18. Macro Reference

This chapter describes the syntax, programming methods and usage of macro commands.

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18.1. Overview

Macros provide the additional functionality your application may need. Macros are automated sequences of commands that are executed at run-time. Macros allow you to perform tasks such as complex scaling operations, string handling, and user interactions with your projects. This chapter describes syntax, usage, and programming methods of macro commands.

18.2. Instructions to use the Macro Editor

Macro editor provides the following functions:
- Display line number
- Undo / Redo
- Cut / Copy / Paste
- Select All
- Toggle Bookmark / Previous Bookmark / Next Bookmark / Clear All Bookmarks
- Toggle All Outlining
- Security -> Use execution condition
- Periodical execution
- Execute one time when HMI starts

The instructions in the following part show you how to use these functions.

1. Open the macro editor; you’ll see the line numbers displayed on the left-hand side of the edit area.
2. Right click on the edit area to open the pop-up menu as shown in the following figure. Disabled operations are colored grey, which indicates that it is not possible to use that function in the current status of the editor. For example, you should select some text to enable the copy function, otherwise it will be disabled. Keyboard shortcuts are also shown.

3. The toolbar provides [Undo], [Redo], [Cut], [Copy], [Paste], [Toggle Bookmark], [Next Bookmark], [Previous Bookmark] and [Clear All Bookmarks] buttons.

4. Any modification will enable the [Undo] function. [Redo] function will be enabled after the undo action is used. To perform the undo/redo, right click to select the item or use the keyboard shortcuts. (Undo: Ctrl+Z, Redo: Ctrl+Y).
5. Select a word in the editor to enable the [Cut] and [Copy] function. After [Cut] or [Copy] is performed, [Paste] function is enabled.

6. Use [Select All] to include all the content in the edit area.

7. If the macro is too long, use bookmarks to manage and read the code with ease. The following illustration shows how it works.
   - Move your cursor to the position in the edit area where to insert a bookmark. Right click, select [Toggle Bookmark]. There will be a blue little square that represents a bookmark on the left hand side of edit area.
- If there is already a bookmark where the cursor is placed, select [Toggle Bookmark] to close it, otherwise to open it.
- Right click and select [Next Bookmark], the cursor will move to where the next bookmark locates. Selecting [Previous Bookmark] will move the cursor to the previous bookmark.

- Selecting [Clear All Bookmarks] will delete all bookmarks.

8. Macro editor provides outlining (or code-folding). Outlining will hide macro codes that belong to the same block, and display them as \[ \ldots \]. There will be a tree diagram on the left hand side of edit area. Click \[ \square \] to hide the block or \[ \square \] to open, as shown in the following figure.
9. Right click to select [Toggle All Outlining] to open all folded macro code blocks.

10. Sometimes the outlining might be incorrect since that the keywords are misjudged as shown in the following figure. To solve this problem, right click and select [Update All Outlining].

11. The statements enclosed in the following keywords are called a “block” of the macro code:

- Function block: sub – end sub
- Iterative statements:
  i. for – next
  ii. while – wend
- Logical statements:
  i. if – end if
- Selective statements: select case – end select

12. The macro editor is not a monopoly window. Returning to the main screen and editing the project with the Work Space window open is allowed.
13. The macro editor provides Find and Replace features.

```
MACRO_OVERFLOW main()
    short h1,i1;f1,m1,ocr
    for h1=0 to 10
        For
        Endfor
        SetValuer, "Local HMI", h1, i1
    endfor
```

14. When [Periodical execution] is checked, this macro will be triggered periodically.

15. Select [Security] » [Use execution condition] » [Settings] to enable security settings:
   - [Disable when Bit is ON]: When Bit is ON, this macro is disabled.
   - [Disable when Bit is OFF]: When Bit is OFF, this macro is disabled.

16. Select [Execute one time when HMI starts], this macro will be executed once when HMI starts up.

18.3. Configuration

A macro contains statements. The statements contain constants, variables and operations. The statements are put in a specific order to create the desired output.

A macro has the following structure:
Macro must have one and only one main function which is the execution start point of macro.
The format is:
```
macro_command main()
  local_variable_declarations
  statements
end macro_command
```

Local variables are used within the main macro function or in a defined function block. Its value remains valid only within the specific block.
Global variables are declared before any function blocks and are valid for all functions in the macro. When local variables and global variables have the same declaration of name, only the local variables are valid.

The following example shows a simple macro which includes a variable declaration and a function call.
```
macro_command main()
  short pressure = 10         // local variable declaration
  SetData(pressure, "Allen-Bradley DF1", N7, 0, 1) // function calling
end macro_command
```

### 18.4. Syntax

#### 18.4.1. Constants and Variables

##### 18.4.1.1. Constants

Constants are fixed values and can be directly written into statements. The formats are:
### Constant Type

<table>
<thead>
<tr>
<th>Constant Type</th>
<th>Note</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decimal integer</td>
<td></td>
<td>345, -234, 0, 23456</td>
</tr>
<tr>
<td>Hexadecimal</td>
<td>Must begin with 0x</td>
<td>0x3b, 0xffff, 0x237</td>
</tr>
<tr>
<td>ASCII</td>
<td>Single character must be enclosed in single quotation marks and a string (group of characters) must be enclosed by double quotation marks.</td>
<td>‘a’, &quot;data&quot;, &quot;name&quot;</td>
</tr>
</tbody>
</table>

### Boolean

| Boolean         | true, false                              |

Here is an example using constants:
```plaintext
macro_command main()
short A, B       // A and B are variables
A = 1234         // 1234 and 0x12 are constants
B = 0x12         // 1234 and 0x12 are constants
end macro_command
```

### 18.4.1.2. Variables

Variables are names that represent information. The information can be changed as the variable is modified by statements.

#### Naming Rules for Variables

- A variable name must start with an alphabet.
- Variable names longer than 32 characters are not allowed.
- Reserved words cannot be used as variable names.

There are 8 different Variable types, 5 for signed data types and 3 for unsigned data types:

<table>
<thead>
<tr>
<th>Variable Type</th>
<th>Description</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>bool (boolean)</td>
<td>1 bit (discrete)</td>
<td>0, 1</td>
</tr>
<tr>
<td>char (character)</td>
<td>8 bits (byte)</td>
<td>+127 to -128</td>
</tr>
<tr>
<td>short (short integer)</td>
<td>16 bits (word)</td>
<td>+32767 to -32768</td>
</tr>
<tr>
<td>int (integer)</td>
<td>32 bits (double word)</td>
<td>+2147483647 to -2147483648</td>
</tr>
<tr>
<td>float (floating point)</td>
<td>32 bits (double word)</td>
<td></td>
</tr>
<tr>
<td>unsigned char</td>
<td>8 bits (byte)</td>
<td>0 to 255</td>
</tr>
<tr>
<td>unsigned short</td>
<td>16 bits (word)</td>
<td>0 to 65535</td>
</tr>
<tr>
<td>unsigned int</td>
<td>32 bits (double word)</td>
<td>0 to 4,294,967,295</td>
</tr>
</tbody>
</table>

#### Declaring Variables

Variables must be declared before being used. To declare a variable, specify the type before the variable name.
Example:
```overflow
int a
short b, switch
float pressure
unsigned short c
```

**Declaring Arrays**

Macros support one-dimensional arrays (zero-based index). To declare an array of variables, specify the type and the variable name followed by the number of variables in the array enclosed in brackets "[]". The length of an array could be 1 to 4096. (Macros only support at most 4096 variables per macro).

Example:
```overflow
int a[10]
short b[20], switch[30]
float pressure[15]
```

The minimum array index is 0 and the maximum is (array size – 1).

