 #define STROBE\_S3 0x08**

Access strobe 3 pin (S3)

**5.5.2.6 #define STROBE\_WRITE 0x20**

Access write pin (WR)

**5.6 Data type limits**

Constants that define various data type limits.

**Defines**

- #define [CHAR\\_BIT](#) 32
- #define [LONG\\_MIN](#) -2147483648
- #define [SCHAR\\_MIN](#) -2147483648
- #define [INT\\_MIN](#) -2147483648
- #define [CHAR\\_MIN](#) -2147483648
- #define [LONG\\_MAX](#) 2147483647
- #define [SCHAR\\_MAX](#) 2147483647
- #define [INT\\_MAX](#) 2147483647
- #define [CHAR\\_MAX](#) 2147483647

**5.6.1 Detailed Description**

Constants that define various data type limits.

**5.6.2 Define Documentation****5.6.2.1 #define CHAR\_BIT 32**

The number of bits in the char type

**5.6.2.2 #define CHAR\_MAX 2147483647**

The maximum value of the char type

**5.6.2.3 #define CHAR\_MIN -2147483648**

The minimum value of the char type

**5.6.2.4 #define INT\_MAX 2147483647**

The maximum value of the int type

**5.6.2.5 #define INT\_MIN -2147483648**

The minimum value of the int type

**5.6.2.6 #define LONG\_MAX 2147483647**

The maximum value of the long type

**5.6.2.7 #define LONG\_MIN -2147483648**

The minimum value of the long type

**5.6.2.8 #define SCHAR\_MAX 2147483647**

The maximum value of the signed char type

**5.6.2.9 #define SCHAR\_MIN -2147483648**

The minimum value of the signed char type

**5.7 Program slot constants**

Constants for use with the [Run\(\)](#) function.

**Defines**

- #define [SLOT1](#) 0
- #define [SLOT2](#) 1
- #define [SLOT3](#) 2
- #define [SLOT4](#) 3
- #define [SLOT5](#) 4
- #define [SLOT6](#) 5
- #define [SLOT7](#) 6

### 5.7.1 Detailed Description

Constants for use with the [Run\(\)](#) function.

See also:

[Run\(\)](#)

### 5.7.2 Define Documentation

#### 5.7.2.1 #define SLOT1 0

Program slot 1.

#### 5.7.2.2 #define SLOT2 1

Program slot 2.

#### 5.7.2.3 #define SLOT3 2

Program slot 3.

#### 5.7.2.4 #define SLOT4 3

Program slot 4.

#### 5.7.2.5 #define SLOT5 4

Program slot 5.

#### 5.7.2.6 #define SLOT6 5

Program slot 6.

#### 5.7.2.7 #define SLOT7 6

Program slot 7.

## 5.8 Log status constants

Constants for use with the [stat\(\)](#) function.

### Defines

- #define [LOG\\_STATUS\\_OPEN](#) 2
- #define [LOG\\_STATUS\\_BUSY](#) 1
- #define [LOG\\_STATUS\\_CLOSED](#) 0

#### 5.8.1 Detailed Description

Constants for use with the [stat\(\)](#) function.

See also:

[Run\(\)](#)

#### 5.8.2 Define Documentation

##### 5.8.2.1 #define [LOG\\_STATUS\\_BUSY](#) 1

Log file is busy.

##### 5.8.2.2 #define [LOG\\_STATUS\\_CLOSED](#) 0

Log file is closed.

##### 5.8.2.3 #define [LOG\\_STATUS\\_OPEN](#) 2

Log file is open.

### 5.9 Time constants

Constants for use with the [Wait\(\)](#) function.

### Defines

- #define [MS\\_1](#) 1
- #define [MS\\_2](#) 2
- #define [MS\\_3](#) 3
- #define [MS\\_4](#) 4
- #define [MS\\_5](#) 5
- #define [MS\\_6](#) 6
- #define [MS\\_7](#) 7

- #define MS\_8 8
- #define MS\_9 9
- #define MS\_10 10
- #define MS\_20 20
- #define MS\_30 30
- #define MS\_40 40
- #define MS\_50 50
- #define MS\_60 60
- #define MS\_70 70
- #define MS\_80 80
- #define MS\_90 90
- #define MS\_100 100
- #define MS\_150 150
- #define MS\_200 200
- #define MS\_250 250
- #define MS\_300 300
- #define MS\_350 350
- #define MS\_400 400
- #define MS\_450 450
- #define MS\_500 500
- #define MS\_600 600
- #define MS\_700 700
- #define MS\_800 800
- #define MS\_900 900
- #define SEC\_1 1000
- #define SEC\_2 2000
- #define SEC\_3 3000
- #define SEC\_4 4000
- #define SEC\_5 5000
- #define SEC\_6 6000
- #define SEC\_7 7000
- #define SEC\_8 8000
- #define SEC\_9 9000
- #define SEC\_10 10000
- #define SEC\_15 15000
- #define SEC\_20 20000
- #define SEC\_30 30000
- #define MIN\_1 60000

### 5.9.1 Detailed Description

Constants for use with the [Wait\(\)](#) function.

See also:

[Wait\(\)](#)

### 5.9.2 Define Documentation

#### 5.9.2.1 #define MIN\_1 60000

1 minute

#### 5.9.2.2 #define MS\_1 1

1 millisecond

#### 5.9.2.3 #define MS\_10 10

10 milliseconds

#### 5.9.2.4 #define MS\_100 100

100 milliseconds

#### 5.9.2.5 #define MS\_150 150

150 milliseconds

#### 5.9.2.6 #define MS\_2 2

2 milliseconds

#### 5.9.2.7 #define MS\_20 20

20 milliseconds

#### 5.9.2.8 #define MS\_200 200

200 milliseconds

**5.9.2.9 #define MS\_250 250**

250 milliseconds

**5.9.2.10 #define MS\_3 3**

3 milliseconds

**5.9.2.11 #define MS\_30 30**

30 milliseconds

**5.9.2.12 #define MS\_300 300**

300 milliseconds

**5.9.2.13 #define MS\_350 350**

350 milliseconds

**5.9.2.14 #define MS\_4 4**

4 milliseconds

**5.9.2.15 #define MS\_40 40**

40 milliseconds

**5.9.2.16 #define MS\_400 400**

400 milliseconds

**5.9.2.17 #define MS\_450 450**

450 milliseconds

**5.9.2.18 #define MS\_5 5**

5 milliseconds

**5.9.2.19 #define MS\_50 50**

50 milliseconds

**5.9.2.20 #define MS\_500 500**

500 milliseconds

**5.9.2.21 #define MS\_6 6**

6 milliseconds

**5.9.2.22 #define MS\_60 60**

60 milliseconds

**5.9.2.23 #define MS\_600 600**

600 milliseconds

**5.9.2.24 #define MS\_7 7**

7 milliseconds

**5.9.2.25 #define MS\_70 70**

70 milliseconds

**5.9.2.26 #define MS\_700 700**

700 milliseconds

**5.9.2.27 #define MS\_8 8**

8 milliseconds

**5.9.2.28 #define MS\_80 80**

80 milliseconds

5.9.2.29 **#define MS\_800 800**

800 milliseconds

5.9.2.30 **#define MS\_9 9**

9 milliseconds

5.9.2.31 **#define MS\_90 90**

90 milliseconds

5.9.2.32 **#define MS\_900 900**

900 milliseconds

5.9.2.33 **#define SEC\_1 1000**

1 second

5.9.2.34 **#define SEC\_10 10000**

10 seconds

5.9.2.35 **#define SEC\_15 15000**

15 seconds

5.9.2.36 **#define SEC\_2 2000**

2 seconds

5.9.2.37 **#define SEC\_20 20000**

20 seconds

5.9.2.38 **#define SEC\_3 3000**

3 seconds

5.9.2.39 `#define SEC_30 30000`

30 seconds

5.9.2.40 `#define SEC_4 4000`

4 seconds

5.9.2.41 `#define SEC_5 5000`

5 seconds

5.9.2.42 `#define SEC_6 6000`

6 seconds

5.9.2.43 `#define SEC_7 7000`

7 seconds

5.9.2.44 `#define SEC_8 8000`

8 seconds

5.9.2.45 `#define SEC_9 9000`

9 seconds

## 5.10 Tone constants

Constants for use with the analog output frequency fields.

