PACIFIC SCIENTIFIC

HIGH PERFORMANCE MOTORS & DRIVES

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Part# MA950-LR
List Price $60 U.S.
May, 1999
Rev F

# M A 9 5 0 - L R

## 950BASIC Reference Manual

## Version 4.1

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# 1 950BASIC Language

**In this chapter**

This chapter describes the overall structure of a 950BASIC program, and the elements of the 950BASIC language. Topics covered are:

- scope
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  - global variables, constants and aliases
  - 'main' program, subroutines, functions and interrupt handlers
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## 1.1 950BASIC Program Structure

**Local variables**

The notion of 'scope' is a key concept in 950BASIC programs. By 'scope', we mean those parts of the program in which a particular name is 'visible'. There are two levels of scope in 950BASIC — global and local. Variables (and constant definitions, aliases, and so on) that are defined inside a 'main' definition, or a subroutine, function, or interrupt handler definition, are considered to be 'local' in scope — that is, they are visible only within that function.

**Global variables**

All other definitions (those occurring outside functions, for example) are considered ‘global’ in scope — they are visible inside main, and inside any subroutine, function, or interrupt handler.

For example, consider the following simple 950BASIC program:

```
dim i as integer
main
dim i as integer
       for i = 1 to 10
          print “the cube of ”;i;" is “;cube(i)
          call increment
       next i
end main
function cube(i as integer) as integer
       cube = i * i * i
end function
sub increment
       i = i+1
end sub
```

This program prints a table of the cubes of the integers from 1 to 10. The first (global) definition of ‘i’ is visible inside subroutine ‘increment’, but ‘shadowed’ by the ‘i’ in main and function ‘cube’. The definition of ‘i’ inside ‘main’ is local to ‘main’, and is NOT the same variable as the ‘i’ inside the function ‘cube’, or inside the subroutine ‘increment’. These same scope rules apply to constant definitions and aliases, as well.

## 1.2 Program Sections

The major sections of a 950BASIC program are:

- setup parameter definitions
- global variables, constants, and aliases
- ‘main’ program, subroutines, functions, and interrupt handlers

Although these sections may appear in any order, we recommend that you keep them in the order shown, or at least choose a single layout style and use it consistently.

## Program template

The program below is an example of the template generated automatically by 950IDE:

```
params
'———————— Parameter Values Header ————————
' Drive:                SC952
' Motor:                R32G
' Performance Setting:   Medium
' Inertia Ratio:        0
'————————— params start ———————————————
ARF0              = 150.000000
ARF1              = 750.000000
Commoff           = 0.000000
ILmtMinus         = 100.000000
ILmtPlus          = 100.000000
ItThresh          = 60.000000
Kip               = 144.513255
Kpp               = 15.000000
Kvi               = 5.000000
Kvp               = 0.059626
Polecount         = 4
BDIOMap1          = Fault_Reset_Inp_Lo
BDIOMap2          = CW_Inhibit_Inp_Lo
BDIOMap3          = CCW_Inhibit_Inp_Lo
BDIOMap4          = 0
BDIOMap5          = Brake_Out_Hi
BDIOMap6          = Fault_Out_Hi
'————————— params end ————————————————
end params
'———————— Define (dim) Global Variables ————
'———————— Main Program ———————————————-
main
end main
'———————— Subroutines and Functions ———————
'———————— Interrupt Routines ————————————-
```

These sections are described in greater detail in the following paragraphs.

### Setup parameter definitions

This section of the program defines the power-on default parameters for servocontroller tuning and configuration. It is executed immediately upon power-up, before entering 'main', and before any interrupts are enabled. The section begins with the keyword 'params' and ends with the keywords 'end' or 'end params' or 'endparams' (this is similar to the format used to define a subroutine or function). The only statements permitted in this section are assignment statements of the form:

```
<pre-defined variable> = <constant expression>
```

This section is automatically generated by 950IDE when File|New is selected from the main menu. Ordinarily, you will not need to modify the statements in this section — they are automatically given optimal values based on the 'new program' dialog, and should not be changed unless further tuning is necessary.

### Global variables, constants, and aliases

This section contains variables, constant definitions, and alias expressions that are considered 'global' in scope — that is, they apply everywhere in the program, unless specifically overridden by another declaration at 'local' scope (inside a subroutine, function, or interrupt handler). Global definitions may be placed almost anywhere in the program text — between subroutines, before or after 'main', and so on.

Global variables, constants, and aliases do not need to be defined before use — the only requirement is that they be defined at some point in the program text. So, in effect, you may have multiple instances of the 'global variables' section throughout your program. However, as a matter of good programming style, we recommend that you keep all global definitions in one place, preferably at or near the beginning of your program.

### Variable definitions

The format of a global variable definition is best described by the following examples:

- `dim a,b, as integer, x,y,z as float`
- `dim ia(3,4) as integer`
- `dim s1, s2 as string*80`
- `dim sa(5,2) as string`

Line 1 declares a and b as integers, x,y, and z as floats. Line 2 declares a 3 x 4 array of integers. Line 3 declares s1 and s2 as strings, each of length 80 Line 4 declares sa as a 5 x 2 array of strings, each with the default length of 32 characters.

In addition, global variables can be specified as 'nv' to indicate that their values are retained when power is turned off. All other global variables are automatically initialized when the program begins (strings are set to empty, and floats and integers are set to 0). There are no restrictions on the ordering of volatile vs. non-volatile user-variables. However, we recommend that, for ease of program maintenance, you place all non-volatile variables definitions in a single section at the beginning of the program, and add new variables to the **end** of that section.

### Constant definitions

The format of a constant declaration is:

```
<name> = <constant_expression>
```

as in

```
const ARRAY_SIZE = 4 * NUMBER_OF_ENTRIES
const PI_SQUARE = 3.1415926535 ^ 2
const GREETING = "Hello"
const SALUTATION = GREETING + ", world!"
const NUMBER_OF_ENTRIES = 5
```

Names for constants follow the same rules as variable names (see below). 'Forward definitions' are allowed; circular definitions are detected and reported at compile-time. Although it is not required, you will probably find it convenient to adopt a convention of keeping all constants in UPPER_CASE, so that you can easily distinguish between constants and variables in your program.

Constant definitions are entirely 'folded' at compile-time. This means that you should always feel free to write maintainable constant expressions such as:

```
const LENGTH = 3
const WIDTH = 10
const AREA = LENGTH * WIDTH
```

The value of AREA is computed at compile-time, so your program will NOT need to compute this at run-time, and your program will be easier to maintain if LENGTH changes at some future date.

**Alias definitions**

An alias is just what you would expect — another name for something. Aliases allow you to define your own names for system resources such as input / output pins. The intention is to make it possible for you to use names that are meaningful to you in your particular application.

The format of an alias expression is:

```
alias <name> = <expression>
```

For example, the following alias defines application-specific uses of input # 1:

```
alias CONVEYOR_IS_RUNNING = (inp1=0)
alias CONVEYOR_IS_STOPPED = (inp1=1)
if CONVEYOR_IS_RUNNING then print
"running" else print "stopped"
```

An alias is much more powerful than a constant. Constant expressions are computable at compile-time, while an alias has a value that is only known (in general) at the time it is used. For this reason, aliases should be used with care — too much aliasing can make it very difficult for you to understand your program.

## 1.3 ‘Main’ program, Subroutines, Functions and Interrupt Handlers

These sections share the same fundamental structure:

```
<section>
       <declarations>
       <statements>
<section end>
```

An example of each of these sections follows, with an explanation of key points.

**‘Main’ definition**

For ‘main’, a typical definition might be

```
main
dim i as integer
       i = 1
       print i
end main
```

Note that the variable ‘i’ defined above in the ‘dim’ statement is a local variable — it is not accessible to other functions, and inside ‘main’, its definition overrides any other variable named ‘i’ that might exist at global scope.

Unlike global variables, local variables MUST be defined at the beginning of the section — they must appear before any executable statement in main. For example, the following is illegal:

```
main
dim i as integer
i = 1
dim j as integer        ‘this is an error!
j = i
end main
```

You may also define local constant definitions and aliases, provided that, like local variables, they appear before any executable statement. Local constant definitions override global definitions of the same name.

For example, given the following global definitions,

```
const N = 1
main
const N = "Hello, world!"
print N
call sub1
end main
sub sub1
      print N
end sub
```

The program will print:

```
Hello world!
1
```

because the N visible inside 'main' is the constant defined there, while the N visible to 'sub1' is the global constant N, whose value is 1.

The 'main' program is the section of your program that will be executed immediately after the 'params' section, regardless of its position in the program text. Other functions, subroutines, and interrupt handlers are executed according to the flow of control defined in the program.

'Main' does not accept arguments, and cannot be called from any other subroutine, function, or interrupt handler.

**Subroutine definition**

For a subroutine, say, 'print_sum', a typical definition might be:

```
sub print_sum(i,j as integer)
      print i+j
end sub
```

The arguments to this subroutine are specified as integer variables, and are passed 'by value' — any assignments to these variables will have no effect on the arguments supplied by the caller. Subroutines are invoked by 'call' instructions, as in

```
call print_sum(3,4)
```

**Function definition**

For a function, say, 'sum_squares', a typical definition might be:

```
function sum_squares(i,j as integer) as integer
      sum_squares = i^2 + j^2
end function
```

The function above returns a value of type integer. The value of the function is assigned by assigning to the name of the function, as if it were a variable. Note, however, that it is not legal to use the function name as a variable on the right-hand-side of an assignment — a function name on the right-hand-side is always an INVOCATION of that function.

There must be at least one statement in the function that assigns a value to the function. However, it is not possible, in general, to detect at compile-time if that statement will actually be executed.

Functions are invoked by name, as in

```
print sum_squares(3,4)
```

**Note:** *This is syntactically identical to an array reference.*

**Interrupt handler definition**

For an interrupt handler, say ‘i1hi’, a typical definition might be:

```
interrupt i1hi
       print “interrupt occurred on input 1"
       intri1hi = TRUE
end interrupt
```

Note that the interrupt is re-enabled by the statement ‘intri1hi = TRUE’. A similar statement must be executed once before the interrupt can be serviced. It is a run-time error to attempt to enable an interrupt for which no handler has been defined.

Interrupt handlers do not return values, and cannot have arguments. They can, however, declare local variables, constants, and aliases, just like other subroutines.

Interrupt handlers are invoked when the 950 hardware detects that the designated interrupt condition has been satisfied (provided that the interrupt has been enabled).

## 1.4 Language definition

**Lexical conventions**

950BASIC is case-insensitive. String literals are not modified, but all other text is treated as if it was entered in upper case. This means that the identifiers “spin”, “Spin”, and “SPIN” all refer to the same entity.

**Identifiers**

Identifiers are alphanumeric, and must start with an alphabetic character or underscore. In addition, they may include the underscore character (‘_’) and dollar sign (‘$’). Identifiers denote variables, functions, subroutines, and statement labels, symbolic constants, and aliases. Identifiers can be at most 40 characters long. User-defined identifiers may not include the period (‘.’). Use of a longer identifier is a compile-time error.

There are several pre-defined variables that have a special form:

| | |
|---|---|
| predefvar | {alpha} {alnum}* '.' {alnum}* |
| alpha | [A-Za-z_] |
| alnum | [A-Za-z_0-9$] |

Many of these pre-defined variables have alternate spellings without the '.' character, such as index.dist and IndexDist. Although both forms are accepted for compatibility, the latter form is preferred, since the '.' character may be used in a future version to indicate structure members. And, although 950BASIC is case-insensitive, we recommend that you adopt a consistent naming convention, such as IndexDist, and avoid having indexDist, index.dist, and Indexdist in the same program.

## Data types

The pre-defined types are INTEGER, FLOAT, and STRING. LONG may be used for INTEGER, and SINGLE or DOUBLE for FLOAT. INTEGER variables are 32-bit signed integers. FLOAT variables are IEEE single-precision floating point numbers. STRING variables are represented internally as a maximum length, a current length, and an array of ascii characters (this means that strings may contain null characters).

When a FLOAT result is assigned to an INTEGER variable, or when a FLOAT argument is used where and INTEGER is expected, the value is coerced to an integer before use. Coercion from FLOAT to INT always rounds to the nearest integer. For example,

```
1.2 rounds to 1

1.7 rounds to 2

-1.2 rounds to -1

-1.7 rounds to -2
```

Scalar INTEGER and FLOAT coercion is automatically provided for function arguments. When passing ARRAYS as arguments, however, the types must match exactly, since coercion could be prohibitively expensive at run-time

String assignment is checked at run-time — an attempt to copy a string to a destination that is too small will result in a run-time error. String indexing is 1-origin. For example, mid$(“abc”,1,1) returns the string “a”.

STRING variables have a firmware-imposed maximum length of 230 characters, and a default maximum length of 32 characters. They may be assigned a different maximum length by declaring them to be of type STRING*n where n is a positive integer between 1 and 230 (inclusive).

Arrays of any of the pre-defined types can be declared. Arrays have a maximum rank of 4 dimensions. The upper bound of each dimension has no compiler-defined limit; however, because of the limited data space of the controller, there is a logical upper bound which depends on the controller model.

Array indexing is 1-origin. The indices in each dimension range from 1 to the upper bound of the dimension. Every reference to an array element is checked at run-time — any attempt to reference beyond the bounds of the array causes a run-time error.

New types can not be defined (there is no support for the TYPE construct of QuickBasic).

**Literal constants**

String constants begin and end with the double-quote character (“”). They can not extend past the end of the input line. Any printable ASCII character may appear in a string constant. An attempt to generate a string literal with non-ASCII characters will cause a compile-time error. Although no check is made to verify that non-ASCII strings are not created at run-time, you should avoid doing so, because attempting to print non-ASCII characters at run-time may confuse the Integrated Development Environment’s debugger.

### Decimal integer constants

Decimal integer constants are a string of decimal digits with no decimal point. A leading '-' sign is optional (and is parsed as a unary minus). For example,

```
1

-1

314159
```

are all valid decimal constants.

### Hexadecimal constants

Hexadecimal constants are denoted by a leading '&H' or '&h', and can not have a sign or decimal point. Hexadecimal constants are composed from the set [0-9A-Fa-f]; upper and lower case may be mixed. For example,

```
&h00ff

&HFF00

&H1234abcd
```

are all valid hexadecimal constants.

**Note:** *Octal and binary constants are not supported.*

### Floating-point constants

Floating-point constants are specified in fixed-point or mantissa-exponent notation. A floating-point constant consists of one of the following.

**Note:** *"." is not a legal floating-point constant, by design.*

| | |
|---|---|
| digit | [0-9] |
| optsign | '+' \| '-' \| /* nothing */ |
| fixed | optsign {digit}+ '.' {digit}*<br>optsign '.' {digit}+ |
| exp | fixed 'e' optsign {digit}+ |
| float | fixed \| exp |

For example:

```
0.1

.1

-.1

-0.1

3.14159E-6

-1.0E6
```

are all valid floating point constants.

## 1.5 Statements

Statements are separated by a new line (CR-LF) or a colon (':').

The statements of the language are:

**AbortMotion**

AbortMotion stops motor motion while allowing continued program execution. Deceleration is determined by the motor torque capability in conjunction with the current limit parameters.

**Alias**

`Alias <name> = <expression>`

Create an alias for an identifier (**Note:** *not just any identifier*). "alias" can be a pre-defined variable or another alias; "id" must be a legal variable name. **Note:** *You cannot create an alias for an array element.*

Like Const definitions, Alias definitions can be made to identifiers not yet defined. Circular definitions are not allowed.

**Note:** *Any duplicate definition of an identifier in the same scope is illegal. However, a local definition can shadow a definition from the global scope. Note that using a single identifier to denote two different objects is disallowed, i.e. you can't have both a label and a variable named "all_done".*

Like constant, variable, and function declarations, Alias declarations made in the global scope are imported into all functions (including the main function).

Example

```
Alias speed = motor.speed     'save some keystrokes
```

**Beep**

Sends the ASCII character &h7 to the serial port.

**Call**

```
CALL sub[(arg1, arg2, ...)]
```

"sub" is the name of a subroutine. The current program counter is saved, sub is invoked, and when sub finishes (by reaching an "exit sub" or "end sub" statement) control is returned to the statement logically following the Call.

A subroutine is essentially a function with no return value. The parameter passing conventions followed by subroutines are the same as those followed by functions. (See below for details.)

**Cls**

This statement transmits 40 line feed characters (ASCII code = 10) to the serial port. Cls clears the display of a terminal.

**Const**

```
Const name = x
```

Declares symbolic constants to be used instead of numeric values. Forward references are allowed, but circular references are not supported.

```
CONST x = y + 2
CONST y = 17
```

unsupported

```
CONST x = y + 2
CONST y = x - 2
```

Like alias, variable, and function declarations, Const declarations made in the global scope are imported into all functions (including the main function).

**Dim**

```
Dim var1 [, var2 [...]] as type [NV]
```

All variables must be declared. Local variables must be declared in the function before use. Global variables can be defined in the module after use in a function (as can functions).

The NV specifier can be used on a Dim statement in the global scope, or in the main function, or a Static statement in function scope.

Variables in the global scope are automatically imported into functions and subroutines. Variables in function scope (including inside the main function) are not accessible in other functions.

Arrays can not be assigned directly; i.e., the following is not allowed:

```
DIM X(5), Y(5) AS INTEGER
X = Y
```

Instead, a loop is needed:

```
DIM X(5), Y(5), I AS INTEGER
       FOR I = 1 to 5
          X(I) = Y(I)
       NEXT I
```

**Exit**

```
Exit {{Sub|Function|Interrupt|For|While}]
```

Exits the closest enclosing context of the specified type. It is a compile-time error to EXIT a construct that is not currently in scope.

**For...Next**

```
For loop_counter = Start_Value To End_Value
[Step increment]

...statements...

Next
```

If step increment is not specified, uses 1 as the step increment. If step increment is positive, continues while the value of End_Value. If step increment is negative, continues while the value of var = limit.

**Note:** *The loop index variable must be a simple identifier, not an array element or a pre-defined variable, and must be a numeric variable (integer or float).*

The semantics of a 'for' loop are defined in terms of the following transformation:

```
FOR var = init TO limit STEP delta
      stlist
NEXT var
```

becomes:

```
var = init
delta_val = delta
limit_val = limit
```

test:

```
IF delta_val 0 AND var limit_val THEN
      GOTO done
ELSEIF delta_val 0 AND var limit_val THEN
      GOTO done
ENDIF
stlist
var = var + delta_val
GOTO test
```

done:

...

**Note:** *Substantially more efficient code can be generated if 'delta' is a constant, i.e. the default value of 1 is used, or specified as an expression which can be evaluated at compile-time.*

## Function

```
Function function-name [(argument-list)] as
function-type

...statements...

End Function
```

On function entry, all local variable strings are “” and all numeric locals are zero (including all elements of local arrays).

If the function takes no arguments, the paramlist should be omitted. An empty paramlist is illegal.

The value returned from the function is specified as in QuickBasic, by assigning to an identifier with the name of the function. For example,

```
FUNCTION cube(x AS FLOAT) AS FLOAT
       cube = x * x * x
END FUNCTION
```

Arguments are passed by value.

**Note:** *Arrays can not be returned by a function. Arrays passed to a function are passed by value.*

If the return value is not set, a runtime error condition is generated (which can be caught with ON ERROR).

Array actuals must conform with formals to the extent that they have the same number of dimensions, and EXACTLY the same type. The size of each dimension is available to the function through the use of local constants that are bound on function entry. For example:

```
FUNCTION sum(x(N) AS INTEGER) AS INTEGER
       DIM i, total AS INTEGER
       sum = 0
       FOR I = 1 TO N
          total = total + x(i)
       next
       sum = total
END FUNC
```

This function exploits the fact that the variable N is automatically assigned a value when the function is called, and that value will be the extent of the array that was passed on that invocation. The variable N is a read-only variable in this context — attempts to write to N cause compile-time errors. Note that we also rely on the fact that the local variable 'total' is automatically initialized to 0 upon function entry.

## GoAbs

GoAbs (Go Absolute) causes the motor to move to the position specified by TargetPos. This position is based on a zero position at electrical home.

The motor speed follows a velocity profile as specified by AccelType, AccelRate, and DecelRate . Direction of travel depends on current position and target position only (DIR has no effect).

**Note:** *The program does not wait for GoAbs completion. After the program initiates this move it immediately goes to the next instruction.*

Variables may be changed during a move using UpdMove.

**GoHome**

GoHome moves the motor shaft to the electrical home position (Position = 0).

The motor speed follows a velocity profile as specified by AccelRate, RunSpeed, and DecelRate.

**Note:** *The program does not wait for GoHome completion. After the program initiates this move it immediately goes to the next instruction.*

GoHome performs the same action as setting TargetPos to zero and executing a GoAbs function.

**GoIncr**

GoIncr (Go Incremental) moves the motor shaft an incremental index from the current position.

Distance, as specified in IndexDist, may be positive or negative. The motor speed follows a trapezoidal velocity profile as specified by AccelType, AccelRate, RunSpeed, and DecelRate.

**Note:** *The program does not wait for motion completion. After the program initiates this move it immediately goes to the next instruction.*

Parameters may be changed during a move using UpdMove.

**GoVel**

GoVel (Go Velocity) moves the motor shaft at a constant speed.

The motor accelerates and reaches maximum speed as specified by AccelRate and RunSpeed, with direction determined by DIR. Stop motion by:

- Programming AbortMotion for maximum deceleration allowed by current limits.
- Programming RunSpeed = 0 for deceleration at rate set by DecelRate.

**Note:** *After the program initiates a GoVel it immediately goes to the next instruction.*

Variables may be changed during a move using UpdMove.

**Goto**

```
Goto label
```

Note that a program can only Goto a label in the same scope. Furthermore, a Goto may jump out of a For or While loop, but not INTO one.

**If...Then...Else**

```
IF condition1 THEN
...statement block1...
[ELSEIF condition2 THEN
...statement block2...]
[ELSE
...statement block3...]
END IF
```

IF...THEN...ELSE statements control program execution based on the evaluation of numeric expressions. The IF...THEN...ELSE decision structure permits the execution of program statements or allows branching to other parts of the program based on the evaluation of the expression.

There are two structures of IF...THEN...ELSE statements, single line and block formats.

**$INCLUDE**

```
$INCLUDE "inclfile"
```

$Include “include-file-name”

Textually include inclfile at this point in the compilation. Note that there can be no space between “$” and “include”, and that the “$include” directive must start at the beginning of the line.

**Input**

```
Input [prompt-string][,|;]input-variable
```

Input reads a character string received by the serial communications port, terminated by a carriage return.

As an option, the “prompt” message is transmitted when the Input statement is encountered. If the prompt string is followed by a semicolon, then a question mark will be printed at the end of the prompt string. If a comma follows the prompt string, then no question mark will be printed.

**Interrupt ... End Interrupt**

```
Interrupt {Interrupt-Source-Name}

..program statements...

End Interrupt
```

As per manual, except that interrupt handlers may now be located anywhere in the program text (e.g., before main).

**Laninterrupt**

```
Laninterrupt ‘[‘axis‘]’
```

Laninterrupt invokes an interrupt to the PacLAN controller specified by [AXIS#].

**Note:** *This command is only available with PacLAN controllers.*

**On Error Goto**

```
On Error Goto Error-Handler-Name
```

or

```
On Error Goto 0
```

When a firmware runtime error condition takes place, ‘Error-Handler-Name’ is called, the error handler is de-installed, and an internal flag (in-error-handler) is set. Any subsequent runtime error (including attempting to set the error handler, or return from the On Error handler) causes an immediate Stop.

On Error Goto 0 disables the current On Error handler; if an error occurs when no error handler is installed, Stop is invoked.

**Pause( )**

`Pause(Pause_Time)` causes the program to pause the amount of time specified by the Pause_Time argument. The motion of the motor is not affected.

**Note:** *This implementation differs from the SC750.*

**Print**

```
Print expression1 [ [,;] expression2 ] [;]
```

Print a list of expressions, separated by delimiters. Any number of delimiters (including zero) can appear before or after the list of expressions. At least one delimiter must appear between each pair of expressions in the printlist.

**Note:** *There need be no expressions at all.*

Examples

```
PRINT    ' print a newline

PRINT ,   ' advance a single tab stop
PRINT a,b ' print a and b, tab between
PRINT a,b,' print a and b, tab between and at
end
PRINT ,,,x,,,    ' tab tab tab x tab tab tab
```

**Restart**

Restart clears the run time error variables and causes program execution to start again from the beginning of the program. Any Interrupts, Subroutines, WHEN statements or loops in process will be aborted. This statement is used to continue program execution after a Run Time Error Handler or to abort from WHEN statements without satisfying the condition.

**Note:** *Restart does not cause the data area to be cleared or in itself change any program or motion variables.*

## Select Case

```
Select Case test-expression
Case expression-list1
...statement block1...
Case expression-list2
...statement block1...
Case expression-list3
...statement block1...
Case Else
...else block...
End Select
```

test-expression must evaluate to an INTEGER or FLOAT value.

expression-list1 is a non-empty list of case-defn, separated by commas.

There can be at most one Case Else, and if present, it must appear as the last case. It will be selected only if all other tests fail.

case-defn can be any of the following:

| | |
|---|---|
| expr | |
| expr TO expr | (tests inclusive (closed range)) |
| IS relop expr | (<, ≤, =, ≥, > ) |
| IS expr | (equiv to “IS = expr”) |

**Note:** *Select-case statements where the case-defn expressions are composed solely of integer constants will be evaluated much more quickly at run-time. (Cases involving variables must be transformed to logically equivalent if-then-else statements.)*

**Static**

```
Static var1 [, var2 [...]] as type
```

The Static statement may be used only inside a function definition. It declares variables that maintain their values across function invocations.

**Stop**

Stop stops the execution of the program.

**Sub...End Sub**

```
Sub [argument-list]
...body of the sub-procedure...
End Sub
```

Declare a subroutine. Invoked via Call. Optionally takes arguments. As with Function, it is illegal to provide an empty parameter list (‘()’) if the subroutine takes no parameters.

**Swap**

```
Swap x, y
```

Swaps the values of the variables. The types of the two variables must be the same. Does not work on arrays; does work on strings.

**UpdMove**

UpdMove (Update Move) updates a move in process with new variables. This allows you to change motion “on the fly” without having to stop motion and restart the motion function again with new variables.

## When

```
When when-condition , when-action
```

When is used for very fast output response to certain input conditions. You specify the condition and action. Upon encountering the When, program execution waits until the defined condition is satisfied. Then the program immediately executes the action and continues with the next line of the program.

The When statement provides latching of several variables when the When condition is satisfied. These variables are:

| | |
|---|---|
| WhenEncpos | WhenRespos |
| WhenPosCommand | WhenTime |
| WhenPosition | |

The software checks for the defined condition every 0.5 millisecond and performs the action within 0.5 millisecond of condition satisfaction.

## While...Wend

```
While condition

...statement block...

Wend
```

While...Wend tells the program to execute a series of statements as long as an expression after the While statement is true.

If the expression is true, then the loop statements between While and Wend are executed. The expression is evaluated again and if the expression is still true, then the loop statements are executed again. This continues until the expression is no longer true. If the expression is not true the statement immediately following the Wend statement is executed.

## 1.6 Built-in Functions

A function that takes a numeric argument (either FLOAT or INTEGER) returns the same type. Coercion between INTEGER and FLOAT is not performed unless necessary. (notation — the args ‘n’ and ‘m’ refer to INTEGER types, as in the definition of the MID$ function, whose signature is MID$(string, integer, integer)

| Name | Args | Return | Semantics |
|---|---|---|---|
| ABS | numeric | numeric | absolute value |
| ATAN | float | float | arc tangent (radians) |
| CINT | numeric | int | truncate (round to nearest int) |
| COS | float | float | cosine |
| EXP | float | float | e ^ arg, arg 88.02969 (o/w overflow) |
| FIX | numeric | int | truncate (round toward zero) |
| INT | numeric | int | truncate (round towards -INFINITY) |
| LOG | float | float | natural log |
| LOG10 | float | float | log base 10 |
| SGN | numeric | integer | sign of argument: -1, 0, 1 |
| SIN | float | float | sine (radians) |
| SQR | float | float | square root of arg |
| TAN | float | float | tangent (radians) |

| String function | | | Description |
|---|---|---|---|
| ASC | string | int | ASCII code for 1st char |
| CHR$ | int | string | One-character string containing the character with the ASCII code of arg. If arg 255, returns CHR$(arg % 256). |
| HEX$ | int | string | printable hexadecimal rep of arg (without leading &H) |
| INKEY$ | | string | one-character string, read from serial port. returns “” if no char available |
| INSTR | [pos],str1,str2 | int | index of str2 in str1, or 0 if not found. optional first arg specifies where to start search (defaults to position 1) |
| LCASE$ | str | str | returns lower-case copy of arg |
| LEFT$ | str,n | str | returns n leftmost chars of str |
| LEN | str | int | returns length of str in bytes |
| LTRIM$ | str | str | trim leading spaces |
| MID$ | str,n[,m] | str | returns substring starting at position n [for up to to m bytes]. |
| OCT$ | n | str | octal string representation of arg |
| RIGHT$ | str,n | str | rightmost n chars of str |
| RTRIM$ | str | str | trim trailing spaces |
| SPACE$ | n | str | returns a string of n spaces |
| STR$ | n | str | decimal string representation of str |
| STRING$ | n,str | str | return n copies of first char of str |
| STRING$ | n,ch | str | return n copies of char |
| TRIM$ | str | str | trim leading AND trailing spaces |
| UCASE$ | str | str | returns upper-case copy of arg |
| VAL | str | numeric | returns numeric value of str |

### Pre-defined variables and commands

The 950BASIC language is augmented by a set of 'pre-defined variables', whose purpose is to set motor-specific control parameters, and by a set of 'pre-defined commands', whose purpose is to control the motor.

For example, AccelRate, DecelRate, and RunSpeed are typically used to set the acceleration rate, deceleration rate, and commanded motor speed for the next commanded move:

```
AccelRate = 1000.0
DecelRate = 1000.0
RunSpeed = 500.0
GoVel
```

The program fragment above sets up the relevant motion parameters, and commands the motor to move in velocity mode.

You cannot create variables (or function names, etc.) that shadow the pre-defined ones. For a complete list of pre-defined variables and commands, refer to the detailed Language Reference section in this manual.

## 1.7 Expressions

### Arithmetic expressions

Arithmetic expressions (expressions involving INTEGER and FLOAT values) can use the following operators. Operators higher in the table have greater precedence than those below:

### Numeric Operators

| Operator | Assoc | Name |
|---|---|---|
| | right | exponentiation |
| - | right | unary minus |
| *, / | left | mult, div |
| MOD | left | modulo |
| +, - | left | add, sub |

## Logical Operators

| Operator | Assoc | Explanation |
|---|---|---|
| =, < >, ≥, ≤, <, > | left | the usual |
| NOT, BITNOT | right | not, boolean not |
| AND, BITAND | left | and, boolean and |
| OR, BITOR, XOR, BITXOR | left | or, boolean or, xor, boolean xor |

Logical expressions (as, for example, in the condition of an 'if' statement) may also use these operators. Strings may also be concatenated with the '+' operator. Logical expressions may be formed from strings, using the comparison operators, NOT, AND, OR, and XOR, with the meaning of an empty string being FALSE, and a non-empty string being TRUE.

Integer values are coerced to floating point values as needed. Floating point values are rounded when coerced to integer values.

**Note:** *This implementation differs from the SC750 which truncated floating point values.*

As with QuickBasic, logical operators are NOT short-circuiting, i.e., when executing the code.

if a(x) or b(y) or c(z) then ...

if a(x) is true, b(y) and c(z) are still invoked.

The BITxxx boolean operators are provided to support bitwise operations on integer values. They operate quite differently from their logical equivalents. For example:

‘2 and 1’ has the value -1 (TRUE, since each operand is ‘true’),

but

‘2 bitand 1’ has the value 0 (since no matching bits are 1).

Similarly,

‘3 or 4’ has the value -1 (TRUE since at least one operand is not FALSE),

while

‘3 bitor 4’ has the value 7 (the three lsb’s are set).

Remember that relational and logical operators return numeric values — 0 for FALSE and -1 for TRUE. Any value not equal to FALSE is considered to be logically equivalent to TRUE for purposes of the logical operators.

It is syntactically incorrect to code:

```
DIM a, b, c, x AS INTEGER
x = a < b < c
```

### String Operators

| Operator | Assoc | Name |
|---|---|---|
| | left | string concatenation |
| <, >, ≤, ≥ | nonassoc | string comparisons (see below) |
| =, <> | nonassoc | string comparisons (see below) |

There is no implicit coercion between strings and numeric types.

String comparison is case-sensitive. Relative comparisons are made using ASCII lexical ordering. The empty string sorts before all other strings.

String comparison operators are non-associative because they evaluate to a numeric value, i.e. it makes no sense to say "a$ = b$ = c$". It is sensible to say "x = a$ = b$"; x is assigned the value TRUE if a$ is the same as b$, and false otherwise.

## 1.8 Function Invocation

A function invocation is denoted in the following manner:

```
var = func(arg1, arg2, ..., argn)
```

The arguments are passed by value. i.e., modifications made to the formal parameters inside a function are not reflected in the actuals.

Arrays are also passed by value to functions. Arrays can not be returned by a function.

A function of no arguments is invoked by using the function name alone. For example, if 'func_none' takes no arguments, then

```
func_none
```

is correct, and

```
func_none()
```

is invalid.

The return value of a function may not be ignored by the caller. If the return value of a function is regularly ignored, the function should be rewritten as a subroutine (which is simply a function with no return value).

**$INCLUDE**

The $INCLUDE directive is used to textually include one file in another. The syntax is described above. The $INCLUDE facility is a simple, powerful way to create a consistent family of applications. By 'including' source files containing commonly used functions, subroutines, constant definitions, aliases, etc., you have control over the source for each application. When you change that source, you can update each application simply by recompiling. (See also the note under the 'Optimizations' section.)

A file cannot include itself, either directly or indirectly. Include file nesting is allowed, but limited to a pre-defined maximum depth (currently 16).

Like the C preprocessor, the path of an include file is relative to the directory of the included file, not the current working directory of the compiler. Suppose, for example, the source program is in directory C:\WORK, and includes the file "..\H\HEADER", and that the file HEADER includes "COMMON". The compiler will look for COMMON in C:\H, not in C:\WORK.

```
C:\WORK
       A.BAS
           $INCLUDE "..\H\HEADER"
C:\H
       HEADER
           $INCLUDE "COMMON"
```

A file may be included multiple times, which can cause compilation errors. For example, if B.BAS includes files MATH and INCL, and INCL also includes MATH, MATH will be included twice, causing a compile-time error.

```
B.BAS
       $INCLUDE "MATH"
       $INCLUDE "INCL"
INCL
       $INCLUDE "MATH"
```

## 1.9 Arrays and Function Parameter Lists

When an array parameter (formal) of a function or subroutine is declared, the number of dimensions is specified, but the extent of (number of elements in) each dimension is not specified. This allows the programmer some freedom when invoking such a function.