Example:
```overflow
char data[100]  // array size is 100
```

In this case, the minimum of array index is 0 and maximum of array index is 99 (=100-1)

**Variable and Array Initialization**

There are two ways variables can be initialized:
- By statement using the assignment operator (=)
  
  Example:
  ```overflow
  int a
  float b[3]
  a = 10
  b[0] = 1
  ```

- During declaration
  ```overflow
  char a = '5', b = 9
  ```

The declaration of arrays is a special case. The entire array can be initialized during declaration by enclosing comma separated values inside curly brackets 

Example:
```overflow
float data[4] = {11, 22, 33, 44}  // now data[0] is 11, data[1] is 22....
```

**18.4.2. Operators**

Operators are used to designate how data is manipulated and calculated.
Macro Reference

EasyBuilder Pro V6.00.0

Operator | Description | Example
--- | --- | ---
= | Assignment operator | pressure = 10

<table>
<thead>
<tr>
<th>Arithmetic Operators</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>Addition</td>
<td>A = B + C</td>
</tr>
<tr>
<td>-</td>
<td>Subtraction</td>
<td>A = B − C</td>
</tr>
<tr>
<td>*</td>
<td>Multiplication</td>
<td>A = B * C</td>
</tr>
<tr>
<td>/</td>
<td>Division</td>
<td>A = B / C</td>
</tr>
<tr>
<td>%</td>
<td>Modulo division (return remainder)</td>
<td>A = B % 5</td>
</tr>
</tbody>
</table>

By default, integer numbers (1, 2, 3, etc) are considered having integer data type; therefore, when division is carried out involving two integer numbers where the result should have decimal point, the decimal part will be removed. To avoid this, add .0 (1.0, 2.0, 3.0, etc) behind the dividend or the divisor to turn it into a floating point number calculation.

Examples:
A = 3 / 2 = 1 → 3 and 2 are both integers; therefore the result is an integer.
B = 3 / 2.0 = 1.5 → 3 is an integer whereas 2.0 is a floating point number, therefore the result is a floating point number.
C = 3.0 / 2 = 1.5 → 3.0 is a floating point number whereas 2 is an integer, therefore the result is a floating point number.

<table>
<thead>
<tr>
<th>Comparison Operators</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;</td>
<td>Less than</td>
<td>if A &lt; 10 then B = 5</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Less than or equal to</td>
<td>if A &lt;= 10 then B = 5</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
<td>if A &gt; 10 then B = 5</td>
</tr>
<tr>
<td>&gt;=</td>
<td>Greater than or equal to</td>
<td>if A &gt;= 10 then B = 5</td>
</tr>
<tr>
<td>==</td>
<td>Equal to</td>
<td>if A == 10 then B = 5</td>
</tr>
<tr>
<td>&lt;&gt;</td>
<td>Not equal to</td>
<td>if A &lt;&gt; 10 then B = 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Logic Operators</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>and</td>
<td>Logical AND</td>
<td>if A &lt; 10 and B &gt; 5 then C = 10</td>
</tr>
<tr>
<td>or</td>
<td>Logical OR</td>
<td>if A &gt;= 10 or B &gt; 5 then C = 10</td>
</tr>
<tr>
<td>xor</td>
<td>Logical Exclusive OR</td>
<td>if A xor 256 then B = 5</td>
</tr>
<tr>
<td>not</td>
<td>Logical NOT</td>
<td>if not A then B = 5</td>
</tr>
</tbody>
</table>

Shift and bitwise operators are used to manipulate bits of signed/unsigned character and integer variables. The priority of these operators is from left to right within the statement.

<table>
<thead>
<tr>
<th>Shift Operators</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;&lt;</td>
<td>Shifts the bits in a bitset to</td>
<td>A = B &lt;&lt; 8</td>
</tr>
</tbody>
</table>
the left a specified number of positions

>> Shifts the bits in a bitset to the right a specified number of positions

A = B >> 8

<table>
<thead>
<tr>
<th>Bitwise Operators</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>&amp;</td>
<td>Bitwise AND</td>
<td>A = B &amp; 0xf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bitwise OR</td>
</tr>
<tr>
<td>^</td>
<td>Bitwise XOR</td>
<td>A = B ^ C</td>
</tr>
<tr>
<td>~</td>
<td>One's complement</td>
<td>A = ~B</td>
</tr>
</tbody>
</table>

Priority of All Operators

The overall priority of all operations from highest to lowest is as follows:

1. Operations within parenthesis are carried out first
2. Arithmetic operations
3. Shift and Bitwise operations
4. Comparison operations
5. Logic operations
6. Assignment

Reserved Keywords

The following keywords are reserved for system. These keywords cannot be used as variable, array, or function names.

+, -, *, /, %, >=, >, <=, <, <=, =, and, or, xor, not, <<, >>, =, &, |, ^, ~
exit, macro_command, for, to, down, step, next, return, bool, short, int, char, float, void, if, then, else, break, continue, set, sub, end, while, wend, true, false
SQRT, CUBERT, LOG, LOG10, SIN, COS, TAN, COT, SEC, CSC, ASIN, ACOS, ATAN, BIN2BCD, BCD2BIN, DEC2ASCII, FLOAT2ASCII, HEX2ASCII, ASCII2DEC, ASCII2FLOAT, ASCII2HEX, FILL, RAND, DELAY, SWAPB, SWAPW, LOBYTE, HIBYTE, LOWORD, HIWORD, GETBIT, SETBIT, SETBITOFF, INVBIT, ADDSUM, XORSUM, CRC, INPORT, OUTPORT, POW, GetCnvTagArrayIndex, GetError, GetData, GetDataEx, SetData, SetDataEx, SetRTS, GetCTS, Beep, SYNC_TRIG_MACRO, ASYNC_TRIG_MACRO, TRACE, FindDataSamplingDate, FindDataSamplingIndex, FindEventLogDate, FindEventLogIndex
StringGet, StringGetEx, StringSet, StringSetEx, StringCopy, StringMid, StringDecAsc2Bin, StringBin2DecAsc, StringDecAsc2Float, StringFloat2DecAsc, StringHexAsc2Bin, StringBin2HexAsc, StringLength, StringCat, StringCompare, StringCompareNoCase, StringFind, StringReverseFind, StringFindOneOf, StringIncluding, StringExcluding, StringToUpper,
StringToLower, StringToReverse, StringTrimLeft, StringTrimRight, StringInsert, String2Unicode
18.5. Statement

18.5.1. Definition Statement

This covers the declaration of variables and arrays. The formal construction is as follows:

<table>
<thead>
<tr>
<th>type</th>
<th>name</th>
</tr>
</thead>
</table>

This defines a variable with name as “name” and type as “type”.

Example:

```c
int A // define a variable A as an integer
type name[constant]
```

This defines an array variable called “name” with size as “constant” and type as “type”.

Example:

```c
int B[10] // where define a variable B as a one-dimensional array of size 10
```

18.5.2. Assignment Statement

Assignment statements use the assignment operator to move data from the expression on the right side of the operator to the variable on the left side. An expression is the combination of variables, constants and operators to yield a value.