### Defines

- `#define TONE_A3 220`
- `#define TONE_AS3 233`
- `#define TONE_B3 247`
- `#define TONE_C4 262`
- `#define TONE_CS4 277`

- #define [TONE\\_D4](#) 294
- #define [TONE\\_DS4](#) 311
- #define [TONE\\_E4](#) 330
- #define [TONE\\_F4](#) 349
- #define [TONE\\_FS4](#) 370
- #define [TONE\\_G4](#) 392
- #define [TONE\\_GS4](#) 415
- #define [TONE\\_A4](#) 440
- #define [TONE\\_AS4](#) 466
- #define [TONE\\_B4](#) 494
- #define [TONE\\_C5](#) 523
- #define [TONE\\_CS5](#) 554
- #define [TONE\\_D5](#) 587
- #define [TONE\\_DS5](#) 622
- #define [TONE\\_E5](#) 659
- #define [TONE\\_F5](#) 698
- #define [TONE\\_FS5](#) 740
- #define [TONE\\_G5](#) 784
- #define [TONE\\_GS5](#) 831
- #define [TONE\\_A5](#) 880
- #define [TONE\\_AS5](#) 932
- #define [TONE\\_B5](#) 988
- #define [TONE\\_C6](#) 1047
- #define [TONE\\_CS6](#) 1109
- #define [TONE\\_D6](#) 1175
- #define [TONE\\_DS6](#) 1245
- #define [TONE\\_E6](#) 1319
- #define [TONE\\_F6](#) 1397
- #define [TONE\\_FS6](#) 1480
- #define [TONE\\_G6](#) 1568
- #define [TONE\\_GS6](#) 1661
- #define [TONE\\_A6](#) 1760
- #define [TONE\\_AS6](#) 1865
- #define [TONE\\_B6](#) 1976
- #define [TONE\\_C7](#) 2093
- #define [TONE\\_CS7](#) 2217
- #define [TONE\\_D7](#) 2349
- #define [TONE\\_DS7](#) 2489
- #define [TONE\\_E7](#) 2637
- #define [TONE\\_F7](#) 2794
- #define [TONE\\_FS7](#) 2960
- #define [TONE\\_G7](#) 3136
- #define [TONE\\_GS7](#) 3322

- #define [TONE\\_A7](#) 3520
- #define [TONE\\_AS7](#) 3729
- #define [TONE\\_B7](#) 3951

### 5.10.1 Detailed Description

Constants for use with the analog output frequency fields.

See also:

[DAC0Frequency](#), [DAC1Frequency](#)

### 5.10.2 Define Documentation

#### 5.10.2.1 #define TONE\_A3 220

Third octave A

#### 5.10.2.2 #define TONE\_A4 440

Fourth octave A

#### 5.10.2.3 #define TONE\_A5 880

Fifth octave A

#### 5.10.2.4 #define TONE\_A6 1760

Sixth octave A

#### 5.10.2.5 #define TONE\_A7 3520

Seventh octave A

#### 5.10.2.6 #define TONE\_AS3 233

Third octave A sharp

#### 5.10.2.7 #define TONE\_AS4 466

Fourth octave A sharp

5.10.2.8 #define TONE\_AS5 932

Fifth octave A sharp

5.10.2.9 #define TONE\_AS6 1865

Sixth octave A sharp

5.10.2.10 #define TONE\_AS7 3729

Seventh octave A sharp

5.10.2.11 #define TONE\_B3 247

Third octave B

5.10.2.12 #define TONE\_B4 494

Fourth octave B

5.10.2.13 #define TONE\_B5 988

Fifth octave B

5.10.2.14 #define TONE\_B6 1976

Sixth octave B

5.10.2.15 #define TONE\_B7 3951

Seventh octave B

5.10.2.16 #define TONE\_C4 262

Fourth octave C

5.10.2.17 #define TONE\_C5 523

Fifth octave C

5.10.2.18 #define TONE\_C6 1047

Sixth octave C

5.10.2.19 #define TONE\_C7 2093

Seventh octave C

5.10.2.20 #define TONE\_CS4 277

Fourth octave C sharp

5.10.2.21 #define TONE\_CS5 554

Fifth octave C sharp

5.10.2.22 #define TONE\_CS6 1109

Sixth octave C sharp

5.10.2.23 #define TONE\_CS7 2217

Seventh octave C sharp

5.10.2.24 #define TONE\_D4 294

Fourth octave D

5.10.2.25 #define TONE\_D5 587

Fifth octave D

5.10.2.26 #define TONE\_D6 1175

Sixth octave D

5.10.2.27 #define TONE\_D7 2349

Seventh octave D

5.10.2.28 #define TONE\_DS4 311

Fourth octave D sharp

5.10.2.29 #define TONE\_DS5 622

Fifth octave D sharp

5.10.2.30 #define TONE\_DS6 1245

Sixth octave D sharp

5.10.2.31 #define TONE\_DS7 2489

Seventh octave D sharp

5.10.2.32 #define TONE\_E4 330

Fourth octave E

5.10.2.33 #define TONE\_E5 659

Fifth octave E

5.10.2.34 #define TONE\_E6 1319

Sixth octave E

5.10.2.35 #define TONE\_E7 2637

Seventh octave E

5.10.2.36 #define TONE\_F4 349

Fourth octave F

5.10.2.37 #define TONE\_F5 698

Fifth octave F

5.10.2.38 **#define TONE\_F6 1397**

Sixth octave F

5.10.2.39 **#define TONE\_F7 2794**

Seventh octave F

5.10.2.40 **#define TONE\_FS4 370**

Fourth octave F sharp

5.10.2.41 **#define TONE\_FS5 740**

Fifth octave F sharp

5.10.2.42 **#define TONE\_FS6 1480**

Sixth octave F sharp

5.10.2.43 **#define TONE\_FS7 2960**

Seventh octave F sharp

5.10.2.44 **#define TONE\_G4 392**

Fourth octave G

5.10.2.45 **#define TONE\_G5 784**

Fifth octave G

5.10.2.46 **#define TONE\_G6 1568**

Sixth octave G

5.10.2.47 **#define TONE\_G7 3136**

Seventh octave G

**5.10.2.48 #define TONE\_GS4 415**

Fourth octave G sharp

**5.10.2.49 #define TONE\_GS5 831**

Fifth octave G sharp

**5.10.2.50 #define TONE\_GS6 1661**

Sixth octave G sharp

**5.10.2.51 #define TONE\_GS7 3322**

Seventh octave G sharp

**5.11 SPC API**

SPC API functions.

**Functions**

- void [Wait](#) (long ms)  
*Wait some milliseconds.*
- void [Yield](#) (void)  
*Yield to another task.*
- void [StopAllTasks](#) (void)  
*Stop all tasks.*
- void [Stop](#) (bool bvalue)  
*Stop the running program.*
- void [ExitTo](#) (task newTask)  
*Exit to another task.*
- void [StartTask](#) (task t)  
*Start a task.*
- unsigned int [SizeOf](#) (variant &value)

*Calculate the size of a variable.*

- int `read` (void)  
*Read a value from a file.*
- int `write` (const int value)  
*Write value to file.*
- int `sqrt` (int x)  
*Compute square root.*
- int `abs` (int num)  
*Absolute value.*
- char `sign` (int num)  
*Sign value.*
- int `close` (void)  
*Close file.*
- byte `open` (const char \*mode)  
*Open file.*
- char `putchar` (const char ch)  
*Write character to debug device.*
- int `puts` (const char \*str)  
*Write string to debug device.*
- void `printf` (const char \*format,...)  
*Print formatted data to debug device.*
- void `abort` (void)  
*Abort current process.*
- long `CurrentTick` (void)  
*Read the current system tick.*
- int `pop` (void)  
*Pop a value off the stack.*
- int `push` (int value)

*Push a value onto the stack.*

- void `RotateLeft` (int &value)  
*Rotate left.*
- void `RotateRight` (int &value)  
*Rotate right.*
- void `Run` (const int slot)  
*Run another program.*
- int `stat` (void)  
*Check log file status.*
- void `StopProcesses` (void)  
*Stop all processes.*

### 5.11.1 Detailed Description

SPC API functions.