For example, a function may be defined to take a one-dimensional array and compute the sum of the elements in the array. A single function can be written that will take a one-dimensional array of any size and correctly compute the sum.

(Because 950BASIC checks array bounds at run time on each access, there is no risk that a function will read or write outside the bounds of the array.)

When a formal parameter to a function is an array, instead of specifying the extent of each dimension, a list of variables is used to both implicitly specify the number of dimensions and to hold the extent of each dimension. These variables are read-only; they can not be modified within the function.

We recommend that you adopt a convention for assigning names to placeholders. One such convention is to use the name of the array with a numerical suffix. For example,

```
function f(a(a1,a2,a3) as integer) as
integer
```

where a1, a2, and a3 are the variables that get the extents of the array 'a'. The function f above would be called as follows:

```
dim x_array(3,4,5) as integer
dim y_array(1,2,10) as integer
print f(x_array()) + f(y_array())
```

In both invocations of 'f', the function correctly determines the extent of each dimension of the passed array.

Remember that when passing an array to a function, the type of the array must match EXACTLY with the type expected by the function. Unlike scalar arguments, which are implicitly coerced from float to int or int to float, arrays are NOT coerced. An attempt to pass an integer array to a function that expects a float array results in a compile-time error.

## Optimizations

As mentioned in an earlier section, constant definitions are completely 'folded' at the point of definition, which makes for more efficient code. Constant expressions inside 950BASIC statements are also folded under certain conditions. For example, in the statement

```
const PI = 3.1415926535
main
   print PI^2
end main
```

the value of PI ^ 2 is not computed at run-time — it has already been detected as a constant value and pre-computed by the compiler as a single literal constant to be printed.

Similarly, the literal constant 3*4*PI in

```
x = 3 * 4 * PI * x
```

is folded at compile-time, leaving only one multiplication to be performed at run-time.

However, certain constant expressions will not be folded. For example, the computation of

```
x = 3 * PI * x * 4
```

will be done at run-time, involving 3 multiplications. This is because the analysis of constant expressions does not attempt to exploit algebraic commutativity laws. Since the basic arithmetic operators are 'left associative', you can ensure the best performance by grouping constant factors together towards the left (or using a new constant definition).

If a function is not referenced (transitively from MAIN, plus any interrupt handlers), the compiler does not generate code for it. So, you can freely $include "libraries" with code that is not used (e.g. a comprehensive library that contains functions supporting several possible axis configurations). Although the compiler will still parse and type-check all of the included source, it will not generate code that goes into the downloaded program.

If select-case cases are all constants, much more efficient code will be generated. If any of the cases is a variable, the generated code will be equivalent to a string of if-then-else statements for all of the cases.

If any of the cases is an open-ended range (e.g., 'is 10'), or covers a large range (e.g., '1 to 1000') a fast table-lookup will be generated. This method can several times faster than the first method.

If all of the cases are constant, and can reasonably be grouped into 'locally dense subsets', then the fastest possible code will be generated — a binary search of dispatch tables, followed by an indirect jump through the table. This last method can be much faster than the first method, so if speed is a consideration, you should keep your cases constant and 'close together'. (It is not necessary that cases be 'textually' close together — it is only necessary that the values form a reasonably dense set.)

The compiler performs limited dead-code elimination based on simple constant analysis. For example, consider the following code

```
const DEBUGGING = FALSE
main
dim i, sum as integer
       for i = 1 to 10
          sum = sum + i
          if DEBUGGING then print “partial sum is
”;sum
       next i
end main
```

Since the value of DEBUGGING is FALSE, the compiler will recognize that the printing of the partial sum can never happen, and will not generate the print statement. This allows you to place debugging code in strategic locations in your programs, and effectively disable it when shipping a production version (and shrink the size of the generated code, as well).

This sort of dead-code elimination also applies to functions whose only point of reference lies in code that is eliminated. In such cases, the functions themselves become dead-code, too, and no code will be generated for their definitions.

The compiler will not, however, eliminate the print statement from the following program, which is a slight variation of the one above:

```
dim DEBUGGING as integer
main
dim i, sum as integer
       DEBUGGING = FALSE
       for i = 1 to 10
          sum = sum + i
          if DEBUGGING then print “partial sum is
”;sum
       next i
end main
```

In this case, the print statement will never be executed, but the code to implement it is still generated. This is because it’s possible that the value of the integer DEBUGGING could be changed by the 950’s Integrated Development Environment Debugger at runtime, causing the print statement to be executed!

## 1.10 PACLAN

**Introduction**

PACLAN is a local area network (LAN) which provides high speed (2.5 MBaud) inter-axis serial communication between Pacific Scientific SC950 single-axis programmable position controllers. The PACLAN can provide support for up to 255 SC950 controllers. Information can be passed between any two axes on a peer-to-peer basis. This capability is supported by specific features built into the BASIC language on the OC950.

PACLAN connectivity is an option and is only available on the OC950-503-01 and OC950-504-01 and OC950-603-01 and OC950-604-01 models. Use ModelExt to determine what type of OC950 you have.

Using PACLAN you can read and write pre-defined variables on any other SC950 connected to the PACLAN. You can also generate interrupts on any of those axes, causing them to perform specific actions.

**Configuration**

Implementing a PACLAN network involves the following simple steps:

- Configure each SC950 on the PACLAN with a unique address using the address selection DIP switch on the OC950 card.
- Connect the SC950s with RG62 coax cable, terminating it at both ends with a 93 ohm terminator.
- Develop programs for the axes that incorporate inter-axis communications.

**Note:** *Please see Section 3.5 in MA950 - 0C950 Hardware and Installation Manual for cabling and hardware information.*

### Reading and Writing Pre-defined Variables

PACLAN provides interaxis communication of the pre-defined variables and PACLAN array variables. Inter-axis pre-defined variables can be used in a BASIC program in exactly the same manner as local pre-defined variables. The SC950 will access the variables, over PACLAN, transparently to the user program.

Within a program, all off-axis variable accesses require the variable name to be appended with the axis address in square brackets. Axis designation, with square brackets, is not required for on-axis variable usage.

### Accessing Pre-defined Variables Over PACLAN

PACLAN provides read/write access to all pre-defined variables on all SC950s connected to the PACLAN. You should use care in writing to pre-defined variables on another axis because extensive use of this capability can lead to programs that are difficult to debug.

Each SC950 also contains two uncommitted variable arrays (LANFlt and LANInt) specifically intended for inter-axis communications. These array variables also have read-write capability. See LANFlt( ) and LANInt( ).

**Note:** *Attempting to read from or write to a controller that is not present on the PACLAN will result in a run-time error on the initiating controller. Use the pre-defined variable Status[ Axis # ] to determine if an axis is present on the PACLAN.*

Example

PACLAN can access any pre-defined variable on any other axis. This is performed by appending the axis address in square brackets after the variable name.

For instance, to set the variable 'x' equal to the value of Velocity on axis 3, use the statement:

```
x = Velocity[3]
```

Example

To set index distance on axis 5 equal to 10,000 counts, use the statement:

```
IndexDist[5] = 10000
```

Pre-defined variables with an axis specifier may be used wherever any other variables are used, with the exception of the WHEN statement.

**LANInt() and LANFlt() Arrays**

Two general purpose read/write variable arrays (one integer, one floating point) are available for user-defined inter-axis message passing. There are 32 elements in each array. These arrays are essentially pre-defined variables that have no pre-defined functionality and are thus available to you for whatever purpose you choose.

The integer array syntax is designated as:

```
x = LANInt( y )[ n ]

LANInt( y )[ n ] = x
```

where y is the array element (1-32) and n specifies the axis address containing the LAN array.

The floating point array syntax is designated as:

```
x = LANFlt( y )[ n ]

LANFlt( y )[ n ] = x
```

where y is the array element (1-32) and n specifies the axis address containing the LAN array.

Again, like the other pre-defined variables, these arrays can be used wherever any other variable can be used.
Please see LANint( ) and LANFlt( ) for additional information.

**PACLAN Interrupts**

Interrupts can be sent from a source axis to a destination axis using PACLAN. To send an interrupt to a program running on another axis, use the SendLANInterrupt function. This function allows you to specify the axis address of the program the interrupt is being sent to. The SendLANInterrupt function also allows you to send an integer argument along with the interrupt.

The receiving axis must have a PACLAN interrupt handler defined or else the SendLANInterrupt will fail. There is a queue on each axis which allows each axis to buffer PACLAN Interrupt requests.

Example

For instance, if axis 3 receives an interrupt from axis 5, it automatically jumps to a PACLAN interrupt handler and starts servicing the PACLAN interrupt. If axis 3 receives a PACLAN interrupt request from axis 2 before it is done servicing the request from axis 5, then it will buffer that request and service it when it is done with axis 5. This queue can hold 32 interrupt requests.

## 1.11 Modbus

**Note:** *The following functionality applies only to OC950s with* ***Enhanced Firmware****. Standard OC950s are are not capable of communicating on a Modbus network.*

**Definition**

Modbus was originally developed by Modicon as a means for PLCs to communicate with programming terminals. It is now widely used by many suppliers of industrial automation equipment seeking a robust, widely supported and inexpensive serial communications protocol.

Modbus is a serial (RS232 or RS485) communications protocol consisting of one master and multiple slaves. The Modbus master initiates all transactions on the Modbus network. These transactions consist primarily of messages to read the values of data on a slave or to write new data values to a slave. The Modbus slaves just generate responses to messages initiated by the master.

An OC950 can be configured to operate as either a Modbus master or as a Modbus slave. In either case there must be a program running on the OC950 in order for it to communicate on Modbus. When there is no program running on the OC950 the OC950 communicates using its native protocol.

### Modbus Register and Data Types

There are two fundamental data types defined by Modbus: bits and registers.

#### Bits

Bits contain one bit of information. In the Modbus address space, bits may be located at addresses 1-9999 (0x references) and 10001-19999 (1x references). In Modbus terminology bits are called either coils (0x references) or inputs (1x references). Inputs are read-only meaning that the master can read the value of these bits, but cannot write a new value to them. Coils are read-write.

An MMI or touchscreen could use a bit reference to read the value of the OC950's Moving pre-defined variable or to write a new value to the Dir variable.

#### Registers

Registers contain 16 bits of information. In the Modbus address space, registers may be located at addresses 30001-39999 (3x references) and 40001-49999 (4x references). In Modbus terminology registers are called either Input Registers (3x references) or Holding Registers (4x references). Input Registers are read-only; the master can read the value of these registers, but cannot write a new value to them. Holding Registers are read-write.

Examples of using register references include an MMI or touchscreen using a register reference to read the value of Velocity or write a new value to IndexDist.

### Floating Point and 32 bit Integer Registers

There are two additional register data types which, while not explicitly defined by Modbus, are supported by many Modbus devices. These are 32 bit integer registers and 32 bit IEEE floating point registers. Each of these extended types uses two adjacent 16 bit registers to hold the 32 bit value. The OC950 supports 32 bit integers and 32 bit floating point as both a master and as a slave. The word-order of the two adjacent 16 bit registers that are combined to form the extended type is configurable using MB32WordOrder and MBFloatWordOrder.

### Using an OC950 as a Modbus Slave

You would set up your OC950 as a Modbus slave to allow a Modbus master, such as a touchscreen or an MMI, to read and/or write values on the OC950. Configuring an OC950 to operate as a Modbus slave consists of adding the following items to your program:

1. An MBInfo Block which maps pre-defined variables and/or user-global variables to specific Modbus addresses.

   The MBInfo block contains multiple $MBMap<xxx> statements which specify this mapping. You can use the Modbus Map Wizard in the 950 IDE to assist you in creating this map. There is also an example program MBDEMO.BAS in the Examples directory (\950win\examples) which contains a complete MBInfo block.

2. Adding a line to set RuntimeProtocol to 2 (Modbus Slave).

   You must set RuntimeProtocol to 2 to tell the OC950 to operate as a Modbus slave. After you set this then the OC950 will respond to Modbus messages, both reads and writes, without any intervention from the user program.

   You should keep in mind the following when configuring an OC950 as a Modbus slave:

   - the OC950 baud rate must match the master's. See BaudRate variable.
   - the OC950 parity must match the master's. See RuntimeParity.
   - the OC950 supports 1 start bit, 8 data bits and 1 stop bit
   - the OC950 does not require or support hardware handshaking. If the master requires it then it must be defeated on the master.
   - 255 is not a valid Modbus slave address. Setting RuntimeProtocol to 2 with an AxisAddr of 255 will cause a Runtime Error 38.

### Using an OC950 as a Modbus Master

The Modbus Master functionality allows an OC950 to communicate with one or more Modbus slaves. You would use an OC950 as a Modbus master to communicate with a Modicon PLC or some other device which can only operate as a Modbus slave. As Modbus master the OC950 would initiate all traffic on the Modbus network.

To use an OC950 as Modbus master, you just need to set RuntimeProtocol to 3 (Modbus Master) and then use any of the eight Modbus functions and statements which implement Modbus master functionality. If you try to use one of these functions or statements without first setting RuntimeProtocol to 3 then you'll get a Runtime Error 37.

There are four Modbus statements added to the OC950 BASIC language to allow the OC950 to operate as a Modbus master to write data to a Modbus Slave. These are:

| | |
|---|---|
| `MBWriteBit(a, b, c)` | write a bit (0x or 1x reference) |
| `MBWrite16(a, b, c)` | write a 16 bit integer (3x or 4x reference) |
| `MBWrite32(a, b, c)` | write a 32 bit integer (double 3x or 4x reference) |
| `MBWriteFloat(a, b, c)` | write a float (double 3x or 4x reference) |

where, in each case:

a is the slave's Modbus address

b is the register address where the data is to be written

c is the new data

There are four Modbus functions added to the OC950 BASIC language to allow the OC950 to operate as a Modbus master to read data from a Modbus slave. These are:

| | |
|---|---|
| `x = MBReadBit(a, b)` | read a bit (0x or 1x reference) |
| `x = MBRead16(a, b)` | read a 16 bit integer (3x or 4x reference) |
| `x = MBRead32(a, b)` | read a 32 bit integer (double 3x or 4x reference) |
| `x = MBReadFloat(a, b)` | read a float (double 3x or 4x reference) |

where, in each case:

a is the slave's Modbus address

b is the register address containing the data we're reading

When one of these functions or statements is executed in your program the OC950 will send a Modbus message to the specified slave and the wait for and process the response message. If any error occurs while sending or receiving the message, it will be indicated in the variable MBErr.

Modbus master statements and functions cannot be nested. If you get an interrupt while waiting for the response to a Modbus master message then you cannot initiate another Modbus transaction (by executing one of the eight Modbus functions or statements) in the interrupt service routine. If you do so then you will generate a Runtime Error 36.

You should keep in mind the following when configuring an OC950 as a Modbus master:

- the OC950 baud rate must match the slaves'. See BaudRate variable.
- the OC950 parity must match the slaves'. See RuntimeParity.
- the OC950 supports 1 start bit, 8 data bits and 1 stop bit
- the OC950 does not require or support hardware handshaking. If a slave requires it then it must be defeated on the slave.

## Modbus Reference

Refer to the following items in the reference section for additional information on Modbus:

| Item | Used for Master or Slave Operation? |
|---|---|
| BaudRate | Both |
| MB32WordOrder | Both |
| MBErr | Master |
| MBFloatWordOrder | Both |
| MBInfo Block | Slave |
| MBMap16 | Slave |
| MBMap32 | Slave |
| MBMapBit | Slave |
| MBMapFloat | Slave |
| MBRead16 | Master |
| MBRead32 | Master |
| MBReadBit | Master |
| MBReadFloat | Master |
| MBWrite16 | Master |
| MBWrite32 | Master |
| MBWriteBit | Master |
| MBWriteFloat | Master |
| RuntimeParity | Both |
| RuntimeProtocol | Both |

## 1.12 Allen-Bradley DF1 Communications Protocol

**Note:** *The following functionality applies only to OC950s with* ***Enhanced Firmware****. Standard OC950s are are not capable of communicating on an Allen-Bradley Communications network.*

### Definition

Allen-Bradley DF1 is a communications utility based on the DF1 peer-to-peer communications protocol. The Allen-Bradley DF1 functionality allows the SC950 to communicate with other devices supporting AB DF1on a peer-to-peer basis.

The SC950 is capable of responding to messages initiated by other devices (unsolicited commands) as well as initiating messages to read and write registers on other devices (solicited commands).

The SC950 support communications with the following Allen-Bradley PLCs.

- SLC500 family of processors — both solicited and unsolicited commands.
- PLC5 family of processors — solicited commands only (the SC950 can initiate read/write commands, but will not respond to read/write commands initiated by the PLC5).

Other devices supporting Allen Bradley DF1 Serial Communications protocol may also be able to communicate with the SC950.

### Procedure

To establish Allen-Bradley DF1 communications between the SC950 and another device:

1. The SC950 comm port (J51) must be wired to the other device properly.
2. All the software communication settings on both devices must match. For more detail, see ABCrc, BaudRate, and RuntimeProtocol. In general the settings on the following page are appropriate.

## Allen-Bradley DF1 settings

The following table lists the settings necessary for AB DF1.

| | SC950 | Other Device |
|---|---|---|
| **Mode** | RunTimeProtocol = 5 * | Full Duplex * |
| **BaudRate** | 19200 | 19200 |
| **Data Bits** | n/a | 8 * |
| **Stop Bits** | n/a | 1 * |
| **Parity** | Parity = 0 | None |
| **Error Detect** | ABCrc = 1<br>ABCrc = 0 | CRC<br>BCC |

* This parameter must be set to the value (setting) indicated.

## Related instructions

The 950BASIC language supports Allen-Bradley DF1 communications using the following command / functions:

- ABInfo Block
- ReadPLC5Binary
- ReadPLC5Float
- ReadPLC5Integer
- ReadSLC5Binary
- ReadSLC5Float
- ReadSLC5Integer
- WritePLC5Binary
- WritePLC5Float
- WritePLC5Integer
- WriteSLC5Binary
- WriteSLC5Float
- WriteSLC5Integer

## Allen-Bradley DF1 Diagnostic Variables

There are several “diagnostic” counters that are maintained by the OC950 firmware as it processes Allen-Bradley DF1 messages. Typically, you don’t need to be concerned with these variables, but they can be helpful in diagnosing problems in setting up or maintaining an Allen-Bradley DF1 application. The variables and a brief expanation are shown below:

| Variable | Explanation |
|---|---|
| ABAcksRcvd | # of message ACKs I’ve received |
| ABAcksSent | # of message ACKs I’ve sent |
| ABAckTimeouts | # of messages I didn’t get an ACK for |
| ABDupMsgs | # of duplicate messages discarded |
| ABErrCount | # of times I called ab_error(..) |
| ABMsgsRcvd | # of messages I’ve received |
| ABMsgsSent | # of messages I’ve sent |
| ABNaksRcvd | # of message NAKs I’ve received |
| ABNaksSent | # of message NAKs I’ve sent |
| ABRspTimeouts | # of messages I didn’t get a response for |
| ABTXQMax | max # of outbound messages stacked up |
| ABUnsRsps | # of unsolicited ‘response’ messages I’ve received |

ACK = Acknowledgement — received message is valid (correct CRC\BCC and frame).

NAK = Negative Acknowledgement — received message is invalid.

## Allen-Bradley DF1 Map Wizard

This wizard will create and/or update an ABInfo block in your program. The ABInfo block is used to map pre-defined variables or user-defined global variables to specific ABComm elements so that an Allen-Bradley DF1device can read or write them. This mapping is only used when the OC950 is processing ABComm messages initiated by another device, not when it is initiating commands.

The wizard allows you to map OC950 variables (in Allen-Bradley DF1 terminology) as Integer file elements (Allen-Bradley pre-defined file # 7), or as Float file elements (Allen-Bradley pre-defined file # 8).

## Procedure

To create a mapping of an OC950 variable to an Allen-Bradley DF1 element you:

1. Select which file (Integer or Float)
2. Specify the element address.
3. Specify the OC950 variable name.

You may also specify an optional scale factor (the default is 1.0). This scale factor is automatically applied when the Allen-Bradley DF1 element is read or written by the Allen-Bradley DF1 master. This is particularly useful for mapping floating point OC950 variables into integer Allen-Bradley DF1 elements. It can also be used for mapping integer OC950.

## Example

For example, you could map RunSpeed as a 16-bit integer element and specify a scale factor of 10.

```
$ABMapInteger(1,runspeed,10.0)
```

Whenever the Allen-Bradley DF1 master reads integer element 1, the OC950 would automatically multiply the present value of RunSpeed by 10 and return this value to the master. And when the master writes to integer element 1 the OC950 will automatically divide the new value by 10.0 before writing it to RunSpeed.

In this case if the value of RunSpeed was 22.5 then the Master would read 225 for integer element 1. Similarly, if the master wrote a value of 307 the RunSpeed would be set to 30.7.

### SLC500 to OC950 Cable

To establish Allen-Bradley DF1 communications between the SC950 and the SLC500 PLC, the following connections are required:

| SC950 (J51) DB9 | SLC500 (Channel 0) DB9 |
|---|---|
| 2 (RS232 TX) | 2 (RS232 RX) |
| 3 (RS232 RX) | 3 (RS232 TX) |
| 5 (Common) | 5 (Common) |

### PLC5 to OC950 Cable

To establish Allen-Bradley DF1 communications between the SC950 and the PLC5, the following connections are required:

| SC950 (J51) DB9 | PLC5 (Channel 0) DB25 |
|---|---|
| 2 (RS232 TX) | 3 (RS232 RX) |
| 3 (RS232 RX) | 2 (RS232 TX) |
| 5 (Common) | 7 (Common) |

## 1.13 Cam Profiling

**Note:** *The following functionality applies only to OC950s with* ***Enhanced Firmware****. Standard OC950s are are not capable of cam profiling.*

### Definition

In the 950, a 'cam' is a cyclic, generally **non-linear** relationship between master encoder position and slave (motor) position. That is, the relationship between slave counts and master counts is no longer a constant ratio, but changes as a function of master counts. As in electronic gearing, once a 'cam' has been made active, the program no longer needs to do anything special to maintain it - the motion profile is repeated indefinitely until the cam is deactivated.

In camming terminology, a master is typically an external encoder. The encoder is wired into the SC950 encoder input port (connector J4 pins 21-24). It is also possible to use the SC950's virtual (internal) encoder.

**Procedure**

To use a cam profile on the SC950, you must perform the following three steps:

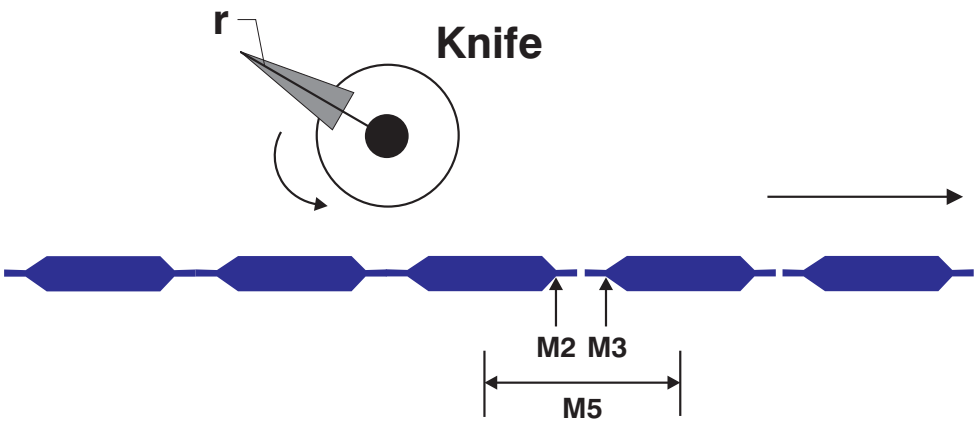
1. Declare the cam. See $DeclareCam.
2. Create the cam profile. See CreateCam.
3. Activate the cam profile. See ActiveCam.

**Related variables**

| | |
|---|---|
| CamMaster | specifies the source of the input to the cam table for cam profiling. |
| CamCorrectDir | specifies the direction of the correction move that is done when a new cam table is activated (by setting ActiveCam = n). |
| Addpoint( ) | adds the specified “point” (master position and corresponding slave position) to the cam table that is being created. |

**Cam Wizard**

The CamWizard is designed to solve a large class of applications generally referred to as “cut to length” applications. The picture below shows a typical setup:




**Explanation**

In this application, material is being fed beneath a rotary knife. The master encoder measures forward movement of the material under the knife. The slave motor controls rotation of the knife. In order for this to work properly, the slave motor must be controlled (as a function of master encoder counts) so that the blade of the rotary knife:

1. Stays out of the way until the proper amount of material has passed
2. Accelerates so that the speed of the knife matches the speed of the material during the cut, and
3. Decelerates back to the original speed until the material is almost in position for the next cut.

(**Note:** *The rotary knife will either accelerate or decelerate to match the speed of the material in the cut phase, depending on whether or not the circumference of the rotary knife is less than or greater than the length of the piece to be cut. You may need to interchange the terms ‘accelerate’ and ‘decelerate’, or simply think of them as signed quantities.*)

950BASIC's AddPoint statements specify a cam profile as a mapping from master position to slave position. But the problem as stated above refers to relative velocities and accelerations, and it's not always clear how to get from velocity and acceleration to position.

The CamWizard was designed to make such applications easy to implement. The only things you need to provide are:

- the number of master counts corresponding to the length of material to be cut,
- the number of slave counts corresponding to one complete rotation of the knife, and
- the ratio of slave counts to master counts during the 'cut' phase of the cycle.

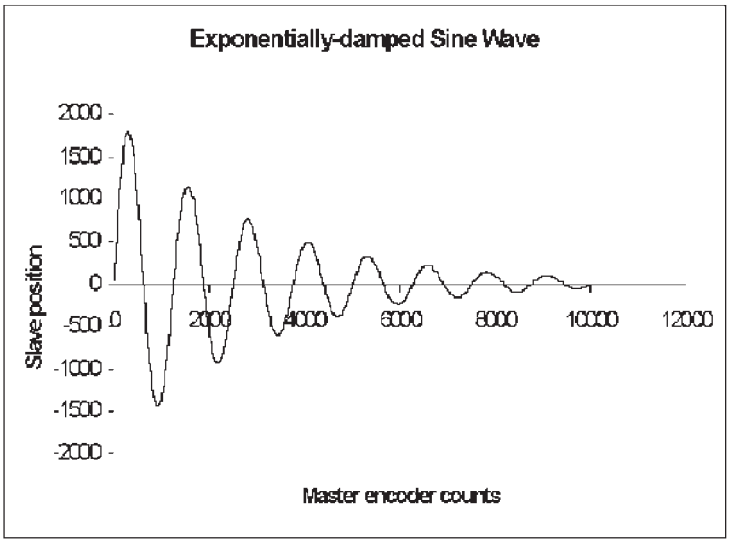
Once you have provided these three pieces of information, the CamWizard will automatically:

- generate code to declare a cam table of the correct size,
- generate a subroutine to create the cam table, and
- generate a subroutine to activate the cam.

Example

In general, you can create a cam to approximate any continuous function, but the CamWizard cannot help you with it. The basic technique is to develop a 950BASIC expression (or function) that defines the slave position as a function of master position, and use it to generate a series of AddPoint statements at appropriate master position intervals.

The following example shows how to create a cam profile that looks like this:



```
const MC = 10000            ‘ master counts in total cycle
const NPOINTS = 501         ‘ number of points in cam profile
const pi = 3.1415926535

‘ tuning constants for nice motion
const k = 0.69314718/100
const w = 1/(7.5*pi)
‘_____________________
$declarecam(2,NPOINTS)
‘_____________________
‘ sub ActivateCam_2
sub activatecam_2
     Enable = 1
     EncPosModulo = MC
     PosModulo = MC
     EncPos = 0
     ActiveCam = 2
end sub
‘_____________________
‘ sub CreateCam_2
‘ This code creates a cam whose profile is an exponentially
‘ damped sine wave.
sub CreateCam_2
    dim m,s as float
    dim i as integer
    CreateCam(2)
       for i = 0 to NPOINTS-1
            ‘ master position
          m = i*(MC/(NPOINTS-1))
            ‘ computed slave position
          s = (1/exp(1.5*k*i)) * sin(2*pi*w*i)
         addpoint(m,2000*s)
       next i
    end createcam
 end sub
‘_____________________-
```

Program (cont'd)

```
‘ Generate a cam that does exponentially-damped sinusoidal

‘ motion, and activate it.  Please note that since we’re computing
‘ 500 points of slave profile here, several seconds will elapse
‘ during the calculation of the cam table.

main
    enable = 1
    vmdir = 0
    vmrunfreq = 1000
    vmgovel
    print “Creating cam 2"
    call CreateCam_2
    call ActivateCam_2
    print “Cam 2 is active now”
end main
```

**Virtual encoder (virtual master)**

The virtual encoder is an internal count generator that can be used as the input to the cam. It is controlled very much like the profile generator that is used to control the motion of the motor. The pre-defined variables and statements associated with the virtual encoder are listed below:

| | | |
|---|---|---|
| **Move parameters** | vmDir | specifies direction for vmGoVel |
| | vmIndexDist | specifies distance for vmGoIncr |
| | vmRunFreq | specifies speed (frequency) for vmGoIncr and vmGoVel |
| **Move statements** | vmGoIncr | executes incremental move |
| | vmGoVel | executes velocity move |
| | vmUpdMove | updates move parameters on move in progress |
| | vmStopMotion | stops motion |
| **Other variables** | vmEncpos | gives the value of the internal counter |
| | vmMoving | indicates whether a move is in progress |

The virtual encoder can be used as the input to the cam either alone (as a virtual master) or in combination with the actual encoder (Encpos) to add an offset to the master position. This functionality is controlled by the variable CamMaster.

# 2 Quick Reference

**Introduction**

This section contains functions, parameters, statements and variables for 950BASIC. Below is a summary table of the list of instructions.