<table>
<thead>
<tr>
<th>VariableName</th>
<th>Expression</th>
</tr>
</thead>
</table>

Example

```c
A = 2 where a variable A is assigned to 2
```

18.5.3. Logical Statements

Logical statements perform actions depending on the condition of a boolean expression. The syntax is as follows:

**Single-Line Format**

```c
If <Condition> then
    [Statements]
else
    [Statements]
end if
```
Example:
if a == 2 then
    b = 1
else
    b = 2
end if

Block Format

<table>
<thead>
<tr>
<th>Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>if &lt;Condition&gt; then</td>
<td>Required. This is the controlling statement. It is FALSE when the</td>
</tr>
<tr>
<td></td>
<td>&lt;Condition&gt; evaluates to 0 and TRUE when it evaluates to non-zero.</td>
</tr>
<tr>
<td>then</td>
<td>Must precede the statements to execute if the &lt;Condition&gt; evaluates to</td>
</tr>
<tr>
<td></td>
<td>TRUE.</td>
</tr>
<tr>
<td>[Statements]</td>
<td>It is optional in block format but necessary in single-line format without</td>
</tr>
<tr>
<td></td>
<td>else. The statement will be executed when the &lt;Condition&gt; is TRUE.</td>
</tr>
<tr>
<td>else if &lt;Condition-n&gt; then</td>
<td>Optional. The else if statement will be executed when the relative</td>
</tr>
<tr>
<td></td>
<td>&lt;Condition-n&gt; is TRUE.</td>
</tr>
<tr>
<td>else</td>
<td>Optional. The else statement will be executed when &lt;Condition&gt; and</td>
</tr>
<tr>
<td></td>
<td>&lt;Condition-n&gt; are both FALSE.</td>
</tr>
<tr>
<td>end if</td>
<td>Must be used to end an if-then statement.</td>
</tr>
</tbody>
</table>

Example:
if a == 2 then
    b = 1
else if a == 3 then
    b = 2
else
    b = 3
end if
18.5.4. Selective Statements

The select-case construction can be used like multiple if-else statements and perform selected actions depending on the value of the given variable. When the matched value is found, all the actions below will be executed until a break statement is met. The syntax is as follows:

**Format without a Default Case**

```plaintext
Select Case [variable]
  Case [value]
    [Statements]
    break
end Select
```

Example:

```plaintext
Select Case A
  Case 1
    b=1
    break
end Select
```

**Format with a Default Case (Case else)**

```plaintext
Select Case [variable]
  Case [value]
    [Statements]
    break
  Case else
    [Statements]
    break
end Select
```

Example:

```plaintext
Select Case A
  Case 1
    b=1
    break
  Case else
    b=0
    break
end Select
```
Multiple cases in the same block

```
Select Case [variable]
  Case [value1]
    [Statements]
  Case [value2]
    [Statements]
    break
end Select
```

Example:
```
Select Case A
  Case 1
    break
  Case 2
    b=2
    break
  Case 3
    b=3
    break
end Select
```

Syntax description

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Case</td>
<td>Must be used to begin the statement.</td>
</tr>
<tr>
<td>[variable]</td>
<td>Required. The value of this variable will be compared to the value of each case.</td>
</tr>
<tr>
<td>Case</td>
<td>Optional. It represents the default case. If none of the cases above are matched, the statements under default case will be executed. When a default case is absent, it will skip directly to the end of the select-case statements if there is no matched case.</td>
</tr>
<tr>
<td>break</td>
<td>Optional. The statements under the matched case will be executed until the break command is reached. If a break command is absent, it simply keeps on executing next statement until the end command is reached.</td>
</tr>
<tr>
<td>end Select</td>
<td>Indicates the end of the select-case statements.</td>
</tr>
</tbody>
</table>

18.5.5. Iterative Statements

Iterative statements control loops and repetitive tasks depending on condition. There are two types of iterative statements.
18.5.5.1. for-next Statements

The for-next statement runs for a fixed number of iterations. A variable is used as a counter to track the progress and test for ending conditions. Use this for fixed execution counts. The syntax is as follows:

```
for [Counter] = <StartValue> to <EndValue> [step <StepValue>]
    [Statements]
next [Counter]
```

Or

```
for [Counter] = <StartValue> to <EndValue> [step <StepValue>]
    [Statements]
next [Counter]
```

Example:
```
for a = 0 to 10 step 2
    b = a
next a
```

Syntax description

<table>
<thead>
<tr>
<th>Syntax</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>for</td>
<td>Must be used to begin the statement</td>
</tr>
<tr>
<td>[Counter]</td>
<td>Required. This is the controlling statement. The result of evaluating the variable is used as a test of comparison.</td>
</tr>
<tr>
<td>&lt;StartValue&gt;</td>
<td>Required. The initial value of [Counter]</td>
</tr>
<tr>
<td>to/down</td>
<td>Required. This determines if the &lt;step&gt; increments or decrements the &lt;Counter&gt;. “to” increments &lt;Counter&gt; by &lt;StepValue&gt;. “down” decrements &lt;Counter&gt; by &lt;StepValue&gt;.</td>
</tr>
<tr>
<td>&lt;EndValue&gt;</td>
<td>Required. The test point. If the &lt;Counter&gt; is greater than this value, the macro exits the loop.</td>
</tr>
<tr>
<td>step</td>
<td>Optional. Specifies that a &lt;StepValue&gt; other than one is to be used.</td>
</tr>
<tr>
<td>[StepValue]</td>
<td>Optional. The increment/decrement step of &lt;Counter&gt;. It can be omitted when the value is 1 if [step &lt;StepValue&gt;] are omitted the step value defaults to 1.</td>
</tr>
<tr>
<td>[Statements]</td>
<td>Optional. Statements to execute when the evaluation is TRUE. “for-next” loops may be nested.</td>
</tr>
<tr>
<td>next</td>
<td>Required.</td>
</tr>
<tr>
<td>[Counter]</td>
<td>Optional. This is used when nesting for-next loops.</td>
</tr>
</tbody>
</table>
18.5.5.2. while-wend Statements

The while-wend statement runs for an unknown number of iterations. A variable is used to test for ending conditions. When the condition is TRUE, the statements inside are executed repetitively until the condition becomes FALSE. The syntax is as follows.

```plaintext
while <Condition>
    [Statements]
wend
```

Example:
```plaintext
while a < 10
    a = a + 10
wend
```

Syntax description
- `while` Must be used to begin the statement.
- `continue` Required. This is the controlling statement. When it is TRUE, the loop begins execution. When it is FALSE, the loop terminates.
- `return [value]` Statements to execute when the evaluation is TRUE.
- `wend` Indicates the end of the while-wend statements.

18.5.5.3. Other Control Commands

- `break` Used in for-next and while-wend. It skips immediately to the end of the iterative statement.
- `continue` Used in for-next and while-wend. It ends the current iteration of a loop and starts the next one.
- `return` The return command inside the main block can force the macro to stop anywhere. It skips immediately to the end of the main block.

18.6. Function Blocks

Function blocks are useful for reducing repetitive codes. It must be defined before use and supports any variable and statement type. A function block could be called by putting its name followed by parameters in parenthesis. After the function block is executed, it returns the value to the caller function where it is used as an assignment value or as a condition. A return type is not required in function definition, which means that a function block does not have to return a value. The parameters can also be ignored in function definition while the function has no need to take any parameters from the caller. The syntax is as follows:

**Function definition with return type**
**sub** type <name> [(parameters)]
   Local variable declarations
   [Statements]
   [return [value]]
end sub

Example:

```plaintext
sub int Add(int x, int y)
   int result
   result = x + y
   return result
end sub

macro_command main()
   int a = 10, b = 20, sum
   sum = Add(a, b)
end macro_command
```
or:

```plaintext
sub int Add()
   int result, x=10, y=20
   result = x + y
   return result
end sub
macro_command main()
   int sum
   sum = Add()
end macro_command
```

**Function definition without return type**

```plaintext
sub <name> [(parameters)]
   Local variable declarations
   [Statements]
end sub

Example:

```plaintext
sub Add(int x, int y)
   int result
   result = x + y
```
end sub

macro_command main()
  int a = 10, b = 20
  Add(a, b)
end macro_command

or:
sub Add()
  int result, x=10, y=20
  result = x + y
end sub

macro_command main()
  Add()
end macro_command

Syntax description

<table>
<thead>
<tr>
<th>sub</th>
<th>Must be used to begin the function block</th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td>Optional. This is the data type of value that the function returns. A function block is not always necessary to return a value.</td>
</tr>
<tr>
<td>(parameters)</td>
<td>Optional. The parameters hold values that are passed to the function. The passed parameters must have their type declared in the parameter field and assigned a variable name. For example: sub int MyFunction(int x, int y). x and y would be integers passed to the function. This function is called by a statement that looks similar to this: ret = MyFunction(456, pressure) where “pressure” must be integer according to the definition of function. Notice that the calling statement can pass hard coded values or variables to the function. After this function is executed, an integer values is return to ‘ret’.</td>
</tr>
<tr>
<td>Local variable declaration</td>
<td>Variables that are used in the function block must be declared first. This is in addition to passed parameters. In the above example x and y are variables that the function can used. Global variables are also available for use in function block.</td>
</tr>
<tr>
<td>[Statements]</td>
<td>Statements to execute</td>
</tr>
<tr>
<td>[return [value]]</td>
<td>Optional. Used to return a value to the calling statement. The value can be a constant or a variable. Return also ends function block execution. A function block is not always necessary to return a value, but, when the return type is defined in the beginning of the definition of function, the return command is needed.</td>
</tr>
<tr>
<td>end sub</td>
<td>Must be used to end a function block.</td>
</tr>
</tbody>
</table>
### 18.7. Built-In Function Block

EasyBuilder Pro has many built-in functions for retrieving and transferring data to the PLC, data management and mathematical functions.

#### 18.7.1. Mathematical Functions

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Syntax</th>
<th>Example</th>
</tr>
</thead>
</table>
| **SQRT** | Calculate the square root of `source` and store the result into `result`. `source` can be a constant or a variable. `result` must be a variable. `source` must be a nonnegative value. | `SQRT(source, result)` | macro_command main()  
float source, result  
SQRT(15, result)  
source = 9.0  
SQRT(source, result)// result is 3.0  
end macro_command |
| **CUBERT** | Calculate the cube root of `source` and store the result into `result`. `source` can be a constant or a variable. `result` must be a variable. `source` must be a nonnegative value. | `CUBERT(source, result)` | macro_command main()  
float source, result  
CUBERT (27, result) // result is 3.0  
source = 27.0  
CUBERT(source, result)// result is 3.0  
end macro_command |
<p>| <strong>POW</strong> | Calculate <code>source1</code> to the power of <code>source2</code>. <code>source1</code> and <code>source2</code> can be a constant or a variable. <code>result</code> must be a variable. <code>source1</code> and <code>source2</code> must be a nonnegative value. | <code>POW(source1, source2, result)</code> | |</p>
<table>
<thead>
<tr>
<th>Name</th>
<th>SIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>SIN(source, result)</td>
</tr>
<tr>
<td>Description</td>
<td>Calculate the sine of source (degree) into result. source can be a constant or a variable. result must be a variable.</td>
</tr>
</tbody>
</table>
| Example | macro_command main()  
float source, result  
SIN(90, result) // result is 1  
source = 30  
SIN(source, result) // result is 0.5 |

<table>
<thead>
<tr>
<th>Name</th>
<th>COS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>COS(source, result)</td>
</tr>
<tr>
<td>Description</td>
<td>Calculate the cosine of source (degree) into result. source can be a constant or a variable. result must be a variable.</td>
</tr>
</tbody>
</table>
| Example | macro_command main()  
float source, result  
COS(90, result) // result is 0  
source = 60  
COS(source, result) // result is 0.5 |

<table>
<thead>
<tr>
<th>Name</th>
<th>TAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>TAN(source, result)</td>
</tr>
<tr>
<td>Description</td>
<td>Calculate the tangent of source (degree) into result. source can be a constant or a variable. result must be a variable.</td>
</tr>
</tbody>
</table>
| Example | macro_command main()  
float source, result  
TAN(45, result) // result is 1  
source = 60 |
```
<table>
<thead>
<tr>
<th>TAN(source, result)  // result is 1.732</th>
</tr>
</thead>
<tbody>
<tr>
<td>end macro_command</td>
</tr>
</tbody>
</table>
```
### COT

**Name**  
COT

**Syntax**  
COT(source, result)

**Description**  
Calculate the cotangent of source (degree) into result. source can be a constant or a variable. result must be a variable.

**Example**  
```c
macro_command main()
float source, result

COT(45, result)// result is 1

source = 60
COT(source, result)// result is 0.5774

dend macro_command
```

### SEC

**Name**  
SEC

**Syntax**  
SEC(source, result)

**Description**  
Calculate the secant of source (degree) into result. source can be a constant or a variable. result must be a variable.

**Example**  
```c
macro_command main()
float source, result

SEC(45, result)// result is 1.414

source = 60
SEC(source, result)// if source is 60, result is 2

dend macro_command
```

### CSC

**Name**  
CSC

**Syntax**  
CSC(source, result)

**Description**  
Calculate the cosecant of source (degree) into result. source can be a constant or a variable. result must be a variable.

**Example**  
```c
macro_command main()
float source, result

CSC(45, result)// result is 1.414

source = 30
CSC(source, result)// result is 2

dend macro_command
```
<table>
<thead>
<tr>
<th>Name</th>
<th>Syntax</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
</table>
| ASIN | ASIN(source, result) | Calculate the arc sine of `source` into `result` (degree). `source` can be a constant or a variable. `result` must be a variable. | macro_command main()  
float source, result  
ASIN(0.8660, result)// result is 60  
source = 0.5  
ASIN(source, result)// result is 30  
end macro_command |
| ACOS | ACOS(source, result) | Calculate the arc cosine of `source` into `result`. `source` can be a constant or a variable. `result` must be a variable. | macro_command main()  
float source, result  
ACOS(0.8660, result)// result is 30  
source = 0.5  
ACOS(source, result)// result is 60  
end macro_command |
| ATAN | ATAN(source, result) | Calculate the arc tangent of `source` into `result`. `source` can be a constant or a variable. `result` must be a variable. | macro_command main()  
float source, result  
ATAN(1, result)// result is 45  
source = 1.732  
ATAN(source, result)// result is 60  
end macro_command |
### Name: LOG

**Syntax:** `LOG(source, result)`

**Description:** Calculates the natural logarithm of a number and saves into `result`. `source` can be either a variable or a constant. `result` must be a variable.

**Example:**
```plaintext
macro_command main()
float source = 100, result

LOG(source, result) // result is approximately 4.6052
end macro_command
```

### Name: LOG10

**Syntax:** `LOG10(source, result)`

**Description:** Calculates the base-10 logarithm of a number and saves into `result`. `source` can be either a variable or a constant. `result` must be a variable.

**Example:**
```plaintext
macro_command main()
float source = 100, result

LOG10(source, result) // result is 2
end macro_command
```

### Name: RAND

**Syntax:** `RAND(result)`

**Description:** Calculates a random integer and saves into `result`. `result` must be a variable.

**Example:**
```plaintext
macro_command main()
short result