### 5.11.2 Function Documentation

#### 5.11.2.1 void abort (void) [`inline`]

Abort current process. Aborts the process with an abnormal program termination. The function never returns to its caller.

#### 5.11.2.2 int abs (int *num*) [`inline`]

Absolute value. Return the absolute value of the value argument. Any scalar type can be passed into this function.

#### Parameters:

*num* The numeric value.

#### Returns:

The absolute value of *num*. The return type matches the input type.

### 5.11.2.3 int close (void) [inline]

Close file. Close the log file.

**Returns:**

The result code.

### 5.11.2.4 long CurrentTick (void) [inline]

Read the current system tick. This function lets you current system tick count.

**Returns:**

The current system tick count.

### 5.11.2.5 void ExitTo (task *newTask*) [inline]

Exit to another task. Immediately exit the current task and start executing the specified task.

**Parameters:**

*newTask* The task to start executing after exiting the current task.

### 5.11.2.6 byte open (const char \* *mode*) [inline]

Open file. Opens the log file. The operations that are allowed on the stream and how these are performed are defined by the mode parameter.

**Parameters:**

*mode* The file access mode. Valid values are "r" - opens the existing log file for reading, "w" - creates a new log file and opens it for writing.

**Returns:**

The result code.

**5.11.2.7 int pop (void) [inline]**

Pop a value off the stack. Pop a 32-bit integer value off the top of the stack.

**Returns:**

The value popped off the top of the stack.

**5.11.2.8 void printf (const char \*format, ...) [inline]**

Print formatted data to debug device. Writes to the debug device a sequence of data formatted as the format argument specifies. After the format parameter, the function expects a variable number of parameters.

**Parameters:**

*format* A constant string literal specifying the desired format.

**5.11.2.9 int push (int value) [inline]**

Push a value onto the stack. Push a 32-bit integer value onto the top of the stack.

**Parameters:**

*value* The value you want to push onto the stack.

**Returns:**

The value pushed onto the stack.

**5.11.2.10 char putchar (const char ch) [inline]**

Write character to debug device. Writes a character to the debug device. If there are no errors, the same character that has been written is returned.

**Parameters:**

*ch* The character to be written.

**Returns:**

The character written to the file.

**5.11.2.11 int puts (const char \* *str*) [inline]**

Write string to debug device. Writes the string to the debug device. The null terminating character at the end of the string is not written. If there are no errors, a non-negative value is returned.

**Parameters:**

*str* The string of characters to be written.

**Returns:**

The result code.

**5.11.2.12 int read (void) [inline]**

Read a value from a file. Read a value from the file associated with the specified handle. The handle parameter must be a variable. The value parameter must be a variable. The type of the value parameter determines the number of bytes of data read.

**Returns:**

The function call result.

**5.11.2.13 void RotateLeft (int & *value*) [inline]**

Rotate left. Rotate the specified variable one bit left through carry.

**Parameters:**

*value* The value to rotate left one bit.

**5.11.2.14 void RotateRight (int & value) [inline]**

Rotate right. Rotate the specified variable one bit right through carry.

**Parameters:**

*value* The value to rotate right one bit.

**5.11.2.15 void Run (const int slot) [inline]**

Run another program. Run the program in the specified slot. The current program will terminate.

**Parameters:**

*slot* The constant slot number for the program you want to execute. See [Program slot constants](#).

**5.11.2.16 char sign (int num) [inline]**

Sign value. Return the sign of the value argument (-1, 0, or 1). Any scalar type can be passed into this function.

**Parameters:**

*num* The numeric value for which to calculate its sign value.

**Returns:**

-1 if the parameter is negative, 0 if the parameter is zero, or 1 if the parameter is positive.

**5.11.2.17 unsigned int SizeOf (variant & value) [inline]**

Calculate the size of a variable. Calculate the number of bytes required to store the contents of the variable passed into the function.

**Parameters:**

*value* The variable.

**Returns:**

The number of bytes occupied by the variable.

**5.11.2.18 int sqrt (int *x*) [inline]**

Compute square root. Computes the square root of *x*.

**Parameters:**

*x* integer value.

**Returns:**

Square root of *x*.

**5.11.2.19 void StartTask (task *t*) [inline]**

Start a task. Start the specified task.

**Parameters:**

*t* The task to start.

**5.11.2.20 int stat (void) [inline]**

Check log file status. Check the status of the system log file.

**Returns:**

The log file status. See [Log status constants](#).

**5.11.2.21 void Stop (bool *bvalue*) [inline]**

Stop the running program. Stop the running program if *bvalue* is true. This will halt the program completely, so any code following this command will be ignored.

**Parameters:**

*bvalue* If this value is true the program will stop executing.

**5.11.2.22 void StopAllTasks (void) [inline]**

Stop all tasks. Stop all currently running tasks. This will halt the program completely, so any code following this command will be ignored.

**5.11.2.23 void StopProcesses (void) [inline]**

Stop all processes. Stop all running tasks except for the main task.

**5.11.2.24 void Wait (long *ms*) [inline]**

Wait some milliseconds. Make a task sleep for specified amount of time (in 1000ths of a second).

**Parameters:**

*ms* The number of milliseconds to sleep.

**5.11.2.25 int write (const int *value*) [inline]**

Write *value* to file. Write a value to the file associated with the specified handle. The handle parameter must be a variable. The value parameter must be a constant, a constant expression, or a variable. The type of the value parameter determines the number of bytes of data written.

**Parameters:**

*value* The value to write to the file.

**Returns:**

The function call result.

**5.11.2.26 void Yield (void) [inline]**

Yield to another task. Make a task yield to another concurrently running task.

**5.12 ctype API**

Standard C ctype API functions.

**Functions**

- int [isupper](#) (int c)  
*Check if character is uppercase letter.*
- int [islower](#) (int c)  
*Check if character is lowercase letter.*
- int [isalpha](#) (int c)  
*Check if character is alphabetic.*
- int [isdigit](#) (int c)  
*Check if character is decimal digit.*
- int [isalnum](#) (int c)  
*Check if character is alphanumeric.*
- int [isspace](#) (int c)  
*Check if character is a white-space.*
- int [isctrl](#) (int c)  
*Check if character is a control character.*
- int [isprint](#) (int c)  
*Check if character is printable.*
- int [isgraph](#) (int c)  
*Check if character has graphical representation.*

- int `ispunct` (int *c*)  
*Check if character is a punctuation.*
- int `isxdigit` (int *c*)  
*Check if character is hexadecimal digit.*
- int `toupper` (int *c*)  
*Convert lowercase letter to uppercase.*
- int `tolower` (int *c*)  
*Convert uppercase letter to lowercase.*

### 5.12.1 Detailed Description

Standard C ctype API functions.

### 5.12.2 Function Documentation

#### 5.12.2.1 `int isalnum (int c) [inline]`

Check if character is alphanumeric. Checks if parameter *c* is either a decimal digit or an uppercase or lowercase letter. The result is true if either `isalpha` or `isdigit` would also return true.

#### Parameters:

*c* Character to be checked.

#### Returns:

Returns a non-zero value (true) if *c* is either a digit or a letter, otherwise it returns 0 (false).

#### 5.12.2.2 `int isalpha (int c) [inline]`

Check if character is alphabetic. Checks if parameter *c* is either an uppercase or lowercase letter.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is an alphabetic letter, otherwise it returns 0 (false).