**Note:** *The default value for parameters designates the value of the instruction at power on and at program start. A numeric value designates the power on/program start default value of a parameter. Default values designated by "set up" are initialized to the value in the PARAMS section of the program. Parameters may also be modified during program execution but will always retain their power on value at the start of program execution.*

| Name | Type | Default Value | Page # |
|---|---|---|---|
| ABCrc | Pre-defined Variable, Integer | | 3-2 |
| ABErr | Pre-defined Variable, Integer | | 3-3 |
| ABInfo...End | | | 3-4 |
| $ABMapFloat() | Statement | | 3-6 |
| $ABMapInteger() | Statement | | 3-7 |
| AbortMotion | Statement | | 3-8 |
| Abs() | Function | | 3-9 |
| AccelGear | Pre-defined Variable, Integer | 16,000,000 rpm/sec | 3-10 |
| AccelRate | Pre-defined Variable, Integer | 10,000 rpm/sec | 3-12 |
| ActiveCam | Pre-defined Variable, Integer | | 3-13 |
| AddPoint() | Statement | | 3-15 |
| ADF0 | Pre-defined Variable, Float | 1,000 Hz | 3-17 |
| ADOffset | Pre-defined Variable, Float | 0 volts | 3-18 |
| Alias | Statement | | 3-19 |
| AnalogIn | Pre-defined Variable, Float, Status Variable, Read Only | | 3-20 |

| Name | Type | Default Value | Page # |
|---|---|---|---|
| AnalogOut1 | Pre-defined Variable, Float, Control Variable | 0 volts | 3-21 |
| AnalogOut2 | Pre-defined Variable, Float, Control Variable | 0 volts | 3-22 |
| And | Operator | | 3-23 |
| ARF0 | Pre-defined Variable, Float, NV Parameter | set up | 3-24 |
| ARF1 | Pre-defined Variable, Float, NV Parameter | set up | 3-25 |
| ARZ0 | Pre-defined Variable, Float | 0 Hz | 3-26 |
| ARZ1 | Pre-defined Variable, Float | 0 Hz | 3-27 |
| Asc() | Function | | 3-28 |
| Atan() | Function | | 3-29 |
| Autostart | Pre-defined Variable, Integer | 0 | 3-30 |
| AxisAddr | Pre-defined Variable, Integer, Read-Only | 255 | 3-31 |
| Band | Operator | | 3-32 |
| BaudRate | Pre-defined Variable, Integer | 19200 | 3-33 |
| BDInp1-BDInp6 | Pre-defined Variable, Integer, Status Variable, Read Only | | 3-34 |
| BDInputs | Pre-defined Variable, Integer, Status Variable, Read-Only | | 3-35 |
| BDIOMap1-BDIOMap6 | Pre-defined Variables, Integer, NV Parameter | | 3-36 |
| BDLgcThr | Pre-defined Variable, Integer | 0 | 3-38 |
| BDOut1-BDOut6 | Pre-defined Variable, Integer, Control Variable | 1 | 3-39 |
| BDOutputs | Pre-defined Variable, Integer, Control Variable | 63 | 3-40 |

| Name | Type | Default Value | Page # |
|---|---|---|---|
| Beep | Statement | | 3-41 |
| BlkType | Pre-defined Variable, Integer | 2 | 3-42 |
| Bnot | Operator | | 3-43 |
| Bor | Operator | | 3-44 |
| Brake | Pre-defined Variable, Integer, Mappable Output Function, Read-Only | | 3-45 |
| Bxor | Operator | | 3-46 |
| Call | Statement | | 3-47 |
| CamCorrectDir | Pre-defined Variable, Integer | 2 | 3-48 |
| CamMaster | Pre-defined Variable, Integer | 0 | 3-50 |
| CamMasterPos | Pre-defined Variable, Integer, Read Only | | 3-51 |
| CamSlaveOffset | Pre-defined Variable, Integer, Read Only | | 3-52 |
| CCDate | Pre-defined Variable, Status Variable, Read Only | factory | 3-53 |
| CCSNum | Pre-defined Variable, Integer, Status Variable, Read Only | factory | 3-54 |
| CcwInh | Pre-defined Variable, Integer | | 3-55 |
| Ccwot | Pre-defined Variable, Integer | 0 | 3-56 |
| Chr$() | Function | | 3-57 |
| Cint() | Function | | 3-58 |
| Cls | Statement | | 3-59 |
| CmdGain | Pre-defined Variable, Float | 0.5 | 3-60 |

| Name | Type | Default Value | Page # |
|---|---|---|---|
| CommEnbl | Pre-defined Variable, Integer, Control Variable | 1 | 3-61 |
| CommOff | Pre-defined Variable, Float, NV Parameter | set up | 3-62 |
| CommSrc | Pre-defined Variable, Integer | 0 | 3-63 |
| ConfigPLS() | Statement | | 3-64 |
| Const | Statement | | 3-66 |
| Cos() | Function | | 3-67 |
| CountsPerRev | Pre-defined Variable, Integer | 4096 | 3-68 |
| CreateCam() | Statement | | 3-69 |
| CwInh | Pre-defined Variable | | 3-71 |
| Cwot | Pre-defined Variable | | 3-72 |
| DecelGear | Pre-defined Variable, Integer | 16,000,000 rpm/sec | 3-73 |
| DecelRate | Pre-defined Variable, Integer | 10,000 rpm/sec | 3-74 |
| $DeclareCam() | Statement | | 3-75 |
| Dim | Statement | | 3-76 |
| Dir | Pre-defined Variable, Integer | 0 | 3-77 |
| DM1F0 | Pre-defined Variable, Integer | 1,000 Hz | 3-78 |
| DM1Gain | Pre-defined Variable, Float | 0.6667 | 3-79 |
| DM1Map | Pre-defined Variable, Integer | 9 | 3-80 |
| DM1Out | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-81 |
| DM2F0 | Pre-defined Variable, Float | 1,000 Hz | 3-82 |
| DM2Gain | Pre-defined Variable, Float | 2.0 | 3-83 |

| Name | Type | Default Value | Page # |
|---|---|---|---|
| DM2Map | Pre-defined Variable, Integer | 1 | 3-84 |
| DM2Out | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-85 |
| Enable | Pre-defined Variable, Integer | 0 | 3-86 |
| Enabled | Pre-defined Variable, Integer, Read-Only | | 3-87 |
| EnablePLS0-EnablePLS7 | Pre-defined Variable, Integer | 0 | 3-88 |
| EncFreq | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-89 |
| EncIn | Pre-defined Variable, Integer | 1024 | 3-90 |
| EncInF0 | Pre-defined Variable, Float | 800,000 | 3-91 |
| EncMode | Pre-defined Variable, Integer | 0 | 3-93 |
| EncOut | Pre-defined Variable, Integer | 1024 | 3-94 |
| EncPos | Pre-defined Variable, Integer | | 3-95 |
| EncPosModulo | Pre-defined Variable, Integer | 0 | 3-96 |
| End | Statement | | 3-97 |
| Err | Pre-defined Variable | | 3-98 |
| Exit | Statement | | 3-100 |
| Exp() | Function | | 3-101 |
| ExtFault | Pre-defined Variable, Integer, Status Variable | | 3-102 |
| Fault | Pre-defined Variable, Integer, Mappable Output Function | | 3-103 |
| FaultCode | Pre-defined Variable, Integer, Status Variable, Read-Only | | 3-104 |

| Name | Type | Default Value | Page # |
|---|---|---|---|
| FaultReset | Pre-defined Variable, Integer, Mappable Input Function | 0 | 3-106 |
| Fix() | Function | | 3-107 |
| For...Next | Statement | | 3-108 |
| Function | Statement | | 3-109 |
| FVelErr | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-111 |
| FwV | Pre-defined Variable, Integer, Status Variable, Read-Only | | 3-112 |
| GearError | Pre-defined Variable, Integer | | 3-113 |
| Gearing | Pre-defined Variable, Integer | 0 | 3-115 |
| GearLock | Pre-defined Variable, Float, Read-Only | | 3-116 |
| GetMotor$() | Function | | 3-118 |
| GoAbs | Statement | | 3-119 |
| GoAbsDir | Pre-defined Variable, Integer | 3 | 3-120 |
| GoHome | Statement | | 3-122 |
| GoIncr | Statement | | 3-123 |
| Goto | Statement | | 3-124 |
| GoVel | Statement | | 3-125 |
| Hex$() | Function | | 3-126 |
| HSTemp | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-127 |
| HwV | Pre-defined Variable, Integer, Status Variable, Read-Only | | 3-128 |

| Name | Type | Default Value | Page # |
|---|---|---|---|
| ICmd | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-129 |
| IFB | Pre-defined Variable, Status Variable, Read-Only | | 3-130 |
| If...Then...Else | Statement | | 3-131 |
| ILmtMinus | Pre-defined Variable, Integer, NV Parameter | set up | 3-132 |
| ILmtPlus | Pre-defined Variable, Integer, NV Parameter | set up | 3-133 |
| $Include | Statement | | 3-134 |
| IndexDist | Pre-defined Variable, Integer | 4096 | 3-135 |
| Inkey$ | String Function | | 3-136 |
| Inp0-Inp20 | Pre-defined Variable, Integer, Read-Only | | 3-137 |
| InPosition | Pre-defined Variable, Integer, Read-Only | | 3-138 |
| InPosLimit | Pre-defined Variable | 5 | 3-139 |
| Input | Statement | | 3-140 |
| Inputs | Pre-defined Variable, Integer, Read-Only | | 3-141 |
| Insert() | Function | | 3-142 |
| Int() | Function | | 3-143 |
| Interrupt...End Interrupt | Statement | | 3-144 |
| Intr {source} | Pre-defined Variable, Integer | | 3-146 |
| Ipeak | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-149 |
| ItF0 | Pre-defined Variable, Float | 0.02 Hz | 3-150 |

| Name | Type | Default Value | Page # |
|---|---|---|---|
| ItFilt | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-151 |
| ItThresh | Pre-defined Variable, Integer, NV Parameter | set up | 3-152 |
| ItThreshA | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-153 |
| I_R | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-154 |
| I_S | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-155 |
| I_T | Pre-defined Variable, Float, Status Variable, Read-Only | | 3-156 |
| Kii | Pre-defined Variable, Float | 50 Hz | 3-157 |
| Kip | Pre-defined Variable, Float, NV Parameter | set up | 3-158 |
| Kpp | Pre-defined Variable, Float, NV Parameter | set up | 3-159 |
| Kvff | Pre-defined Variable, Float | 0 % | 3-160 |
| Kvi | Pre-defined Variable, Float, NV Parameter | set up | 3-161 |
| Kvp | Pre-defined Variable, Float, NV Parameter | set up | 3-162 |
| LanFLT() | Pre-defined Array Variable, Float | 0.0 | 3-163 |
| LANint() | Pre-defined Array Variable, Integer | 0 | 3-164 |
| LANInterrupt[] | Statement | | 3-165 |
| LANIntrArg | Pre-defined Array Variable, Integer | | 3-166 |
| LANIntrSource | Pre-defined Variable, Integer | | 3-167 |
| Lcase$() | Function | | 3-168 |
| Left$() | Function | | 3-169 |

| Name | Type | Default Value | Page # |
|---|---|---|---|
| Len() | Function | | 3-170 |
| Log() | Function | | 3-171 |
| Log10() | Function | | 3-172 |
| Ltrim$() | Function | | 3-173 |
| Main | Statement | | 3-174 |
| MB32WordOrder | Pre-defined Variable | 1 | 3-175 |
| MBErr | Pre-defined Variable, Integer | 0 | 3-176 |
| MBFloatWordOrder | Pre-defined Variable | 1 | 3-178 |
| MBInfo Block ... End | Statement | | 3-179 |
| $MBMapBit() | Statement | | 3-180 |
| $MBMap16() | Statement | | 3-182 |
| $MBMap32() | Statement | | 3-183 |
| $MBMapFloat() | Statement | | 3-184 |
| MBReadBit() | Pre-defined Function | | 3-185 |
| MBRead16() | Pre-defined Function | | 3-186 |
| MBRead32() | Pre-defined Function | | 3-187 |
| MBReadFloat() | Pre-defined Function | | 3-189 |
| MBWriteBit() | Statement | | 3-191 |
| MBWrite16() | Statement | | 3-192 |
| MBWrite32() | Statement | | 3-193 |
| MBWriteFloat() | Statement | | 3-195 |
| Mid$() | Function | | 3-197 |
| Mod | Operator | | 3-198 |

| Name | Type | Default Value | Page # |
|---|---|---|---|
| Model | Pre-defined Variable, Integer, Status Variable, Read-Only | | 3-199 |
| ModelExt | Pre-defined Variable, Integer, Status Variable, Read-Only | | 3-200 |
| ModifyEncPos( ) | Statement | | 3-201 |
| Motor | Pre-defined Variable | sine(1,162,758,483) | 3-202 |
| Moving | Pre-defined Variable, Integer, Read-Only | 0 | 3-203 |
| OCDate | Pre-defined Variable, Integer, Status Variable, Read-Only | factory | 3-204 |
| OCSNum | Pre-defined Variable, Integer, Status Variable, Read-Only | factory | 3-205 |
| Oct$() | Function | | 3-206 |
| On Error Goto | Statement | | 3-207 |
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| Name | Type | Default Value | Page # |
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# 3 Instructions

**Introduction**

This section is an alphabetical reference to 950BASIC instructions:

- commands
- functions
- statements
- string functions
- parameters
- statements
- string variables
- variables

The name and type of each instruction is listed at the top of each page. The instruction is then described based on the following categories:

**Purpose:** The purpose of the instruction.

**Syntax:** The complete notation of the instruction.

**Related instructions:** Other commands that are similar to this particular instruction.

**Programming guidelines:** Pertinent information about the instruction and its use.

**Example program:** Possible use of the instruction in a program.

# ABCrc

## (Pre-defined Variable, Integer)

**Purpose**

ABCrc sets the method by which an Allen-Bradley DF1 message is checked for validity.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
ABCrc = 1    Sets message check method to CRC
ABCrc = 0    Sets message check method to BCC
```

**Guidelines**

The setting in the SC950 MUST match the setting in the PLC.

**Example**

The following program reads an integer from a SLC500 PLC. It then sets RunSpeed to twice the integer read from the SLC500.

**Note:** *All communication settings on both devices (SC950 and SLC500) must match.*

```
main
dim SLC5Speed as integer
runtimeprotocol = 5          'Allen-Bradley DF1 protocol
baudrate = 19200             'baudrate MUST match PLC setting
abcrc = 1                    'Set check to CRC — MUST match PLC setting
SLC5Speed = ReadSLC5Integer(5,7,19)
RunSpeed = SLC5Speed * 2
end
```

# ABErr

## (Pre-defined Variable, Integer)

**Purpose**

ABErr contains the error code of the last Allen-Bradley DF1 transaction.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
x = ABErr
```

**Guidelines**

| ABErr | Meaning |
|---|---|
| 0 | No error |
| 1 | Response error |
| 2 | Response timeout |
| 3 | Max number of NAKs (negative acknowledgements) received |
| 4 | Max number of ENQs (enquiries) sent and still no response |
| 5 | SC950 Allen-Bradley DF1 receive buffer is full |

# ABInfo...End

**Purpose**

The ABInfo block section of a program is used to map pre-defined variables and/or global user variables to specific SC950 register addresses so that the OC950 can respond to unsolicited messages from a SLC500.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
ABInfo

   <$ABMap Statements>

End
```

**Guidelines**

This ABInfo block is only used when you are configuring the OC950 as an Allen-Bradley DF1device communicating with a SLC500. The ABInfo block is only needed when the SLC500 initiates read/wrtie commands to the SC950. If the SC950 initiates all read/write commands, then the ABInfo block is unnecessary.

There can be only one ABInfo block in a program. It should be put before the Main section of the program.

**Related instructions**

`ABMapInteger, ABMapFloat`

## ABInfo...End (continued)

**Example**

This example maps several pre-defined variables and one global user variable (MyFloat) to SC950 Allen-Bradley Df1 file registers. IndexDist is mapped to Register 1 of the SC950 Integer file. Position is mapped to Register 27 of the SC950 Integer file. MyFloat is mapped to Register 9 of the SC950 Float file.

```
ABInfo
    $ABMapInteger(1, IndexDist)
    $ABMapInteger(27, Position )
    $ABMapFloat(9, MyFloat )
End
Dim MyFloat As Float


Main
    RuntimeProtocol = 5
    ...
```

# $ABMapFloat( )

## (Statement)

**Purpose**

$ABMapFloat( ) maps a float variable (pre-defined or user defined) to the SC950 Float File register.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
$ABMapFloat(x, MyFloat)
```

x = register number

MyFloat = Pre-defined or global user-defined float variable.

**Guidelines**

Only needed when the SLC500 initiates read (write) transactions from (to) the SC950.

**Related instructions**

`ABInfo Block`

**Example**

This example maps a predefined variable (RunSpeed) and a global user variable (MyFlt) to SC950 ABComm Float file registers. RunSpeed is mapped to Register 1 of the SC950 Float file. MyFlt is mapped to Register 5 of the SC950 Float file.

```
Dim MyFlt as float
ABInfo
    $ABMapFloat(1, RunSpeed)
    $ABMapFloat(5, MyFlt)
End
```

# $ABMapInteger( )
## (Statement)

**Purpose**

$ABMapInteger( ) maps an integer variable (pre-defined or user defined) to the SC950 Integer File register.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
$ABMapInteger(x, MyVar)
```

x = register number.

MyVar = Predefined or global user-defined integer variable.

**Guidelines**

Only needed when the SLC500 initiates read (write) transactions from (to) the SC950.

**Related instructions**

`ABInfo Block`

**Example**

This example maps a pre-defined variable (IndexDist) and a global user variable (MyInt) to SC950 Allen-Bradley Integer file registers. IndexDist is mapped to Register 1 of the SC950 Integer file. MyInt is mapped to Register 27 of the SC950 Integer file.

```
Dim MyInt as integer
ABInfo
    $ABMapInteger(1, IndexDist)
    $ABMapInteger(27, MyInt )
End
```

# AbortMotion

## (Statement)

**Purpose**

AbortMotion stops motor motion while allowing continued program execution.

Deceleration is determined by the motor torque capability in conjunction with the current limit parameters.

**Syntax**

```
AbortMotion
```

**Example**

This program segment commands the motor at constant velocity until input 1 goes to a logic 0 then the motor is commanded to stop.

```
AccelRate = 12000              'Set acceleration rate equal to 12,000 RPM/sec
RunSpeed = 120                 'Set Run speed equal to 120 RPM
GoVel
When Inp1 = 0, AbortMotion
Print "Move Aborted!"
```

# Abs()
## (Function)

**Purpose**

Abs(x) converts the associated value (x) to an absolute value. If the value is negative, it is converted to a positive value. If the value is positive, it is not changed.

**Syntax**

```
result = Abs(x)
```

**Guidelines**

Enter the argument (the value) in parentheses immediately following the term Abs.

**Example**

```
for x = -10 to 10
    print Abs(x)
next
```

# AccelGear

## (Pre-defined Variable, Integer)

**Purpose**

AccelGear sets the maximum acceleration that will be commanded on the follower when Gearing is turned ON or the electronic gearing ratio (Ratio or PulsesOut / PulsesIn ) is increased. This maximum acceleration limit remains in effect until Gearlock is achieved. Once Gearlock is achieved the follower will follow the master with whatever acceleration or deceleration is required.

**Note:** *AccelGear is independent of DecelGear. Each variable must be set, independently, to the appropriate value for the desired motion.*

---

**Syntax** `AccelGear = x`

Units rpm/sec

Range 1 to 16,000,000 rpm/sec

Default 16,000,000 rpm/sec

---

**Guidelines** Set AccelGear prior to initiating Gearing.

**Related instructions** `DecelGear, GearError, GearLock`

## AccelGear (continued)

**Example** This example shows how to use AccelGear to limit acceleration and then make up the lost distance.

```
AccelGear = 10000              'set AccelGear
Ratio      = 1.0
Enable     = 1
GearError = 0                  'clear GearError
Gearing    = 1
While GearLock = 0
Wend                           'wait for LOCK
IndexDist = GearError
GoIncr
```

# AccelRate

## (Pre-defined Variable, Integer)

**Purpose**

AccelRate (acceleration rate) sets the maximum commanded acceleration rate when the speed is increased.

**Note**: *AccelRate is independent of DecelRate. Each variable must be set, independently, to the appropriate value for the desired motion.*

**Syntax**

```
AccelRate = x
```

Units: rpm/sec

Range: 1 to 16,000,000 rpm/sec

Default: 10,000 rpm/sec

**Guidelines**

Set AccelRate prior to initiating the move. You can update AccelRate during a move by executing an UpdMove statement.

**Related instructions**

`DecelRate`

**Example**

This example sets AccelRate to 10,000 RPM/sec and does an incremental move of 10 motor revolutions (assuming CountsPerRev is 4096).

```
RunSpeed = 1000
AccelRate = 10000
DecelRate = 10000
IndexDist = 40960
GoIncr
```

# ActiveCam

## (Pre-defined Variable, Integer)

**Purpose**

ActiveCam activates the specified cam table. This means that the Position Command will be calculated based upon the Master Position (CamMasterPos) and the points in the specified cam table.

When you activate a new cam, the drive accelerates (at AccelGear) or decelerates (at DecelGear) as necessary to the speed required by the present motion of the Cam Master and the slave position profile defined in the cam table.

When speed synchronization is achieved, GearLock is set to one and a correction move is performed to bring the slave into position lock with the cam table. The direction of this move is controlled by CamCorrectDir. The parameters of this correction move are the same as for any other move, i.e. AccelRate, DecelRate and RunSpeed.

You should note that if the master is not moving or if the slave position profile in the cam table doesn't require cam motion when the cam is activated then the speed synchronization will occur instantly and the correction move will be executed as soon as the cam is activated.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

---

**Syntax**

```
ActiveCam = x
```

Range

0 - 8

## ActiveCam (continued)

**Guidelines**

ActiveCam is automatically set to zero (i.e. any cam is disengaged) when the drive is disabled.

The correction move can be disabled. Set CamCorrectDir = 3.

You must declare and create a cam table before you make it active.

If RunSpeed is equal to zero when you set ActiveCam then a run-time error will be generated because the correction move cannot be performed.

**Related instructions**

`CamCorrectDir`

**Example**

In the following example, a cam is declared, created, and activated.

```
$DeclareCam(1, 5)                ‘allocate space for cam #1, 5 points
main
   CreateCam(1)                  ‘start the cam create block
      AddPoint(0, 0)
      AddPoint(200, 100)
      AddPoint(400, 200)         ‘add the points
      AddPoint(600, 300)
      AddPoint(800, 400)
    End                          ‘end the cam create block
Enable = 1                       ‘enable the motor
EncPosModulo = 800               ‘set EncPosModulo to master counts/cycle
PosModulo = 400                  ‘set PosModulo to slave (SC950) counts/cycle
EncPos = 0                       ‘clear the counter
ActiveCam = 1                    ‘activate cam #1
End
```

# AddPoint( )
## (Statement)

**Purpose**

The Addpoint( ) statement adds the specified "point" (master position and corresponding slave position) to the cam table that is being created. This statement may only be used inside a CreateCam block.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
AddPoint(master_position, slave_position)
```

**Guidelines**

You must be inside a CreateCam block to use the Addpoint statement.

The master position for the first Addpoint statement in a CreateCam block must always be zero.

The master position must always increase as you add points to the cam table.

There must be at least three points in your cam table.

**Related instructions**

`$DeclareCam`

## AddPoint( ) (continued)

**Example** In the following example, a cam is declared, created, and activated.

```
$DeclareCam(1, 5)                ‘allocate space for cam #1, 5 points

main
   CreateCam(1)                  ‘start the cam create block
      AddPoint(0, 0)
      AddPoint(200, 100)
      AddPoint(400, 200)         ‘add the points
      AddPoint(600, 300)
      AddPoint(800, 400)
   End                           ‘end the cam create block
Enable = 1                       ‘enable the motor
EncPosModulo = 800               ‘set EncPosModulo to master counts/cycle
PosModulo = 400                  ‘set PosModulo to slave counts/cycle
EncPos = 0                       ‘clear the counter
ActiveCam = 1                    ‘activate cam #1
End
```

# ADF0

## (Pre-defined Variable, Float)

**Purpose** ADF0 is the first-order low-pass filter corner frequency for the analog input channel (J4-1 to J4-2).

**Syntax** `ADF0 = x`

Units Hertz

Range 0.01 to 4.17e7

Default 1,000 Hertz

**Guidelines** ADF0 is the corner frequency in Hz of the single-order low-pass filter. The purpose of the filter is to attenuate the high frequency components from the digitized input signal. Decreasing ADF0 lowers the response time to input changes, but it also increases the effective resolution of AnalogIn

| **ADF0** | **AnalogIn** | |
|---|---|---|
| | **Effective Bits** | **LSB Size** |
| Max | 14 | 1.6 mV |
| 150 | 16 | 0.4 mV |
| 10 | 18 | 0.1 mV |

# ADOffset

## (Pre-defined Variable, Float)

**Purpose** ADOffset adjusts the steady-state value of the analog command input.

**Syntax** `ADOffset = x`

Units Volts

Range -15 to +15

Default 0 volts

**Guidelines** AnalogIn is equal to the differential voltage between J4-1 and J4-2 plus the ADOffset.

# Alias
## (Statement)

**Purpose**

Alias allows you to define your own names for system resources, such as Input or Output pins.

**Syntax**

```
Alias <name> = <expression>
```

**Guidelines**

ALIAS is much more powerful than CONST. Constant expressions are computable at compile-time, whereas an alias has a value that may only be known at the time that it is being used. For this reason ALIASes should be used with care—-too much aliasing can make it very difficult for you to read your own program.

**Related instructions**

`Const`

**Example**

```
Alias CONVEYOR_IS_RUNNING = (inp1=0)
if CONVEYOR_IS_RUNNING then
    print “The conveyor is running”
end if
```

# AnalogIn

## (Pre-defined Variable, Float, Status Variable, Read Only)

**Purpose** AnalogIn (Analog input) contains the digitized value of the analog input channel, which is the differential voltage of J4-1 (+) relative to J4-2 (-) after ADOffset is added and passed through ADFO low-pass filter.

**Syntax** `x = AnalogIn`

Units Volts

Range -13.5 to +13.5

Default None

**Guidelines** AnalogIn can be monitored to check the presence and voltage of signals at the analog input terminals.

# AnalogOut1

## (Pre-defined Variable, Float, Control Variable)

**Purpose** AnalogOut1 (Analog Output1) sets the voltage level of the DAC Monitor 1 (J4-3) when DM1Map = 0.

**Syntax** `AnalogOut1 = x`

Units Volts

Range -5.0 to +4.961

Default 0 volts

**Guidelines** When DM1Map is not equal to 0, AnalogOut1 is not used.

# AnalogOut2

## (Pre-defined Variable, Float, Control Variable)

**Purpose** AnalogOut2 (Analog Output1) sets the voltage level of the DAC Monitor 2 (J4-4) when DM2Map = 0.

**Syntax** `AnalogOut2 = x`

Units Volts

Range -5.0 to +4.961

Default 0 volts

**Guidelines** When DM2Map is not equal to 0, AnalogOut2 is not used.

# And
## (Operator)

**Purpose**

And performs a logical AND operation on two expressions.

**Syntax**

```
result = A and B
```

**Guidelines**

The result evaluates to True if, and only if, both expressions are True. Otherwise, the result is False.

**Related instructions**

`Or, Xor, Band, Bor, Bxor`

**Example**

```
x = 17
y = 27
if (x > 20) And (y > 20) then
    print “This won’t get printed”
end if
if (x < 20) And (y > 20) then
    print “This will get printed”
end if
```

# ARF0

## (Pre-defined Variable, Float, NV Parameter)

**Purpose** ARF0 is the first velocity loop compensation anti-resonance low-pass filter corner frequency.

**Syntax** `ARF0 = x`

Units Hertz

Range 0.01 to 10e6

-10e6 to -0.01

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

**Guidelines** ARF0 is the corner frequency, in Hz, of one of two single-order low-pass anti-resonant filters or if < 0 is the under damped pole pair frequency in Hz and ARF1 would be the pole pair Q. The purpose of the anti-resonant filters is to attenuate the velocity loop gain at the mechanical resonant frequency.

**Related instructions** `ARF1, ARZ0, ARZ1`

# ARF1

## (Pre-defined Variable, Float, NV Parameter)

**Purpose** ARF1 is the second velocity loop compensation anti-resonance low-pass filter corner frequency.

---

**Syntax** `ARF1 = x`

Units Hertz

Range 0.01 to 10,000,000

1 to 100 (Q)

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

---

**Guidelines** ARF1 is the corner frequency, in Hz, of one of two single-order low-pass anti-resonant filters or if ARF0 is < 0, then ARF1 is the Q of the under damped pole pair. The purpose of the anti-resonant filters is to attenuate the velocity gain at the mechanical resonant frequency.

**Related instructions** `ARF0, ARZ0, ARZ1`

# ARZ0

## (Pre-defined Variable, Float)

**Purpose** ARZ0 is the first velocity loop compensation zero.

**Syntax** `ARZ0 = x`

Units Hertz

Range 20 to 1e5

-1e5 to -35

Default 0 Hertz

**Guidelines** ARZ0 is generally not needed and should be set to 0, which eliminates it entirely. For very demanding compensation schemes it can be used to add lead compensation or with ARZ1 to add a notch filter. ARZ0 positive sets the zero frequency in Hz and if < 0 sets the under damped zero pair frequency in Hz.

**Related instructions** `ARF0, ARF1, ARZ1`

# ARZ1

## (Pre-defined Variable, Float)

**Purpose** ARZ0 is the second velocity loop compensation zero.

**Syntax** `ARZ1 = x`

Units Hertz

Range 20 to 1e6

-100 to 100 (Q)

Default 0 Hertz

**Guidelines** ARZ1 is generally not needed and should be set to 0 which eliminates it entirely. For very demanding compensation schemes it can be used to add lead compensation or with ARZ0 to add a notch filter. ARZ1 sets the zero frequency in Hz or if ARZ0 is set < 0 then ARZ1 sets the under damped zero pair Q.

**Related instructions** `ARF0, ARF1, ARZ0`

# Asc()
## (Function)

**Purpose**

ASC(string expression)returns a decimal numeric value that is the ASCII code for the first character of the string expression(x$).

**Syntax**

```
x = Asc(s$)
```

**Guidelines**

If the string begins with an uppercase letter, the value of Asc() will be between 65 and 90.

If the string begins with a lowercase letter, the value of Asc() will be between 97 and 122.

Values 0 to 9 return 48 to 57.

# Atan()
## (Function)

**Purpose** Atan() (arc tangent) returns the arctangent of its argument in radians.

**Syntax**

```
result = atan(x)
```

**Guidelines**

The result is always between -pi/2 and pi/2.

The value of x may be any numeric type.

To convert from degrees to radians, multiply by 0.01745329

# Autostart

## (Pre-defined Variable, Integer)

**Purpose** Autostart specifies whether or not the program in the OC950 starts executing automatically when AC power is applied.

0 = Program does not start automatically

1 = Program starts automatically

---

**Syntax** `Autostart = x`

Units none

Range 0 or 1

Default 0

---

**Guidelines** Autostart should be set to 0 or 1 in the Variables Window (**Compiler** Menu, **Variables** option) of the 950 IDE.

# AxisAddr

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** AxisAddr indicates the PacLAN address of the OC950. It can also be used as a general configuration parameter, allowing you to have the same program in different drives that behaves differently on some of them depending upon what value the DIP switch is set to.

**Syntax** `x = AxisAddr`

Units none

Range 1 to 255

Default Set by Address DIP Switch S1 on OC950.

**Guidelines** Every OC950 in a PacLAN network must have a unique address.

# Band
## (Operator)

**Purpose**

Band performs a bitwise AND of two integer expressions.

**Syntax**

```
result = x Band y
```

**Guidelines**

The Band operator performs a bitwise And operation on the two numeric expressions. The expressions are converted to integers (32 bits) before the Band operation takes place.

For each of the 32 bits in the result, the bit will be set to 1 if, and only if, the corresponding bit in both of the arguments is 1.

**Example**

```
x = 45                  '0010 1101 binary
y = 99                  '0110 0011 binary
print x Band y          'prints: 33 (0010 0001)
```

# BaudRate

## (Pre-defined Variable, Integer)

**Purpose** BaudRate specifies the baudrate used on the OC950 Serial Port. It can be set to either 19200 or 9600 baud.

**Syntax** `BaudRate = x`

Range 9600 or 19200

Default 19200

**Guidelines** When you configure your OC950 to communicate at 9600 baud, it will communicate at this baudrate while the program is running and when the program is stopped. Therefore, it is essential that you also configure the 950IDE software on your PC to communicate at the same baudrate.

Once you configure your OC950 to communicate at 9600 baud, this information is retained after cycling power.

Please see Appendix A, “Operating at 9600 Baud” for additional information.

# BDInp1-BDInp6

## (Pre-defined Variable, Integer, Status Variable, Read Only)

**Purpose**

BDInp1 reads the state of BDIO1, J4-7.

BDInp2 reads the state of BDIO2, J4-8.

BDInp3 reads the state of BDIO3, J4-9.

BDInp4 reads the state of BDIO4, J4-10.

BDInp5 reads the state of BDIO5, J4-11.

BDInp6 reads the state of BDIO6, J4-12.

**Syntax**

```
x = BDInpX
```

Range

0 or 1

**Guidelines**

BDInpX indicates whether BDIOX input voltage is above or below the logic threshold selected by the variable BDLgcThr.

BDInpX = 0 indicates a logic low input

BDInpX = 1 indicates a logic high input

# BDInputs

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** BDInputs reads the state of the BDIO inputs in parallel. This variable is determined by the voltage levels applied to the BDIO Input pins J4-7 to J4-12.

**Syntax** `x = BDInputs`

Range 0 to 63 (6 BDIOs)

**Guidelines** BDInputs = 1*BDIO1 + 2*BDIO2 + 4*BDIO3 + 8*BDIO4 + 16*BDIO5 + 32*BDIO6.

0 corresponds to a low input, while 1 corresponds to a high input.

For example, BDInputs = 12 means that BDIO 1, 2, 5, 6 are low and BDIO 3, 4 are high.

See BDInp1-6 to query inputs individually.

# BDIOMap1-BDIOMap6

## (Pre-defined Variables, Integer, NV Parameter)

**Purpose** BDIOMap1-BDIOMap6 sets the logical function of the BDIOs on J4-7 to J4-12.

**Syntax** `BDIOMap = x`

Range -2,147,482,648 to 2,147,482,648

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function assigns the following default functions:

| BDIOMapX | Default |
|---|---|
| BDIOMap1 | Fault Reset Input Active Low |
| BDIOMap2 | CW Inhibit Input Active Low |
| BDIOMap3 | CCW Inhibit Input Active Low |
| BDIOMap4 | OFF |
| BDIOMap5 | Brake Output Active High |
| BDIOMap6 | Fault Output Active High |

**Guidelines** To use one of the BDIO points as a programmable Input/Output the mapping for that point must be removed. Remove the mapping by setting the appropriate BDIOMap variable to zero.

## BDIOMap1-BDIOMap6 (continued)

Although the value is a 32 bit integer, the value is easily set in the Variables Screen or in the program using the following pre-defined constants for setting the BDIOMap variables:

| | |
|---|---|
| Fault_Reset_Inp_Hi | Fault_Out_Hi |
| Fault_Reset_Inp_Lo | Fault_Out_Lo |
| CW_Inhibit_Inp_Hi | Enabled_Out_Hi |
| CW_Inhibit_Inp_Lo | Enabled_Out_Lo |
| CCW_Inhibit_Inp_Hi | Brake_Out_Hi |
| CCW_Inhibit_Inp_Lo | Brake_Out_Lo |

**Related instructions**

Input Functions: FaultReset, CwInh, CcwInh
Output Functions: Fault, Enabled, Brake

**Example**

BDIOMap4 = Enabled_Out_Lo will map Enabled as an active low output to J4-10.

# BDLgcThr

## (Pre-defined Variable, Integer)

**Purpose** BDLgcThr sets the switching threshold for the Base drive inputs (BDInp1 - BDInp6) and the pull up voltage for the Base drive outputs (BDOut1 - BDOut6).

**Syntax** `BDLgcThr = x`

**Range** 0 or 1

**Default** 0 (5 volt compatible)

**Guidelines** 0 selects 5 volt logic compatibility

1 selects 24 volt logic compatibility

| BDLgcThr | Low (Volts) | High (Volts) | Pull up (Volts) |
|---|---|---|---|
| 0 | 2.1 | 3.1 | 5.0 |
| 1 | 4.0 | 5.0 | 12.0 |

# BDOut1-BDOut6

## (Pre-defined Variable, Integer, Control Variable)

**Purpose**

BDOut1-BDOut6 allows setting the output logic state of BDIO outputs not mapped to an output function via BDIOMapX.

BDOut1 sets the state of BDIO1, J4-7

BDOut2 sets the state of BDIO2, J4-8

BDOut3 sets the state of BDIO3, J4-9

BDOut4 sets the state of BDIO4, J4-10

BDOut5 sets the state of BDIO5, J4-11

BDOut6 sets the state of BDIO6, J4-12

---

**Syntax** `BDOutX = x`

Range 0 or 1

Default 1 (transistor turned off)

---

**Guidelines**

0 turns on the pull down transistor

1 turns off the pull down transistor

To use a BDIO point as an input, the associated BDOut must be set to 1. This is the default value.

# BDOutputs

## (Pre-defined Variable, Integer, Control Variable)

**Purpose** For BDIO outputs not mapped to an output function via BDIOMap, allows setting their output logic state in parallel.

**Syntax** `BDOutputs = x`

Range 0 to 63 (6 BDIOs)

Default 63

**Guidelines** BDOutputs = 1*BDIO1 + 2*BDIO2 + 4*BDIO3 + 8 *BDIO4 + 16*BDIO5 + 32*BDIO6.

0 will turn on the corresponding pull down transistor, while 1 will turn off the corresponding pull down transistor.

**Note:** *BDIOs mapped to output functions via their BDIOMap are determined by that function and their value in BDOutputs will be ignored.*

For example, BDInputs = 12 would pull down BDIO 1, 2, 5, 6 and open circuit BDIO 3, 4.

See BDOut1-6 to control outputs individually.

# Beep
## (Statement)

**Purpose** Beep transmits a BEEP character (ASCII 07) to the serial port.

**Syntax**

```
Beep
```

**Example**

```
print “Listen to this...”
pause(0.5)
Beep
```

# BlkType

## (Pre-defined Variable, Integer)

**Purpose** BlkType specifies configuration as a position, velocity, or torque block.

**Syntax** `BlkType = x`

Range 0, 1 or 2

Default 2 (Position Mode)

**Guidelines** BlkType sets the overall control functionality of the drive. For block diagrams of the drive configurations, refer to the manual which describes the alternative BlkType settings. When used in any of the analog modes, the analog control is the differential voltage applied to the Analog Cmd+ (Analog Command + ) and Analog Cmd- (Analog Command - ) inputs (J4-1 and J4-2 respectively).

| BlkType | Servo Configuration |
|---|---|
| 0 | Analog Torque Block |
| 1 | Analog Velocity Block |
| 2 | Digital Position Block |

# Bnot
## (Operator)

**Purpose**

Bnot performs a bitwise NOT of the integer expression.

**Syntax**

```
result = Bnot x
```

**Guidelines**

The Bnot operator performs a bitwise NOT operation on a numeric expression. The expression is converted to an integer (32 bits) before the BNOT operation takes place.