RAND(result) // result is not a fixed value when executes macro every time
end macro_command
```
## 18.7.2. Data Transformation

<table>
<thead>
<tr>
<th>Name</th>
<th>BIN2BCD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Syntax</strong></td>
<td>BIN2BCD(source, result)</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Transforms a binary-type value (source) into a BCD-type value (result). source can be a constant or a variable. result must be a variable.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>short source, result</td>
</tr>
<tr>
<td></td>
<td>BIN2BCD(1234, result)  // result is 0x1234</td>
</tr>
<tr>
<td></td>
<td>source = 5678</td>
</tr>
<tr>
<td></td>
<td>BIN2BCD(source, result)  // result is 0x5678</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>BCD2BIN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Syntax</strong></td>
<td>BCD2BIN(source, result)</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Transforms a BCD-type value (source) into a binary-type value (result). source can be a constant or a variable. result must be a variable.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>short source, result</td>
</tr>
<tr>
<td></td>
<td>BCD2BIN(0x1234, result)  // result is 1234</td>
</tr>
<tr>
<td></td>
<td>source = 0x5678</td>
</tr>
<tr>
<td></td>
<td>BCD2BIN(source, result)  // result is 5678</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>DEC2ASCII</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Syntax</strong></td>
<td>DEC2ASCII(source, result[start], len)</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Transforms a decimal value (source) into an ASCII string and save it to an array (result). len represents the length of the string and the unit of length depends on result’s type., i.e. if result’s type is “char” (the size is byte), the length of the string is (byte * len). If result’s type is “short” (the size is word), the length of the string is (word * len), and so on. The first character is put into result[start], the second character is put into result[start + 1], and the last character is put into result[start + (len -1)]. source and len can be a constant or a variable. result must be a variable. start must be a constant.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>macro_command main()</td>
</tr>
</tbody>
</table>
short source
char result1[4]
short result2[4]
char result3[6]
source = 5678

DEC2ASCII(source, result1[0], 4)
// result1[0] is '5', result1[1] is '6', result1[2] is '7', result1[3] is '8'
// the length of the string (result1) is 4 bytes ( = 1 * 4)

DEC2ASCII(source, result2[0], 4)
// result2[0] is '5', result2[1] is '6', result2[2] is '7', result2[3] is '8'
// the length of the string (result2) is 8 bytes ( = 2 * 4)

source = -123
DEC2ASCII(source, result3[0], 6)
// result1[0] is '-', result1[1] is '0', result1[2] is '0', result1[3] is '1'
// result1[4] is '2', result1[5] is '3'
// the length of the string (result1) is 6 bytes ( = 1 * 6)

end macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>HEX2ASCII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>HEX2ASCII(source, result[start], len)</td>
</tr>
<tr>
<td>Description</td>
<td>Transforms a hexadecimal value (source) into ASCII string saved to an array (result). len represents the length of the string and the unit of length depends on result’s type, i.e. if result’s type is “char” (the size is byte), the length of the string is (byte * len). If result’s type is “short” (the size is word), the length of the string is (word * len), and so on. source and len can be a constant or a variable. result must be a variable. start must be a constant.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>short source</td>
</tr>
<tr>
<td></td>
<td>char result[4]</td>
</tr>
<tr>
<td></td>
<td>source = 0x5678</td>
</tr>
<tr>
<td></td>
<td>HEX2ASCII (source, result[0], 4)</td>
</tr>
<tr>
<td></td>
<td>// result[0] is '5', result[1] is '6', result[2] is '7', result[3] is '8'</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>
### FLOAT2ASCII

<table>
<thead>
<tr>
<th>Name</th>
<th>FLOAT2ASCII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>FLOAT2ASCII(source, result[start], len)</td>
</tr>
<tr>
<td>Description</td>
<td>Transforms a floating value (source) into ASCII string saved to an array (result). len represents the length of the string and the unit of length depends on result’s type., i.e. if result’s type is “char” (the size is byte), the length of the string is (byte * len). If result’s type is “short” (the size is word), the length of the string is (word * len), and so on. source and len can be a constant or a variable. result must be a variable. start must be a constant.</td>
</tr>
</tbody>
</table>
| Example    | macro_command main()  
float source  
char result[4]  
source = 56.8  
FLOAT2ASCII (source, result[0], 4)  
// result[0] is '5', result[1] is '6', result[2] is '.', result[3] is '8' |

### ASCII2DEC

<table>
<thead>
<tr>
<th>Name</th>
<th>ASCII2DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>ASCII2DEC(source[start], result, len)</td>
</tr>
<tr>
<td>Description</td>
<td>Transforms a string (source) into a decimal value saved to a variable (result). The length of the string is len. The first character of the string is source[start]. source and len can be a constant or a variable. result must be a variable. start must be a constant.</td>
</tr>
</tbody>
</table>
| Example    | macro_command main()  
char source[4]  
short result  
source[0] = '5'  
source[1] = '6'  
source[2] = '7'  
source[3] = '8'  
ASCII2DEC(source[0], result, 4)  // result is 5678 |

end macro_command
<table>
<thead>
<tr>
<th>Name</th>
<th>ASCII2HEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>ASCII2HEX (source[start], result, len)</td>
</tr>
<tr>
<td>Description</td>
<td>Transforms a string (source) into a hexadecimal value saved to a variable (result). The length of the string is len. The first character of the string is source[start]. source and len can be a constant or a variable. result must be a variable. start must be a constant.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>char source[4]</td>
</tr>
<tr>
<td></td>
<td>short result</td>
</tr>
<tr>
<td></td>
<td>source[0] = '5'</td>
</tr>
<tr>
<td></td>
<td>source[1] = '6'</td>
</tr>
<tr>
<td></td>
<td>source[2] = '7'</td>
</tr>
<tr>
<td></td>
<td>source[3] = '8'</td>
</tr>
<tr>
<td></td>
<td>ASCII2HEX (source[0], result, 4) // result is 0x5678</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>ASCII2FLOAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>ASCII2FLOAT(source[start], result, len)</td>
</tr>
<tr>
<td>Description</td>
<td>Transforms a string (source) into a float value saved to a variable (result). The length of the string is len. The first character of the string is source[start]. source and len can be a constant or a variable. result must be a variable. start must be a constant.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>char source[4]</td>
</tr>
<tr>
<td></td>
<td>float result</td>
</tr>
<tr>
<td></td>
<td>source[0] = '5'</td>
</tr>
<tr>
<td></td>
<td>source[1] = '6'</td>
</tr>
<tr>
<td></td>
<td>source[2] = '.'</td>
</tr>
<tr>
<td></td>
<td>source[3] = '8'</td>
</tr>
<tr>
<td></td>
<td>ASCII2FLOAT (source[0], result, 4) // result is 56.8</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>
## 18.7.3. Data Manipulation

<table>
<thead>
<tr>
<th>Name</th>
<th>Syntax</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
</table>
| **FILL** | `FILL(source[start], preset, count)` | Sets the first count elements of an array (`source`) to a specified value (`preset`). `source` and `start` must be a variable, and `preset` can be a constant or variable. | ```
macro_command main()
char result[4]
char preset
FILL(result[0], 0x30, 4) // result[0] is 0x30, result[1] is 0x30, result[2] is 0x30, result[3] is 0x30
preset = 0x31
FILL(result[0], preset, 2) // result[0] is 0x31, result[1] is 0x31
end macro_command``` |
| **SWAPB** | `SWAPB(source, result)` | Exchanges the high-byte and low-byte data of a 16-bit `source` into `result`. `source` can be a constant or a variable. `result` must be a variable. | ```
macro_command main()
short source, result
SWAPB(0x5678, result)// result is 0x7856
source = 0x123
SWAPB(source, result)// result is 0x2301
end macro_command``` |
| **SWAPW** | `SWAPW(source, result)` | Exchanges the high-word and low-word data of a 32-bit `source` into `result`. `source` can be a constant or a variable. `result` must be a variable. | ```
macro_command main()
int source, result
SWAPW (0x12345678, result)// result is 0x56781234
source = 0x12345
SWAPW (source, result)// result is 0x23450001
end macro_command``` |
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOBYTE</strong></td>
<td>Retrieves the low byte of a 16-bit source into result. source can be a constant or a variable. result must be a variable.</td>
</tr>
<tr>
<td><strong>HIBYTE</strong></td>
<td>Retrieves the high byte of a 16-bit source into result. source can be a constant or a variable. result must be a variable.</td>
</tr>
<tr>
<td><strong>LOWORD</strong></td>
<td>Retrieves the low word of a 32-bit source into result. source can be a constant or a variable. result must be a variable.</td>
</tr>
</tbody>
</table>

**Example**

```
macro_command main()
short source, result

LOBYTE(0x1234, result)// result is 0x34

source = 0x123
LOBYTE(source, result)// result is 0x23

dend macro_command
```

```
macro_command main()
short source, result

HIBYTE(0x1234, result)// result is 0x12

source = 0x123
HIBYTE(source, result)// result is 0x01

dend macro_command
```

```
macro_command main()
int source, result

LOWORD(0x12345678, result)// result is 0x5678

source = 0x1234
LOWORD(source, result)// result is 0x2345

dend macro_command
```
### HIWORD

<table>
<thead>
<tr>
<th>Name</th>
<th>HIWORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>HIWORD(source, result)</td>
</tr>
<tr>
<td>Description</td>
<td>Retrieves the high word of a 32-bit source into result. source can be a constant or a variable. result must be a variable.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
</tbody>
</table>