**5.12.2.3 int iscntrl (int *c*) [inline]**

Check if character is a control character. Checks if parameter *c* is a control character.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a control character, otherwise it returns 0 (false).

**5.12.2.4 int isdigit (int *c*) [inline]**

Check if character is decimal digit. Checks if parameter *c* is a decimal digit character.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a decimal digit, otherwise it returns 0 (false).

**5.12.2.5 int isgraph (int *c*) [inline]**

Check if character has graphical representation. Checks if parameter *c* is a character with a graphical representation.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* has a graphical representation, otherwise it returns 0 (false).

**5.12.2.6 int islower (int *c*) [inline]**

Check if character is lowercase letter. Checks if parameter *c* is an lowercase alphabetic letter.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is an lowercase alphabetic letter, otherwise it returns 0 (false).

**5.12.2.7 int isprint (int *c*) [inline]**

Check if character is printable. Checks if parameter *c* is a printable character (i.e., not a control character).

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a printable character, otherwise it returns 0 (false).

**5.12.2.8 int ispunct (int *c*) [inline]**

Check if character is a punctuation. Checks if parameter *c* is a punctuation character.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a punctuation character, otherwise it returns 0 (false).

**5.12.2.9 int isspace (int *c*) [inline]**

Check if character is a white-space. Checks if parameter *c* is a white-space character.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a white-space character, otherwise it returns 0 (false).

**5.12.2.10 int isupper (int *c*) [inline]**

Check if character is uppercase letter. Checks if parameter *c* is an uppercase alphabetic letter.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is an uppercase alphabetic letter, otherwise it returns 0 (false).

**5.12.2.11 int isxdigit (int *c*) [inline]**

Check if character is hexadecimal digit. Checks if parameter *c* is a hexadecimal digit character.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a hexadecimal digit character, otherwise it returns 0 (false).

**5.12.2.12 int tolower (int *c*) [inline]**

Convert uppercase letter to lowercase. Converts parameter *c* to its lowercase equivalent if *c* is an uppercase letter and has a lowercase equivalent. If no such conversion is possible, the value returned is *c* unchanged.

**Parameters:**

*c* Uppercase letter character to be converted.

**Returns:**

The lowercase equivalent to *c*, if such value exists, or *c* (unchanged) otherwise..

**5.12.2.13 int toupper (int *c*) [inline]**

Convert lowercase letter to uppercase. Converts parameter *c* to its uppercase equivalent if *c* is a lowercase letter and has an uppercase equivalent. If no such conversion is possible, the value returned is *c* unchanged.

**Parameters:**

*c* Lowercase letter character to be converted.

**Returns:**

The uppercase equivalent to *c*, if such value exists, or *c* (unchanged) otherwise..

## 6 File Documentation

### 6.1 SPCAPIDocs.h File Reference

Additional documentation for the SPC API. #include "SPCDefs.h"

### 6.1.1 Detailed Description

Additional documentation for the SPC API. [SPCAPIDocs.h](#) contains additional documentation for the SPC API

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**Author:**

John Hansen (bricxcc\_at\_comcast.net)

**Date:**

2011-10-10

**Version:**

2

## 6.2 SPCDefs.h File Reference

Constants, macros, and API functions for SPC. `#include "spmem.h"`

### Defines

- `#define TRUE 1`
- `#define FALSE 0`
- `#define SERIAL_BUFFER_SIZE 255`
- `#define CHAR_BIT 32`
- `#define LONG_MIN -2147483648`
- `#define SCHAR_MIN -2147483648`
- `#define INT_MIN -2147483648`
- `#define CHAR_MIN -2147483648`
- `#define LONG_MAX 2147483647`
- `#define SCHAR_MAX 2147483647`

- #define INT\_MAX 2147483647
- #define CHAR\_MAX 2147483647
- #define DAC\_MODE\_DCOUT 0
- #define DAC\_MODE\_SINEWAVE 1
- #define DAC\_MODE\_SQUAREWAVE 2
- #define DAC\_MODE\_SAWPOSWAVE 3
- #define DAC\_MODE\_SAWNEGWAVE 4
- #define DAC\_MODE\_TRIANGLEWAVE 5
- #define DAC\_MODE\_PWMVOLTAGE 6
- #define LED\_BLUE 0x02
- #define LED\_RED 0x01
- #define DIGI\_PIN0 0x01
- #define DIGI\_PIN1 0x02
- #define DIGI\_PIN2 0x04
- #define DIGI\_PIN3 0x08
- #define DIGI\_PIN4 0x10
- #define DIGI\_PIN5 0x20
- #define DIGI\_PIN6 0x40
- #define DIGI\_PIN7 0x80
- #define STROBE\_S0 0x01
- #define STROBE\_S1 0x02
- #define STROBE\_S2 0x04
- #define STROBE\_S3 0x08
- #define STROBE\_READ 0x10
- #define STROBE\_WRITE 0x20
- #define SLOT1 0
- #define SLOT2 1
- #define SLOT3 2
- #define SLOT4 3
- #define SLOT5 4
- #define SLOT6 5
- #define SLOT7 6
- #define LOG\_STATUS\_OPEN 2
- #define LOG\_STATUS\_BUSY 1
- #define LOG\_STATUS\_CLOSED 0
- #define MS\_1 1
- #define MS\_2 2
- #define MS\_3 3
- #define MS\_4 4
- #define MS\_5 5
- #define MS\_6 6
- #define MS\_7 7
- #define MS\_8 8

- #define [MS\\_9](#) 9
- #define [MS\\_10](#) 10
- #define [MS\\_20](#) 20
- #define [MS\\_30](#) 30
- #define [MS\\_40](#) 40
- #define [MS\\_50](#) 50
- #define [MS\\_60](#) 60
- #define [MS\\_70](#) 70
- #define [MS\\_80](#) 80
- #define [MS\\_90](#) 90
- #define [MS\\_100](#) 100
- #define [MS\\_150](#) 150
- #define [MS\\_200](#) 200
- #define [MS\\_250](#) 250
- #define [MS\\_300](#) 300
- #define [MS\\_350](#) 350
- #define [MS\\_400](#) 400
- #define [MS\\_450](#) 450
- #define [MS\\_500](#) 500
- #define [MS\\_600](#) 600
- #define [MS\\_700](#) 700
- #define [MS\\_800](#) 800
- #define [MS\\_900](#) 900
- #define [SEC\\_1](#) 1000
- #define [SEC\\_2](#) 2000
- #define [SEC\\_3](#) 3000
- #define [SEC\\_4](#) 4000
- #define [SEC\\_5](#) 5000
- #define [SEC\\_6](#) 6000
- #define [SEC\\_7](#) 7000
- #define [SEC\\_8](#) 8000
- #define [SEC\\_9](#) 9000
- #define [SEC\\_10](#) 10000
- #define [SEC\\_15](#) 15000
- #define [SEC\\_20](#) 20000
- #define [SEC\\_30](#) 30000
- #define [MIN\\_1](#) 60000
- #define [TONE\\_A3](#) 220
- #define [TONE\\_AS3](#) 233
- #define [TONE\\_B3](#) 247
- #define [TONE\\_C4](#) 262
- #define [TONE\\_CS4](#) 277
- #define [TONE\\_D4](#) 294