For each of the 32 bits in the result, the bit will be set to 1 if the corresponding bit in the argument is 0; the bit will be set to 0 if the corresponding bit in the argument is 1.

**Example**

```
x = 45                          '0010 1101 binary
print Bnot x                    'prints: -46
```

# Bor

## (Operator)

**Purpose**

Bor performs a bitwise OR of two integer expressions.

**Syntax**

```
result = x Bor y
```

**Guidelines**

The Bor operator performs a bitwise OR operation on the two numeric expressions. The expressions are converted to integers (32 bits) before the BOR operation takes place.

For each of the 32 bits in the result, the bit will be set to 1 if the corresponding bit in either of the arguments is 1.

**Example**

```
x = 45                  '0010 1101 binary
y = 99                  '0110 0011 binary
print x Bor y           'prints: 111 (0110 1111)
```

# Brake

## (Pre-defined Variable, Integer, Mappable Output Function)

## (Read-Only)

**Purpose** Brake indicates when the motor is not powered and a mechanical brake is needed to hold the motor.

**Syntax** `x = Brake`

Range 0 or 1

**Guidelines** 0 = the motor is powered and the brake should be off.

1 = the mechanical brake should engage

To insure that a mechanical brake is engaged when a drive's control power is removed, the Brake function should be mapped active high to a BDIO pin.

# Bxor
## (Operator)

**Purpose**

Bxor performs a bitwise XOR of two integer expressions.

**Syntax**

```
result = x Bxor y
```

**Guidelines**

The Bxor operator performs a bitwise XOR operation on the two numeric expressions. The expressions are converted to integers (32 bits) before the BXOR operation takes place.

For each of the 32 bits in the result, the bit will be set to 1 if the corresponding bits in the two arguments are different from each other. If the corresponding bits are identical (both 0 or both 1), then the bit will be set to 0.

**Example**

```
x = 45                  '0010 1101 binary
y = 99                  '0110 0011 binary
print x Bor y           'prints: 78 (0100 1110)
```

# Call

## (Statement)

**Purpose**

Call transfers program control to a subroutine. When the subroutine is finished then control is transferred to the line following the CALL. The CALL statement replaces the GOSUB statement, which is no longer supported.

**Syntax**

```
Call sub [(arg1, arg2, ...)]
```

**Guidelines**

A subroutine is essentially a function with no return value. Arguments to subroutines are passed “by value”. This means that the subroutine receives a copy of these arguments. Any assignments to these arguments made by the subroutine will have no effect on these variables in the calling function or subroutine.

**Related instructions**

`Sub`

**Example**

```
Call PrintSum(3, 4)
...
Sub PrintSum( i, j as integer)
    print i+j
End Sub
```

# CamCorrectDir

## (Pre-defined Variable, Integer)

**Purpose**

CamCorrectDir specifies the direction of the correction move that is done when a new cam table is activated (by setting ActiveCam = n) or when speed synchronization is achieved.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

---

**Syntax**

`CamCorrectDir = x`

Range

0, 1, 2, 3

Default

2 (shortest distance)

---

**Guidelines**

CamCorrectDir can have one of the following values:

| | |
|---|---|
| 0 | move is done clockwise |
| 1 | move is done counter-clockwise |
| 2 | move is done in the direction which will yield the shortest move (see below) |
| 3 | no correction move is performed. |

The correction move is done using AccelRate, DecelRate and RunSpeed. You should note that even if CamCorrectDir specifies (for example) a clockwise correction move, this just specifies the direction of the superimposed move. If the cam generated speed is the opposite direction and is larger than RunSpeed then the slave will just slow down.

For CamCorrectDir = 2, the direction of the correction is calculated (based upon PosModulo) to yield the shortest distance move. For example, if PosModulo = 10000 and the clockwise correction move would be 8000 then a counter-clockwise move of 2000 will be performed instead.

**Related instructions**

`ActiveCam`

## CamCorrectDir (continued)

**Example** In the following example, the correction move will be done in the direction yielding the shortest move distance.

```
....
'The cam table for Cam #1 needs to have been
'already declared and created
'_____________________
CamCorrectDir = 2
ActiveCam = 1
    ....
```

# CamMaster

## (Pre-defined Variable, Integer)

**Purpose** CamMaster is used to specify the source of the input to the cam table for cam profiling.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

---

**Syntax** `CamMaster = x`

Range 0, 1, 2

Default 0 (“real” encoder + “virtual” encoder)

---

**Guidelines** CamMaster can be given one of the following values:

| | |
|---|---|
| 0 | Encpos + vmEncpos |
| 1 | vmEncpos only (Encpos is ignored) |
| 2 | Encpos only (vmEncpos is ignored) |

**Related instructions** `CamMasterPos`

# CamMasterPos

## (Pre-defined Variable, Integer, Read-Only)

**Purpose**

CamMasterPos gives the value of the master position presently being used as the input to the cam table. The value of CamMasterPos depends upon Encpos, vmEncpos and CamMaster as follows:

| Value of CamMaster | Value of CamMasterPos is: |
|---|---|
| 0 | vmEncpos + Encpos |
| 1 | vmEncpos |
| 2 | Encpos |

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

---

**Syntax**

```
x = CamMasterPos
```

Units

encoder counts

Range

0 - EncposModulo

---

**Related instructions**

`CamMaster, Encpos, vmEncpos`

# CamSlaveOffset

## (Pre-defined Variable, Integer, Read-Only)

**Purpose**

CamSlaveOffset indicates the offset (or difference) between PosCommand and the position command that is calculated from the active cam table based upon the present value of Encpos and/or vmEncpos. This offset is the result of incremental (GoIncr) or velocity (GoVel) moves that have been superimposed (by you) on the cam table.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
x = CamSlaveOffset
```

Units: feedback counts

Range: 0 - PosModulo

**Guidelines**

If there is no active cam (ActiveCam = 0) then the value of this variable is undefined.

# CCDate

## (Pre-defined Variable, Status Variable, Read Only)

**Purpose** CCDate gives the Control Card date code.

**Syntax** `CCDate = x`

Range 0 to $2^{31}$

Default Set at factory

# CCSNum

## (Pre-defined Variable, Integer, Status Variable, Read Only)

**Purpose** CCSNum gives the Control Card serial number.

**Syntax** `CCSNum = x`

Range 0 to $2^{31}$

Default Set at factory

# CcwInh

## (Pre-defined Variable, Integer)

**Purpose** CcwInh indicates the current state of the CCWINH (Inhibit -) Input. It can also be used as an interrupt source.

**Syntax** `x = CcwInh`

Range 0 or 1

Units none

Default none

# Ccwot

## (Pre-defined Variable, Integer)

**Purpose** Ccwot sets the counter-clockwise software overtravel limit. When the position of the motor becomes more negative than this limit, a counter-clockwise overtravel interrupt will occur if that interrupt is active.

**Syntax** `Ccwot = x`

Range -134,217,728 to 134,217,727 resolver counts

Units resolver counts

Default 0

# Chr$()
## (Function)

**Purpose** Chr$() returns a one character string whose ASCII value is the argument.

**Syntax**

```
s$ = Chr$(x)
```

**Guidelines** The argument to Chr$() must be a numeric value in the range 0 to 255.

**Example** This example will print an uppercase “B”.

```
dim a$ as string
a$ = Chr$(66)
print a$
```

# Cint()
## (Function)

**Purpose** Cint() converts a numeric expression to the closest integer number.

**Syntax**

```
x = Cint( numeric-expression )
```

**Related instructions** Int(), Fix()

# Cls

## (Statement)

**Purpose**

Cls transmits 40 line feed characters (ASCII code = 10) to the serial port. Cls clears the display of a terminal.

**Syntax**

```
Cls
```

**Example**

```
print “Take a good look now ...”
pause(2)
cls
```

# CmdGain

## (Pre-defined Variable, Float)

**Purpose** CmdGain sets the scale factor of the analog input for BlkTypes 0 and 1.

**Syntax** `CmdGain = x.x`

Units, Range
BlkType = 0 Amperes/Volt
$\pm 10^{10} * I_{peak}$

BlkType = 1 KRPM/Volt
$\pm 10^{10}$

BlkType = 2 Not Applicable

Default 0.5

**Guidelines** CmdGain is a floating point variable that sets the command gain on the analog input (voltage from J4-1 to J4-2) for BlkTypes:

0 (Analog torque block) and

1 (Analog velocity block)

# CommEnbl

## (Pre-defined Variable, Integer, Control Variable)

**Purpose** CommEnbl allows/disallows normal commutation.

**Syntax** `CommEnbl = x`

Range 0 or 1

Default 1

**Guidelines** 0 (disables commutation; commutation angle set only by CommOff)

1 (enables commutation)

**IMPORTANT NOTE**

**CommEnbl must always be 1 for normal operation. Leaving CommEnbl at 0 can overheat and possibly damage the motor.**

# CommOff

## (Pre-defined Variable, Float, NV Parameter)

**Purpose** CommOff sets the origin for the electrical commutation angle.

**Syntax** `CommOff = x.x`

Units degrees

Range 0 to 360

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function sets this value to 0 degrees.

**Guidelines** Proper value for standard Pacific Scientific motors is 0.

**Note:** *For CommSrc = 1 (incremental encoder commutation) CommOff is set to 0 on every power up, independent of the value in the non-volatile memory. Drive RAM value is always read/write.*

# CommSrc

## (Pre-defined Variable, Integer)

**Purpose** CommSrc selects resolver or incremental encoder feedback for motor commutation.

**Syntax** `CommSrc = x`

Range 0 or 1

Default 0 (resolver)

**Guidelines** 0 selects resolver feedback commutation — PoleCount set to number of motor pole pairs.

1 selects incremental encoder feedback commutation — PoleCount set to number of quadrature encoder counts per motor electrical cycle.

**Note:** *Writing to CommSrc sets Polecount = 0. Therefore, first set CommSrc to the correct value and then set PoleCount.*

# ConfigPLS()

## (Statement)

**Purpose**

ConfigPLS() configures the functionality of one of the eight Programmable Limit Switches (PLS) on the OC950.

**Syntax**

```
ConfigPLS(PLSNumber, StartPosition, Duration,
       ActiveLevel, Source)
```

| | |
|---|---|
| PLSNumber: | the PLS being configured (0-7) |
| StartPosition: | the position where the PLS turns on |
| Duration: | the distance for which the PLS is on |
| ActiveLevel: | 0 - output is set to zero when the PLS is ON |
| | 1 - output is set to one when the PLS is ON |
| Source: | 0 - Resolver Position |
| | 1 - Encoder Position |

**Guidelines**

The ConfigPLS( ) statement just configures the PLS. You must enable the PLS using the appropriate EnablePLSx pre-defined variable before the PLS starts executing.

PLSs can be used to generate position based interrupts. The I/O points are bi-directional on the OC950. Therefore, configure an interrupt to occur on the rising/falling edge of the Input (IntrI0Hi) associated with the Output (Out0) that the PLS (PLS0) is controlling.

## ConfigPLS() (continued)

**Related instructions**

`EnablePLSx`

**Example**

The statements below will configure PLS0 such that Out0 will be set to 1 when `Position` is between 4096 and 4196. Out0 will be set to 0 at all other times.

```
ConfigPLS(0, 4096, 100, 1, 0)
EnablePLS0 = 1
```

The example below will configure PLS0 to generate an interrupt once during each rev of the motor.

```
Main
    PosModulo = 4096
    ConfigPLS(0, 2048, 500, 1, 0)
    EnablePLS0 = 1
    Enable = 1
    IntrI0Hi = 1
    Runspeed = 1000
    GoVel
    While 1:wend
End
Interrupt I0Hi
    Print "Interrupt generated on PLS0"
    IntrI0Hi = 1              'Re-enable "I0Hi" interrupt on exit"
End Interrupt
```

# Const
## (Statement)

**Purpose**

Const declares symbolic constants to be used instead of numeric values.

**Syntax**

```
Const name = x
```

**Guidelines**

Using the CONST Statement can make your program much more readable and self-documenting.

Unlike variables, CONSTANTS can assume only one value in a program.

**Related instructions**

`Alias`

**Example**

```
Const SLEW_SPEED = 2500
Const WORK_SPEED = 100
RunSpeed = SLEW_SPEED : GoVel
Pause(0.5)
RunSpeed = WORK_SPEED : GoVel
```

# Cos()
## (Function)

**Purpose** Cos(x) returns the cosine of x, where x is in radians.

**Syntax**

```
y = Cos(x)
```

**Guidelines** x must be in radians. To convert from degrees to radians, multiply by 0.017453.

# CountsPerRev

## (Pre-defined Variable, Integer)

**Purpose** CountsPerRev specifies the scaling of all position-based pre-defined variables.

**Syntax** `CountsPerRev = x`

Units Resolver Counts

Range 4096, 8192, 16384, 32768, 65536

Default 4096

**Guidelines** CountsPerRev specifies the scaling and hence, the resolution, of all position based variables. The default value is 4096 resolver counts per motor revolution (5.27 arc-min).

**Note**: *This variable controls the resolution of position variables. It* ***does not*** *affect accuracy.*

# CreateCam( )
## (Statement)

**Purpose**

The CreateCam( ) statement is used to initiate the creation of a cam table. The actual points in the cam table are inserted with a series of AddPoint() statements. The CreateCam( ) block must terminated by an End statement.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

---

**Syntax**

```
CreateCam( n )
   AddPoint(0, y1 )
   ....
   AddPoint(xx, yy)
End
```

where n is the cam number (1-8) of the cam table that you are creating.

---

**Guidelines**

You must “declare” a cam table before you “create” the cam table.

You can “create” a cam table as many times as you want.

You must “create” a cam table before you make it “active”.

You cannot “create” a cam table if it is “active”.

**The master position for the first entry must be 0.**

The master positions must keep increasing as you add points.

EncPosModulo must equal the total master distance in you CAM.

For a repeating CAM, PosModulo should be set equal to the distance that the slave travels in one CAM cycle.

## CreateCam( ) (continued)

**Related instructions**

`DeclareCam, AddPoint, ActiveCam`

**Example**

In the following example, a cam is declared, created, and activated.

```
$DeclareCam(1, 5)                 'allocate space for cam #1, 5 points
main
   CreateCam(1)                   'start the cam create block
      AddPoint(0, 0)
      AddPoint(200, 100)
      AddPoint(400, 200)          'add the points
      AddPoint(600, 300)
      AddPoint(800, 400)
    End                           'end the cam create block
Enable = 1                        'enable the motor
EncPosModulo = 800                'set EncPosModulo to master counts/cycle
PosModulo = 400                   'set PosModulo to slave (SC950) counts/cycle
EncPos = 0                        'clear the counter
ActiveCam = 1                     'activate cam #1
End
```

# CwInh

## (Pre-defined Variable)

**Purpose** CwInh indicates the current state of the CWINH (Inhibit +) Input. It can also be used as an interrupt source.

**Syntax** `x = CwInh`

Range 0 or 1

Units none

Default none

# Cwot

## (Pre-defined Variable)

| | |
|---|---|
| **Purpose** | Cwot sets the clockwise software overtravel limit. When the position of the motor becomes more positive than this limit, a clockwise overtravel interrupt will occur if that interrupt is active. |
| **Syntax** | `Cwot = x` |
| Range | -134,217,728 to 134,217,727 resolver counts |
| Units | resolver counts |
| Default | 0 |

# DecelGear

## (Pre-defined Variable, Integer)

**Purpose**

DecelGear sets the maximum deceleration that will be commanded on the follower when Gearing is turned ON or the electronic gearing ratio (Ratio or PulsesOut / PulsesIn ) is decreased. This maximum acceleration limit remains in effect until Gearlock is achieved. Once Gearlock is achieved the follower will follow the master with whatever acceleration or deceleration is required.

**Note:** *DecelGear is independent of AccelGear. Each variable must be set, independently, to the appropriate value for the desired motion.*

---

**Syntax** `DecelGear = x`

Units rpm/sec

Range 1 to 16,000,000 rpm/sec

Default 16,000,000 rpm/sec

---

**Guidelines** Set DecelGear prior to initiating Gearing.

**Related instructions** `AccelGear, GearError, GearLock`

# DecelRate

## (Pre-defined Variable, Integer)

**Purpose**

DecelRate (deceleration rate) sets the maximum commanded deceleration rate when the speed is decreased.

**Note**: *DecelRate is independent of AccelRate. Each variable must be set, independently, to the appropriate value for the desired motion.*

---

**Syntax**

```
DecelRate = x
```

Units: rpm/sec

Range: 1 to 16,000,000 rpm/sec

Default: 10,000 rpm/sec

---

**Guidelines**

Set DecelRate prior to initiating the move. You can update DecelRate during a move by executing an UpdMove statement.

**Related instructions**

`AccelRate`

---

**Example**

This example sets DecelRate to 5,000 RPM/sec and does an incremental move of 10 motor revolutions (assuming CountsPerRev is 4096).

```
RunSpeed = 1000
AccelRate = 10000
DecelRate = 5000
IndexDist = 40960
GoIncr
```

# $DeclareCam( )
## (Statement)

**Purpose**

$DeclareCam( ) allocates memory for the specified cam table. You must "declare" a cam table before you can "create" the cam table. The $DeclareCam( ) statement must be put before the word MAIN in your program.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
$DeclareCam(x, y)
```

where x is the cam number (1-8) and y is the maximum number of points that you will be putting into the cam table. y must be less than 1000.

**Guidelines**

This statement allocates memory for the cam table. You don't have to put in as many points as you "declare", but you can't put in more points.

**Related instructions**

`CreateCam, AddPoint, ActiveCam`

**Example**

To declare cam #1 with 10 points, the statement is:

$DeclareCam(1, 10).

**Note:** *The $DeclareCam statement must appear before main.*

```
$DeclareCam(1, 10)


main
   . . .
end
```

# Dim

## (Statement)

**Purpose**

The DIM statement is used for declaring variables before use. All variables (except pre-defined variables) must be declared before they can be used.

The DIM statement may also be used to specify that a global variable is non-volatile. When the controller is power-cycled non-volatile variables retain the value present when the controller was powered down. All other user variables are initialized to zero.

---

**Syntax**

```
Dim var1 [, var2 [...]] as type [NV]
```

where type is:

| | |
|---|---|
| INTEGER | 32 bit integer |
| FLOAT | IEEE single precision float |
| STRING | default length is 32 characters |

---

**Guidelines**

The default length for strings can be overridden by following the STRING type designator with a * (see example).

See the examples for how to use DIM to dimension an array.

**Related instructions**

`Static`

---

**Example**

```
Dim x, y, z as Integer NV
                                  '3 non-volatile integers
Dim q as float                    '1 floating point
Dim Array1(4,5) as integer        'a 4x5 array
Dim A$ as String*50
                                  'a 50 character string
```

# Dir

## (Pre-defined Variable, Integer)

**Purpose**

Dir specifies the direction that the motor will turn when a GoVel statement is executed. It has no effect on any other motion statements.

If Dir = 0 then the motor will turn in the positive direction.

If Dir = 1 then the motor will turn in the negative direction.

---

**Syntax** `Dir = x`

Units none

Range 0 or 1

Default 0

---

**Guidelines** Positive and negative directions of motor motion are defined by the PosPolarity variable.

**Related instructions** `GoVel, PosPolarity`

# DM1F0

## (Pre-defined Variable, Integer)

**Purpose** DM1F0 sets the frequency in Hz of a single pole low-pass filter on the DAC Monitor 1 output (J4-3).

**Syntax** `DM1F0 = x`

Units Hertz

Range 0.01 to 4.17e7

Default 1000 Hertz

**Guidelines** DM1F0 can be used to attenuate high frequency components from the DM1Map selected signal. Setting DM1F0 to 1 Hz and using DM1Out to examine the filtered value is an easy way to accurately measure the selected signal's dc value.

# DM1Gain

## (Pre-defined Variable, Float)

**Purpose** Sets the multiplicative scale factor applied to the DM1Map selected signal before outputting on DAC Monitor 1 (J4-3).

**Syntax** `DM1Gain = x`

Default 0.6667

**Guidelines** Changing DM1Map changes DM1Gain's value unless DM1Map changes to a signal with identical units, such as VelCmdA to VelFB (DM1Map = 1 to 2). Set DM1Gain to keep the signal in the DAC Monitor in the ±5 volt range. Below lists units when DM1Gain = 1.

| Monitor # | Scale Factor | Monitor # | Scale Factor |
|---|---|---|---|
| 0 | No Effect | 15 | 1 V/Cycle |
| 1 | 1 V/kRPM | 16 | 1 V/Amp |
| 2 | 1 V/kRPM | 17 | 1 V/Amp |
| 3 | 1 V/kRPM | 18 | 1 V/Amp |
| 4 | 1 V/kRPM | 19 | 1 V/100% |
| 5 | 1 V/Rev | 20 | 1 V/100% |
| 6 | 1 V/Rev | 21 | 1 V/100% |
| 7 | 1 V/Rev | 22 | 1 V/V |
| 8 | 1 V/Amp | 23 | 1 V/Rev |
| 9 | 1 V/Amp | 24 | 1 V/Amp |
| 10 | 1 V/V | 25 | 1 V/Amp |
| 11 | 1 V/Hz | 26 | 1 V/100% |
| 12 | 10 V/4096 | 27 | 1 V/100% |
| 13 | 1 V/100% | 28 | 1 V/kRPM |
| 14 | 1 V/ Degree C | | |

**Related instructions** `DM1Map, DM1F0, and DM1Out.`

# DM1Map

## (Pre-defined Variable, Integer)

**Purpose** DM1Map selects signal sent to the DAC Monitor 1 output on J4-3.

**Syntax** `DM1Map = x`

Range 0 to 65,537

Default 9 (IFB, Current Feedback )

**Guidelines** See Hardware manual for definitions of mnemonics.

| Monitor # | Mnemonic | Monitor # | Mnemonic |
|---|---|---|---|
| 0 | AnalogOut1 | 16 | IR |
| 1 | VelFB | 17 | IS |
| 2 | VelCmdA | 18 | IT |
| 3 | VelErr | 19 | VR |
| 4 | FVelErr | 20 | VS |
| 5 | Position* | 21 | VT |
| 6 | PosError* | 22 | VBus |
| 7 | PosCommand* | 23 | ResPos * |
| 8 | ICmd | 24 | Cmd Non-Trq Current |
| 9 | IFB | 25 | Non-Trq IFB |
| 10 | AnalogIn | 26 | Trq Voltage Duty Cycle |
| 11 | EncFreq | 27 | Non-Trq Voltage Duty Cycle |
| 12 | EncPos* | 28 | VelCmd |
| 13 | ItFilt | 65536 | Clamp Off ** |
| 14 | HSTemp | 65537 | Clamp On ** |
| 15 | Comm Ang * | | |

*Will wrap around when the signal exceeds the output voltage level.
**The value of the selected signal does not change.

**Related instructions** `DM1Gain, M1F0, and DM1Out`

# DM1Out

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose**

DM1Out indicates the value of the selected, filtered variable output to DAC Monitor 1 (J4-3). The value is reported in the units of the selected variable. For example, DM1Map = 1 selects VelCmdA and the units would be RPM.

**Syntax**

```
x = DM1Out
```

Range

Depends on DM1Map selected signal.

**Guidelines**

With DM1F0 set low, such as 1 Hz, DM1Out's value will accurately measure the DM1Map selected signal's dc component.

DM1Out can also be used to examine variables that can not be directly queried, such as motor phase voltage duty cycle, DM1Map = 19, 20 or 21.

# DM2F0

## (Pre-defined Variable, Float)

**Purpose** DM2F0 sets the frequency in Hz of a single pole low-pass filter on the DAC Monitor 2 output (J4-4).

**Syntax** `DM2F0 = x`

Units Hertz

Range 0.01 to 4.17e7

Default 1000 Hertz

**Guidelines** DM2F0 can be used to attenuate high frequency components from the DM2Map selected signal. Setting DM2F0 to 1 Hz and using DM2Out to examine the filtered value is an easy way to accurately measure the selected signal's dc value.

# DM2Gain

## (Pre-defined Variable, Float)

**Purpose** DM2Gain sets the multiplicative scale factor applied to the DM2Map selected signal before outputting on DAC Monitor 2 (J4-4).

**Syntax** `DM2Gain = x`

Default 2.0

**Guidelines** Changing DM2Map changes DM2Gain's value unless DM2Map changes to a signal with identical units, such as VelCmdA to VelFB (DM2Map = 1 to 2). Set DM2Gain to keep the signal in the DAC Monitor in the ±5 volt range. Below lists units when DM2Gain = 1.

| Monitor # | Scale Factor | Monitor # | Scale Factor |
|---|---|---|---|
| 0 | No Effect | 15 | 1 V/Cycle |
| 1 | 1 V/kRPM | 16 | 1 V/Amp |
| 2 | 1 V/kRPM | 17 | 1 V/Amp |
| 3 | 1 V/kRPM | 18 | 1 V/Amp |
| 4 | 1 V/kRPM | 19 | 1 V/100% |
| 5 | 1 V/Rev | 20 | 1 V/100% |
| 6 | 1 V/Rev | 21 | 1 V/100% |
| 7 | 1 V/Rev | 22 | 1 V/V |
| 8 | 1 V/Amp | 23 | 1 V/Rev |
| 9 | 1 V/Amp | 24 | 1 V/Amp |
| 10 | 1 V/V | 25 | 1 V/Amp |
| 11 | 1 V/Hz | 26 | 1 V/100% |
| 12 | 10 V/4096 | 27 | 1 V/100% |
| 13 | 1 V/100% | 28 | 1 V/kRPM |
| 14 | 1 V/ Degree C | | |

**Related instructions** `DM2Map, DM2F0, and DM2Out.`

# DM2Map

## (Pre-defined Variable, Integer)

**Purpose** DM2Map selects signal sent to the DAC Monitor 2 output on J4-3.

**Syntax** `DM2Map = x`

Range 0 to 65,537

Default 1 (VelFB, Velocity Feedback )

**Guidelines** See Hardware manual for definitions of mnemonics.

| Monitor # | Mnemonic | Monitor # | Mnemonic |
|---|---|---|---|
| 0 | AnalogOut2 | 16 | IR |
| 1 | VelFB | 17 | IS |
| 2 | VelCmdA | 18 | IT |
| 3 | VelErr | 19 | VR |
| 4 | FVelErr | 20 | VS |
| 5 | Position* | 21 | VT |
| 6 | PosError* | 22 | VBus |
| 7 | PosCommand* | 23 | ResPos * |
| 8 | ICmd | 24 | Cmd Non-Trq Current |
| 9 | IFB | 25 | Non-Trq IFB |
| 10 | AnalogIn | 26 | Trq Voltage Duty Cycle |
| 11 | EncFreq | 27 | Non-Trq Voltage Duty Cycle |
| 12 | EncPos* | 28 | VelCmd |
| 13 | ItFilt | 65536 | Clamp Off ** |
| 14 | HSTemp | 65537 | Clamp On ** |
| 15 | Comm Ang * | | |

*Will wrap around when the signal exceeds the output voltage level.
**The value of the selected signal does not change.

**Related instructions** `See DM2Gain, DM2F0, and DM2Out`

# DM2Out

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** DM2Out indicates the value of the selected, filtered variable output to DAC Monitor 2 (J4-4). The value is reported in the units of the selected variable. For example, DM2Map = 1 selects VelCmdA and the units would be RPM.

**Syntax** `x = DM2Out`

Range Depends on DM2Map selected signal.

**Guidelines** With DM2F0 set low, such as 1 Hz, DM1Out's value will accurately measure the DM1Map selected signal's dc component.

DM2Out can also be used to examine variables that can not be directly queried, such as motor phase voltage duty cycle, DM2Map = 19, 20 or 21.

# Enable

## (Pre-defined Variable, Integer)

**Purpose**

Enable controls whether or not power can flow to the motor, (i.e. whether or not the drive ***can be enabled***).

0 (Disables the drive)

1 (Allows drive to be enabled)

---

**Syntax** `Enable = x`

Units none

Range 0 or 1

Default 0

---

**Guidelines**

Before power can flow to the motor, the following must all be true:

1. Drive is not faulted.
2. Enable* input (J4-6) is connected to I/O RTN.
3. Enable pre-defined variable is set to 1.

**Related instructions** `Enabled`

# Enabled

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** Enabled indicates whether or not power can flow to the motor, (i.e. whether or not the drive ***is enabled***).

**Syntax** `x = Enabled`

Units none

Range 0 or 1

Default none

**Guidelines** Before power can flow to the motor, the following must all be true:

1. Drive is not faulted.
2. Enable* input (J4-6) is connected to I/O RTN.
3. Enable pre-defined variable is set to 1.

**Related instructions** `Enable`

**Example**

```
If (Enabled = 1) then
    print “Drive is Enabled!”
else
    print “Drive is NOT Enabled”
end if
```

# EnablePLS0-EnablePLS7

## (Pre-defined Variable, Integer)

**Purpose**

There are eight EnablePLS pre-defined variables, one for each of the eight Programmable Limit Switches (PLS). They are used to enable or disable the programmable limit switch that is associated with the appropriate Output point.

**Syntax**

```
EnablePLSX = x
```

Units: none

Range: 0 or 1

Default: 0

**Guidelines**

Use EnablePLSx = 1 to enable a Programmable Limit Switch. Use ConfigPLS( ) to configure the Programmable Limit Switch.

**Related instructions**

`ConfigPLS( )`

**Example**

The statements below will configure PLS0 such that Out0 will be set to 1 when Position is between 4096 and 4196. Out0 will be set to 0 at all other times.

```
ConfigPLS( 0, 4096, 100, 1)
EnablePLS0 = 1
```

# EncFreq

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** EncFreq (Encoder Frequency) is the frequency in quadrature pulses per second of the external encoder, (or steps per second if step-and-direction format is used).

**Syntax** `x = EncFreq`

Units Quadrature encoder counts per second (EncMode = 0)

Steps per second (EncMode = 1)

Range -3,000,000 to +3,000,000

Calculation EncFreq = Encoder Speed (RPM) * Encoder Line Count/15

**Guidelines** Calculated from delta EncPos at position loop update rate. Although the values returned do not have fractional parts, this variable is communicated as a floating point quantity. See EncInF0 for recommended maximum count frequencies.

# EncIn

## (Pre-defined Variable, Integer)

**Purpose** EncIn specifies the line count of the encoder being used, (or one-fourth the steps/revolution if step-and-direction input format is used).

**Syntax** `EncIn = x`

Units Encoder line count (EncMode = 0)

Steps per quarter-revolution (EncMode = 1)

Range 1 to 65535

Default 1024

**Guidelines** EncIn is used to insure proper units in KPP, KVP, VelFB when using an encoder for Servo feedback (RemoteFB = 1 or 2).

EncIn is also used when using the encoder input port for Electronic Gearing and using the Ratio variable to specify the electronic gearing ratio.

# EncInF0

## (Pre-defined Variable, Float)

**Purpose** EncInF0 selects digital low pass filter frequency on the incremental encoder input connected to J4-21 through J4-24.

**Syntax** `EncInF0 = x`

Units Hertz

Range 4 values depending on EncMode:

EncMode = 0 (Quadrature Decode)

| EncInF0 (Hz) | Max Hardware Quad Count Limit (Hz) | Min Hardware Pulse Width (micro second) |
|---|---|---|
| 1,600,000 | 3,333,333 | 0.6 |
| 800,000 | 952,400 | 2.1 |
| 400,000 | 476,200 | 4.2 |
| 200,000 | 238,100 | 8.4 |

EncMode = 1 or 2 (Step, Dir or Up, Down)

| EncInF0 (Hz) | Max Hardware Quad Count Limit (Hz) | Min Hardware Pulse Width (micro second) |
|---|---|---|
| 800,000 | 833,333 | 0.6 |
| 200,000 | 238,000 | 2.1 |
| 100,000 | 119,000 | 4.2 |
| 50,000 | 59,500 | 8.4 |

Default 800,000

## EncInF0 (continued)

**Guidelines**

EncInF0 is the maximum recommended count frequency for reliable operation. If the maximum input frequency is < EncInF0, lowering it will give better noise rejection.

The maximum hardware count limits require ideal timing with exact 50% duty cycle, perfect quadrature symmetry, etc. The recommended EncInF0 count takes real world signal tolerances into account. With the SC900's emulated encoder out wired to another SC900's encoder in, and EncInF0 = 1,600,000 Hz, the count frequency can work reliably up to 2,000,000 Hz.

# EncMode

## (Pre-defined Variable, Integer)

**Purpose** EncMode specifies the type of digital command expected at the incremental position command port.

**Syntax** `EncMode = x`

Range 0, 1, 2, or 3

Default 0 (quadrature)

**Guidelines** EncMode replaces the SC750 pre-defined variable StepDir.

| Value of EncMode | Description |
|---|---|
| 0 | Selects quadrature encoder pulses |
| 1 | Selects step and direction input signals |
| 2 | Selects up/down input signals |
| 3 | Ignores input signal, EncPos value held |

# EncOut

## (Pre-defined Variable, Integer)

**Purpose** EncOut selects the resolution of the incremental shaft position output port (J4-14, J4-15, J4-16, J4-17, and J4-19, J4-20).

**Syntax** `EncOut = x`

Units Emulated encoder line count

Range 0, 128, 256, 512, 1024, 2048, 4096, 8192, 16384,

125, 250, 500, 1000, 2000, 4000, 8000, 16000

Default 1024

**Guidelines** EncOut = 0 cross connects the Encoder input (J4-21, J4-22 and J4-23, J4-24) to the Encoder output to provide buffering. CH Z out (J4-19, J4-20) is held fixed for EncOut = 0.

# EncPos

## (Pre-defined Variable, Integer)

**Purpose**

EncPos indicates the position of the external encoder. For example, with a 1024 line-count encoder, each increment of EncPos is equal to 1/4096 of a revolution of the encoder shaft.

If Encoder Position Modulo functionality is active (i.e. EncPosModulo not equal to 0) the EncPos will be automatically reset to zero every time it reaches the modulo value.

---

**Syntax**

```
x = Encpos or Encpos = x
```

Units

encoder counts

Range

-2,147,483,648 to -2,147,483,648

or

0 to EncPosModulo-1

Default

none

---

**Guidelines**

EncPos is not affected by the value of EncIn. EncMode must be set to the appropriate value for the type of encoder input you are using.

**Related instructions**

`EncIn, EncInF0, EncMode, EncPosModulo`

# EncPosModulo

## (Pre-defined Variable, Integer)

**Purpose** EncPosModulo specifies the encoder modulo value. The encoder modulo value is the value of EncPos where EncPos is automatically reset to zero.

**Syntax** `EncPosModulo = x`

Units encoder counts

Range 0 to 2,147,483,647

Default 0

**Guidelines** Setting EncPosModulo to 0 turns off the Encoder Position Modulo function and EncPos is never automatically reset. This is the default setting.