```c
macro_command main()
    int source, result
    HIWORD(0x12345678, result)// result is 0x1234
    source = 0x12345
    HIWORD(source, result)// result is 0x0001
end macro_command
```

### 18.7.4. Bit Transformation

<table>
<thead>
<tr>
<th>Name</th>
<th>GETBIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>GETBIT(source, result, bit_pos)</td>
</tr>
<tr>
<td>Description</td>
<td>Gets the state of designated bit position of a data (source) into result. result value will be 0 or 1. source and bit_pos can be a constant or a variable. result must be a variable.</td>
</tr>
<tr>
<td>Example</td>
<td></td>
</tr>
</tbody>
</table>

```c
macro_command main()
    int source, result
    short bit_pos
    GETBIT(9, result, 3)// result is 1
    source = 4
    bit_pos = 2
    GETBIT(source, result, bit_pos)// result is 1
end macro_command
```
<table>
<thead>
<tr>
<th>Name</th>
<th>SETBITON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>SETBITON(source, result, bit_pos)</td>
</tr>
<tr>
<td>Description</td>
<td>Changes the state of designated bit position of a data (source) to 1, and put changed data into result. source and bit_pos can be a constant or a variable. result must be a variable.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main() int source, result short bit_pos SETBITON(1, result, 3) // result is 9 source = 0 bit_pos = 2 SETBITON(source, result, bit_pos) // result is 4 end macro_command</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>SETBITOFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>SETBITOFF(source, result, bit_pos)</td>
</tr>
<tr>
<td>Description</td>
<td>Changes the state of designated bit position of a data (source) to 0, and put in changed data into result. source and bit_pos can be a constant or a variable. result must be a variable.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main() int source, result short bit_pos SETBITOFF(9, result, 3) // result is 1 source = 4 bit_pos = 2 SETBITOFF(source, result, bit_pos) // result is 0 end macro_command</td>
</tr>
</tbody>
</table>
### Name
INVBIT

### Syntax
INVBIT(source, result, bit_pos)

### Description
Inverts the state of designated bit position of a data (source), and put changed data into result. 
source and bit_pos can be a constant or a variable. result must be a variable.

### Example
```c
macro_command main()
int source, result
short bit_pos

INVBIT(4, result, 1)// result = 6

source = 6
bit_pos = 1
INVBIT(source, result, bit_pos)// result = 4

end macro_command
```

#### 18.7.5. Communication

### Name
DELAY

### Syntax
DELAY(time)

### Description
Suspends the execution of the current macro for at least the specified interval (time). The unit of time is millisecond.
time can be a constant or a variable.

### Example
```c
macro_command main()
int time == 500

DELAY(100)// delay 100 ms
DELAY(time)// delay 500 ms

end macro_command
```
### ADDSUM

**Name**: ADDSUM

**Syntax**: ADDSUM(source[start], result, data_count)

**Description**: Adds up the elements of an array (source) from source[start] to source[start + data_count - 1] to generate a checksum. Puts the checksum into result. result must be a variable. data_count is the amount of the accumulated elements and can be a constant or a variable.

**Example**

```c
macro_command main()
    char data[5]
    short checksum
    data[0] = 0x1
    data[1] = 0x2
    data[2] = 0x3
    data[3] = 0x4
    data[4] = 0x5
    ADDSUM(data[0], checksum, 5)// checksum is 0xf
end macro_command
```

### XORSUM

**Name**: XORSUM

**Syntax**: XORSUM(source[start], result, data_count)

**Description**: Uses XOR to calculate the checksum from source[start] to source[start + data_count - 1]. Puts the checksum into result. result must be a variable. data_count is the amount of the calculated elements of the array and can be a constant or a variable.

**Example**

```c
macro_command main()
    char data[5] = {0x1, 0x2, 0x3, 0x4, 0x5}
    short checksum
    XORSUM(data[0], checksum, 5)// checksum is 0x1
end macro_command
```

### BCC

**Name**: BCC

**Syntax**: BCC(source[start], result, data_count)

**Description**: Same as XORSUM.

**Example**

```c
macro_command main()
    char data[5] = {0x1, 0x2, 0x3, 0x4, 0x5}
    char checksum
    BCC(data[0], checksum, 5) // checksum is 0x1
end macro_command
```
### Macro Reference

#### Name: CRC

**Syntax:**

```
CRC(source[start], result, data_count)
```

**Description:**

Calculates 16-bit CRC of the variables from `source[start]` to `source[start + data_count - 1]`. Puts in the 16-bit CRC into `result`. `result` must be a variable. `data_count` is the amount of the calculated elements of the array and can be a constant or a variable.

**Example:**

```macro_command main()
char data[5] = {0x1, 0x2, 0x3, 0x4, 0x5}
short checksum

CRC(data[0], checksum, 5)  // checksum is 0xbb2a, 16-bit CRC
end macro_command
```

#### Name: OUTPORT

**Syntax:**

```
OUTPORT(source[start], device_name, data_count)
```

**Description:**

Sends out the specified data from `source[start]` to `source[start + data_count - 1]` to PLC via a COM port or the ethernet. `device_name` is the name of a device defined in the device table and the device must be a “Free Protocol”-type device. `data_count` is the amount of sent data and can be a constant or a variable.

**Example:**

To use an `OUTPORT` function, a “Free Protocol” device must be created first as follows:

The device is named “MODBUS RTU Device”. The port attribute depends on the setting of this device. (the current setting is “19200,E, 8, 1”)

Below is an example of executing an action of writing single coil (SET ON) to a MODBUS device.

```macro_command main()
char command[32]
short address, checksum

FILL(command[0], 0, 32)// command initialization

command[0] = 0x1// station no
```
command[1] = 0x5 // function code : Write Single Coil
address = 0
HIBYTE(address, command[2])
LOBYTE(address, command[3])

command[4] = 0xff // force bit on
command[5] = 0

CRC(command[0], checksum, 6)
LOBYTE(checksum, command[6])
HIBYTE(checksum, command[7])

// send out a “Write Single Coil” command
OUTPORT(command[0], "MODBUS RTU Device", 8)
end macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>INPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>INPORT(read_data[start], device_name, read_count, return_value)</td>
</tr>
<tr>
<td>Description</td>
<td>Reads data from a COM port or the ethernet. These data is stored to read_data[start]~read_data[start + read_count - 1]. device_name is the name of a device defined in the device table and the device must be a “Free Protocol”-type device. read_count is the required amount of reading and can be a constant or a variable. If the function is used successfully to get sufficient data, return_value is 1, otherwise is 0.</td>
</tr>
<tr>
<td>Example</td>
<td>Below is an example of executing an action of reading holding registers of a MODBUS device.</td>
</tr>
</tbody>
</table>

// Read Holding Registers
macro_command main()
char command[32], response[32]
short address, checksum
short read_no, return_value, read_data[2]

FILL(command[0], 0, 32) // command initialization
FILL(response[0], 0, 32)

command[0] = 0x1 // station no
command[1] = 0x3 // function code : Read Holding Registers
address = 0
HIBYTE(address, command[2])
LOBYTE(address, command[3])

read_no = 2 // read 2 words (4x_1 and 4x_2)
HIBYTE(read_no, command[4])
LOBYTE(read_no, command[5])

CRC(command[0], checksum, 6)
LOBYTE(checksum, command[6])
HIBYTE(checksum, command[7])

// send out a ‘Read Holding Registers” command
OUTPORT(command[0], “MODBUS RTU Device”, 8)

// read responses for a ‘Read Holding Registers” command
INPORT(response[0], "MODBUS RTU Device", 9, return_value)

if return_value > 0 then

SetData(read_data[0], "Local HMI", LW, 100, 2)
end if

end macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>INPORT2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>INPORT2(response[start], device_name, receive_len, wait_time)</td>
</tr>
<tr>
<td>Description</td>
<td>Read data from a communication port (COM Port or Ethernet Port). The data read will be saved in response. The description of device_name is the same as OUTPORT. receive_len stores the length of the data received, this must be a variable. receive_len total length can’t exceed the size of response. wait_time (in millisecond) can be a constant or variable. After the data is read, if there’s no upcoming data during the designated time interval, the function returns.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
</tbody>
</table>

short wResponse[6], receive_len, wait_time=20

INPORT2(wResponse[0], "Free Protocol", receive_len, wait_time)
// wait_time unit : millisecond

if receive_len > 0 then
SetData(wResponse[0], "Local HMI", LW, 0, 6)  
// set responses to LW0
end if

end macro_command

---

**Name**: INPORT3  

**Syntax**: INPORT3(response[start], device_name, read_count, receive_len)

**Description**: Read data from a communication port (COM Port or Ethernet Port). The data read will be saved in response. The amount of data to be read can be specified. The data that is not read yet will be stored in HMI buffer memory for the next read operation, in order to prevent losing data. The description of device_name is the same as OUTPORT. read_count stores the length of the data read each time. receive_len stores the length of the data received, this must be a variable. receive_len total length can’t exceed the size of response.

**Example**:  