- #define [TONE\\_DS4](#) 311
- #define [TONE\\_E4](#) 330
- #define [TONE\\_F4](#) 349
- #define [TONE\\_FS4](#) 370
- #define [TONE\\_G4](#) 392
- #define [TONE\\_GS4](#) 415
- #define [TONE\\_A4](#) 440
- #define [TONE\\_AS4](#) 466
- #define [TONE\\_B4](#) 494
- #define [TONE\\_C5](#) 523
- #define [TONE\\_CS5](#) 554
- #define [TONE\\_D5](#) 587
- #define [TONE\\_DS5](#) 622
- #define [TONE\\_E5](#) 659
- #define [TONE\\_F5](#) 698
- #define [TONE\\_FS5](#) 740
- #define [TONE\\_G5](#) 784
- #define [TONE\\_GS5](#) 831
- #define [TONE\\_A5](#) 880
- #define [TONE\\_AS5](#) 932
- #define [TONE\\_B5](#) 988
- #define [TONE\\_C6](#) 1047
- #define [TONE\\_CS6](#) 1109
- #define [TONE\\_D6](#) 1175
- #define [TONE\\_DS6](#) 1245
- #define [TONE\\_E6](#) 1319
- #define [TONE\\_F6](#) 1397
- #define [TONE\\_FS6](#) 1480
- #define [TONE\\_G6](#) 1568
- #define [TONE\\_GS6](#) 1661
- #define [TONE\\_A6](#) 1760
- #define [TONE\\_AS6](#) 1865
- #define [TONE\\_B6](#) 1976
- #define [TONE\\_C7](#) 2093
- #define [TONE\\_CS7](#) 2217
- #define [TONE\\_D7](#) 2349
- #define [TONE\\_DS7](#) 2489
- #define [TONE\\_E7](#) 2637
- #define [TONE\\_F7](#) 2794
- #define [TONE\\_FS7](#) 2960
- #define [TONE\\_G7](#) 3136
- #define [TONE\\_GS7](#) 3322
- #define [TONE\\_A7](#) 3520
- #define [TONE\\_AS7](#) 3729
- #define [TONE\\_B7](#) 3951

## Functions

- void **Wait** (long ms)  
*Wait some milliseconds.*
- void **Yield** (void)  
*Yield to another task.*
- void **StopAllTasks** (void)  
*Stop all tasks.*
- void **Stop** (bool bvalue)  
*Stop the running program.*
- void **ExitTo** (task newTask)  
*Exit to another task.*
- void **StartTask** (task t)  
*Start a task.*
- unsigned int **SizeOf** (variant &value)  
*Calculate the size of a variable.*
- int **read** (void)  
*Read a value from a file.*
- int **write** (const int value)  
*Write value to file.*
- int **sqrt** (int x)  
*Compute square root.*
- int **abs** (int num)  
*Absolute value.*
- char **sign** (int num)  
*Sign value.*
- int **close** (void)  
*Close file.*
- byte **open** (const char \*mode)  
*Open file.*

- char **putchar** (const char ch)  
*Write character to debug device.*
- int **puts** (const char \*str)  
*Write string to debug device.*
- void **printf** (const char \*format,...)  
*Print formatted data to debug device.*
- void **abort** (void)  
*Abort current process.*
- long **CurrentTick** (void)  
*Read the current system tick.*
- int **pop** (void)  
*Pop a value off the stack.*
- int **push** (int value)  
*Push a value onto the stack.*
- void **RotateLeft** (int &value)  
*Rotate left.*
- void **RotateRight** (int &value)  
*Rotate right.*
- void **Run** (const int slot)  
*Run another program.*
- int **stat** (void)  
*Check log file status.*
- void **StopProcesses** (void)  
*Stop all processes.*
- int **isupper** (int c)  
*Check if character is uppercase letter.*
- int **islower** (int c)  
*Check if character is lowercase letter.*

- int [isalpha](#) (int c)  
*Check if character is alphabetic.*
- int [isdigit](#) (int c)  
*Check if character is decimal digit.*
- int [isalnum](#) (int c)  
*Check if character is alphanumeric.*
- int [isspace](#) (int c)  
*Check if character is a white-space.*
- int [isctrl](#) (int c)  
*Check if character is a control character.*
- int [isprint](#) (int c)  
*Check if character is printable.*
- int [isgraph](#) (int c)  
*Check if character has graphical representation.*
- int [ispunct](#) (int c)  
*Check if character is a punctuation.*
- int [isxdigit](#) (int c)  
*Check if character is hexadecimal digit.*
- int [toupper](#) (int c)  
*Convert lowercase letter to uppercase.*
- int [tolower](#) (int c)  
*Convert uppercase letter to lowercase.*

### 6.2.1 Detailed Description

Constants, macros, and API functions for SPC. [SPCDefs.h](#) contains declarations for the SPC API resources

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**Date:**

2011-08-11

**Version:**

1

## 6.2.2 Define Documentation

### 6.2.2.1 #define CHAR\_BIT 32

The number of bits in the char type

### 6.2.2.2 #define CHAR\_MAX 2147483647

The maximum value of the char type

### 6.2.2.3 #define CHAR\_MIN -2147483648

The minimum value of the char type

### 6.2.2.4 #define DAC\_MODE\_DCOUT 0

Steady (DC) voltage output.

### 6.2.2.5 #define DAC\_MODE\_PWMVOLTAGE 6

PWM square wave output.

**6.2.2.6 #define DAC\_MODE\_SAWNEGWAVE 4**

Negative going sawtooth output.

**6.2.2.7 #define DAC\_MODE\_SAWPOSWAVE 3**

Positive going sawtooth output.

**6.2.2.8 #define DAC\_MODE\_SINEWAVE 1**

Sine wave output.

**6.2.2.9 #define DAC\_MODE\_SQUAREWAVE 2**

Square wave output.

**6.2.2.10 #define DAC\_MODE\_TRIANGLEWAVE 5**

Triangle wave output.

**6.2.2.11 #define DIGI\_PIN0 0x01**

Access digital pin 0 (B0)

**6.2.2.12 #define DIGI\_PIN1 0x02**

Access digital pin 1 (B1)

**6.2.2.13 #define DIGI\_PIN2 0x04**

Access digital pin 2 (B2)

**6.2.2.14 #define DIGI\_PIN3 0x08**

Access digital pin 3 (B3)

**6.2.2.15 #define DIGI\_PIN4 0x10**

Access digital pin 4 (B4)

**6.2.2.16 #define DIGI\_PIN5 0x20**

Access digital pin 5 (B5)

**6.2.2.17 #define DIGI\_PIN6 0x40**

Access digital pin 6 (B6)

**6.2.2.18 #define DIGI\_PIN7 0x80**

Access digital pin 7 (B7)

**6.2.2.19 #define FALSE 0**

A false value

**6.2.2.20 #define INT\_MAX 2147483647**

The maximum value of the int type

**6.2.2.21 #define INT\_MIN -2147483648**

The minimum value of the int type

**6.2.2.22 #define LED\_BLUE 0x02**

Turn on the blue onboard LED.

**6.2.2.23 #define LED\_RED 0x01**

Turn on the red onboard LED.

**6.2.2.24 #define LOG\_STATUS\_BUSY 1**

Log file is busy.

**6.2.2.25 #define LOG\_STATUS\_CLOSED 0**

Log file is closed.

**6.2.2.26 #define LOG\_STATUS\_OPEN 2**

Log file is open.