**Related instructions** `EncPos, PosModulo`

# End
## (Statement)

**Purpose**

The End statement is used to mark the end of a program, a subroutine, a function, an If...Then...Else block, a Select Case block, an Interrupt service routine or a Params section.

**Syntax**

```
End {[Main|Sub|Function|If|Select|Interrupt| Params]}
```

**Guidelines**

Once the End statement is encountered the block structure is terminated.

**Related instructions**

`Main, Sub, Function, Select Case, Interrupt, Params`

# Err

## (Pre-defined Variable)

**Purpose** Err indicates what caused the most recent Runtime Error. The table below shows what each value of Err means.

| Value of Err | Error Caused by | Value of Err | Error Caused by |
|---|---|---|---|
| 1 | Division by zero in arithmetic | 21 | (not used) |
| 2 | Stack is full. | 22 | No Interrupt Handler defined |
| 3 | (not used) | 23 | (not used) |
| 4 | (not used) | 24 | PACLAN Transmit Error |
| 5 | (not used) | 25 | PACLAN Response Timeout |
| 6 | Out of Memory | 26 | PACLAN Response Error |
| 7 | (not used) | 27 | Interrupt Error |
| 8 | (not used) | 28 | Maximum String Length Exceeded |
| 9 | (not used) | 29 | String Overflow |
| 10 | (not used) | 30 | Array Index Bounds Error |
| 11 | Attempt to use Feature not available in this firmware | 31 | Invalid Axis in PACLAN Message |
| 12 | Internal Firmware Error | 32 | No LAN Interrupt Handler |
| 13 | Invalid Predefined Variable ID Number | 33 | LAN Interrupt Queue is full |
| 14 | Attempt to write to a Read-Only Variable | 34 | LAN Interrupt is not available |
| 15 | DSP Read Error | 35 | LAN Interrupt: Destination is busy |
| 16 | DSP Write Error | 36 | MODBUS: Attempt to do nested Master functions |
| 17 | DSP Command Error | 37 | MODBUS: Attempt to use Master w/o setting RuntimeProtocol |
| 18 | (not used) | 38 | MODBUS: Illegal Slave Address (255) |
| 19 | (not used) | 39 | AB DF1: Invalid PLC Address (0-255) |
| 20 | (not used) | 40 | AB DF1: Invalid PLC File Number Specified |

## Err (continued)

| Value of Err | Error Caused by | Value of Err | Error Caused by |
|---|---|---|---|
| 41 | AB DF1: Invalid PLC Element Number Specified | 51 | AddPoint: Used AddPoint outside a CreateCam block. |
| 42 | AB DF1: too many unresolved messages outstanding | 52 | CreateCam: EndList without Create |
| 43 | AB DF1: Attempt to use AB DF1 w/o setting RunTimeProtocol | 53 | CreateCam: Tried to create a cam with less than three points. |
| 44 | AB DF1: Transmit queue overflow | 54 | AddPoint: Used the same master position for two points or master position was negative |
| 45 | $DeclareCam: Invalid Cam Number specified | 55 | CreateCam: Tried to create the ActiveCam. |
| 46 | $DeclareCam: Too many points specified. | 56 | ActiveCam: Tried to activate a cam that was not created. |
| 47 | CreateCam: Tried to Create a new cam before finished creating the first one. | 57 | ActiveCam: Tried to activate a cam while it is being created. |
| 48 | CreateCam: Tried to create cam w/o declaring it. | 58 | ActiveCam: Tried to activate a cam while RunSpeed =0. |
| 49 | Addpoint: Tried to add more points than declared | 59 | ActiveCam: Tried to activate a cam with master position outside the cam table. |
| 50 | Addpoint: Starting Master position is non-zero. | | |

Runtime errors are caused by the program running on the OC950 trying to do something that is not allowed. For example, runtime errors occur when you attempt to write a value that is too high or too low to a particular variable. We try to catch as many errors as possible when the program is compiled but some errors can only be detected when the program is running.

The particular problem which caused the Runtime Error (F4 Fault) can be determined by looking at the value of the Err variable. Use the Variables Window to find the value of Err.

# Exit

## (Statement)

**Purpose**

The Exit statement is used to exit from a subroutine, a function, an interrupt, a For...Next or a While...Wend.

**Syntax**

```
Exit {{Sub|Function|Interrupt|For|While}]
```

**Guidelines**

You should not confuse the Exit statement with the End statement. The Exit statement causes program control to pass to the end of the block structure whereas the End statement defines the end of the structure.

**Related instructions**

`Sub, Function, Interrupt, For...Next, While...Wend`

# Exp()
## (Function)

**Purpose** Exp() returns ***e*** (the base of natural logarithms) raised to a power.

**Syntax**

```
result = Exp(x)
```

**Guidelines** The Exp() function complements the action of the Log() function.

**Related instructions** `Log(), Log10()`

# ExtFault

## (Pre-defined Variable, Integer, Status Variable)

**Purpose** ExtFault provides additional information on FaultCodes Blinking 1 (1) or E (14) and Alternating F 3 (243), 0 otherwise.

Range 0 to 16

**Guidelines** In the variables window, poll the value of ExtFault for additional fault information.. Values listed below:

| LED Display | Value of ExtFault | Description |
|---|---|---|
| 1 | 1 | \|VelFB\| < 21038 |
| 1 | 2 | \|VelFB\| < 1.5*max(\|VelLmtxx\|) |
| E | 0 | No ExtFault information |
| E | 1 | Resolver calibration data corrupted |
| E | 2 | Excessive dc offset in current feedback sensor |
| E | 3 | DSP incompletely reset by line power dip |
| E | 6 | Excessive dc offset in Analog Command A/D |
| E | 7 | Unable to determine option card type |
| E | 8 | DSP stack overflow |
| E | 10 | Firmware and control card ASIC incompatible |
| E | 11 | Actual Model does not match value in non-volatile memory |
| E | 12 | Unable to determine power stage |
| E | 13 | Control card non-volatile parameters corrupt |
| E | 14 | Option card non-volatile parameters corrupt |
| F3 | 15 | RAM failure |
| F3 | 16 | Calibration RAM failure |

# Fault

## (Pre-defined variable, Integer, Mappable Output Function)

**Purpose** Fault indicates whether the drive has faulted and is disabled.

**Syntax**

```
x = Fault
```

Range 0 or 1

**Guidelines** 0 is not faulted, normal operation.

1 is faulted, no power flow to the motor.

**Related instructions** `FaultCode and ExtFault`

# FaultCode

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** FaultCode indicates a fault has occurred. When the status display is not a 0 or an 8, a fault has occurred. Reset the drive by asserting the fault reset signal or by cycling drive AC power.

**Syntax**

```
x = FaultCode
```

Range 0 to 255

**Guidelines** 0 means the drive is not faulted and not enabled, while 8 means the drive is not faulted and enabled. Alternating 8r means actively inhibiting CW motion and alternating 8l means actively inhibiting CCW motion.

| Status LED | Value | Fault Meaning |
|---|---|---|
| (Blinking) 1 | 1 | Velocity feedback (VelFB) over speed |
| (Blinking) 2 | 2 | Motor Over-Temp |
| (Blinking) 3 | 3 | Drive Over-Temp |
| (Blinking) 4 | 4 | Drive I*t |
| (Blinking) 5 | 5 | l-n Fault (9x3) |
| (Blinking) 6 | 6 | Control ±12 V supply under voltage |
| (Blinking) 7 | 7 | Output over current or bus over voltage |
| (Blinking) 9 | 9 | Shunt regulator overload |
| (Blinking) A | 10 | Bus OV detected by DSP |
| (Blinking) b | 11 | Auxiliary +5V Low |

**Table (cont'd)**

| Status LED | Value | Fault Meaning |
|---|---|---|
| (Blinking) C | 12 | Not assigned |
| (Blinking) d | 13 | Not assigned |
| (Solid) E* | 14 | Processor throughput fault |
| (Blinking) E* | 14 | Power Up Self Test Failure |
| (Alternating) E1 | 225 | Bus UV, Bus Voltage VBusThresh |
| (Alternating) E2 | 226 | Ambient Temp Too Low |
| (Alternating) E3 | 227 | Encoder commutation align failed (Only CommSrc=1) |
| (Alternating) E4 | 228 | Drive software incompatible with NV memory version |
| (Alternating) E5* | 229 | Control Card hardware not compatible with drive software version |
| (Alternating) E6 | 230 | Drive transition from unconfigured to configured while enabled |
| (Alternating) E7 | 231 | Two AInNull events too close together |
| (Alternating) F1 | 241 | Excessive Position Following Error |
| (Alternating) F3 | 243 | Parameter Checksum Error (Memory Error) |
| (Alternating) F4 | | Run-time Error. |

*FaultReset cannot reset these faults.

See ExtFault for further information on Blinking E, Blinking 1 and Alternating F3. See Err for Alternating F4.

# FaultReset

## (Pre-defined Variable, Integer, Mappable Input Function)

**Purpose** FaultReset is used to reset drive faults.

**Syntax** `FaultReset = x`

Range 0 or 1

Default 0 at power up if not mapped

**Guidelines** FaultReset active automatically disables the drive. When not mapped to a BDIO, setting FaultReset to 1 via the serial port will reset the latched function.

If the fault persists when FaultReset is active, the drive remains faulted. If the Fault condition does not persist, then setting FaultReset to 1 clears the latched fault and returning FaultReset to 0 resumes normal operation.

# Fix()
## (Function)

**Purpose** Fix() returns the truncated integer part of x.

**Syntax**

```
result = Fix(x)
```

**Guidelines** Fix() does not round off numbers, it simply eliminates the decimal point and all digits to the right of the decimal point.

**Related instructions** `Abs(), Cint(), Int()`

# For...Next
## (Statement)

**Purpose**

For...Next allows a series of statements to be executed in a loop a specified number of times.

**Syntax**

```
For loop_counter = Start_Value To End_Value [Step
increment]

...statements...

Next
```

**Guidelines**

You can exit from a For...Next loop using the Exit For. If step increment is omitted then increment defaults to 1.

The loop_counter can be floating point or integer.

The Step increment can be positive or negative, integer or floating point.

**Related instructions**

`While...Wend, Exit`

**Example**

```
Dim x as integer
For x = 1 to 100 Step 2
    Print x                    'print 2 to 100 in 2's
Next


dim x as float
for x = 0.5 to 1.2 step 0.1
    print x                    'print 0.5 to 1.2 in 0.1 increments
next
```

# Function
## (Statement)

**Purpose**

The Function statement is used to declare and define the name, arguments and type of a user defined function. The code for the function immediately follows the function statement and must be terminated by an End Function statement.

**Syntax**

```
Function function-name [(argument-list)] as
function-type

...statements...

End Function
```

**Guidelines**

On entry to the function all local variables are initialized to zero including all elements of local arrays. All local string variables are initialized to the null string ("").

If a function takes no arguments then the argument-list (including the parentheses) must be omitted, both when declaring the function and when using the function.

The return value for the function is specified by making an assignment to the function name. See the example below.

Arguments, including array arguments, are passed by value. Arrays cannot be returned from functions.

**Related instructions**

`Dim, Static, End, Exit, Sub`

## Function (continued)

**Example** This example declares a function that calculates the cube of a floating point number.

```
Main
    dim LocalFloat as float
    LocalFloat = 1.234
    LocalFloat = cube(LocalFloat)
    print LocalFloat
End Main

Function cube( x as float) as float
    cube = x^3
End Function
```

# FVelErr

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** FVelErr is commanded velocity - measured velocity (VelCmdA - VelFB) after being processed by the velocity loop compensation anti-resonant filter section.

**Syntax** `x = FVelErr`

Units RPM

Range -48,000 to +48,000

**Related instructions** `ARF0, ARF1, ARZ0, ARZ1`

# FwV

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** FwV indicates the 950 firmware version number. For example, FwV = 1100 would be version 1.1.

**Syntax** `x = FwV`

Range 1000 to 65535

# GearError

## (Pre-defined Variable, Integer)

**Purpose**

GearError indicates the amount of position deviation that has accumulated on the slave axis (in an electronic gearing application) as a result of the slave axis limiting its acceleration or deceleration while achieving velocity synchronization.

**Syntax**

```
x = GearError
```

Units

resolver counts

**Guidelines**

GearError is never set to zero automatically. It will continue to accumulate position deviation each time acceleration limiting is activated. In most situations you should set GearError to zero before doing something that will activate acceleration limiting.

The slave axis' acceleration or deceleration is limited to AccelGear or DecelGear whenever:

1. Gearing is turned on or turned off.
2. Ratio is changed.
3. PulsesIn or PulsesOut is changed.

**Related instructions**

`AccelGear, DecelGear, GearLock`

## GearError (continued)

**Example**

```
AccelGear = 10000
PulsesIn  = 1
PulsesOut = 1
GearError = 0
Gearing = 1
While GearLock = 0 : Wend     'catch up the position lost while
                              acceleration was being limited
IndexDist = GearError
GoIncr
```

# Gearing

## (Pre-defined Variable, Integer)

**Purpose** Gearing controls the Electronic Gearing Functionality. Turns electronic gearing on or off and sets the allowed direction of motion for electronic gearing.

| Value | Description |
|---|---|
| 0 | Off. No electronic gearing. |
| 1 | On. Motor motion allowed in either direction/ |
| 2 | On. Motor motion allowed only in the positive direction. |
| 3 | On. Motor motion allowed only in the negative direction. |

**Syntax** `Gearing = x`

Units none

Range 0, 1, 2, 3

Default 0

**Guidelines** The pre-defined variable Moving does not recognize motor motion caused by electronic gearing.

When unidirectional gearing is used (Gearing = 2 or 3) then motion in the allowed direction occurs only when the master encoder returns to the point at which it originally reversed direction. ***Note that other motion commands such as GoVel or GoIncr can cause motor motion in the disabled gearing direction.***

Other motion commands, such as GoVel or GoIncr, may be executed while gearing is active. These moves will be superimposed (added to) on the motion caused by electronic gearing.

**Related instructions** `PulsesIn, PulsesOut, EncIn`

# GearLock

## (Pre-defined Variable, Integer, Read-Only)

**Purpose**

The GearLock variable indicates when the slave axis (follower axis) in an electronic gearing application has achieved velocity synchronization with the electronic gearing master. The amount of position deviation that has accumulated while the slave axis was limiting its acceleration or deceleration is contained in the variable GearError.

---

**Syntax**

```
x = GearLock
```

where:

x = 0 indicates that the slave has not achieved velocity synchronization.

x = 1 indicates that the slave has achieved velocity synchronization.

Range

0 or 1

---

**Guidelines**

The slave axis' acceleration or deceleration is limited to AccelGear or DecelGear whenever:

1. Gearing is turned on or turned off.
2. Ratio is changed.
3. PulsesIn or PulsesOut is changed.

**Related instructions**

`AccelGear, DecelGear, GearError`

## GearLock (continued)

**Example**

```
AccelGear = 10000
PulsesIn  = 1
PulsesOut = 1
GearError = 0
Gearing = 1
While GearLock = 0 : Wend     'catch up the position lost while
                              acceleration was being limited
IndexDist = GearError
GoIncr
```

# GetMotor$()

## (Function)

**Purpose**

GetMotor$() returns a string which indicates the motor name that was specified with the last SetMotor(...) function.

**Syntax**

```
A$ = GetMotor$
```

**Guidelines**

GetMotor$() always returns the motor name in upper-case, even if you specified the name with lower-case letters.

**Related instructions**

`SetMotor()`

# GoAbs

## (Statement)

**Purpose**

GoAbs (Go to Absolute Position) causes the motor to move to the position specified by TargetPos. This is an absolute position referenced to the position where PosCommand = 0.

**Syntax**

```
GoAbs
```

**Guidelines**

Program execution continues with the line immediately following the GoAbs statement as soon as the move is initiated. Program execution does not wait until the move is complete.

**Related instructions**

`AbortMotion, GoHome, GoIncr, GoVel`

# GoAbsDir

## (Pre-defined Variable, Integer)

**Purpose** GoAbsDir determines the direction of rotation when PosModulo (or EncposModulo) is used and an absolute move (GoAbs) is commanded.

| GoAbsDir | Direction |
|---|---|
| 0 | Clockwise (CW) |
| 1 | Counter-Clockwise (CCW) |
| 2 | Shortest Distance (CW or CCW) |
| 3 | None |

**Syntax**

```
GoAbsDir = x
```

Units none

Range 0, 1, 2, 3

Default 3

**Guidelines** Set GoAbsDir before GoAbs.

## GoAbsDir (continued)

**Example** The following program illustrates GoAbsDir. Assume Position = 550.

```
Enable = 1
PosModulo = 1000
AccelRate = 1000
DecelRate = 1000
RunSpeed = 5000
TargetPos = 850
GoAbsDir = 0
GoAbs                    'The motor will travel CW 300 counts.
GoAbsDir = 1
GoAbs                    'The motor will travel CCW 700 counts
GoAbsDir = 2
GoAbs                    'The motor will travel 300 counts CW
GoAbsDir = 3
GoAbs                    'The motor will travel CW 300 counts
```

# GoHome

## (Statement)

**Purpose**

GoHome causes the motor to move to the position specified where PosCommand = 0. The GoHome statement is identical to a GoAbs statement with TargetPos = 0.

The motor speed follows a velocity profile as specified by AccelRate, DecelRate, and RunSpeed. This profile may be modified during the move using the UpdMove statement.

**Syntax**

```
GoHome
```

**Guidelines**

Program execution continues with the line immediately following the GoHome statement as soon as the move is initiated. Program execution does not wait until the move is complete.

The drive must be enabled in order for any motion to take place.

**Related instructions**

`AbortMotion, GoAbs, GoIncr, GoVel`

# GoIncr

## (Statement)

**Purpose**

GoIncr (Go Incremental) causes the motor to move a distance specified by IndexDist.

The motor speed follows a velocity profile as specified by AccelRate, DecelRate, and RunSpeed. This profile may be modified during the move using the UpdMove statement.

**Syntax**

```
GoIncr
```

**Guidelines**

Program execution continues with the line immediately following the GoIncr statement as soon as the move is initiated. Program execution does not wait until the move is complete.

The drive must be enabled in order for any motion to take place.

**Related instructions**

`AbortMotion, GoAbs, GoHome, GoVel`

# Goto

## (Statement)

**Purpose**

GOTO causes the software to jump to the specified label and continue executing from there.

**Syntax**

```
Goto Label
```

**Guidelines**

**GOTO is NOT RECOMMENDED as a looping technique.** Excessive use of the GOTO statement can lead to disorganized and confusing programs. Preferred looping techniques are:

For...Next

If...Then...Else

While...Wend

**Related instructions**

`On Error Goto`

# GoVel

## (Statement)

**Purpose**

GoVel (Go at Velocity) causes the motor to move at a constant speed specified by RunSpeed and direction specified by Dir.

The motor speed follows a velocity profile as specified by AccelRate, DecelRate, and RunSpeed. This profile may be modified during the move using the UpdMove statement.

**Syntax**

```
GoVel
```

**Guidelines**

Program execution continues with the line immediately following the GoVel statement as soon as the move is initiated. Program execution does not wait until the move is complete.

The drive must be enabled in order for any motion to take place.

**Related instructions**

`AbortMotion, GoAbs, GoHome, GoIncr`

# Hex$()

## (Function)

**Purpose**

Hex$() converts an integer number to its equivalent hexadecimal ASCII string.

**Syntax**

```
result$ = Hex$(x)
```

**Guidelines**

Hexadecimal numbers are numbers to the base 16 (rather than base 10). The argument to Hex$() is rounded to an integer before Hex$(x) is evaluated.

**Related instructions**

`Oct$(), Str$()`

**Example**

```
dim x,y as integer
dim result1$, result2$ as string
x = 20
y = &H6A
result1$ = Hex$(x)
result2$ = Hex$(y)
print result1$, result2$
Prints: 14            6A
```

# HSTemp

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** HSTemp indicates the drive heatsink temperature.

**Syntax** `x = HSTemp`

Units Degrees Centigrade

Range -10 to +150

**Guidelines** The drive heat sink temperature is monitored to determine if the drive is within a safe operating region for the power electronics. This variable can be used to see how much thermal margin remains for a given application.

**Related instructions** `ItThresh`

# HwV

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** HwV indicates the drive's control electronics hardware version number.

**Syntax** `x = HwV`

Range Greater than 0

**Guidelines** 12 = first production control card version

# ICmd

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** ICmd indicates the commanded motor torque current. Note that ILmtMinus and ILmtPlus limit the range of this variable.

**Syntax** `x = ICmd`

Units Amperes

Range -Ipeak to +Ipeak

# IFB

## (Pre-defined Variable, Status Variable, Read-Only)

**Purpose** IFB indicates the measured motor torque current value.

**Syntax** `x = IFB`

Units Amperes

Range -Ipeak to +Ipeak

**Guidelines** IFB can be monitored to observe the actual torque current flowing in the motor. IFB should equal ICmd.

# If...Then...Else
## (Statement)

**Purpose**

If...Then...Else statements controls program execution based on the evaluation of numeric or string expressions

**Syntax**

```
IF condition1 THEN
    ...statement block1...
[ ELSEIF condition2 THEN
    ...statement block2...]
[ELSE
    ...statement block3...]
END IF
```

**Guidelines**

If condition1 is True then statement block1 is executed. Otherwise, if condition2 is True then statement block2 is executed. If the original IF condition is False and all ELSEIF conditions are False then the ELSE statement block (statement block3) is executed.

**Related instructions**

`Select Case, While...Wend, Exit`

# ILmtMinus

## (Pre-defined Variable, Integer, NV Parameter)

**Purpose** ILmtMinus (Counter-Clockwise Current Limit) sets the maximum allowable torque current amplitude in the counter-clockwise direction. This is a percentage of the drive's peak current rating (Ipeak).

**Syntax** `ILmtMinus = x`

Units % (Percentage) of peak current rating of drive.

Range 0 to 100

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

**Guidelines** Only integer values may be entered (i.e. no fractional numbers).

***Warning***

***If ILmtMinus*0.01*Ipeak > twice the motor's continuous current rating, the motor's over temperature sensor is not guaranteed to always respond fast enough to prevent motor winding damage.***

# ILmtPlus

## (Pre-defined Variable, Integer, NV Parameter)

**Purpose** ILmtPlus (Clockwise Current Limit) sets the maximum allowable torque current amplitude in the clockwise direction. This is a percentage of the drive's peak current rating (Ipeak).

**Syntax** `ILmtPlus = x`

Units % (Percentage) of peak current rating of drive.

Range 0 to 100

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

**Guidelines** Only integer values may be entered (i.e. no fractional numbers).

***Warning***

***If ILmtPlus*0.01*Ipeak twice the motor's continuous current rating, the motor's over temperature sensor is not guaranteed to always respond fast enough to prevent motor winding damage.***

# $Include
## (Statement)

**Purpose**

The $Include statement allows you to textually include multiple separate files in a single source file.

**Syntax**

```
$Include “include-file-name”
```

**Guidelines**

A file cannot include itself, either directly or indirectly. Include file nesting is allowed to a depth of 16. Relative paths in a nested include file are relative to the directory location of the include file, not the current working directory of the compiler.

**Example**

This example shows two files, myinc.inc and myfile.bas. The file myinc.inc has a sub-procedure for doing and incremental move that is used by the main program in myfile.bas.

**MyInc.Inc**

```
Sub DoIndexMove(Distance as integer)
    IndexDist = Distance
    GoIncr
    while Moving : wend
End Sub
```

**MyFile.Bas**

```
$Include “myinclude.inc”
Main
while 1
    call DoIndexMove(4096)
    Pause(0.5)
wend
End Main
```

# IndexDist

## (Pre-defined Variable, Integer)

**Purpose** IndexDist specifies the distance that the motor will turn during an incremental move (GoIncr).

**Syntax** `IndexDist = x`

Units resolver counts

Range

Default 4096

**Guidelines** Specify IndexDist before initiating a GoIncr statement.

**Related instructions** `AccelRate, DecelRate, RunSpeed, GoIncr`

**Example** This example sets IndexDist to 40,960 (10 motor revolutions, assuming CountsPerRev is 4096) and does an incremental move.

```
RunSpeed = 1000
AccelRate = 10000
DecelRate = 5000
IndexDist = 40960
GoIncr
```

# Inkey$

## (String Function)

**Purpose**

Inkey$ returns a 1 character string corresponding to the character in the serial port receive buffer. If there is no character waiting the Inkey$ will be the Null string (“”). If several characters are pending only the first one is returned.

**Syntax**

```
x$ = Inkey$
```

**Guidelines**

Assigning a string from Inkey$ removes the character from the serial port’s receive buffer.

**Related instructions**

`Character Interrupt`

**Example**

The following program lines remove all characters from the receive buffer and put them into A$.

```
new$ = Inkey$
while new$   “”
    A$ = A$ + new$
    new$ = Inkey$
wend
```

# Inp0-Inp20

## (Pre-defined Variable, Integer, Read-Only)

**Purpose**

Inp0-Inp20 reports the value of one of the discrete digital inputs on the OC950.

0 - indicates a logic low level

1 - indicates a logic high level

---

**Syntax**

`x = Inpn`

Units: none

Range: 0 or 1

Default: none

---

**Guidelines**

Each of the 21 inputs can be used to trigger an interrupt on either or both its high-to-low and/or low-to-high transition(s).

**Related instructions**

`Inputs`

---

**Example**

Wait for Inp0=0 and Inp1=1 before starting...

```
While (Inp0 = 1) OR (Inp1 = 0) : Wend
Print "Starting"
```

# InPosition

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** InPosition indicates whether or not the motor has achieved commanded position. InPosition is useful to monitor move commands to ensure that the desired motion has been completed. InPosition is always 0 (False) or 1 (True).

---

**Syntax** `x = InPosition`

Units none

Range 0 or 1

Default none

---

**Guidelines** InPosition is 1 (True) only if all the following are true:

- Drive is enabled
- Moving = 0
- Position Error less than InPosLimit

**Related instructions** `InPosLimit, Moving`

# InPosLimit

## (Pre-defined Variable)

**Purpose** InPosLimit specifies the tolerance of Position Error (PosError) within which the InPosition flag will be set to 1 (True).

---

**Syntax** `InPosLimit = x`

Units resolver counts

Range

Default 5

---

**Guidelines** Set InPosLimit before using InPosition.

**Related instructions** `InPosition`

# Input
## (Statement)

**Purpose**

The Input statement reads a character string received from the serial port, terminated by a carriage-return.

**Syntax**

```
Input [prompt-string] [ , | ; ] input-variable
```

**Guidelines**

The input variable can be integer, floating-point or a string.

As an option, the prompt-string is transmitted when the Input statement is encountered. This prompt-string can be either a string constant or a string variable. If the prompt-string is followed by a semi-colon, then a question mark will be printed at the end of the prompt-string. If the prompt-string is followed by a comma then no question mark will be printed.

**Related instructions**

`Inkey$`

**Example**

```
dim YourName$ as string
input “What’s your name”; YourName$
print “Hello ”;YourName$;", I’m leaving..."
```

# Inputs

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** Inputs reports the status of the 21 bi-direction I/O points on the OC950 as a parallel word. For each bit in Inputs:

0 - corresponds to a low logic level

1 - corresponds to a high logic level

---

**Syntax** `x = Inputs`

Units none

Range 0 - 21,757,952

Default none

---

**Guidelines** Use Inp0 - Inp20 to look at inputs individually.

**Related instructions** `Inp`*`n`*`, BDInputs, Outputs, BDOutputs`

# Instr()
## (Function)

**Purpose**

Instr() returns the starting location of a substring within a string.

**Syntax**

```
result = Instr([n], x$, y$)
```

x$ is the string

y$ is the substring

n optionally sets the start of the search

**Guidelines**

n must be in the range 1 to 255

Instr() returns 0 if:

- n  Len( x$ )
- y$ cannot be found in x$

If y$ is null (empty, “”), Instr() returns n)

**Related instructions**

`Len()`

# Int()
## (Function)

**Purpose**

Int() (convert to largest integer) truncates an expression to a whole number.

**Syntax**

```
result = Int(x)
```

**Guidelines**

Int() behaves the same as Fix() for positive numbers. They behave differently for negative numbers.

**Related instructions**

`Cint(), Fix()`

**Example**

```
Print Int(12.34)          ' prints the value 12
Print Int(-12.34)         ' prints the value -13
```

# Interrupt...End Interrupt

## (Statement)

**Purpose**

The Interrupt statement marks the beginning of an Interrupt Service Routine. The Interrupt Service Routine is defined by a program structure resembling a subroutine. The interrupt feature permits execution of a user-defined subroutine upon receipt of a hardware interrupt signal or a pre-defined interrupt event.

**Syntax**

```
Interrupt {Interrupt-Source-Name}

..program statements...

End Interrupt
```

**Guidelines**

Interrupts are triggered by pre-defined events or external hardware sources. The interrupt-source-name and interrupt enable flag are unique for each interrupt source.

Receiving an interrupt will suspend program execution and the interrupt service routine will be executed. Then program execution will resume at the point that it was interrupted.

Interrupts are enabled (or disabled) by setting (or clearing) the associated interrupt enable flag. Interrupts are disabled until explicitly enabled. After an interrupt is triggered it is automatically disabled until it is enabled again in your program.

**Related instructions**

`Intr{Interrupt-Source-Name}, Sub...Endsub, Restart`

## Interrupt...End Interrupt (continued)

**Example**

```
main
    Time = 0
    IntrI0Lo = 1
    while 1
       pause(0.5)
       Out0=0 : Pause(0.005) : Out0=1
    wend
end main

Interrupt I0Lo
    print “I’m awake”
    If Time > 10 then
       print “OK. That’s it.”
    else
       IntrI0Lo = 1
    end if
End Interrupt
```

# Intr {source}

## (Pre-defined Variable, Integer)

**Purpose** Intr{*Interrupt-source-name*} is used to enable or disable interrupts from the specified source. If you enable a given interrupt then there must be an Interrupt Service Routine for that interrupt source in your program.

**Syntax** `Intr{source} = x`

Units none

Range 0 (disabled) or 1 (enabled)

Default 0 (disabled)

**Guidelines**

| | |
|---|---|
| IntrCcwinh | when CCWInh goes True. |
| IntrCcwot | when Position < CcwOt. |
| IntrCwinh | when CWInh goes True. |
| IntrChar | when a character is received. |
| IntrCwot | when Position > CwOt. |
| IntrDisable | when the drive gets disabled. |
| IntrFault | when the drive faults. |
| IntrI0Hi | when Inp0 goes from 0 to 1 |
| IntrI0Lo | when Inp0 goes from 1 to 0 |
| IntrI1Hi | when Inp1 goes from 0 to 1 |
| IntrI1Lo | when Inp1 goes from 1 to 0 |
| IntrI2Hi | when Inp2 goes from 0 to 1 |
| IntrI2Lo | when Inp2 goes from 1 to 0 |
| IntrI3Hi | when Inp3 goes from 0 to 1 |
| IntrI3Lo | when Inp3 goes from 1 to 0 |

**Table (cont'd)**

| | |
|---|---|
| IntrI4Hi | when Inp4 goes from 0 to 1 |
| IntrI4Lo | when Inp4 goes from 1 to 0 |
| IntrI5Hi | when Inp5 goes from 0 to 1 |
| IntrI5Lo | when Inp5 goes from 1 to 0 |
| IntrI6Hi | when Inp6 goes from 0 to 1 |
| IntrI6Lo | when Inp6 goes from 1 to 0 |
| IntrI7Hi | when Inp7 goes from 0 to 1 |
| IntrI7Lo | when Inp7 goes from 1 to 0 |
| IntrI8Hi | when Inp8 goes from 0 to 1 |
| IntrI8Lo | when Inp8 goes from 1 to 0 |
| IntrI9Hi | when Inp9 goes from 0 to 1 |
| IntrI9Lo | when Inp9 goes from 1 to 0 |
| IntrI10Hi | when Inp10 goes from 0 to 1 |
| IntrI10Lo | when Inp10 goes from 1 to 0 |
| IntrI11Hi | when Inp11 goes from 0 to 1 |
| IntrI11Lo | when Inp11 goes from 1 to 0 |
| IntrI12Hi | when Inp12 goes from 0 to 1 |
| IntrI12Lo | when Inp12 goes from 1 to 0 |
| IntrI13Hi | when Inp13 goes from 0 to 1 |
| IntrI13Lo | when Inp13 goes from 1 to 0 |
| IntrI14Hi | when Inp14 goes from 0 to 1 |
| IntrI14Lo | when Inp14 goes from 1 to 0 |
| IntrI15Hi | when Inp15 goes from 0 to 1 |
| IntrI15Lo | when Inp15 goes from 1 to 0 |
| IntrI16Hi | when Inp16 goes from 0 to 1 |
| IntrI16Lo | when Inp16 goes from 1 to 0 |

# Intr {source}(continued)

**Table (cont'd)**

| | |
|---|---|
| IntrI17Hi | when Inp17 goes from 0 to 1 |
| IntrI17Lo | when Inp17 goes from 1 to 0 |
| IntrI18Hi | when Inp18 goes from 0 to 1 |
| IntrI18Lo | when Inp18 goes from 1 to 0 |
| IntrI19Hi | when Inp19 goes from 0 to 1 |
| IntrI19Lo | when Inp19 goes from 1 to 0 |
| IntrI20Hi | when Inp20 goes from 0 to 1 |
| IntrI20Lo | when Inp20 goes from 1 to 0 |
| IntrPACLAN | when a PACLAN interrupt is received. |
| IntrPosError | When a Position Error Fault would have occurred. |

**Related instructions**

`Interrupt...End Interrupt`

**Example**

```
IntrI0Lo = 1
    while 1
       pause(0.5)
       Out0 = 0
       pause(0.005)              'toggle I/O point 0
       Out0 = 1
    wend
End Main
Interrupt I0Lo
    print "Interrupt"
    IntrI0Lo = 1
End Interrupt
```

# Ipeak

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** Ipeak is the drive's maximum 0-peak current rating.

**Syntax** `x = Ipeak`

Units Amperes

Range single value (see Default below)

Default

| Model Number | Ipeak |
|---|---|
| 952 | 7.5 |
| 953 | 15.0 |
| 954 | 30.0 |
| 955 | 60.0 |

# ItF0

## (Pre-defined Variable, Float)

**Purpose** ItF0 specifies the corner frequency of the low-pass filters implementing the I*t drive thermal protection circuit.

**Syntax** `ItF0 = x`

Units Hertz

Range Lower limit set by Model

Upper limit > 10

Default 0.02 Hertz

**Guideline** ItF0, in conjunction with ItThresh, specifies the thermal protection circuit for the drive. ItF0 is the corner frequency of a low-pass filter which processes an estimate of the drive's power dissipation. Increasing ItF0 makes the response more sensitive to over-current conditions.