```plaintext```
macro_command main()
short wResponse[6], receive_len

INPORT3(wResponse[0], "Free Protocol", 6, receive_len)  // read 6 words
if receive_len >= 6 then
    SetData(wResponse[0], "Local HMI", LW, 0, 6)  // set responses to LW0
end if
end macro_command
```

---

**Name**: GetData  

**Syntax**: GetData(read_data[start], device_name, device_type, address_offset, data_count)  
or  GetData(read_data, device_name, device_type, address_offset, 1)

**Description**: Receives data from the PLC. Data is stored into read_data[start]~read_data[start + data_count - 1]. data_count is the amount of received data. In general, read_data is an array, but if data_count is 1, read_data can be an array or an ordinary variable. Below are two methods to read one word data from PLC.

```plaintext```
macro_command main()
short read_data_1[2], read_data_2
GetData(read_data_1[0], "FATEK KB Series", RT, 5, 1)
GetData(read_data_2, "FATEK KB Series", RT, 5, 1)
end macro_command
```
**Device_name** is the PLC name enclosed in the double quotation marks (""") and this name has been defined in the device list of system parameters as follows (see FATEK KB Series):

```
Device list:

- Local HMI: Local HMI, Location: Local, Device type: MT3104 H 800 x...
```

**Device_type** is the device type and encoding method (binary or BCD) of the PLC data. For example, if **device_type** is LW_BIN, it means the register is LW and the encoding method is binary. If use BIN encoding method, "_BIN" can be ignored. If **device_type** is LW_BCD, it means the register is LW and the encoding method is BCD.

**Address_offset** is the address offset in the PLC.
For example, GetData(read_data_1[0], "FATEK KB Series", RT, 5, 1) represents that the address offset is 5.
If **address_offset** uses the format —"N#AAAAA" —, N indicates that PLC's station number is N. AAAAA represents the address offset. This format is used while multiple PLCs or controllers are connected to a single serial port. For example, GetData(read_data_1[0], "FATEK KB Series", RT, 2#5, 1) represents that the PLC’s station number is 2. If GetData() uses the default station number defined in the device list as follows, it is not necessary to define station number in **address_offset**.
The number of registers actually read from depends on both the type of the \textit{read\_data} variable and the value of the number of \textit{data\_count}.

<table>
<thead>
<tr>
<th>type of read_data</th>
<th>data_count</th>
<th>actual number of 16-bit register read</th>
</tr>
</thead>
<tbody>
<tr>
<td>char (8-bit)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>char (8-bit)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>bool (8-bit)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>bool (8-bit)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>short (16-bit)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>short (16-bit)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>int (32-bit)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>int (32-bit)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>float (32-bit)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>float (32-bit)</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

When a \texttt{GetData()} is executed using a 32-bit data type (int or float), the function will automatically convert the data. For example,

```c
macro\_command\ main()
float f
GetData(f, "MODBUS", 6x, 2, 1)   // f will contain a floating point value
end\ macro\_command
```

Example

```c
macro\_command\ main()
bool a
```
```c
bool b_array[30]
char c
char c_array[20]
short s
short s_array[50]
int i
int i_array[10]
float f
float f_array[15] double g[10]
```

```c
// get the state of LB2 to the variable a
GetData(a, "Local HMI", LB, 2, 1)

// get 30 states of LB0 ~ LB29 to the variables b_array[0] ~ b_array[29]
GetData(b_array[0], "Local HMI", LB, 0, 30)

// get lower byte of LW-0 to the variable c
// note that char is 1 byte, and a LW address occupies 2 bytes (1 word).
// Reading the first byte in a word register will get the lower byte of the word.
// Ex: when the value in LW-0 is 0x0201, then variable c will read 0x01
GetData(c, "Local HMI", LW, 0, 1)

// get data of LW1 ~ LW10 to the c_array[0] ~ c_array[19]
GetData(c_array[0], "Local HMI", LB, 0, 20)

// get one word from LW-2 to the variable s
GetData(s, "Local HMI", LW, 2, 1)

// get 50 words from LW-0 ~ LW-49 to the variables s_array[0] ~ s_array[49]
GetData(s_array[0], "Local HMI", LW, 0, 50)

// get 2 words from LW-6 ~ LW-7 to the variable e
// Ex: When value in LW-6 is 0x0002, in LW-7 is 0x0001, then i will read 0x00010002(65538)
// note that int occupies 2 words (32-bit)
GetData(i, "Local HMI", LW, 6, 1)

// get 20 words (10 integer values) from LW-0 ~ LW-19 to variables i_array[0]
// ~ i_array[9], note that type of i_array[10] is int.
GetData(i_array[0], "Local HMI", LW, 0, 10)

// get data from LW-10 ~ LW-11 to the variable f
// note that type of variable f is float.
GetData(f, "Local HMI", LW, 10, 1)