**6.2.2.27 #define LONG\_MAX 2147483647**

The maximum value of the long type

**6.2.2.28 #define LONG\_MIN -2147483648**

The minimum value of the long type

**6.2.2.29 #define MIN\_1 60000**

1 minute

**6.2.2.30 #define MS\_1 1**

1 millisecond

**6.2.2.31 #define MS\_10 10**

10 milliseconds

**6.2.2.32 #define MS\_100 100**

100 milliseconds

**6.2.2.33 #define MS\_150 150**

150 milliseconds

**6.2.2.34 #define MS\_2 2**

2 milliseconds

**6.2.2.35 #define MS\_20 20**

20 milliseconds

---

|                 |                           |                  |
|-----------------|---------------------------|------------------|
| <b>6.2.2.36</b> | <b>#define MS_200 200</b> | 200 milliseconds |
| <b>6.2.2.37</b> | <b>#define MS_250 250</b> | 250 milliseconds |
| <b>6.2.2.38</b> | <b>#define MS_3 3</b>     | 3 milliseconds   |
| <b>6.2.2.39</b> | <b>#define MS_30 30</b>   | 30 milliseconds  |
| <b>6.2.2.40</b> | <b>#define MS_300 300</b> | 300 milliseconds |
| <b>6.2.2.41</b> | <b>#define MS_350 350</b> | 350 milliseconds |
| <b>6.2.2.42</b> | <b>#define MS_4 4</b>     | 4 milliseconds   |
| <b>6.2.2.43</b> | <b>#define MS_40 40</b>   | 40 milliseconds  |
| <b>6.2.2.44</b> | <b>#define MS_400 400</b> | 400 milliseconds |
| <b>6.2.2.45</b> | <b>#define MS_450 450</b> | 450 milliseconds |

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|                 |                           |                  |
|-----------------|---------------------------|------------------|
| <b>6.2.2.46</b> | <b>#define MS_5 5</b>     | 5 milliseconds   |
| <b>6.2.2.47</b> | <b>#define MS_50 50</b>   | 50 milliseconds  |
| <b>6.2.2.48</b> | <b>#define MS_500 500</b> | 500 milliseconds |
| <b>6.2.2.49</b> | <b>#define MS_6 6</b>     | 6 milliseconds   |
| <b>6.2.2.50</b> | <b>#define MS_60 60</b>   | 60 milliseconds  |
| <b>6.2.2.51</b> | <b>#define MS_600 600</b> | 600 milliseconds |
| <b>6.2.2.52</b> | <b>#define MS_7 7</b>     | 7 milliseconds   |
| <b>6.2.2.53</b> | <b>#define MS_70 70</b>   | 70 milliseconds  |
| <b>6.2.2.54</b> | <b>#define MS_700 700</b> | 700 milliseconds |
| <b>6.2.2.55</b> | <b>#define MS_8 8</b>     | 8 milliseconds   |

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|                 |                                      |   |
|-----------------|--------------------------------------|---|
| <b>6.2.2.56</b> | <b>#define MS_80 80</b>              | 80 milliseconds                           |
| <b>6.2.2.57</b> | <b>#define MS_800 800</b>            | 800 milliseconds                          |
| <b>6.2.2.58</b> | <b>#define MS_9 9</b>                | 9 milliseconds                            |
| <b>6.2.2.59</b> | <b>#define MS_90 90</b>              | 90 milliseconds                           |
| <b>6.2.2.60</b> | <b>#define MS_900 900</b>            | 900 milliseconds                          |
| <b>6.2.2.61</b> | <b>#define SCHAR_MAX 2147483647</b>  | The maximum value of the signed char type |
| <b>6.2.2.62</b> | <b>#define SCHAR_MIN -2147483648</b> | The minimum value of the signed char type |
| <b>6.2.2.63</b> | <b>#define SEC_1 1000</b>            | 1 second                                  |
| <b>6.2.2.64</b> | <b>#define SEC_10 10000</b>          | 10 seconds                                |
| <b>6.2.2.65</b> | <b>#define SEC_15 15000</b>          | 15 seconds                                |

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|                 |                             |            |
|-----------------|-----------------------------|------------|
| <b>6.2.2.66</b> | <b>#define SEC_2 2000</b>   | 2 seconds  |
| <b>6.2.2.67</b> | <b>#define SEC_20 20000</b> | 20 seconds |
| <b>6.2.2.68</b> | <b>#define SEC_3 3000</b>   | 3 seconds  |
| <b>6.2.2.69</b> | <b>#define SEC_30 30000</b> | 30 seconds |
| <b>6.2.2.70</b> | <b>#define SEC_4 4000</b>   | 4 seconds  |
| <b>6.2.2.71</b> | <b>#define SEC_5 5000</b>   | 5 seconds  |
| <b>6.2.2.72</b> | <b>#define SEC_6 6000</b>   | 6 seconds  |
| <b>6.2.2.73</b> | <b>#define SEC_7 7000</b>   | 7 seconds  |
| <b>6.2.2.74</b> | <b>#define SEC_8 8000</b>   | 8 seconds  |
| <b>6.2.2.75</b> | <b>#define SEC_9 9000</b>   | 9 seconds  |

**6.2.2.76 #define SERIAL\_BUFFER\_SIZE 255**

Serial port receive and send buffer size

**6.2.2.77 #define SLOT1 0**

Program slot 1.

**6.2.2.78 #define SLOT2 1**

Program slot 2.

**6.2.2.79 #define SLOT3 2**

Program slot 3.

**6.2.2.80 #define SLOT4 3**

Program slot 4.

**6.2.2.81 #define SLOT5 4**

Program slot 5.

**6.2.2.82 #define SLOT6 5**

Program slot 6.

**6.2.2.83 #define SLOT7 6**

Program slot 7.

**6.2.2.84 #define STROBE\_READ 0x10**

Access read pin (RD)

**6.2.2.85 #define STROBE\_S0 0x01**

Access strobe 0 pin (S0)

**6.2.2.86 #define STROBE\_S1 0x02**

Access strobe 1 pin (S1)

**6.2.2.87 #define STROBE\_S2 0x04**

Access strobe 2 pin (S2)

**6.2.2.88 #define STROBE\_S3 0x08**

Access strobe 3 pin (S3)

**6.2.2.89 #define STROBE\_WRITE 0x20**

Access write pin (WR)

**6.2.2.90 #define TONE\_A3 220**

Third octave A

**6.2.2.91 #define TONE\_A4 440**

Fourth octave A

**6.2.2.92 #define TONE\_A5 880**

Fifth octave A

**6.2.2.93 #define TONE\_A6 1760**

Sixth octave A

**6.2.2.94 #define TONE\_A7 3520**

Seventh octave A

**6.2.2.95 #define TONE\_AS3 233**

Third octave A sharp

**6.2.2.96 #define TONE\_AS4 466**

Fourth octave A sharp

**6.2.2.97 #define TONE\_AS5 932**

Fifth octave A sharp

**6.2.2.98 #define TONE\_AS6 1865**

Sixth octave A sharp

**6.2.2.99 #define TONE\_AS7 3729**

Seventh octave A sharp

**6.2.2.100 #define TONE\_B3 247**

Third octave B

**6.2.2.101 #define TONE\_B4 494**

Fourth octave B

**6.2.2.102 #define TONE\_B5 988**

Fifth octave B

**6.2.2.103 #define TONE\_B6 1976**

Sixth octave B

**6.2.2.104 #define TONE\_B7 3951**

Seventh octave B

**6.2.2.105 #define TONE\_C4 262**

Fourth octave C

**6.2.2.106 #define TONE\_C5 523**

Fifth octave C

**6.2.2.107 #define TONE\_C6 1047**

Sixth octave C

**6.2.2.108 #define TONE\_C7 2093**

Seventh octave C

**6.2.2.109 #define TONE\_CS4 277**

Fourth octave C sharp

**6.2.2.110 #define TONE\_CS5 554**

Fifth octave C sharp

**6.2.2.111 #define TONE\_CS6 1109**

Sixth octave C sharp

**6.2.2.112 #define TONE\_CS7 2217**

Seventh octave C sharp

**6.2.2.113 #define TONE\_D4 294**

Fourth octave D

**6.2.2.114 #define TONE\_D5 587**

Fifth octave D

**6.2.2.115 #define TONE\_D6 1175**

Sixth octave D

**6.2.2.116 #define TONE\_D7 2349**

Seventh octave D

**6.2.2.117 #define TONE\_DS4 311**

Fourth octave D sharp

**6.2.2.118 #define TONE\_DS5 622**

Fifth octave D sharp

**6.2.2.119 #define TONE\_DS6 1245**

Sixth octave D sharp

**6.2.2.120 #define TONE\_DS7 2489**

Seventh octave D sharp

**6.2.2.121 #define TONE\_E4 330**

Fourth octave E

**6.2.2.122 #define TONE\_E5 659**

Fifth octave E

**6.2.2.123 #define TONE\_E6 1319**

Sixth octave E

**6.2.2.124 #define TONE\_E7 2637**

Seventh octave E

**6.2.2.125 #define TONE\_F4 349**

Fourth octave F

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|           |                              |                        |
|-----------|------------------------------|------------------------|
| 6.2.2.126 | <b>#define TONE_F5 698</b>   | Fifth octave F         |
| 6.2.2.127 | <b>#define TONE_F6 1397</b>  | Sixth octave F         |
| 6.2.2.128 | <b>#define TONE_F7 2794</b>  | Seventh octave F       |
| 6.2.2.129 | <b>#define TONE_FS4 370</b>  | Fourth octave F sharp  |
| 6.2.2.130 | <b>#define TONE_FS5 740</b>  | Fifth octave F sharp   |
| 6.2.2.131 | <b>#define TONE_FS6 1480</b> | Sixth octave F sharp   |
| 6.2.2.132 | <b>#define TONE_FS7 2960</b> | Seventh octave F sharp |
| 6.2.2.133 | <b>#define TONE_G4 392</b>   | Fourth octave G        |
| 6.2.2.134 | <b>#define TONE_G5 784</b>   | Fifth octave G         |
| 6.2.2.135 | <b>#define TONE_G6 1568</b>  | Sixth octave G         |