**Note:** *The minimum frequency for ItF0 (slowest to fault) is limited to protect the drive's power electronics.*

# ItFilt

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** ItFilt is the drive's output current amplitude low pass filtered by ItF0 and normalized by Ipeak to a percentage. ItFilt is the input to the drive's I*t thermal protection fault.

---

**Syntax** `x = ItFilt`

Units % (percentage) of drive peak current.

Range 0 to 100

---

**Guidelines** ItFilt provides a means of evaluating the I*t protection circuit. When ItFilt exceeds the threshold specified by ItThreshA, the drive faults with Faultcode 4.

ItFilt = ItF0 low pass filter of (|IR| + |IS| + |IT|)*(50/Ipeak)

# ItThresh

## (Pre-defined Variable, Integer, NV Parameter)

**Purpose** ItThresh sets the maximum continuous output current, as a percentage of Ipeak, before the I*t thermal protection faults the drive.

---

**Syntax** `ItThresh = x`

Units % (percentage) of drive peak current

Range 0 to 100 (Actual upper limit depends on Model)

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

---

**Guidelines** ItThresh, in conjunction with ItF0, specifies the thermal protection fault for the drive. The actual I*t fault threshold may be lowered if the heat sink temperature (HSTemp) gets too high.

**Note:** *The maximum value for ItThresh is limited to protect the drive's power electronics.*

**Related instructions** `ItThreshA`

# ItThreshA

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** ItThreshA is the maximum continuous output current, as a percentage of Ipeak, trip level for the I*t thermal protection fault.

**Syntax** `x = ItThreshA`

Units percent

Range 0 to 100

Default none

**Guidelines** ItThresh, sets the desired value for ItThreshA and the two are equal for lower heat sink temperatures, i.e. lower HsTemps. At higher HSTemps, ItThreshA may be lowered to protect the power stage. When ItFilt exceeds ItThreshA, the drive will I*t fault. When doing a worst case motion profile examining ItThreshA, ItFilt, and HSTemp will indicate how much drive thermal margin remains.

# I_R

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** I_R is the measured current flowing in Motor Phase R, J2-4.

**Syntax** `x = I_R`

Units Amps

# I_S

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** I_S is the measured current flowing in Motor Phase S, J2-3.

**Syntax** `x = I_S`

Units Amps

# I_T

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** I_T is the measured current flowing in Motor Phase T, J2-2.

**Syntax** `x = I_T`

Units Amps

# Kii

## (Pre-defined Variable, Float)

**Purpose** Kii sets the integral gain of the current loops.

**Syntax** `Kii = x`

Units Hertz

Range 0 to 2546

Default 50 Hertz

**Guidelines** Kii is the current loop's integral gain. It defines the frequency where the current loop compensation transitions from predominantly integral characteristics (gain decreasing with frequency) to predominantly proportional characteristics (constant gain with frequency). This value should typically be less than 10% of the current loop's bandwidth.

**Related instructions** `Kip`

# Kip

## (Pre-defined Variable, Float, NV Parameter)

**Purpose** Kip sets the proportional gain of the current loop.

**Syntax** `Kip = x`

Units Volts/Ampere

Range 0 to 2.15e5/Ipeak

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

**Guidelines** Current loop bandwidth in Rad/sec is Kip/L, where L is the motor's line-to-line inductance (in henries)

Recommended bandwidth is 2Π * 1000 Rad/sec

Maximum bandwidth is 2Π * 1500 Rad/sec.

# Kpp

## (Pre-defined Variable, Float, NV Parameter)

**Purpose** Kpp sets the proportional gain of the position loop.

**Syntax** `Kpp = x`

Units Hertz

Range 0.0 to 159.4

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

**Guidelines** Kpp is defined by the following relationship:

$$VelCmd(rad / sec) = 2 * \Pi * Kpp * PosError(Rad)$$

# Kvff

## (Pre-defined Variable, Float)

**Purpose** Kvff sets the proportion of velocity feed forward signal added to the velocity command from differentiated position command.

**Syntax** `Kvff = x`

Units % (Percentage)

Range 0 to 199.9

Default 0 %

**Guidelines** Kvff is functional only for positioning modes, BlkType = 2.

When Kvff = 0, the net velocity command in positioning mode results entirely from PosError. For this case, there will be a static nonzero PosError when commanding a constant shaft speed. This error is know as the following error. Velocity feed forward adds a term to VelCMd proportional to delta PosCommand at the position loop update rate which can decrease following error.

Increasing Kvff reduces steady state following error and gives faster response time. However, if Kvff is too large, it will cause overshoot. Typically, Kvff should not be set larger than 80% for smooth dynamics and acceptable overshoot, but should be set to 100% for minimum following error, which may be necessary in electronic gearing applications.

# Kvi

## (Pre-defined Variable, Float, NV Parameter)

**Purpose** Kvi sets the integral gain of the velocity loop.

**Syntax** `Kvi = x`

Units Hertz

Range 0.0 to 636.6

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

**Guidelines** Kvi is the velocity loop integral gain. It defines the frequency where the velocity loop compensation transitions from predominantly integral characteristics (gain decreasing with frequency) to predominantly proportional characteristics (constant gain with frequency). This value should typically be less than 10% of the velocity loop bandwidth.

**Related instructions** `Kvp`

# Kvp

## (Pre-defined Variable, Float, NV Parameter)

**Purpose** Kvp sets the proportional gain of the velocity loop.

**Syntax** `Kvp = x`

Units Amps/(Radians/Second)

Range 0 to Ipeak*12.6

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

**Guidelines** Kvp is defined by the following relationship:

Kvp = Commanded motor torque current / Velocity Error

where Commanded motor current has units of (amperes) and Velocity Error has units of (radians/second).

Kvp must be adjusted for total load inertia and motor torque constant.

**Note:**

*Idealized velocity loop bandwidth (rad/sec) =*

$$Kvp * \left( Kt \Big/ J(lb - in - \sec^2) \right) rad / \sec^2 / Amp$$

Maximum recommended idealized bandwidth = 2Π * 400 Rad/sec.

# LANFlt

## (Pre-defined Array Variable, Float)

**Purpose**

LANFlt(n) is an array of 32 floating point variables that is globally accessible over PACLAN. Each OC950 has its own LANFlt() array.

**Syntax**

```
LANFlt( n ) [ y ] = z
```

or,

```
z = LANFlt(n) [y]
```

where n is the array index (1-32) and y is the Axis Address of the OC950 whose LANFlt array we are using.

Units: none

Range:

Default: 0.0 for all entries

**Guidelines**

The [Axis #] designation can be omitted when reading or writing your own LANFlt(n) variables.

**Related instructions**

`LANInt`

# LANint( )

## (Pre-defined Array Variable, Integer)

**Purpose**

LANInt(n) is an array of 32 integer variables that is globally accessible over PACLAN. Each OC950 has its own LANInt() array.

**Syntax**

```
LANInt( n ) [ y ] = z
```

or,

```
z = LANInt(n) [y]
```

where n is the array index (1-32) and y is the Axis Address of the OC950 whose LANInt array we are using.

Units: none

Range:

Default: 0 for all entries

**Guidelines**

The [Axis #] designation can be omitted when reading or writing your own LANFlt(n) variables.

**Related instructions**

`LANFlt`

# LANInterrupt[ ]
## (Statement)

**Purpose**

LANInterrupt[n] invokes the PACLAN interrupt on axis n.

**Syntax**

```
LANInterrupt[ n ]
```

where n identifies the address of the destination of the interrupt.

**Guidelines**

Before issuing this statement in your program you should ensure that the destination axis is connected to the PACLAN and is running a program. Otherwise, a runtime error will be generated on the source axis.

**Related instructions**

`LANIntrSource, Interrupt, SendLANInterrupt()[]`

# LANIntrArg

## (Pre-defined Array Variable, Integer)

**Purpose** LANIntrArg contains an integer value specified by the source axis of the PACLAN interrupt when that axis invokes a PACLAN interrupt. LANIntrArg can be used in the PACLAN interrupt handler for any purpose you want.

---

**Syntax** `x = LANIntrArg`

Units none

Range

Default 0

---

**Related instructions** `LANIntrSource, SendLANInterrupt()[]`

# LANIntrSource

## (Pre-defined Variable, Integer)

**Purpose** LANIntrSource indicates the axis address of the source of a PACLAN interrupt. This variable was called Axis.Intr in the SC750.

---

**Syntax** `x = LANIntrSource`

Units none

Range 1 - 255

Default none

---

**Guidelines** LANIntrSource is set automatically by the firmware when it processes and dispatches a PACLAN interrupt. You can use it in your PACLAN interrupt handler to do different things depending upon who sent you the interrupt.

**Related instructions** `LANIntrArg, SendLANInterrupt()[]`

# Lcase$()

## (Function)

**Purpose**

Lcase$() converts a string expression to lowercase characters.

**Syntax**

```
result$ = Lcase$(string-expression)
```

**Guidelines**

Lcase$() affects only letters in the string expression. Other characters (such as numbers) are not changed.

**Related instructions**

`Ucase$( )`

**Example**

```
dim x$ as string
x$ = "U.S.A"
print Lcase$(x$)                ‘prints: u.s.a
```

# Left$()
## (Function)

**Purpose**

Left$() returns a string of the n leftmost characters in a string expression.

**Syntax**

```
result$ = Left$(x$,n)
```

**Guidelines**

If n is greater than Len(x$) then the entire string will be returned.

**Related instructions**

`Len(), Mid$(), Right$()`

**Example**

```
a$ = "Mississippi"
print Left$(a$, 5)              'prints: Missi
```

# Len()
## (Function)

**Purpose** Len() returns the number of characters in a string expression.

**Syntax**

```
result = Len(x$)
```

**Guidelines** Non-printing characters and blanks are included.

**Example**

```
x$ = "New York, New York"
Print Len( x$ )              'prints: 18
```

# Log()
## (Function)

**Purpose** Log() returns the natural logarithm of a numeric expression.

**Syntax**

```
result = Log(x)
```

**Guidelines** x must be greater than 0.

**Related instructions** `Exp(), Log10()`

**Example**

```
Print Log( 45.0 / 7.0 )                ‘prints:  1.860752
Print Log( 1 )                         ‘prints:  0
```

# Log10()
## (Function)

**Purpose** Log10() returns the base 10 logarithm of a numeric expression.

**Syntax**

```
result = Log10(x)
```

**Guidelines** x must be greater than 0.

**Related instructions** `Exp(), Log()`

**Example**

```
Print Log10(100)          'prints: 2
Print Log10(1)            'prints: 0
```

# Ltrim$()
## (Function)

**Purpose**

Ltrim$() returns a copy of the original string with leading blanks removed.

**Syntax**

```
result$ = Ltrim$(x$)
```

**Guidelines**

x$ can be any string-expression

**Related instructions**

`Rtrim$(), Trim$()`

**Example**

```
x$ = "      Hello      "
print "("+ Ltrim$(x$) +")"    'prints (Hello     )
```

# Main

## (Statement)

**Purpose**

Main is used to indicate the start of your program. Every program begins with Main and ends with End Main. This program structure is created for you automatically when you use the New Program function on the File menu.

**Syntax**

```
Main
...your main program...
End Main
```

**Guidelines**

There can be only one Main and End Main in your program.

**Related instructions**

`Sub, Function, Interrupt`

**Example**

```
Main
    print "This is all there is to it."
End Main
```

# MB32WordOrder

## (Pre-defined Variable)

**Purpose** MB32WordOrder specifies the word order for 32 bit (double register) Modbus register accesses. This affects 32 bit integers. The word order for floating point variables is specified by MBFloatWordOrder. The setting for MB32WordOrder affects both master and slave operations.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

---

**Syntax** `MB32WordOrder = x`

Range 0 or 1

where:

0 - least significant word first, most significant word second

1 - most significant word first, least significant word second

Default 1

# MBErr

## (Pre-defined Variable, Integer)

**Purpose**

MBErr indicates whether or not an error occurred (and which error) when you execute a MODBUS Master statement or function (e.g. MBWriteBit). MBErr is only set to zero when the program starts executing. After that, it has a "sticky" functionality in that anytime an error occurs MBErr will get updated so you can do multiple MODBUS Master transactions and then verify that MBErr is zero to make sure that were all successful.

| Value | Description |
|---|---|
| 0 | no Error |
| -1 | No Response from Slave (time-out) |
| -2 | Invalid Slave Address Specified (must be 0-254) |
| -3 | Invalid Bit Address Specified (must be 1-9999 or 10001-19999) |
| -4 | Invalid Register Address Specified (must be 30001-39999 or 40001-49999) |

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
MBErr = 0

x = MBErr
```

Range 0, -1, -2, -3, -4

Default 0

**Guidelines**

Set MBErr to zero before each block of MODBUS Master transactions you execute.

Please refer to Section 1.11, "Using an OC950 as a Modbus Master"

**Example** This example initializes MBErr to 0 and then performs two MODBUS master transactions, first it reads a new value for RunSpeed and then it writes 1 to bit 1 on the Modbus slave. If either transaction fails the it calls HandleModbusError which sets Out19 and stops the program.

```
RuntimeProtocol   = 3          'Modbus Master
MBFloatWordOrder = 0           'LS word first
MBErr = 0                      'initialize MBErr to zero
RunSpeed = MBReadFloat(5, 40001 )
MBWriteBit(5, 1, 1)
If MBErr <> 0 then call HandleModBusError
...
Sub HandleModbusError
    NV_MBErr = MBErr           'save MBErr to an NV Variable
    Out19 = 0                  'indicate we're faulted
    Stop                       'stop the program
End                            'HandleModbusError
```

# MBFloatWordOrder

## (Pre-defined Variable)

**Purpose** MBFloatWordOrder specifies the word order for floating point (double register) Modbus register accesses. This affects 32 bit integers. The word order for long integer variables is specified by MB32WordOrder. The setting for MBFloatWordOrder affects both master and slave operations.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

---

**Syntax** `MBFloatWordOrder = x`

Range 0 or 1

where:

0 - least significant word first, most significant word second

1 - most significant word first, least significant word second

Default 1

# MBInfo Block...End

## (Statement)

**Purpose**

The MBInfo block section of a program is used to map pre-defined variables and/or global user variables to specific Modbus register addresses so that the OC950 can operate as a Modbus slave.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
MBInfo

   <$MBMap Statements>

End
```

**Guidelines**

This MBInfo block is only used when you are configuring the OC950 as a Modbus Slave. It is not used when you are operating as a Modbus Master. There can be only one MBInfo block in a program. It should be put before the Main section of the program.

Please refer to Section 1.11, “Using an OC950 as a Modbus Slave”

**Related instructions**

`$MBMapBit, $MBMap16, $MBMap32, $MBMapFloat`

## MBInfo Block...End (continued)

**Example** This example maps several pre-defined variables and one global user variable (MyFloat) to Modbus registers.

```
MBInfo
    $MBMapBit(1, Dir)
    $MBMap16(40001, IndexDist)
    $MBMap32(40002, Position )
    $MBMap32(40004, MyFloat )
    $MBMapFloat( 40006, RunSpeed )
End


Dim MyFloat As Float

Main
RuntimeProtocol = 2
...
```

# $MBMapBit( )
## (Statement)

**Purpose**

$MBMapBit( ) maps a pre-defined variable or a global user variable to a Modbus Bit Register Address (0x reference or 1x reference).

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
$MapBit( Modbus Address, Variable Name)
```

**Guidelines**

This statement is used to map a pre-defined variable or a global user variable to a MODBUS address when the 950 is acting as a MODBUS slave.

Once a variable has been mapped and the Modbus Slave Protocol has been turned on (RuntimeProtocol=2), the Modbus master can read and/or write to this variable without any interaction by the user's program.

The $MBMapBit statement must be located inside an MBInfo block.

**Related instructions**

`RuntimeProtocol`

**Example**

In the example below, the pre-defined variable Dir is mapped to MODBUS address 1 and the pre-defined variable Enable is mapped to the MODBUS address 10002.

```
MBInfo
    $MBMapBit( 1, Dir)
    $MBMapBit(10002, Enable)
End
```

# $MBMap16( )

## (Statement)

**Purpose**

$MBMap16( ) maps a pre-defined variable or a global user variable to a Modbus 16 Bit Register Address (3x reference or 4x reference).

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
$Map16(Modbus Address, Variable Name[,ScaleFactor])
```

**Guidelines**

Once a variable has been mapped and the Modbus Slave Protocol has been turned on (RuntimeProtocol=2), the Modbus master can read and/or write to these variables without any interaction by the user's program.

**Related instructions**

`$MBMap`

**Example**

In the example below, the pre-defined variable Faultcode is mapped to MODBUS address 30001, and the pre-defined variable RunSpeed is mapped to the MODBUS address 40001 and the pre-defined variable Velocity is mapped to MODBUS address 40002 with a scale factor of 10.

```
MBInfo
    $MBMap16(30001, Faultcode)
    $MBMap16(40001, RunSpeed)
    $MBMap16(40002, Velocity, 10)
End
```

# $MBMap32( )
## (Statement)

**Purpose**

$MBMap32( ) maps a pre-defined variable or a global user variable to two contiguous Modbus 16 Bit Register Addresses (3x reference or 4x reference) as a 32 bit integer.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
$Map32( Modbus Address, Variable Name[,ScaleFactor] )
```

**Guidelines**

Once a variable has been mapped and the Modbus Slave Protocol has been turned on (RuntimeProtocol=2), the Modbus master can read and/or write to these variables without any interaction by the user's program.

**Related instructions**

`MB32WordOrder , MBFloatWordOrder`

**Example**

```
MBInfo
    $MBMap32( 30001, Position)
    $MBMap32( 30003, PosCommand)
    $MBMap32( 40001, IndexDist)
    $MBMap32( 40003, TargetPos)
End
```

# $MBMapFloat( )

## (Statement)

**Purpose**

$MBMapFloat( ) maps a pre-defined variable or a global user variable to two contiguous Modbus 16 Bit Register Addresses (0x reference or 1x reference) as a floating point number.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
$MapFloat( Modbus Address, Variable Name)
```

**Guidelines**

Once a variable has been mapped and the Modbus Slave Protocol has been turned on (RuntimeProtocol=2), the Modbus master can read and/or write to these variables without any interaction by the user's program.

**Related instructions**

`MB32WordOrder, MBFloatWordOrder`

**Example**

```
MBInfo
    $MBMapFloat( 30001, Velocity)
    $MBMapFloat( 30003, Time)
    $MBMapFloat( 40001, RunSpeed)
End
```

# MBReadBit( )

## (Pre-defined Function)

**Purpose**

This function reads a bit value (0x or 1x reference) from the specified MODBUS slave and returns the value read. If any error occurs then this function will return zero and set the predefined variable MBErr to indicate the source of the error.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
x = MBReadBit( SlaveAddress, RegisterAddress)
```

**Guidelines**

This is a Modbus Master function, so you must set RuntimeProtocol to 3 (MODBUS Master) before using this function. Otherwise, you will get a RuntimeError.

Modbus Master statements and function cannot be nested. If you get an Interrupt while waiting for a response to a Modbus Master statement or function then you cannot initiate another Modbus Master statement or function in the Interrupt Handler. If you do so then you will get a Runtime Error 36.

Please refer to Section 1.11, “Using an OC950 as a Modbus Master”

**Related instructions**

`MBReadBit, MBRead16, MBRead32 , MBReadFloat`

`MBWriteBit, MBWrite16, MBWrite32, MBWriteFloat`

`MB32WordOrder, MBFloatWordOrder, MBErr`

**Example**

This example reads a bit value from register 10005 on the MODBUS slave at address 5 and puts the value in IndexDist.

```
RuntimeProtocol   = 3          'Modbus Master
RunSpeed = MBRead32(5, 10005 )
```

# MBRead16( )

## (Pre-defined Function)

**Purpose**

This function reads an integer value from the specified MODBUS slave and returns the value read. If any error occurs then this function will return zero and set the pre-defined variable MBErr to indicate the source of the error.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
x = MBRead16( SlaveAddress, RegisterAddress)
```

**Guidelines**

This is a Modbus Master function, so you must set RuntimeProtocol to 3 (MODBUS Master) before using this function. Otherwise, you will get a RuntimeError.

Modbus Master statements and function cannot be nested. If you get an Interrupt while waiting for a response to a Modbus Master statement or function then you cannot initiate another Modbus Master statement or function in the Interrupt Handler. If you do so then you will get a Runtime Error 36.

Please refer to Section 1.11, “Using an OC950 as a Modbus Master”

**Related instructions**

```
MBReadBit, MBRead16, MBRead32 , MBReadFloat

MBWriteBit, MBWrite16, MBWrite32, MBWriteFloat

MB32WordOrder, MBFloatWordOrder ,MBErr
```

**Example**

This example reads an integer value from register 40005 on the MODBUS slave at address 5 and puts the value in IndexDist.

```
RuntimeProtocol   = 3       ‘Modbus Master

RunSpeed = MBRead32(5, 40005 )
```

# MBRead32( )

## (Pre-defined Function)

**Purpose**

This function reads a long integer (32 bits) value from the specified MODBUS slave and returns the value read. If any error occurs then this function will return zero and set the predefined variable MBErr to indicate the source of the error.

The register address passed to this function is the first register address of the 32 bit integer value.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
x = MBRead32( SlaveAddress, RegisterAddress)
```

**Guidelines**

This is a Modbus Master function, so you must set RuntimeProtocol to 3 (MODBUS Master) before using this function. Otherwise, you will get a RuntimeError.

Modbus Master statements and function cannot be nested. If you get an Interrupt while waiting for a response to a Modbus Master statement or function then you cannot initiate another Modbus Master statement or function in the Interrupt Handler. If you do so then you will get a Runtime Error 36.

There is not complete standardization on the format of long integer (32 bit) numbers among all MODBUS devices. You may need to set MB32WordOrder to 0 (its default value is 1) in order to properly receive long integer (32 bit) numbers from a MODBUS slave.

Please refer to Section 1.11, “Using an OC950 as a Modbus Master”

**Related instructions**

`MBReadBit, MBRead16, MBRead32 , MBReadFloat`

`MBWriteBit, MBWrite16, MBWrite32, MBWriteFloat`

`MB32WordOrder, MBFloatWordOrder ,MBErr`

## MBRead32( ) (continued)

**Example**

This example reads a long integer value from registers 40003 (and 40004) on the MODBUS slave at address 5 and puts the value in IndexDist. In this example the MODBUS slave sends long integer data low word first, so we need to set MB32WordOrder to 0 in order to receive this data properly.

```
RuntimeProtocol   = 3          'Modbus Master
MB32WordOrder = 0              'LS word first
RunSpeed = MBRead32(5, 40003 )
```

# MBReadFloat( )

## (Pre-defined Function)

**Purpose**

This function reads a floating point value from the specified MODBUS slave and returns the value read. If any error occurs then this function will return zero and set the predefined variable MBErr to indicate the source of the error.

The register address passed to this function is the first register address of the 32 bit floating point value.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
x = MBReadFloat( SlaveAddress, RegisterAddress)
```

**Guidelines**

This is a Modbus Master function, so you must set RuntimeProtocol to 3 (MODBUS Master) before using this function. Otherwise, you will get a RuntimeError.

Modbus Master statements and function cannot be nested. If you get an Interrupt while waiting for a response to a Modbus Master statement or function then you cannot initiate another Modbus Master statement or function in the Interrupt Handler. If you do so then you will get a Runtime Error 36.

There is not complete standardization on the format of floating point numbers among all MODBUS devices. You may need to set MBFloatWordOrder to 0 (its default value is 1) in order to properly receive floating point numbers from a MODBUS slave.

Please refer to Section 1.11, “Using an OC950 as a Modbus Master”

**Related instructions**

`MBReadBit, MBRead16, MBRead32 , MBReadFloat`

`MBWriteBit, MBWrite16, MBWrite32, MBWriteFloat`

`MB32WordOrder, MBFloatWordOrder ,MBErr`

## MBReadFloat( ) (continued)

**Example** This example reads a floating point value from registers 40001 and 40002 on the MODBUS slave at address 5 and puts the value in RunSpeed. In this example the MODBUS slave sends floating point data low word first, so we need to set MBFloatWordOrder to 0 in order to receive this data properly.

```
RuntimeProtocol   = 3            'Modbus Master
MBFloatWordOrder = 0             'LS word first
RunSpeed = MBReadFloat(5, 40001 )
```

# MBWriteBit( )

## (Statement)

**Purpose**

This statement writes a bit value to a 1x reference register the specified MODBUS slave. If any error occurs then this function will set the predefined variable MBErr to indicate the source of the error.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
MBWriteBit(SlaveAddress,RegisterAddress,IntegerValue)
```

**Guidelines**

This is a Modbus Master statement, so you must set RuntimeProtocol to 3 (MODBUS Master) before using it. Otherwise, you will get a RuntimeError.

Modbus Master statements and function cannot be nested. If you get an Interrupt while waiting for a response to a Modbus Master statement or function then you cannot initiate another Modbus Master statement or function in the Interrupt Handler. If you do so then you will get a Runtime Error 36.

Please refer to Section 1.11, “Using an OC950 as a Modbus Master”

**Related instructions**

```
MBReadBit, MBRead16, MBRead32 , MBReadFloat

MBWriteBit, MBWrite16, MBWrite32, MBWriteFloat

MB32WordOrder, MBFloatWordOrder, MBErr
```

**Example**

This example writes the integer value of Inp0 to registers 1 on the MODBUS slave at address 5.

```
RuntimeProtocol   = 3          'Modbus Master

MBWriteBit(5, 1, Inp0 )
```

# MBWrite16( )

## (Statement)

**Purpose**

MBWrite16( ) writes an integer (16 bits) value to the specified MODBUS slave. If any error occurs then this function will set the predefined variable MBErr to indicate the source of the error.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
MBWrite16(SlaveAddress,RegisterAddress,IntegerValue)
```

**Guidelines**

This is a Modbus Master statement, so you must set RuntimeProtocol to 3 (MODBUS Master) before using it. Otherwise, you will get a RuntimeError.

Modbus Master statements and function cannot be nested. If you get an Interrupt while waiting for a response to a Modbus Master statement or function then you cannot initiate another Modbus Master statement or function in the Interrupt Handler. If you do so then you will get a Runtime Error 36.

Please refer to Section 1.11, “Using an OC950 as a Modbus Master”

**Related instructions**

```
MBReadBit, MBRead16, MBRead32, MBReadFloat

MBWriteBit, MBWrite16, MBWrite32, MBWriteFloat

MB32WordOrder, MBFloatWordOrder, MBErr
```

**Example**

This example writes the integer value of IndexDist to registers 40001 on the MODBUS slave at address 5.

```
RuntimeProtocol   = 3          'Modbus Master

MBWrite16(5, 40001, IndexDist )
```

# MBWrite32( )

## (Statement)

**Purpose**

This statement writes a long integer (32 bits) value to the specified MODBUS slave. If any error occurs then this function will set the predefined variable MBErr to indicate the source of the error.

The register address passed to this function is the first register address of the 32 bit long integer value.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
MBWrite32( SlaveAddress, RegisterAddress,
LongIntegerValue)
```

**Guidelines**

This is a Modbus Master statement, so you must set RuntimeProtocol to 3 (MODBUS Master) before using it. Otherwise, you will get a RuntimeError.

Modbus Master statements and function cannot be nested. If you get an Interrupt while waiting for a response to a Modbus Master statement or function then you cannot initiate another Modbus Master statement or function in the Interrupt Handler. If you do so then you will get a Runtime Error 36.

There is not complete standardization on the format of long integer numbers among all MODBUS devices. You may need to set MB32WordOrder to 0 (its default value is 1) in order to properly write floating point numbers to a MODBUS slave.

Please refer to Section 1.11, “Using an OC950 as a Modbus Master”

**Related instructions**

`MBReadBit, MBRead16, MBRead32, MBReadFloat`

`MBWriteBit, MBWrite16, MBWrite32, MBWriteFloat`

`MB32WordOrder, MBFloatWordOrder, MBErr`

## MBWrite32( ) (continued)

**Example**

This example writes the long integer value of TargetPos to registers 40001 (and 40002) on the MODBUS slave at address 5. In this example the MODBUS slave accepts long integer data low word first, so we need to set MB32WordOrder to 0 in order for the slave to receive this data properly.

```
RuntimeProtocol   = 3          'Modbus Master
MB32WordOrder = 0              'LS word first
MBWrite32(5, 40001, TargetPos )
```

# MBWriteFloat( )

## (Statement)

**Purpose**

This statement writes a floating point value to the specified MODBUS slave. If any error occurs then this function will set the predefined variable MBErr to indicate the source of the error.

The register address passed to this function is the first register address of the 32 bit floating point value.

**Note:** *This feature is only available in the Enhanced OC950 Firmware.*

**Syntax**

```
MBWriteFloat(SlaveAddress,RegisterAddress,FloatValue)
```

**Guidelines**

This is a Modbus Master statement, so you must set RuntimeProtocol to 3 (MODBUS Master) before using it. Otherwise, you will get a RuntimeError.

Modbus Master statements and function cannot be nested. If you get an Interrupt while waiting for a response to a Modbus Master statement or function then you cannot initiate another Modbus Master statement or function in the Interrupt Handler. If you do so then you will get a Runtime Error 36.

There is not complete standardization on the format of floating point numbers among all MODBUS devices. You may need to set MBFloatWordOrder to 0 (its default value is 1) in order to properly write floating point numbers to a MODBUS slave.

Please refer to Section 1.11, “Using an OC950 as a Modbus Master”

**Related instructions**

`MBReadBit, MBRead16, MBRead32, MBReadFloat`

`MBWriteBit, MBWrite16, MBWrite32, MBWriteFloat`

`MB32WordOrder, MBFloatWordOrder, MBErr`

## MBWriteFloat( ) (continued)

**Example** This example writes the floating point value 1.5 to registers 40001 (and 40002) on the MODBUS slave at address 5. In this example the MODBUS slave accepts floating point data low word first, so we need to set MBFloatWordOrder to 0 in order for the slave to receive this data properly.

```
RuntimeProtocol   = 3          'Modbus Master
MBFloatWordOrder = 0           'LS word first
MBWriteFloat(5, 40001, 1.5 )
```

# Mid$()
## (Function)

**Purpose**

Mid$() returns a substring of the original string that begins at the specified offset location and is of the specified (optional) length.

**Syntax**

```
result = Mid$(x$, start [,length])
```

**Guidelines**

Start and length must both be numeric expressions.

If length is omitted then Mid$() returns a substring that starts at start and goes to the end of x$.

**Related instructions**

`Instr(), Left$(), Len(), Right$()`

**Example**

```
x$ = "abcdefghi"
print Mid$(x$, 1, 5)          'prints: abcde
print Mid$(x$, 6)             'prints: fghi
```

# Mod
## (Operator)

**Purpose**

This is the modulus or “remainder” operator. It divides one number by another and returns the remainder.

**Syntax**

```
x = y MOD z
```

**Guidelines**

This MOD operator is only used in numeric expressions. There is a Position Modulo value (PosModulo) and an encoder position modulo value (EncPosModulo). These are separate pre-defined variables and are not related directly to the MOD operator.

**Example**

```
print 19 MOD 5                ‘prints: 4
```

# Model

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** Model indicates the drive model number (power level).

**Syntax** `Model = x`

Range 952, 953, 954, 955

# ModelExt

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose**

ModelExt gives information about the type of OC950 that you have.

**Syntax**

```
x = ModelExt
```

Range

| Model # | Explanation |
|---|---|
| 501 | 32K |
| 502 | 128K |
| 503 | 32K with PACLAN |
| 504 | 128K with PACLAN |
| 601 | 32K with Enhanced Features |
| 602 | 128K with Enhanced Features |
| 603 | 32K with PACLAN and Enhanced Features |
| 604 | 128K with PACLAN and Enhanced Features |

**Related instructions**

`Model`

# ModifyEncPos( )

## Statement

**Purpose**

ModifyEncPos translates EncPos (encoder position) from old_value to new_value.

**Syntax**

```
ModifyEncPos(old_value, new_value)
```

**Guidelines**

Use ModifyEncPos to zero out the encoder position (EncPos) before starting a cam.

**Related instructions**

`EncPos, ActiveCam`

**Example**

The following program illustrates ModifyEncPos. The encoder position captured by BDIO5 (Reg2 will be the zero position).

```
When Reg2HiFlag, Continue
    ModifyEncPos(Reg2HiEncPos,0)
    PosCommand = 0
    ActiveCam = 1
```

# Motor

## (Pre-defined Variable)

**Purpose** Motor indicates the first 4 characters of the motor part number used to determine the Signature Series current wave shape used to eliminate torque constant ripple.

**Syntax** `x = Motor`

Range Up to any 4 ASCII characters.

Default Sine(1,162,768,483)

# Moving

## (Pre-defined Variable, Integer, Read-Only)

**Purpose**

Moving indicates whether or not the commanded motion profile is complete.

0 - commanded motion complete

1 - move in progress

---

**Syntax**

```
x = Moving
```

Units: none

Range: 0 or 1

Default: 0

---

**Guidelines**

Moving only indicates whether or not the commanded motion profile is complete. Even when the commanded motion profile is completed (Moving = 0) there may still be motor motion as the result of settling time and/or electronic gearing.

**Related instructions**

`InPosition, InPosLimit`

---

**Example**

```
IndexDist = 10000
GoIncr
While Moving : Wend
Pause(0.5)
IndexDist = -IndexDist
GoIncr
```

# OCDate

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** OCDate gives the Option Card date code.

**Syntax** `x = OCDate`

Range 0 to $2^{31}$

Default Set at factory

# OCSNum

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** OCSNum gives the Option Card serial number.

**Syntax** `x = OCSNum`

Range 0 to $2^{31}$

Default Set at factory

# Oct$()

## (Function)

**Purpose**

Oct$() converts an integer number to its equivalent octal ASCII string.

**Syntax**

```
result$ = Oct$(x)
```

**Guidelines**

Octal numbers are numbers to the base 8 (rather than base 10).

The argument to Oct$() is rounded to an integer before Oct$(x) is evaluated.

**Related instructions**

`Hex$(), Str$()`

**Example**

```
dim x,y as integer
dim result1$, result2$ as string
x = 20
y = &H6A
result1$ = Oct$(x)
result2$ = Oct$(y)
print result1$, result2$      'Prints: 24 152
```

# On Error Goto
## (Statement)

**Purpose**

On Error Goto allows you to define a run-time error handler to prevent run-time errors from halting program execution. Different error handlers can be defined for different parts of the program. An error handler is active from when the On Error Goto statement is executed until another one is executed.

**Syntax**

```
On Error Goto Error-Handler-Name
```

or

```
On Errror Goto 0
```

**Guidelines**

An error handler has the same structure as a subroutine, but must end with a Restart disables any user defined run-time error handler and reinstalls the default handler. Any subsequent run-time error will print an error message and halt the program.

Errors occurring within the error handler are handled by the default error handler. This means that they will halt program execution.

**Related instructions**

`Restart`

## On Error Goto (continued)

**Example**

```
dim Count as integer
main
    dim y as integer
    if Count < 10 then
       on error goto MyHandler
    else
       on error goto 0
    end if
    y = 0
    pause(0.5)
    y = 1/y
    print "I'll never get here"
end main

Sub MyHandler
    Count=Count+1
    print Count
    restart
End Sub
```

# Or
## (Operator)

**Purpose**

Or performs a logical OR operation on two expressions.

**Syntax**

```
result = A or B
```

**Guidelines**

The result evaluates to True if either of the expressions is True. Otherwise, the result is False.

**Related instructions**

`Or, Xor, Band, Bor, Bxor`

**Example**

```
x = 17
y = 27
if (x > 20) or (y >20) then
    print “This will get printed”
end if

if (x < 20) or (y > 20) then
    print “...so will this.”
end if
```

# Out0-Out20

## (Pre-defined Variable, Integer)

**Purpose** Outn (Out0 - Out20) sets the state of the individual discrete outputs.

**Syntax** `Outn = x`

Units none

Range 0 or 1

Default 1

**Guidelines** 0 turns the output transistor on, output is pulled down.

1 turns the output transistor off, output is pulled up.

**Related instructions** `Outputs, BDOut`*`n`*`, BDOutputs`

**Example**

```
while 1
Out1 = 1
pause(0.5)
Out1 = 0
pause(0.5)
wend
```

# Outputs
## (Pre-defined Variable, Integer)

**Purpose** Outputs allows setting of the Outputs in parallel.

**Syntax** `Outputs = x`

Units none

Range 0 to 2,097,151

Default 2,097,151 (all outputs are 1)

**Guidelines** For each bit in Outputs:

0 turns the output transistor on, output is pulled down.

1 turns the output transistor off, output is pulled up.

**Related instructions** `Out`*n*`, BDOutputs, BDOut`*n*

**Example**

```
while 1
    Outputs = &h155555        'alternate outputs
    pause(0.5)
    Outputs = &h0AAAAA        'alternate again
    pause(0.5)
wend
```

# $PACLANAddr

## (Compiler Directive)

**Purpose**

The $PACLANAddr directive allows you to specify what axes a program can be downloaded to. The $PACLANAddr directive must be enclosed in a ProgramInfo block. This is created automatically by the OC950 IDE when you use File|New to create a new program.

**Syntax**

```
ProgramInfo
    $PACLANAddr( axis list )
End ProgramInfo
```

**Guidelines**

You can specify any number of axes in the axis list by separating them with commas. You can also specify a range of addresses using the to keyword.

**Examples**

These two examples show both a simple $PACLANAddr() directive that just specifies axis 255 and then a more complicated PACLANAddr() directive that specifies axes 1 and 3 and axes 6 through 9.

```
ProgramInfo
    $PACLANAddr(255)
End ProgramInfo


ProgramInfo
    $PACLANAddr(1,3, 6 to 9)
End ProgramInfo
```

# Params...End Params

## (Statement)

**Purpose**

The Params...End Params section of your program specifies the values for the non-volatile parameters. This section is created for you automatically when you use the New Program selection on the File menu.

**Syntax**

```
Params

   parameter1 = parameter-value

   parameter2 = parameter-value

   ...

End Params
```

**Guidelines**

The values assigned to the parameters in the parameters section of your program are automatically written to these parameters the next time that you power up the drive - before the program gets executed.

So, even if Autostart is not set and the program does not run automatically, these values will get initialized to the values that you have specified. All other pre-defined variables get initialized to fixed default values.

**Related instructions**

`ARF0, ARF1, CommOff, PoleCount, Kip, ILmtMinus, ILmtPlus, ItThresh, Kpp, Kvi, Kvp`

# Pause( )

## (Statement)

**Purpose**

Pause causes the program execution to pause for a specified amount of time. The motion of the motor is not affected.

**Syntax**

```
Pause(x)
```

**Guidelines**

Interrupts are active during a Pause() statement.

**Related instructions**

`Time`

**Example**

```
for x = 0.1 to 2.0 step 0.1
    Out0 = 1
    Pause(x)
    Out0 = 0
    Pause(x)
next
```

# PoleCount

## (Pre-defined Variable, Integer, NV Parameter)

**Purpose** PoleCount matches the drive for the appropriate motor pole count or encoder quadrature counts per motor cycle.

---

**Syntax** `PoleCount = x`

Units motor poles

Range 2 to 65534 (even numbers only)

1 to 65535 Encoder Counts per electrical cycle.

Default Parameter value specified in the Params...End Params section of your program. The 950 IDE **New Program** function calculates this value based upon the specified motor and drive.

---

**Guidelines** For CommSrc = 0, PoleCount sets the number of motor poles

For CommSrc = 1, PoleCount sets the number of encoder quadrature counts per motor electrical cycle.

**Note:** *Set CommSrc before writng to PoleCount.*

***Warning***

***When the PoleCount set does not match the actual pole count, the motor's operation will be erratic.***

# PosCommand

## (Pre-defined Variable, Integer)

**Purpose**

PosCommand (Position Command) contains the current position command.

The value of PosCommand is affected by PosModulo and PosPolarity.

**Syntax**

```
PosCommand = x
```

Units: resolver counts

Range: -134,217,728 to +134,217,727

**Guidelines**

PosCommand can be used to determine the position being commanded.

You can write to PosCommand at any time; this establishes a new electrical home position (where PosCommand = 0). Writing to PosCommand will not affect motor motion.

**Related instructions**

`Position, PosModulo, PosPolarity`

**Example**

The following program lines set electrical home position when Inp0 goes to a 0.

```
Dir = 0 : RunSpeed = 100 : GoVel
When Inp0 = 0, Continue
AbortMotion
While Moving : Wend
PosCommand = 0
```

# PosError

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** PosError (Actual Position Error) is equal to the difference between the position command (PosCommand) and the actual position (Position).

**Syntax** `x = PosError`

Units Counts (same units as position feedback)

Range -134,217,728 to +134,217,727

**Guidelines** This variable only makes sense for position control blocks, BlkType = 2.

# PosErrorMax

## (Pre-defined Variable, Integer)

**Purpose** PosErrorMax sets the maximum value in position feed back counts for the position loop following error fault.

**Syntax** `PosErrorMax = x`

Units Counts (same units as position feedback).

Range 0 to 294,912,000 (4500 revs)

Default 40960

**Guidelines** The following error fault compares PosError with the PosError predicted from EncFreq and Kvff and if the magnitude of the difference is larger than PosErrorMax continuously for longer than 1 second or statistically larger over half the time, the drive will generate a following error fault (“ F 1 ”).

# Position

## (Pre-defined Variable, Integer, Read-Only)

**Purpose**

Position indicates the motor's actual position. This is a read-only variable and cannot be set directly by the software.

The value of Position is affected by PosModulo and PosPolarity.

---

**Syntax**

```
x = Position
```

Units: resolver counts

Range: -134,217,728 to +134,217,727

Default: set equal to ResPos on power up

---

**Guidelines**

If you write a new value to PosCommand then Position will be automatically changed such that PosError (the difference between them) is unchanged.

**Related instructions**

`PosCommand, PosModulo, PosPolarity`

---

**Example**

```
print Position, PosCommand
PosCommand = 0
print Position, PosCommand
```

# PosModulo

## (Pre-defined Variable, Integer)

**Purpose**

PosModulo specifies the position modulo value. The position modulo value is the value of Position where Position is automatically reset to zero.

If PosModulo is zero (the default value) then position modulo is not used.

**Syntax**

```
PosModulo = x
```

Units: resolver counts

Range: 0 to 134,217,727

Default: 0 (turned off)

**Guidelines**

PosModulo is useful for rotary motion applications.

**Related instructions**

`EncPosModulo`

# PosPolarity

## (Pre-defined Variable, Integer)

**Purpose**

PosPolarity specifies the connection between motor shaft rotation direction (clockwise or counter-clockwise) and position variables' direction as follows:

0: clockwise is positive, ccw is negative

1: clockwise is negative, ccw is positive

After you change PosPolarity all commanded motion will be reversed from what it was.

---

**Syntax** `PosPolarity = x`

Units none

Range 0 or 1

Default 0

---

**Guidelines**

The drive must be disabled (Enabled = 0) to change PosPolarity. When the drive is enabled (Enabled = 1), PosPolarity is read-only.

PosPolarity is used for reversing direction for an entire program.

**Related instructions** `PosModulo`

## PosPolarity (continued)

**Example**

```
Enable = 0
PosPolarity = 1
Enable = 1
IndexDist = 4096                ‘goes ccw
GoIncr
while Moving : wend
pause(1)
Dir = 0 : GoVel                 ‘goes ccw
```

# Print
## (Statement)

**Purpose**

Print displays formatted output through the serial port while the program is running.

**Syntax**

```
Print expression1 [ [,;] expression2 ] [;]
```

**Guidelines**

950BASIC defines zones of 13 characters which can be used to produce output in columns.

If a list of expressions is separated by commas (,) then each subsequent expression is printed in the next zone.

If a list of expressions is separated by semi-colons (;) then the zones are ignored and consecutive expressions are printed in the next available character space.

If a PRINT statement ends in a comma or semi-colon then carriage-return/line-feed at the end of serial output is suppressed.

**Example**

```
Print “Hello” , “Goodbye”
Print “Hello” ; “Goodbye”
Print “Hello” , “Goodbye”;
Print “...The End.”
```

# PulsesIn

## (Pre-defined Variable, Integer)

**Purpose**

PulsesIn specifies the number of encoder counts used when specifying an exact electronic gearing ratio.

PulsesIn is the number of encoder counts required to increase PosCommand by PulsesOut resolver counts when using exact gearing.

**Syntax**

```
PulsesIn = x
```

Units: encoder counts

Range: 1 to 32767

Default: 1

**Guidelines**

PulsesIn or PulsesOut must be set more recently than Ratio in order to use exact electronic gearing.

**Related instructions**

`Gearing, PulsesOut, Ratio`

# PulsesOut

## (Pre-defined Variable, Integer)

**Purpose**

PulsesOut specifies the number of resolver counts used when specifying an exact electronic gearing ratio.

PulsesOut is the number of resolver counts that the motor will move for each PulsesIn number of encoder counts.

**Syntax**

```
PulsesOut = x
```

Units: resolver counts

Range: -CountsPerRev/2 to CountsPerRev / 2

Default: 1

**Guidelines**

PulsesIn or PulsesOut must be set more recently than Ratio in order to use exact electronic gearing.

**Related instructions**

`Gearing, PulsesIn, Ratio`

# Random

## (Pre-defined Variable, Float, Read-Only)

**Purpose** Random returns a pseudo random number from a uniform distribution between 0.0 and 1.0 (inclusive).

**Syntax** `x = Random`

Range 0.0 to 1.0

**Guidelines** Use Randomize to seed the random number generator.

**Related instructions** `Randomize`

**Example** The following program illustrates this, by printing two identical 'random' number sequences, followed by a different 'random' number sequence. The first two sequences are identical because the seed is the same for each sequence. The third uses the default value of the 'randomize' argument to force the system to seed the random number generator with the current time.

```
main
dim i as integer
randomize(1)
for i = 1 to 5
      print random;
next i
print
randomize(1)
for i = 1 to 5
     print random;
next i
print
randomize
for i = 1 to 5
     print random;
next i
end
```

# Randomize

## (Statement)

**Purpose**

Randomize[(x)] initializes the random number generator. It has an optional floating-point argument, to specify the initial 'seed'. If the optional argument is not present, the system will use the current time as the seed. Given the same initial seed, any two sequences of random numbers will be identical.

**Syntax**

```
Randomize[(x)]
```

**Guidelines**

Use Random to get a random number.

**Related instructions**

`Random`

**Example** The following program illustrates this, by printing two identical 'random' number sequences, followed by a different 'random' number sequence. The first two sequences are identical because the seed is the same for each sequence. The third uses the default value of the 'randomize' argument to force the system to seed the random number generator with the current time.

```
main
dim i as integer
randomize(1)
for i = 1 to 5
      print random;
next i
print
randomize(1)
for i = 1 to 5
     print random;
next i
print
randomize
for i = 1 to 5
     print random;
next i
end
```

# Ratio

## (Pre-defined Variable, Floating point)

| | |
|---|---|
| **Purpose** | Ratio sets the electronic gearing ratio (rev to rev) between the encoder shaft (master) and the motor shaft (slave). |
| **Syntax** | `Ratio = x` |
| Units | Motor revolutions / Encoder Revolution |
| Range | -2,000 to 2,000 |
| Default | 1.0 |
| **Guidelines** | Ratio must be set more recently than PulsesIn or PulsesOut in order to use Ratio to control electronic gearing. |
| **Related instructions** | `EncIn` |

# ReadPLC5Binary( )

## (Pre-defined Function)

**Purpose**

ReadPLC5Binary( ) reads the specified (16 bit) element from the specified binary file on the specified PLC5.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the PLC5 connected to the OC950's serial port and wait for the response. If there is a valid response then the OC950 will put the data in the appropriate variable (i.e. the variable on the left-hand-side of the equals sign). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
x = ReadPLC5Binary(node address, file number,
element number)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1 Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadSLC5Integer, ReadPLC5Float, WritePLC5Integer, WritePLC5Binary, WritePLC5Float`

## ReadPLC5Binary( ) (continued)

**Example** The following program reads an integer from a PLC5 binary file. It then sets RunSpeed to twice the integer read from the PLC5.

**Note:** *All communication settings on both devices (SC950 and PLC5) must match.*

```
main
dim PLC5Speed as integer
runtimeprotocol = 5              'Allen-Bradley DF1 Protocol
baudrate = 19200                 'baudrate MUST match PLC
                                  setting
abcrc = 1                        'Set check to CRC — MUST
                                  match PLC setting
PLC5Speed = ReadPLC5Binary(5,3,19)
                                 'PLC5 File 3 = Binary File
RunSpeed = PLC5Speed * 2
end
```

# ReadPLC5Float( )

## (Pre-defined Function)

**Purpose**

ReadPLC5Float( ) reads the specified (32 bit) element from the specified float file on the specified PLC5.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the PLC5 connected to the OC950's serial port and wait for the response. If there is a valid response then the OC950 will put the data in the appropriate variable (i.e. the variable on the left-hand-side of the equals sign). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
x = ReadPLC5Float(node address, file number, element number)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1 Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadSLC5Integer, ReadPLC5Binary, WritePLC5Integer, WritePLC5Binary, WritePLC5Float`

## ReadPLC5Float( ) (continued)

**Example** The following program reads a float from a PLC5 binary file. It then sets RunSpeed to 3.45 times the value read from the PLC5.

**Note:** *All communication settings on both devices (SC950 and PLC5) must match.*

```
main
dim PLC5Speed as float

runtimeprotocol = 5              'Allen-Bradley DF1 Protocol
baudrate = 19200                 'baudrate MUST match PLC setting
abcrc = 1                        'Set check to CRC — MUST match PLC setting
PLC5Speed = ReadPLC5Float(5, 8, 1)
                                 'PLC5 File 8 = Float File
RunSpeed = PLC5Speed * 3.45
end
```

# ReadPLC5Integer( )

## (Pre-defined Function)

**Purpose**

ReadPLC5Integer( ) reads the specified (16 bit) element from the specified integer file on the specified PLC5.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the PLC5 connected to the OC950's serial port and wait for the response. If there is a valid response then the OC950 will put the data in the appropriate variable (i.e. the variable on the left-hand-side of the equals sign). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
x = ReadPLC5Integer(node address, file number,
element number)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1 Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadPLC5Binary, ReadPLC5Float,WritePLC5Integer, WritePLC5Binary, WritePLC5Float`

## ReadPLC5Integer( ) (continued)

**Example** The following program reads an integer from a PLC5. It then sets RunSpeed to twice the integer read from the PLC5.

**Note:** *All communication settings on both devices (SC950 and PLC5) must match.*

```
main
dim PLC5Speed as integer


runtimeprotocol = 5          'Allen-Bradley DF1 Protocol
baudrate = 19200             'baudrate MUST match PLC
                             setting
abcrc = 1                    'Set check to CRC — MUST
                              match PLC setting
PLC5Speed = ReadPLC5Integer(5, 7, 19)
                             'PLC5 File 7 = Integer File
RunSpeed = PLC5Speed * 2
end
```

# ReadSLC5Binary( )

## (Pre-defined Function)

**Purpose**

ReadSLC5Binary( ) reads the specified element (16 bits) from the specified binary file on the specified SLC500.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the SLC500 connected to the OC950's serial port and wait for the response. If there is a valid response then the OC950 will put the data in the appropriate variable (i.e. the variable on the left-hand-side of the equals sign). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
x = ReadSLC5Binary(SLC500 address, file number,
element number)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1 Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadSLC5Integer, ReadSLC5Float, WriteSLC5Integer, WriteSLC5Integer, WriteSLC5Float`

## ReadSLC5Binary( ) (continued)

**Example** The following program reads an integer from a SLC500 PLC binary file. It then sets IndexDist to twice the value read from the SLC500.

**Note:** *All communication settings on both devices (SC950 and SLC500) must match.*

```
main
dim SLC5Dist as integer


runtimeprotocol = 5                    'Allen-Bradley DF1 Protocol
baudrate = 19200                       'baudrate MUST match PLC
                                        setting
abcrc = 1                              'Set check to CRC — MUST
                                        match PLC setting
SLC5Speed = ReadSLC5Binary(5, 3, 19)
                                       'SLC500 File 3 = Binary File
IndexDist = SLC5Dist * 2
end
```

# ReadSLC5Float( )

## (Pre-defined Function)

**Purpose**

ReadSLC5Float( ) reads the specified element (32 bits) from the specified Floating file on the specified SLC500.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the SLC500 connected to the OC950's serial port and wait for the response. If there is a valid response then the OC950 will put the data in the appropriate variable (i.e. the variable on the left-hand-side of the equals sign). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
x = ReadSLC5Float(SLC500 address, file number,
element number)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1 Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadSLC5Integer, ReadSLC5Binary, WriteSLC5Integer, WriteSLC5Integer, WriteSLC5Binary`

## ReadSLC5Float( ) (continued)

**Example** The following program reads a float from a SLC500 PLC. It then sets RunSpeed to 2.55 * value read from the SLC500.

**Note:** *All communication settings on both devices (SC950 and SLC500) must match.*

```
main
dim SLC5Speed as float
runtimeprotocol = 5                    'Allen-Bradley DF1 Protocol
baudrate = 19200                       'baudrate MUST match PLC setting
abcrc = 1                              'Set check to CRC — MUST match PLC setting
SLC5Speed = ReadSLC5Float(5, 8, 19)
                                       'SLC500 File 8 = Float File
RunSpeed = SLC5Speed * 2.55
end
```

# ReadSLC5Integer( )

## (Pre-defined Function)

**Purpose**

ReadSLC5Integer( ) reads the specified (16 bit) element from the specified integer file on the specified SLC500.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the SLC500 connected to the OC950's serial port and wait for the response. If there is a valid response then the OC950 will put the data in the appropriate variable (i.e. the variable on the left-hand-side of the equals sign). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
x = ReadSLC5Integer(SLC500 address, file number,
element number)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1 Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadSLC5Binary, ReadSLC5Float, WriteSLC5Binary, WriteSLC5Integer, WriteSLC5Float`

## ReadSLC5Integer( ) (continued)

**Example** The following program reads an integer from a SLC500 PLC. It then sets RunSpeed to twice the integer read from the SLC500.

**Note:** *All communication settings on both devices (SC950 and SLC500) must match.*

```
main
dim SLC5Speed as integer
runtimeprotocol = 5                    'Allen-Bradley DF1 Protocol
baudrate = 19200                       'baudrate MUST match PLC
                                        setting
abcrc = 1                              'Set check to CRC — MUST
                                        match PLC setting
SLC5Speed = ReadSLC5Integer(5, 7, 19)
                                       'SLC500 File 7 = Integer File
RunSpeed = SLC5Speed * 2
end
```

# Reg1HiEncpos

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** Reg1HiEncpos contains the latched value of the encoder counter (EncPos) when the Reg1 input (J4-10) captured its last low-to-high registration event.

**Note:** *RegControl must be set to 0 in order for Reg1HiEncpos to be latched.*

---

**Syntax** `x = Reg1HiEncpos`

Units encoder counts

Range

Default none

---

**Guidelines** Set Reg1HiFlag to 0 to arm the registration latch.

**Related instructions** `RegControl, Reg1HiFlag, Reg1LoEncpos`

# Reg1HiFlag

## (Pre-defined Variable, Integer)

**Purpose**

Reg1HiFlag is used to arm and monitor the Reg1Hi registration data latches.

Set Reg1HiFlag to zero to arm the latches (i.e. prepare them to capture data at a registration transition). This flag will automatically be set to one when the hardware detects a low-to-high transition on Reg1 (J4-10).

---

**Syntax** `Reg1HiFlag = x`

Units none

Range 0 or 1

Default 0

---

**Guidelines** RegControl determines what data gets latched on a Reg1 transition.

**Related instructions** `RegControl`

# Reg1HiPosition

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** Reg1HiPosition contains the latched value of the motor position (Position) when the Reg1 input (J4-10) captured its last low-to-high registration event.

**Syntax** `x = Reg1HiPosition`

Units resolver counts

Range

Default none

**Guidelines** Set Reg1HiFlag to 0 to arm the registration latch.

**Related instructions** `RegControl`

# Reg1LoEncpos

## (Pre-defined Variable, Integer, Read-Only)

**Purpose**

Reg1LoEncpos contains the latched value of the encoder counter (EncPos) when the Reg1 input (J4-10) captured its last high-to-low registration event.

**Note:** *RegControl must be set to 0 in order for Reg1LoEncpos to be latched.*

---

**Syntax**

```
x = Reg1LoEncpos
```

Units: encoder counts

Range:

Default: none

---

**Guidelines**

Set Reg1HiFlag to 0 to arm the registration latch.

**Related instructions**

`RegControl`

# Reg1LoFlag

## (Pre-defined Variable, Integer)

**Purpose**

Reg1LoFlag is used to arm and monitor the Reg1Lo registration data latches.

Set Reg1LoFlag to zero to arm the latches (i.e. prepare them to capture data at a registration transition). This flag will automatically be set to one when the hardware detects a high-to-low transition on Reg1 (J4-10).

---

**Syntax**

```
Reg1LoFlag = x
```

Units: none

Range: 0 or 1

Default: 0

---

**Guidelines**

RegControl determines what data gets latched on a Reg1 transition.

**Related instructions**

`RegControl`

# Reg1LoPosition

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** Reg1LoPosition contains the latched value of the motor position when the Reg1 input (J4-10) captured its last high-to-low registration event.

**Syntax** `x = Reg1LoPosition`

Units resolver counts

Range

Default none

**Guidelines** Set Reg1LoFlag to 0 to arm the registration latch.

**Related instructions** `RegControl`

# Reg2HiEncpos

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** Reg2HiEncpos contains the latched value of the encoder counter (EncPos) when the Reg2 input (J4-11) captured its last low-to-high registration event.

**Note:** *RegControl must be set to 1 in order for Reg2HiEncpos to be latched.*

---

**Syntax** `x = Reg2HiEncpos`

Units encoder counts

Range

Default none

---

**Guidelines** Set Reg2HiFlag to 0 to arm the registration latch.

**Related instructions** `RegControl`

# Reg2HiFlag

## (Pre-defined Variable, Integer)

**Purpose**

Reg2HiFlag is used to arm and monitor the Reg2Hi registration data latches.

Set Reg2HiFlag to zero to arm the latches (i.e. prepare them to capture data at a registration transition). This flag will automatically be set to one when the hardware detects a low-to-high transition on Reg2 (J4-11).

---

**Syntax** `Reg2HiFlag = x`

Units none

Range 0 or 1

Default 0

---

**Guidelines** RegControl determines what data gets latched on a Reg2 transition.

**Related instructions** `RegControl`

# Reg2HiPosition

## (Pre-defined Variable, Integer, Read-Only)

**Purpose**

Reg2HiPosition contains the latched value of the motor position (Position) when the Reg2 input (J4-11) captured its last low-to-high registration event.

**Note:** *RegControl must be set to 2 in order for Reg2HiPosition to be latched.*

---

**Syntax**

```
x = Reg2HiPosition
```

Units: resolver counts

Range:

Default: none

---

**Guidelines**

Set Reg2HiFlag to 0 to arm the registration latch.

**Related instructions**

`RegControl`

# Reg2LoEncpos

## (Pre-defined Variable, Integer, Read-Only)

**Purpose**

Reg2LoEncpos contains the latched value of the encoder counter (EncPos) when the Reg2 input (J4-11) captured its last high-to-low registration event.

**Note:** *RegControl must be set to 1 in order for Reg2LoEncpos to be latched.*

---

**Syntax**

```
x = Reg2LoEncpos
```

Units: encoder counts

Range:

Default: none

---

**Guidelines**

Set Reg2LoFlag to 0 to arm the registration latch.

**Related instructions**

`RegControl`

# Reg2LoFlag

## (Pre-defined Variable, Integer)

**Purpose**

Reg2LoFlag is used to arm and monitor the Reg2Lo registration data latches.

Set Reg2LoFlag to zero to arm the latches (i.e. prepare them to capture data at a registration transition). This flag will automatically be set to one when the hardware detects a high-to-low transition on Reg1 (J4-11).

---

**Syntax**

```
Reg2LoFlag = x
```

Units: none

Range: 0 or 1

Default: 0

---

**Guidelines**

RegControl determines what data gets latched on a Reg2 transition.

**Related instructions**

`RegControl`

# Reg2LoPosition

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** Reg2LoPosition contains the latched value of the motor position (Position) when the Reg2 input (J4-11) captured its last high-to-low registration event.

**Note:** *RegControl must be set to 2 in order for Reg2LoPosition to be latched.*

---

**Syntax** `x = Reg2LoPosition`

Units resolver counts

Range

Default none

---

**Guidelines** Set Reg2LoFlag to 0 to arm the registration latch.

**Related instructions** `RegControl`

# RegControl

## (Pre-defined Variable, Integer)

**Purpose**

RegControl controls what data (EncPos or Position) gets latched into the registration latches. Functionality is shown below:

| Value of RegControl | Functionality |
|---|---|
| 0 | Reg1 transitions capture Position and EncPos<br>Reg2 transitions are ignored |
| 1 | Reg1 transitions capture Position<br>Reg2 transitions capture EncPos |
| 2 | Reg1 transitions capture Position<br>Reg2 transitions capture Position |

**Syntax**

```
RegControl = x
```

Units: none

Range: 0, 1, 2

Default: 0

**Guidelines**

Set RegControl to the desired value before capturing any registration data.

BDIOMap4 must be set to 0 (off) if Reg1 is being used.

BDIOMap5 must be set to 0 (off) if Reg2 is being used.

**Related instructions**

`Reg1HiFlag, Reg1LoFlag, Reg2HiFlag, Reg2LoFlag`

# RemoteFB

## (Pre-defined Variable, Integer)

**Purpose** RemoteFB selects the source of the feedback signal for the loops.

**Syntax** `RemoteFB = x`

Units When RemoteFB is not equal to 0 the units on the following variables change as shown below:

| Variable Name | Units (RemoteFB = 1 or 2) | Units (RemoteFB = 0) |
|---|---|---|
| PosCommand | encoder counts | resolver counts |
| PosError | | |
| PosErrorMax | | |
| InPosLimit | | |
| IndexDist | | |
| TargetPos | | |
| Cwot | | |
| Ccwot | | |
| WhenPosCommand | | |
| RunSpeed | encoder counts/sec | rpm |
| AccelRate | encoder counts/sec/sec | rpm/sec |
| DecelRate | encoder counts/sec/sec | rpm/sec |

Range 0, 1, or 2

Default 0 (all loops closed around resolver)

## RemoteFB (continued)

**Guidelines**

0 Resolver velocity and resolver position feedback

1 Resolver velocity and encoder position feedback

2 Encoder velocity and encoder position feedback

When RemoteFB is not equal to 0, make sure EncIn is set to the proper value so that scaling of KPP, KVP, and VelFB will be in the default units.

When RemoteFB is equal to 1 or 2, Encpos becomes Read/Only and the variable Position becomes Read/Write. Use PosCommand to change the value of Encpos in this configuration.

RemoteFB is Read/Only when the drive is enabled. If you attempt to change the value of RemoteFB with the drive enabled it will be ignored.

# ResPos

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

| | |
|---|---|
| **Purpose** | ResPos (Resolver Position) is the absolute mechanical orientation of the resolver relative to the motor housing. |
| **Syntax** | `x = ResPos` |
| Units | Resolver Counts (1 Resolver count = 1/65536 rev) |
| Range | 0 to 65535 |
| **Guidelines** | Respos varies from zero to maximum range and then back to zero as the motor rotates positive through one complete revolution. |
| **Related instructions** | `PosPolarity` |

# Restart
## (Statement)

**Purpose**

Restart causes program execution to begin again from the beginning of the program. Restart is the only way to exit from an Error Handler routine. Any interrupts, WHEN statements or loops in progress will be aborted.

**Note:** *RESTART does not clear the user program variables or by itself change any program variables, any pre-defined variables or have any effect on motor motion.*

**Syntax**

```
Restart
```

**Guidelines**

If the RESTART statement is used to exit from a user error handler then an infinite loop will occur if the error condition is not cleared.

**Related instructions**

`AbortMotion, On Error Goto`

# Right$()
## (Function)

**Purpose**

Right$() returns a string of the n rightmost characters in a string expression.

**Syntax**

```
result$ = Right$(x$, n)
```

**Guidelines**

If n is greater than Len(x$) then the entire string will be returned.

**Related instructions**

`Len(), Mid$(), Left$()`

**Example**

```
a$ = "Mississippi"
print Right$(a$, 5)          'prints: sippi
```

# Rtrim$()
## (Function)

**Purpose** Returns a copy of the original string with trailing blanks removed.

**Syntax**

```
result$ = Rtrim$(x$)
```

**Guidelines** x$ can be any string-expression

**Related instructions** `Ltrim$(), Trim$()`

**Example**

```
x$ = "      Hello      "
print "(" + Rtrim$(x$) + ")"'prints: (     Hello)
```

# RunSpeed

## (Pre-defined Variable, Floating Point)

| | |
|---|---|
| **Purpose** | RunSpeed sets the maximum speed allowed during an incremental (GoIncr) or absolute (GoAbs) move, and sets the commanded speed during a velocity move (GoVel). |
| **Syntax** | `RunSpeed = x` |
| Units | RPM |
| Range | 0 to 20,000 (actual maximum is set by motor and drive) |
| Default | 1000 |
| **Guidelines** | Specify RunSpeed before initiating any move commands. |
| **Related instructions** | `GoAbs, GoHome, GoIncr, GoVel, UpdMove` |

# RuntimeParity

## (Pre-defined Variable)

**Purpose** This variable is used to specify the Runtime Parity. The valid values for RuntimeParity are:

| Value | Explanation |
|---|---|
| 0 | none (no parity) |
| 1 | odd parity |
| 2 | even parity |

**Syntax** `RuntimeParity = x`

Range 0, 1, 2

Default 0

# RuntimeProtocol

## (Pre-defined Variable)

**Purpose** RuntimeProtocol specifies the RuntimeProtocol. The valid values for RuntimeProtocol are:

| Value | Explanation |
|---|---|
| 0 | none |
| 1 | user-defined binary |
| 2 | Modbus Slave |
| 3 | Modbus Master |
| 4 | OC950 Protocol (allows communication with IDE) |
| 5 | Allen-Bradley DF1 Communications Protocol |

**Note:** *Modbus functionality (RuntimeProtocol = 2 or 3) and Allen-Bradley DF1 functionality (RuntimeProtocol = 5) are only available in the enhanced OC950 firmware.*

**IMPORTANT NOTE**

**When you set RuntimeProtocol to any value other than zero then Inp20 is automatically used to stop the user program. When Inp20 is brought low (0) then the program will stop. This is done because when a run-time protocol is in use it is impossible to stop the program over the serial port. This means that if you use RuntimeProtocol then neither Inp20 nor Out20 may be used in your program for any purpose other than stopping your program.**

---

**Syntax** `RuntimeProtocol = x`

Range 0, 1, 2, 3, 4

Default 0

# ScurveTime

## (Pre-defined Variable, Floating Point)

**Purpose**

ScurveTime sets the amount of S-curve smoothing that is applied to all velocity profiles. The greater the value of ScurveTime, the smoother (lower jerk) the profile.

---

**Syntax**

```
ScurveTime = x
```

Units

seconds

Range

0.000 to 0.256 seconds

(0.002, 0.004, 0.008, 0.016, 0.032, 0.064, 0.128, 0.256)

Default

0 (trapezoidal profile)

---

**Guidelines**

Specifying a non-zero value for ScurveTime will increase move time by ScurveTime. For example, a trapezoidal move (ScurveTime = 0) that takes 0.500 seconds to complete, will take 0.756 seconds to complete if ScurveTime is set to 0.256.

ScurveTime can only be changed when the motor is not moving (Moving = 0). If you attempt to change ScurveTime while the motor is moving, the command will be ignored.

**Related instructions**

`AccelRate, DecelRate`

## ScurveTime (continued)

**Example**

```
main
Enable = 1
AccelRate = 10000
Decel Rate = 10000
RunSpeed = 1000
IndexDist = 40960

‘time the move without S-curve
ScurveTime = 0
Time = 0
GoIncr
While Moving : Wend
Print Time

‘now time the move with S-curve
ScurveTime = 0.256
Time = 0
GoIncr
While Moving : Wend
Print Time
end main
```

# Select Case
## (Statement)

**Purpose**

Select Case executes one of several statement blocks depending upon the value of an expression.

**Syntax**

```
Select Case test-expression
   Case expression-list1
   ...statement block1...
   Case expression-list2
   ...statement block1...
   Case expression-list3
   ...statement block1...
   Case Else
   ...else block...
End Select
```

**Guidelines**

The test-expression must evaluate to a numeric or floating-point value.

There may be as many Cases in the Select Case statement as you want. There can only be one Case Else and it must be the last case in the sequence. The Case Else statement block is executed if all other tests fail.

Select Case statements where the expression-lists are integer constants are executed more more quickly at run-time.

**Related instructions**

`If...Then...Else`

## Select Case (continued)

**Example** This example prints out some interesting information about the numbers between 1 and 20.