**6.2.2.136 #define TONE\_G7 3136**

Seventh octave G

**6.2.2.137 #define TONE\_GS4 415**

Fourth octave G sharp

**6.2.2.138 #define TONE\_GS5 831**

Fifth octave G sharp

**6.2.2.139 #define TONE\_GS6 1661**

Sixth octave G sharp

**6.2.2.140 #define TONE\_GS7 3322**

Seventh octave G sharp

**6.2.2.141 #define TRUE 1**

A true value

**6.2.3 Function Documentation****6.2.3.1 void abort (void) [inline]**

Abort current process. Aborts the process with an abnormal program termination. The function never returns to its caller.

**6.2.3.2 int abs (int *num*) [inline]**

Absolute value. Return the absolute value of the value argument. Any scalar type can be passed into this function.

**Parameters:**

*num* The numeric value.

**Returns:**

The absolute value of num. The return type matches the input type.

**6.2.3.3 int close (void) [inline]**

Close file. Close the log file.

**Returns:**

The result code.

**6.2.3.4 long CurrentTick (void) [inline]**

Read the current system tick. This function lets you current system tick count.

**Returns:**

The current system tick count.

**6.2.3.5 void ExitTo (task *newTask*) [inline]**

Exit to another task. Immediately exit the current task and start executing the specified task.

**Parameters:**

*newTask* The task to start executing after exiting the current task.

**6.2.3.6 int isalnum (int *c*) [inline]**

Check if character is alphanumeric. Checks if parameter *c* is either a decimal digit or an uppercase or lowercase letter. The result is true if either isalpha or isdigit would also return true.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is either a digit or a letter, otherwise it returns 0 (false).

**6.2.3.7 int isalpha (int *c*) [inline]**

Check if character is alphabetic. Checks if parameter *c* is either an uppercase or lowercase letter.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is an alphabetic letter, otherwise it returns 0 (false).

**6.2.3.8 int isctrl (int *c*) [inline]**

Check if character is a control character. Checks if parameter *c* is a control character.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a control character, otherwise it returns 0 (false).

**6.2.3.9 int isdigit (int *c*) [inline]**

Check if character is decimal digit. Checks if parameter *c* is a decimal digit character.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a decimal digit, otherwise it returns 0 (false).

**6.2.3.10 int isgraph (int *c*) [inline]**

Check if character has graphical representation. Checks if parameter *c* is a character with a graphical representation.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* has a graphical representation, otherwise it returns 0 (false).

**6.2.3.11 int islower (int *c*) [inline]**

Check if character is lowercase letter. Checks if parameter *c* is an lowercase alphabetic letter.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is an lowercase alphabetic letter, otherwise it returns 0 (false).

**6.2.3.12 int isprint (int *c*) [inline]**

Check if character is printable. Checks if parameter *c* is a printable character (i.e., not a control character).

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a printable character, otherwise it returns 0 (false).

**6.2.3.13 int ispunct (int *c*) [inline]**

Check if character is a punctuation. Checks if parameter *c* is a punctuation character.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a punctuation character, otherwise it returns 0 (false).

**6.2.3.14 int isspace (int *c*) [inline]**

Check if character is a white-space. Checks if parameter *c* is a white-space character.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is a white-space character, otherwise it returns 0 (false).

**6.2.3.15 int isupper (int *c*) [inline]**

Check if character is uppercase letter. Checks if parameter *c* is an uppercase alphabetic letter.

**Parameters:**

*c* Character to be checked.

**Returns:**

Returns a non-zero value (true) if *c* is an uppercase alphabetic letter, otherwise it returns 0 (false).

### 6.2.3.16 int isxdigit (int *c*) [inline]

Check if character is hexadecimal digit. Checks if parameter *c* is a hexadecimal digit character.

#### Parameters:

*c* Character to be checked.

#### Returns:

Returns a non-zero value (true) if *c* is a hexadecimal digit character, otherwise it returns 0 (false).

### 6.2.3.17 byte open (const char \* *mode*) [inline]

Open file. Opens the log file. The operations that are allowed on the stream and how these are performed are defined by the mode parameter.

#### Parameters:

*mode* The file access mode. Valid values are "r" - opens the existing log file for reading, "w" - creates a new log file and opens it for writing.

#### Returns:

The result code.

### 6.2.3.18 int pop (void) [inline]

Pop a value off the stack. Pop a 32-bit integer value off the top of the stack.

#### Returns:

The value popped off the top of the stack.

### 6.2.3.19 void printf (const char \* *format*, ...) [inline]

Print formatted data to debug device. Writes to the debug device a sequence of data formatted as the format argument specifies. After the format parameter, the function expects a variable number of parameters.

**Parameters:**

*format* A constant string literal specifying the desired format.

**6.2.3.20 int push (int value) [inline]**

Push a value onto the stack. Push a 32-bit integer value onto the top of the stack.

**Parameters:**

*value* The value you want to push onto the stack.

**Returns:**

The value pushed onto the stack.

**6.2.3.21 char putchar (const char ch) [inline]**

Write character to debug device. Writes a character to the debug device. If there are no errors, the same character that has been written is returned.

**Parameters:**

*ch* The character to be written.

**Returns:**

The character written to the file.

**6.2.3.22 int puts (const char \* str) [inline]**

Write string to debug device. Writes the string to the debug device. The null terminating character at the end of the string is not written. If there are no errors, a non-negative value is returned.

**Parameters:**

*str* The string of characters to be written.

**Returns:**

The result code.

**6.2.3.23 int read (void) [inline]**

Read a value from a file. Read a value from the file associated with the specified handle. The handle parameter must be a variable. The value parameter must be a variable. The type of the value parameter determines the number of bytes of data read.

**Returns:**

The function call result.

**6.2.3.24 void RotateLeft (int & value) [inline]**

Rotate left. Rotate the specified variable one bit left through carry.

**Parameters:**

*value* The value to rotate left one bit.

**6.2.3.25 void RotateRight (int & value) [inline]**

Rotate right. Rotate the specified variable one bit right through carry.

**Parameters:**

*value* The value to rotate right one bit.

**6.2.3.26 void Run (const int slot) [inline]**

Run another program. Run the program in the specified slot. The current program will terminate.

**Parameters:**

*slot* The constant slot number for the program you want to execute. See [Program slot constants](#).

**6.2.3.27 char sign (int num) [inline]**

Sign value. Return the sign of the value argument (-1, 0, or 1). Any scalar type can be passed into this function.

**Parameters:**

*num* The numeric value for which to calculate its sign value.

**Returns:**

-1 if the parameter is negative, 0 if the parameter is zero, or 1 if the parameter is positive.

**6.2.3.28 unsigned int SizeOf (variant & value) [inline]**

Calculate the size of a variable. Calculate the number of bytes required to store the contents of the variable passed into the function.

**Parameters:**

*value* The variable.

**Returns:**

The number of bytes occupied by the variable.

**6.2.3.29 int sqrt (int x) [inline]**

Compute square root. Computes the square root of x.

**Parameters:**

*x* integer value.

**Returns:**

Square root of x.

**6.2.3.30 void StartTask (task *t*) [inline]**

Start a task. Start the specified task.

**Parameters:**

*t* The task to start.

**6.2.3.31 int stat (void) [inline]**

Check log file status. Check the status of the system log file.

**Returns:**

The log file status. See [Log status constants](#).

**6.2.3.32 void Stop (bool *bvalue*) [inline]**

Stop the running program. Stop the running program if *bvalue* is true. This will halt the program completely, so any code following this command will be ignored.

**Parameters:**

*bvalue* If this value is true the program will stop executing.

**6.2.3.33 void StopAllTasks (void) [inline]**

Stop all tasks. Stop all currently running tasks. This will halt the program completely, so any code following this command will be ignored.

**6.2.3.34 void StopProcesses (void) [inline]**

Stop all processes. Stop all running tasks except for the main task.

**6.2.3.35 int tolower (int *c*) [inline]**

Convert uppercase letter to lowercase. Converts parameter *c* to its lowercase equivalent if *c* is an uppercase letter and has a lowercase equivalent. If no such conversion is possible, the value returned is *c* unchanged.

**Parameters:**

*c* Uppercase letter character to be converted.

**Returns:**

The lowercase equivalent to *c*, if such value exists, or *c* (unchanged) otherwise..

**6.2.3.36 int toupper (int *c*) [inline]**

Convert lowercase letter to uppercase. Converts parameter *c* to its uppercase equivalent if *c* is a lowercase letter and has an uppercase equivalent. If no such conversion is possible, the value returned is *c* unchanged.

**Parameters:**

*c* Lowercase letter character to be converted.

**Returns:**

The uppercase equivalent to *c*, if such value exists, or *c* (unchanged) otherwise..

**6.2.3.37 void Wait (long *ms*) [inline]**

Wait some milliseconds. Make a task sleep for specified amount of time (in 1000ths of a second).

**Parameters:**

*ms* The number of milliseconds to sleep.

### 6.2.3.38 int write (const int *value*) [inline]

Write value to file. Write a value to the file associated with the specified handle. The handle parameter must be a variable. The value parameter must be a constant, a constant expression, or a variable. The type of the value parameter determines the number of bytes of data written.

#### Parameters:

*value* The value to write to the file.

#### Returns:

The function call result.

### 6.2.3.39 void Yield (void) [inline]

Yield to another task. Make a task yield to another concurrently running task.

## 6.3 spmem.h File Reference

Constants defining superpro shared memory addresses.

#### Defines

- #define [ADChannel0](#) @0x00
- #define [ADChannel1](#) @0x01
- #define [ADChannel2](#) @0x02
- #define [ADChannel3](#) @0x03
- #define [DigitalIn](#) @0x08
- #define [DigitalOut](#) @0x09
- #define [DigitalControl](#) @0x0A
- #define [StrobeControl](#) @0x0B
- #define [Timer0](#) @0x0C
- #define [Timer1](#) @0x0D
- #define [Timer2](#) @0x0E
- #define [Timer3](#) @0x0F
- #define [SerialInCount](#) @0x10
- #define [SerialInByte](#) @0x11
- #define [SerialOutCount](#) @0x12

- #define `SerialOutByte` @0x13
- #define `DAC0Mode` @0x18
- #define `DAC0Frequency` @0x19
- #define `DAC0Voltage` @0x1A
- #define `DAC1Mode` @0x1B
- #define `DAC1Frequency` @0x1C
- #define `DAC1Voltage` @0x1D
- #define `LEDControl` @0x1E
- #define `SystemClock` @0x1F

### 6.3.1 Detailed Description

Constants defining superpro shared memory addresses. `spmem.h` contains declarations for superpro shared memory addresses.

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John Hansen (bricxcc\_at\_comcast.net)

**Date:**

2011-09-01

**Version:**

1

### 6.3.2 Define Documentation

#### 6.3.2.1 #define `ADChannel0` @0x00

Reads the current voltage on A0 input. Value ranges from 0 to 1023. Updated every millisecond. Read only.

**6.3.2.2 #define ADChannel1 @0x01**

Reads the current voltage on A1 input. Value ranges from 0 to 1023. Updated every millisecond. Read only.

**6.3.2.3 #define ADChannel2 @0x02**

Reads the current voltage on A2 input. Value ranges from 0 to 1023. Updated every millisecond. Read only.

**6.3.2.4 #define ADChannel3 @0x03**

Reads the current voltage on A3 input. Value ranges from 0 to 1023. Updated every millisecond. Read only.

**6.3.2.5 #define DAC0Frequency @0x19**

Control the frequency of the DAC0 analog output (O0). Read/write.

**6.3.2.6 #define DAC0Mode @0x18**

Control the operation of the DAC0 analog output (O0). See [SuperPro analog output mode constants](#) for valid values. Read/write.

**6.3.2.7 #define DAC0Voltage @0x1A**

Control the voltage of the DAC0 analog output (O0). Read/write.

**6.3.2.8 #define DAC1Frequency @0x1C**

Control the frequency of the DAC1 analog output (O1). Read/write.

**6.3.2.9 #define DAC1Mode @0x1B**

Control the operation of the DAC1 analog output (O1). See [SuperPro analog output mode constants](#) for valid values. Read/write.

**6.3.2.10 #define DAC1Voltage @0x1D**

Control the voltage of the DAC1 analog output (O1). Read/write.

**6.3.2.11 #define DigitalControl @0x0A**

Write 8 bits to the digital control port B0 - B7. Set the mode of any of the 8 digital signals. 1 == output, 0 == input.

**6.3.2.12 #define DigitalIn @0x08**

Read 8 bits from the digital port B0 - B7. Read only.

**6.3.2.13 #define DigitalOut @0x09**

Write 8 bits to the digital port B0 - B7. Read/Write.

**6.3.2.14 #define LEDControl @0x1E**

Control the operation of the two onboard LDEs (red and blue). See [SuperPro LED control constants](#) for valid values. Read/write.

**6.3.2.15 #define SerialInByte @0x11**

Read the next serial byte from the serial port receive queue. Reading this value removes the byte from the receive queue. Serial port input data is stored in a 255 byte temporary buffer. Read only.

**6.3.2.16 #define SerialInCount @0x10**

Read the count of serial bytes in the receive queue. Enables a user program to check if any data is available to be read from the serial port. Read only.

**6.3.2.17 #define SerialOutByte @0x13**

Write a byte to the serial port send queue. Serial port output data is stored in a 255 byte temporary buffer. Do not write to this address if SerialCount is 255. Write only.

**6.3.2.18 #define SerialOutCount @0x12**

Read the count of serial bytes in the send queue. Enables a user program to check how many bytes are waiting to be sent out the serial port. Read only.

**6.3.2.19 #define StrobeControl @0x0B**

Write 6 bits to the digital strobe port S0 - WR. Controls the operation of the six strobe outputs (S0, S1, S2, S3, RD, and WR). See [SuperPro Strobe control constants](#) for valid values.

**6.3.2.20 #define SystemClock @0x1F**

Read the system clock. The system clock counts up continuously at one count per millisecond. Read only.

**6.3.2.21 #define Timer0 @0x0C**

Read/write countdown timer 0. Counts down until it reaches zero (per millisecond).

**6.3.2.22 #define Timer1 @0x0D**

Read/write countdown timer 1. Counts down until it reaches zero (per millisecond).

**6.3.2.23 #define Timer2 @0x0E**

Read/write countdown timer 2. Counts down until it reaches zero (per millisecond).

**6.3.2.24 #define Timer3 @0x0F**

Read/write countdown timer 3. Counts down until it reaches zero (per millisecond).

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