```
main
dim x as integer
for x = 1 to 20
    print x;" is “;
    select case x
       case 1, 3, 5, 7, 9
          print ”Odd"
       case 4, 8
          print “4 or 8"
       case 12 to 18
          print ”between 12 and 18"
       case else
          print “other”
    end select
next
end main
```

# SendLANInterrupt( x) [n]

## (Pre-defined Function)

**Purpose**

SendLANInterrupt(x)[n] invokes PACLAN interrupt on axis n.

The value of x is passed along to the destination of the PACLAN interrupt and is automatically placed in the axis' LANIntrArg pre-defined variable.

**Syntax**

```
result = SendLANInterrupt(arg)[axis]
```

where n identifies the address of the destination of the interrupt.

The value returned in 'result' will be one of the following:

| | |
|---|---|
| 0 | destination received and accepted the interrupt (success!) |
| 1 | PACLAN transmit failure |
| 2 | transmit OK but no response |
| 3 | destination's LANInterrupt queue is full |
| 4 | destination doesn't have a PACLAN interrupt defined |
| 5 | destination is not running a program |
| 6 | destination is busy downloading a program |

**Guidelines**

Before issuing this statement in your program you should ensure that the destination axis is connected to the PACLAN and is running a program. Otherwise, a runtime error will be generated on the source axis.

The SendLANInterrupt()[ ] function differs from LANInterrupt[ ] in two ways:

- It always returns a value indicating whether or not the signal was received by the destination axis. The LANInterrupt statement will fault the drive if the destination cannot accept the signal.
- The SendLANInterrupt()[] function can send a specific argument along with the interrupt signal. For the LANInterrupt[] statement, the argument value is always 0.

## SendLANInterrupt( x) [n] (continued)

**Related instructions**

`LANIntrArg, LANIntrSource, Interrupt, Status`

**Example**

The following example shows two main programs — one for axis 128, and one for axis 255. The program on axis 255 repeatedly sends a LAN interrupt signal to axis 128 with a sequence count as the argument. The program on axis 128 prints the count, the argument received and the address of the sending axis and the increments its count.

```
'——————— axis 255 ————————-
main
dim count as integer
while 1
    print SendLANInterrupt(count)[128]
    count=count+1
    pause(0.5)
wend
end main
```

## SendLANInterrupt( x) [n] (continued)

```
'------- axis 128 --------
main
IntrPACLAN = 1
while 1 : wend
end main

Interrupt PACLAN
    static count as integer
    print "Count:",count
    print "Arg:", LANIntrArg
    print "Source:",LANIntrSource
    print "^^^^^^^^^^^^^^^^^^^^^^^^^"
end interrupt
```

# SetMotor()

## Function

**Purpose**

SetMotor() specifies the motor Back EMF waveshaping to be used by the OC950.

**Syntax**

```
SetMotor(string-expression)
```

**Guidelines**

When you specify a motor name with the SetMotor() function, the OC950 looks up that name to see if it has a custom waveshape for that motor. If it does, then it uses this Back EMF waveshape for Signature Series waveshaping. If it does not find the motor name, then it uses a sine-wave for Back EMF waveshaping.

**Related instructions**

`GetMotor$`

**Example**

```
SetMotor("R32G")
Print GetMotor$
```

# Sgn()
## (Function)

**Purpose** Sgn() returns the sign of a numeric expression.

**Syntax**

```
result = Sgn(x)
if:
x < 0 returns -1
x = 0 returns 0
x > 0 returns 1
```

**Guidelines** x is any numeric expression

Not to be confused with the trig function Sin().

**Example**

```
print sgn(-33)          'prints -1
print sgn(0)            'prints 0
print sgn(45.77)        'prints 1
```

# SHL

## (Left Shift Operator)

**Purpose** Left Shift Operator

**Syntax**

```
result = operand1 SHL operand2
```

**Guidelines** This operator performs a left shift by operand2 places of operand1. This is equivalent to multiplying operand1 by 2 operand2 number of times.

# SHRA

## (Arithmetic Right Shift Operator)

**Purpose** Arithmetic Right Shift Operator

**Syntax**

```
result = operand1 SHRA operand2
```

**Guidelines** This operator performs an arithmetic right shift of operand1 by operand2 number of places. This is equivalent to dividing operand1 by 2 operand2 number of times.

# SHRL

## (Logical Right Shift Operator)

**Purpose** Logical Right Shift Shift Operator

**Syntax**

```
result = operand1 SHRL operand2
```

**Guidelines** This operator performs a logical right shift of operand1 by operand2 number of places. In a logical right shift zeros are shifted in from the left.

# Sin()
## (Function)

**Purpose** Sin(x) returns the sine of x, where x is in radians.

**Syntax**

```
y = Sin(x)
```

**Guidelines** x must be in radians. To convert from degrees to radians, multiply by 0.017453.

# Space$()
## (Function)

**Purpose**

Space$() returns a string of n spaces.

**Syntax**

```
result$ = Space$(n)
```

n is 0 to 255

**Guidelines**

n is rounded to an integer before Space$() is evaluated.

**Related instructions**

`String$()`

**Example**

```
x$ = "(" + Space$(2) + "hello" + Space$(6) + ")"
print x$                          prints: (  hello      )
```

# Sqr()
## (Function)

**Purpose** Sqr() returns the square root of a numeric expression.

**Syntax**

```
result = Sqr(x)
```

**Guidelines** x must be greater than or equal to zero.

**Example**

```
x = 10
print Sqr(x)                    'prints: 3.162278
```

# Static
## (Statement)

**Purpose**

Used for declaring variables before use. All variables (except pre-defined variables) must be declared before they can be used.

The Static statement is used in a Function, Sub or Interrupt to specify that the specified variable's value be remembered even when the Function or Sub is finished. The next time that the Function, Sub or Interrupt is executed, the value will be available.

**Syntax**

```
Static var1 [, var2 [...]] as type
```

where *type* is:

| | |
|---|---|
| INTEGER | 32 bit integer |
| FLOAT | IEEE single precision float |
| STRING | default length is 32 characters |

**Guidelines**

The default length for strings is 32 characters. This default can be overridden by following the STRING type designator with a * (see example).

**Related instructions**

`Dim, Sub, Function, Interrupt`

## Static (continued)

**Example** This example illustrates the difference between using Dim and Static in a Sub procedure. 'x' always gets reset to zero, while 'y' continually gets incremented.

```
main
    while 1
       call MySub
       pause(1)
    wend
end main

sub MySub
    dim x as integer          'value is forgotten
    static y as integer       'value is remembered
       x = x + 1
       y = y + 1
       print x,y
end sub
```

# Status

## (Pre-defined Variable)

**Purpose**

Status[axis] can be used over PACLAN to determine if a particular axis is connected to the PACLAN and whether or not that axis is presently running a program.

**Syntax**

```
x = Status[n]
```

where n is the address of the axis that you are interested in.

Status returns the following values:

0 axis is not connected to PACLAN

1 axis is connected but not running a program

3 axis is connected and is running a program

**Guidelines**

You can look at your own status variable without using the [ ] axis specifier, but why would you?

**Example**

This example checks all 255 possible axis addresses and prints out a message for every axis that is connected to the PACLAN.

```
main
dim x as integer
for x = 1 to 255
    if Status[x] = 1 then
       print “Axis”;x;" is connected."
    elseif Status[x] = 3 then
       print “Axis”;x;" is running a program."
    endif
next
end main
```

# Stop
## (Statement)

**Purpose** Stops execution of the user program.

**Syntax**

```
Stop
```

**Guidelines** When the user program stops the OC950 goes back to message mode, waiting for a command over the communications link.

**Related instructions** `AbortMotion`

# Str$()
## (Function)

**Purpose**

Str$() returns a string representing the value of a numeric expression.

**Syntax**

```
result$ = Str$(x)
```

**Related instructions**

```
Hex$(), Oct$()
```

**Example**

```
x = 45.2 / 7
print str$(x)                    ‘ prints 6.457
```

# String$()
## (Function)

**Purpose**

String$() returns a string containing the specified number of occurrences of the specified character.

**Syntax**

```
x$ = String$(n, a$)                [1]

or

x$ = String$(n, m)                 [2]
```

**Guidelines**

n is the number of occurrences of the desired character (the length of the returned string).

In [1], the returned string will consist of the first character in a$.

In [2], the returned string will consist of the ASCII value of m.

**Related instructions**

`Space$()`

**Example**

```
Print String$(5, 45)
                                   'prints: ——-
Print String$(5, "A")              'prints: AAAAA
```

# Sub...End Sub
## (Statement)

**Purpose**

The Sub statement declares a sub procedure and defines the sub procedures format.

**Syntax**

```
Sub [argument-list]

...body of the sub-procedure...

End Sub
```

**Guidelines**

A sub procedure is invoked with the Call statement. A sub-procedure can accept arguments like a function but does not return any value. If the sub-procedure does not take any arguments, then it is illegal to provide an empty argument-list (“”) either when defining the sub-procedure or when calling it.

**Related instructions**

`Call, Function, Exit, End`

## Sub...End Sub (continued)

**Example** This example defines a sub-procedure that takes one integer argument.

```
main
    dim x as integer
    for x = 1 to 10
       call MySub(x)
       pause(1)
    next
end main

sub MySub(a as integer)
    print a;"--> ";
    if a < = 5 then
       print a * 0.5
    else
       print a * 2.0
    end if
end sub
```

# Swap
## (Statement)

**Purpose** Swap exchanges the value of two variables.

**Syntax**

```
Swap x, y
```

**Guidelines** The two variables must be both numeric (floating point of integer) or both strings.

**Example**

```
dim A$, B$ as string
A$ = “Hello”
B$ = “Good-bye”
print A$, B$
Swap A$, B$
print A$, B$
```

# SysLanWindow1-8

## (Pre-defined Variable)

**Purpose** These variables provide advanced troubleshooting information about the ARCNET network.

| SysLanWindowX | Description |
|---|---|
| SysLanWindow1 | Number of Messages initiated by this node. |
| SysLanWindow2 | Number of messages processed by this node. |
| SysLanWindow3 | Number of broadcast messages initiated by this node. |
| SysLanWindow4 | Number of broadcast messages processed by this node. |
| SysLanWindow5 | Number of times we couldn't send a response to a message. |
| SysLanWindow6 | Number of unexpected response we have received. |
| SysLanWindow7 | Number of messages lost due to receiver overflow. |
| SysLanWindow8 | Number of network reconfigurations. |

# Tan()
## (Function)

**Purpose** Tan(x) returns the tangent of x, where x is in radians.

**Syntax**

```
y = Tan(x)
```

**Guidelines** x must be in radians. To convert from degrees to radians, multiply by 0.017453.

# TargetPos

## (Pre-defined Variable, Integer)

| | |
|---|---|
| **Purpose** | TargetPos specifies the target position for an absolute (GoAbs) move. TargetPos is an absolute position referenced to the electrical home position (the position where PosCommand = 0). |
| **Syntax** | `TargetPos = x` |
| Units | resolver counts |
| Range | |
| Default | 0 |
| **Guidelines** | Set TargetPos before initiating a GoAbs. |
| **Related instructions** | `GoAbs` |

# Time

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** Time contains the value of the free-running 32 bit timer that is maintained by the internal firmware on the OC950. The resolution on this timer is 1 millisecond.

**Syntax** `Time = x`

Units seconds

Range 0 to -2,147,483 (~24.8 days)

**Guidelines** The Time variable is set to zero when the SC950 is powered on.

**Related instructions** `WhenTime`

# Trim$()
## (Function)

**Purpose**

Trim$() returns a copy of the original string with leading and trailing blanks removed.

**Syntax**

```
result$ = Trim$(x$)
```

**Guidelines**

x$ can be any string-expression

**Related instructions**

`Ltrim$(), Rtrim$()`

**Example**

```
x$ = "      Hello      "
print "("+ Trim$(x$) +")"     'prints: (Hello)
```

# Ucase$()

## (Function)

**Purpose**

Ucase$() converts a string expression to uppercase characters.

**Syntax**

```
result$ = Ucase$(string-expression)
```

**Guidelines**

Ucase$() affects only letters in the string expression. Other characters (such as numbers) are not changed.

**Related instructions**

`Lcase$( )`

**Example**

```
dim x$ as string
x$ = "u.s.a"
print Ucase$(x$)                ‘prints: U.S.A
```

# UpdMove
## (Statement)

**Purpose**

UpdMove (Update Move parameters) updates a move that is in progress with new move parameters. This allows you to change motion "on the fly" without having to stop motion and initiate a new move.

UpdMove updates AccelRate, DecelRate, Dir, and RunSpeed.

**Syntax**

```
UpdMove
```

**Guidelines**

Program execution continues with the line immediately following the UpdMove statement as soon as the move is initiated. Program execution does not wait until the move is complete.

The drive must be enabled in order for any motion to take place.

UpdMove will not initiate motion if there is not a move in progress. The UpdMove statement will be ignored.

**Related instructions**

`AbortMotion, GoAbs, GoHome, GoIncr`

# Val()
## (Function)

**Purpose** Val() returns the numerical value of a string.

**Syntax**

```
result = Val(a$)
```

**Guidelines** If the first character of a$ is not numeric then Val() will return 0.

**Related instructions** `Str$()`

# VBus

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** VBus is the voltage of the high voltage dc supply, rectified from the AC line, used to power the motor.

**Syntax** `x = VBus`

Units Volts

Range 0 to 1,000

**Guidelines** Monitoring this variable can be used to detect the presence of the AC line power for the motor DC supply.

For 115 Vac line power the Bus is nominally 160 Vdc.

For 240 Vac line power the Bus is nominally 330 Vdc.

For 480 Vac line power the Bus is nominally 670 Vdc.

# VBusThresh

## (Pre-defined Variable, Float)

**Purpose** VBusThresh is an adjustable parameter to allow the drive to fault if the AC line power for the motor DC supply is low.

**Syntax** `VBusThresh = x`

Units Volts

Range -1 to +1000

Default -1 (fault is disabled).

**Guidelines** When VBus < VBusThresh, the drive will fault and display a blinking "E 1." This functionality allows the drive to have an interlock so that it will not try to move the motor unless there is sufficient motor bus voltage.

VBusThresh = 255 is a good value to detect a 230 Vac line more than 15% low.

**Note:** *A value of -1 disables the Bus Under Voltage Fault ("E 1").*

# VelCmd

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** VelCMd is the net desired velocity loop command input.

**Syntax** `x = VelCmd`

Units RPM

Range VelLmtLo to VelLmtHi (-21,000 to +21,000)

Default

**Related instructions** `VelLmtHi, VelLmtLo`

# VelErr

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** VelErr is commanded velocity - measured velocity (VelCmd - VelFB).

**Syntax** `x = VelErr`

Units RPM

Range -48,000 to +48,000

# VelFB

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** VelFB is the instantaneous value of the velocity feedback.

**Syntax** `x = VelFB`

Units RPM

Range -48,000 to +48,000 for resolver

-30,000 to +30,000 for encoder

Default none

**Guidelines** For normal operation, RemoteFB = 0 or 1, VelFB is the resolver velocity. For RemoteFB = 2, VelFB is based on delta EncPos at a position loop update rate.

# VelLmtHi

## (Pre-defined Variable, Float)

**Purpose** VelLmtHi sets the highest VelCmd value allowed and a VelFB overspeed fault threshold.

**Syntax** `VelLmtHi = x`

Units RPM

Range -21,039 to +21,039

Default 10,000

**Guidelines** For BlkTypes that have a velocity loop (BlkType = 1, 2), VelCmd and VelCmd2 are clamped to be less than VelLmtHi. In torque control, BlkType (0), VelLmtHi has no clamping function. If VelLmtHi is reduced to below the current value of VelCmd2 or VelCmd, then VelCmd2 and/or VelCmd are reduced to VelLmtLo.

For all BlkTypes, a fault with FaultCode = 1 will occur if

$$|\text{VelFb}| > 1.5 * \max \text{ of } (|\text{VelLmtLo}|, |\text{VelLmtHi}|)$$

**Related instructions** `VelLmtLo`

# VelLmtLo

## (Pre-defined Variable, Float)

**Purpose** VelLmtLo sets the smallest VelCmd value allowed and a VelFB overspeed fault threshold.

**Syntax** `VelLmtLo = x`

Units RPM

Range -21,039 to +21,039

Default -10,000

**Guidelines** For BlkTypes that have a velocity loop (BlkType = 1, 2), VelCmd and VelCmd2 are clamped to be greater than VelLmtLo. In torque control, BlkType (0), VelLmtLo has no clamping function. If VelLmtLo is increased to above the current value of VelCmd2 or VelCmd, then VelCmd2 and/or VelCmd are increased to VelLmtLo.

For all BlkTypes, a fault with FaultCode = 1 will occur if

$$|\text{VelFb}| > 1.5 * \max \text{ of } \left(|\text{VelLmtLo}|, |\text{VelLmtHi}|\right)$$

**Related instructions** `VelLmtHi`

# Velocity

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** Velocity is VelFB passed through a 3.5 Hz low pass filter.

**Syntax** `x = Velocity`

Units RPM

Range -30,000 to +30,000

**Guidelines** When the measured velocity exceeds Velocity's range, Velocity's value will be incorrect. See VelFB for and instantaneous indication of measured velocity that is accurate to higher speeds.

# vmDir

## (Pre-defined Variable, Integer)

**Purpose** vmDir specifies the direction that the virutal encoder will go when a vmGoVel statement is executed. It will also set the direction of the virtual encoder when a vmUpdMove is executed if the virtual encoder is performing a velocity move.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

---

**Syntax** `vmDir = x`

Range 0, 1

Default 0

---

**Guidelines** 0 is positive

1 is negative

**Related instructions** `vmRunFreq, vmGoVel`

---

**Example** ‘This will run the virtual encoder forward at 20,000 counts/sec

```
vmRunFreq = 20000
vmDir = 0
vmGovel
pause(5)
```

This will run the virtual encoder backwards at 40,000 counts/sec

```
vmRunFreq = 40000
vmDir = 1
vmGoVel
```

# vmEncpos

## (Pre-defined Variable, Integer)

**Purpose**

vmEncpos contains the current value of the virtual encoder counter. The virtual encoder is controlled using vmGoVel and vmGoIncr.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
vmEncpos = x
```

Units

counts

Range

0 to (EncposModulo-1)

**Guidelines**

EncPosModulo is used as the modulo value for vmEncpos.

**Related instructions**

`vmGoIncr, vmGoVel, vmMoving`

**Example**

This example shows how vmEncpos is updated during a vmGoIncr move.

```
vmRunFreq    = 10000
vmIndexDist = 100000
Time = 0
EncposModulo = 200000
vmEncpos = 0
vmGoIncr
while Time < 12
  Print “Time = ”;Time,"vmEncpos =
“;vmEncpos,”vmMoving = “;vmMoving
  Pause(1)
wend
```

# vmGoIncr
## (Statement)

**Purpose**

vmGoIncr (Go Incremental) causes the virtual master to move a distance specified by vmIndexDist.

The virtual master runs at the frequency specified by vmRunFreq. This frequency may be modified during the move by using the vmUpdMove statement.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
vmGoIncr
```

**Guidelines**

Program execution continues with the line immediately following the vmGoIncr statement as soon as the move is initiated. Program execution does not wait until the move is complete.

The drive does not need to be enabled in order for to use the virtual master.

**Related instructions**

`vmGoVel , vmStopMotion, vmUpdMove`

## vmGoIncr (continued)

**Example** This example moves the virtual encoder 100,000 counts at a frequency of 20,000 counts/second. This move will take abount 5 seconds.

```
'set up vmEncpos and virtual move parameters
vmEncpos     = 0
vmRunFreq    = 20000
vmIndexDist = 100000
'initiate the move

time = 0
'set time to zero just for measurement
vmGoIncr

'wait for the move to be complete

while vmMoving = 1 : wend
'print the results

print "vmEncpos = ";vmEncpos
print "time      = ";time
```

# vmGoVel
## (Statement)

**Purpose**

vmGoVel (Go at Velocity) causes the virtual master to move continuously at the frequency specified by vmRunFreq in the direction (positive or negative) specified by vmDir. The frequency may be modified during the move by using the vmUpdMove statement.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
vmGoVel
```

**Guidelines**

Program execution continues with the line immediately following the vmGoVel statement as soon as the move is initiated. Program execution does not wait until the move is complete.

You can stop a velocity move on the virtual encoder by using the vmStopMotion statement.

Executing a vmGoIncr statement after executing a vmGoVel (and before a vmStopMotion) will cause the virtual encoder to switch over to an incremental move which will terminate when vmIndexDist encoder counts have been put out.

The drive does not need to be enabled in order for to use the virtual master.

**Related instructions**

```
vmGoIncr , vmStopMotion, vmUpdMove
```

**Example**

This will run the virtual encoder forward at 20,000 counts/sec

```
vmRunFreq = 20000
vmDir = 0
vmGovel
```

# vmMoving

## (Pre-defined Variable, Integer, Read-Only)

**Purpose** vmMoving indicates whether or not the virtual encoder is moving.

0 - virtual encoder is not moving

1 - virtual encoder is moving

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

---

**Syntax**

```
x = vmMoving
```

Range 0, 1

---

**Guidelines**

**Related instructions** `vmGoVel, vmGoIncr`

---

**Example**

```
'Start an incremental move on the virtual encoder
vmRunFreq    = 10000
vmIndexDist = 123456
vmGoIncr

time = 0
while vmMoving : wend
print time
```

# vmRunFreq

## (Pre-defined Variable, Floating point)

**Purpose** vmRunFreq sets the maximum frequency allowed during an incremental (vmGoIncr) move, and sets the commanded speed during a velocity move (vmGoVel).

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

---

**Syntax** `vmRunFreq = x`

Units encoder counts/second

Range 0 - 1,000,000

Default 10,000

---

**Guidelines** The resolution of vmRunFreq is 1,000 counts/second

**Related instructions** `vmGoVel, vmDir, vmGoIncr, vmIndexDist`

---

**Example**

```
'This will run the virtual encoder forward at 20,000 counts/sec
vmRunFreq = 20000
vmDir     = 0
vmGovel
```

# vmStopMotion

## (Statement)

**Purpose**

vmStopMotion stops the virtual encoder. vmEncpos will stay at it's present value.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
vmStopMotion
```

**Guidelines**

Program execution continues with the line immediately following the vmStopMotion statement as soon as the move is initiated. Program execution does not wait until the move is complete.

**Related instructions**

`vmGoIncr, vmGoVel, vmUpdMove`

**Example**

This will run the virtual encoder forward at 20,000 counts/sec for 5 seconds and the stop it.

```
vmRunFreq = 20000
vmDir = 0
vmGovel

pause(5)
vmStopMotion
```

# vmUpdMove
## (Statement)

**Purpose**

vmUpdMove (Update Virtual Encoder Move paramaters) updates a move that is in progress with new move parameters. This allows you to change motion "on the fly" without having to stop motion and initiate a new move.

vmUpdMove updates vmDir and vmRunFreq.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
vmUpdMove
```

**Guidelines**

Program execution continues with the line immediately following the vmUpdMove statement as soon as the move is initiated. Program execution does not wait until the move is complete.

vmUpdMove will not initiate motion if there is not a move in progress. The vmUpdMove statement will be ignored.

**Related instructions**

`vmGoIncr, vmGoVel`

## vmUpdMove (continued)

**Example** This example will initiate an incremental move of 100,000 counts at 50,000 counts/sec. After 1 second, it will change the move speed to 10,000 counts/sec and update the move parameters.

```
' set up the initial parameters and initiate the
move
vmRunFreq = 50000
vmIndexDist = 100000


time = 0
vmGoIncr


'pause 1 second and then update the frequency


pause(1)
vmRunFreq = 10000
vmUpdMove


'wait for the move to be complete and print out the
elapsed time


while vmMoving : wend
print time
```

# When
## (Statement)

**Purpose**

The WHEN statement is used for very fast response to certain input conditions. Upon encountering and executing the WHEN statement, program execution waits until the specified condition is satisfied. When the condition is satisfied, the when-action is executed immediately and the program continues at the next line after the WHEN statement.

Interrupts are active and will be serviced during the execution of a WHEN statement. The execution of an interrupt service routine will not affect how quickly the when-action is executed after the when-condition is satisfied.

**Syntax**

```
When when-condition , when-action
```

when-conditions:

- INP0 - INP20 = 0,1
- BDINP1 - BDINP6 = 0,1
- Position < value
- Position > value
- EncPos < value
- EncPos > value
- PosCommand < value
- PosCommand > value
- Time > value
- Reg1HiFlag
- Reg1LoFlag
- Reg2HiFlag
- Reg2LoFlag

## When (continued)

when-actions:

- AbortMotion
- Continue
- GoAbs
- GoHome
- GoIncr
- GoVel
- Out0 - Out20 = 0,1
- Ratio = value
- UpdMove

**Guidelines**

The When condition is checked every 1 millisecond. At the instant (within 1 msec) that the when-condition is satisfied, the values of the following variables are strobed into special when variables:

- Encpos—WhenEncPos
- PosCommand—WhenPosCommand
- Position—WhenPosition
- ResPos—WhenResPos
- Time—WhenTime

**Related instructions**

`WhenEncPos, WhenPosCommand, WhenPosition, WhenResPos, WhenTime`

**Example**

```
When Inp0 = 1, continue
    ...
When EncPos > 10000, Out3=1
    ...
When Time > 5.6, Ratio = -2.2
```

# WhenEncPos

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** WhenEncPos records the value of EncPos when the WHEN condition is satisfied.

**Syntax** `x = WhenEncPos`

Units encoder counts

Range -2,147,483,648 to 2,147,483,647

**Related instructions** `When Statement, EncPos`

# WhenPosCommand

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** WhenPosCommand records the value of PosCommand when the WHEN condition is satisfied.

**Syntax** `x = WhenPosCommand`

Units resolver counts

Range -134,217,728 to 134,217,727

**Guidelines** The WHEN condition is checked once per millisecond.

**Related instructions** `When Statement, PosCommand`

# WhenPosition

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** WhenPosition records the value of Position when the WHEN condition is satisfied.

**Syntax** `x = WhenPosition`

Units resolver counts

Range -134,217,728 to 134,217,727

**Guidelines** The WHEN condition is checked once per millisecond.

**Related instructions** `When Statement, Position`

# WhenRespos

## (Pre-defined Variable, Integer, Status Variable, Read-Only)

**Purpose** WhenRespos records the value of Respos when the WHEN condition is satisfied.

**Syntax** `x = WhenRespos`

Units resolver counts

Range 0 - CountsPerRev

**Guidelines** The WHEN condition is checked once per millisecond.

**Related instructions** `When Statement, Respos`

# WhenTime

## (Pre-defined Variable, Float, Status Variable, Read-Only)

**Purpose** WhenTime records the value of Time when the WHEN condition is satisfied.

**Syntax** `x = WhenTime`

Units seconds

Range 0 - 2,147,483 (~24.8 days)

**Guidelines** The WHEN condition is checked once per millisecond.

**Related instructions** `When Statement, Time`

# While...Wend

## (Statement)

**Purpose**

Executes a series of statements for as long as the condition after the WHILE is True.

**Syntax**

```
While condition
...statement block...
Wend
```

**Guidelines**

While...Wend statements may be nested. Each Wend is matched to the most recent While. Unmatched While or Wend statements cause compile time errors.

**Related instructions**

`Exit, For...Next`

**Example**

```
Time = 0
While Time < 5
    Dir = Inp0 : GoVel
Wend
AbortMotion
```

# WritePLC5Binary( )

## (Statement)

**Purpose**

WritePLC5Binary( ) writes the specified (16 bit) element to the specified binary file on the specified PLC5.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the SLC500 connected to the OC950's serial port and wait for an acknowledgement (ACK). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
WritePLC5Binary(node address, file number, element
number, value)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1 Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadPLC5Integer, ReadPLC5Binary, ReadPLC5Float, WritePLC5Integer, WriteSLC5Float`

## WritePLC5Binary( )(continued)

**Example** The following program writes an integer to the PLC5 binary file. Note that all communication settings on both devices (SC950 and PLC5) must match.

```
main
dim PLC5Speed as integer


runtimeprotocol = 5              'Allen-Bradley DF1 protocol
baudrate = 19200                 'baudrate MUST match PLC
                                  setting
abcrc = 1                        'Set check to CRC — MUST
                                  match PLC setting
PLC5Speed = 1234
WritePLC5Binary(5, 3, 19, PLC5Speed)
                                 'PLC5 File 3 = Binary File
end
```

# WritePLC5Float( )

## (Statement)

**Purpose**

WritePLC5Float( ) writes the specified (32 bit) element to the specified float file on the specified PLC5.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the SLC500 connected to the OC950's serial port and wait for an acknowledgement (ACK). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
WritePLC5Float(node address, file number, element
number, value)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1 Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadPLC5Integer, ReadPLC5Binary, ReadPLC5Float, WritePLC5Integer , WritePLC5Binary`

## WritePLC5Float( ) (continued)

**Example** The following program writes a float to the PLC5 binary file. Note that all communication settings on both devices (SC950 and PLC5) must match.

```
main
dim PLC5Speed as float


runtimeprotocol = 5              'Allen-Bradley DF1 protocol
baudrate = 19200                 'baudrate MUST match PLC
                                  setting
abcrc = 1                        'Set check to CRC — MUST
                                  match PLC setting
PLC5Speed = 345.678
WritePLC5Float(5, 8, 19, PLC5Speed)
                                 'PLC5 File 8 = Float File
end
```

# WritePLC5Integer( )

## (Statement)

**Purpose**

WritePLC5Integer( ) writes the specified (16 bit) element to the specified integer file on the specified PLC5.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the SLC500 connected to the OC950's serial port and wait for an acknowledgement (ACK). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
WritePLC5Integer(node address, file number, element
number, value)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadPLC5Integer, ReadPLC5Binary, ReadPLC5Float, WritePLC5Binary, WriteSLC5Float`

## WritePLC5Integer( ) (continued)

**Example** The following program writes an integer to the PLC5. Note that all communication settings on both devices (SC950 and PLC5) must match.

```
main
dim PLC5Speed as integer


runtimeprotocol = 5              'Allen-Bradley DF1 protocol
baudrate = 19200                 'baudrate MUST match PLC
                                  setting
abcrc = 1                        'Set check to CRC — MUST
                                  match PLC setting
PLC5Speed = 1234
WritePLC5Integer(5, 7, 19, PLC5Speed)
                                 'PLC5 File 7 = Integer File
end
```

# WriteSLC5Binary( )

## (Statement)

**Purpose**

WriteSLC5Binary( ) writes the specified (16 bit) element to the specified binary file on the specified SLC500.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the SLC500 connected to the OC950's serial port and wait for an acknowledgement (ACK). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
WriteSLC5Binary(node address, file number, element
number, value)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadSLC5Binary, ReadSLC5Float, WriteSLC5Integer, ReadSLC5Integer, WriteSLC5Float`

## WriteSLC5Binary( ) (continued)

**Example** The following program writes an integer to the SLC500 PLC Binary file. Note that all communication settings on both devices (SC950 and SLC500) must match.

```
main
dim SLC5Speed as integer


runtimeprotocol = 5              'Allen-Bradley DF1 protocol
baudrate = 19200                 'baudrate MUST match PLC
                                  setting
abcrc = 1                        'Set check to CRC — MUST
                                  match PLC setting
SLC5Speed = 1234
WriteSLC5Binary(5, 3, 19, SLC5Speed)
                                 'SLC500 File 3 = Binary File
end
```

# WriteSLC5Float( )

## (Statement)

**Purpose**

WriteSLC5Float( ) writes the specified (32 bit) element to the specified float file on the specified SLC500.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the SLC500 connected to the OC950's serial port and wait for an acknowledgement (ACK). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
WriteSLC5Float(node address, file number, element
number, value)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1 Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadSLC5Binary, ReadSLC5Float, WriteSLC5Integer, ReadSLC5Integer, WriteSLC5Binary`

## WriteSLC5Float( ) (continued)

**Example** The following program writes a float to the SLC500 PLC float file. Note that all communication settings on both devices (SC950 and SLC500) must match.

```
main
dim SLC5Speed as float


runtimeprotocol = 5              'Allen-Bradley DF1 protocol
baudrate = 19200                 'baudrate MUST match PLC
                                  setting
abcrc = 1                        'Set check to CRC — MUST
                                  match PLC setting
SLC5Speed = 456.789
WriteSLC5Float(5, 8, 19, SLC5Speed)
                                 'SLC500 File 8 = Float File
end
```

# WriteSLC5Integer( )

## (Statement)

**Purpose**

WriteSLC5Integer( ) writes the specified (16 bit) element to the specified integer file on the specified SLC500.

When this function is encountered in the OC950 program, the OC950 will send the appropriate message to the SLC500 connected to the OC950's serial port and wait for an acknowledgement (ACK). If there is no valid response then the OC950 will set the status variable ABErr appropriately.

**Note:** *This feature is only available in the Enhanced OC950 Firmware*.

**Syntax**

```
WriteSLC5Integer(node address, file number, element
number, value)
```

**Guidelines**

You must first set RuntimeProtocol to 5 (Allen-Bradley DF1Protocol) before using this function. Other communication parameters (baudrate and ABCrc) on the SC950 must match the corresponding parameters on the PLC.

**Related instructions**

`ReadSLC5Binary, ReadSLC5Float, WriteSLC5Binary, ReadSLC5Integer, WriteSLC5Float`

## WriteSLC5Integer( ) (continued)

**Example** The following program writes an integer to the SLC500 PLC. Note that all communication settings on both devices (SC950 and SLC500) must match.

```
main
dim SLC5Speed as integer


runtimeprotocol = 5            'Allen-Bradley DF1 protocol
baudrate = 19200               'baudrate MUST match PLC
                               setting
abcrc = 1                      'Set check to CRC — MUST
                                match PLC setting
SLC5Speed = 1234
WriteSLC5Integer(5, 7, 19, SLC5Speed)
                               'SLC500 File 7 = Integer File
end
```

# Xor
## (Operator)

**Purpose**

Xor performs a logical XOR operation on two expressions.

**Syntax**

```
result = A xor B
```

**Guidelines**

The result evaluates to True if, and only if, one of the boolean expressions is True and the other boolean expression is False.

Otherwise, the result is False.

**Related instructions**

`Or, Xor, Band, Bor, Bxor`

**Example**

```
x = 17
y = 27
if (x > 20) Xor (y > 20) then
    print “This will get printed.”
end if

if (x < 20) And (y > 20) then
    print “This won’t get printed.”
end if
```

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# Appendix A
# Operating at 9600 Baud

**Procedure**

To set up your OC950 to operate at 9600 Baud, follow these steps:

1. Verify that the Firmware version is 1.2 or greater. Select **Variables** in the **Compile** menu, type **FWV** in the Variables/expression box and press **<Enter>**. The current value should be 1200 or greater.
2. Establish communications with the OC950 at 19200 baud. Type **BaudRate** in the Variables/expresion box and press **<Enter>**. The current value should be 19200.
3. **<Tab>** to the New Value box and type **9600** and press **<Enter>**. A warning message will appear indicating that the Target (the OC950) is not responding. Click on **<OK>** to clear this error window.
4. Close the Variables Window.
5. Select **Communications** in the **Options** Menu. In the Communications Options Window, select **9600** baud and click on **<OK>**.
6. Return to the Variables Window, by selecting **Variables** in the **Compile** Menu, and verify that BaudRate is set to 9600.

The OC950 and the 950IDE will now both communicate at the new baud rate.

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