// get 30 words (15 float variables) from LW-0 ~ LW-29 to variables f_array[0]
```
~ f_array[14], note that type of f_array[15] is float.
// note that float occupies 2 words (32-bit)
GetData(f_array[0], "Local HMI", LW, 0, 15)

end macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>GetDataEx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>GetDataEx(read_data[start], device_name, device_type, address_offset, data_count) or GetDataEx(read_data, device_name, device_type, address_offset, 1)</td>
</tr>
<tr>
<td>Description</td>
<td>Receives data from the PLC and continue executing next command even if no response from this device. Descriptions of read_data, device_name, device_type, address_offset and data_count are the same as GetData.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>bool a</td>
</tr>
<tr>
<td></td>
<td>bool b</td>
</tr>
<tr>
<td></td>
<td>bool b_array[30]</td>
</tr>
<tr>
<td></td>
<td>char c</td>
</tr>
<tr>
<td></td>
<td>char c_array[20]</td>
</tr>
<tr>
<td></td>
<td>short s</td>
</tr>
<tr>
<td></td>
<td>short s_array[50]</td>
</tr>
<tr>
<td></td>
<td>int i</td>
</tr>
<tr>
<td></td>
<td>int i_array[10]</td>
</tr>
<tr>
<td></td>
<td>float f</td>
</tr>
<tr>
<td></td>
<td>float f_array[15]</td>
</tr>
<tr>
<td></td>
<td>// get the state of LB2 to the variable a</td>
</tr>
<tr>
<td></td>
<td>GetDataEx(a, &quot;Local HMI&quot;, LB, 2, 1)</td>
</tr>
<tr>
<td></td>
<td>// get 30 states of LB0 ~ LB29 to the variables b_array[0] ~ b_array[29]</td>
</tr>
<tr>
<td></td>
<td>GetDataEx(b_array[0], &quot;Local HMI&quot;, LB, 0, 30)</td>
</tr>
<tr>
<td></td>
<td>// get lower byte of LW-0 to the variable c</td>
</tr>
<tr>
<td></td>
<td>// note that char is 1 byte, and a LW address occupies 2 bytes (1 word). Reading the first byte in a word register will get the lower byte of the word.</td>
</tr>
<tr>
<td></td>
<td>// Ex: when the value in LW-0 is 0x0201, then variable c will read 0x01</td>
</tr>
<tr>
<td></td>
<td>GetDataEx(c, &quot;Local HMI&quot;, LW, 0, 1)</td>
</tr>
<tr>
<td></td>
<td>// get data of LW1 ~ LW10 to the c_array[0] ~ c_array[19]</td>
</tr>
<tr>
<td></td>
<td>GetDataEx(c_array[0], &quot;Local HMI&quot;, LB, 0, 20)</td>
</tr>
<tr>
<td></td>
<td>// get one word from LW-2 to the variable s</td>
</tr>
<tr>
<td></td>
<td>GetDataEx(s, &quot;Local HMI&quot;, LW, 2, 1)</td>
</tr>
</tbody>
</table>
// get 50 words from LW-0 ~ LW-49 to the variables s_array[0] ~ s_array[49]
GetDataEX(s_array[0], "Local HMI", LW, 0, 50)

// get 2 words from LW-6 ~ LW-7 to the variable e
// Ex: When value in LW-6 is 0x0002, in LW-7 is 0x0001, then i will read
0x00010002(65538)
// note that int occupies 2 words (32-bit)
GetDataEX(i, "Local HMI", LW, 6, 1)

// get 20 words (10 integer values) from LW-0 ~ LW-19 to variables i_array[0] ~ i_array[9], note that type of i_array[10] is int.
GetDataEX(i_array[0], "Local HMI", LW, 0, 10)

// get data from LW-10 ~ LW-11 to the variable f
// note that type of variable f is float.
GetDataEX(f, "Local HMI", LW, 10, 1)

// get 30 words (15 float variables) from LW-0 ~ LW-29 to variables f_array[0] ~ f_array[14], note that type of f_array[15] is float.
// note that float occupies 2 words (32-bit)
GetDataEX(f_array[0], "Local HMI", LW, 0, 15)

end macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>SetData</th>
</tr>
</thead>
</table>
| Syntax | SetData(send_data[start], device_name, device_type, address_offset, data_count)  
or  
SetData(send_data, device_name, device_type, address_offset, 1) |
| Description | Send data to the PLC. Data is defined in send_data[start]~ send_data[start + data_count - 1].  
data_count is the amount of sent data. In general, send_data is an array, but if  
data_count is 1, send_data can be an array or an ordinary variable. Below are  
two methods to send one word data. |

macro_command main()
short send_data_1[2] = { 5, 6}, send_data_2 = 5
SetData(send_data_1[0], "FATEK KB Series", RT, 5, 1)
SetData(send_data_2, "FATEK KB Series", RT, 5, 1)
end macro_command

device_name is the PLC name enclosed in the double quotation marks ("*) and  
this name has been defined in the device list of system parameters.  
device_type is the device type and encoding method (binary or BCD) of the PLC.
data. For example, if device_type is LW_BIN, it means the register is LW and the encoding method is binary. If use BIN encoding method, "_BIN" can be ignored. If device_type is LW_BCD, it means the register is LW and the encoding method is BCD.

address_offset is the address offset in the PLC. For example, SetData(read_data_1[0], "FATEK KB Series", RT, 5, 1) represents that the address offset is 5.

If address_offset uses the format -“N#AAAAA”, N indicates that PLC’s station number is N. AAAA represents the address offset. This format is used while multiple PLCs or controllers are connected to a single serial port. For example, SetData(read_data_1[0], "FATEK KB Series", RT, 2#5, 1) represents that the PLC’s station number is 2. If SetData () uses the default station number defined in the device list, it is not necessary to define station number in address_offset.

The number of registers actually sends to depends on both the type of the send_data variable and the value of the number of data_count.

<table>
<thead>
<tr>
<th>type of read_data</th>
<th>data_count</th>
<th>actual number of 16-bit register send</th>
</tr>
</thead>
<tbody>
<tr>
<td>char (8-bit)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>char (8-bit)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>bool (8-bit)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>bool (8-bit)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>short (16-bit)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>short (16-bit)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>int (32-bit)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>int (32-bit)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>float (32-bit)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>float (32-bit)</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

When a SetData() is executed using a 32-bit data type (int or float), the function will automatically send int-format or float-format data to the device. For example,

```c
macro_command main()
float f = 2.6
SetData(f, "MODBUS", 6x, 2, 1)   // will send a floating point value to the device
end macro_command
```

Example

```c
macro_command main()
int i
bool a = true
bool b[30]
short c = false
short d[50]
int e = 5
int f[10]
```
for i = 0 to 29
  b[i] = true
next i

for i = 0 to 49
  d[i] = i * 2
next i

for i = 0 to 9
  f[i] = i * 3
next i

// set the state of LB2
SetData(a, "Local HMI", LB, 2, 1)

// set the states of LB0 ~ LB29
SetData(b[0], "Local HMI", LB, 0, 30)

// set the value of LW-2
SetData(c, "Local HMI", LW, 2, 1)

// set the values of LW-0 ~ LW-49
SetData(d[0], "Local HMI", LW, 0, 50)

// set the values of LW-6 ~ LW-7, note that the type of e is int
SetData(e, "Local HMI", LW, 6, 1)

// set the values of LW-0 ~ LW-19
// 10 integers equal to 20 words, since each integer value occupies 2 words.
SetData(f[0], "Local HMI", LW, 0, 10)

end macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>SetDataEx</th>
</tr>
</thead>
</table>
| Syntax | SetDataEx (send_data[start], device_name, device_type, address_offset, data_count)  
or  
SetDataEx (send_data, device_name, device_type, address_offset, 1) |
| Description | Send data to the PLC and continue executing next command even if no response from this device.  
Descriptions of send_data, device_name, device_type, address_offset and data_count are the same as SetData. |
| Example  | macro_command main() |
int i
do a = true
bool b[30]
short c = false
short d[50]
int e = 5
int f[10]

for i = 0 to 29
b[i] = true
next i

for i = 0 to 49
d[i] = i * 2
next i

for i = 0 to 9
f[i] = i * 3
next i

// set the state of LB2
SetDataEx (a, "Local HMI", LB, 2, 1)

// set the states of LB0 ~ LB29
SetDataEx (b[0], "Local HMI", LB, 0, 30)

// set the value of LW-2
SetDataEx (c, "Local HMI", LW, 2, 1)

// set the values of LW-0 ~ LW-49
SetDataEx (d[0], "Local HMI", LW, 0, 50)

// set the values of LW-6 ~ LW-7, note that the type of e is int
SetDataEx (e, "Local HMI", LW, 6, 1)

// set the values of LW-0 ~ LW-19
// 10 integers equal to 20 words, since each integer value occupies 2 words.
SetDataEx (f[0], "Local HMI", LW, 0, 10)

cold macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>GetError</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>GetError (err)</td>
</tr>
<tr>
<td>Description</td>
<td>Get an error code.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
</tbody>
</table>
short err
char byData[10]

GetDataEx(byData[0], "MODBUS RTU", 4x, 1, 10)// read 10 bytes

// if err is equal to 0, it is successful to execute GetDataEx()
GetErr(err)// save an error code to err

end macro_command

### PURGE

<table>
<thead>
<tr>
<th>Name</th>
<th>PURGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>PURGE (com_port)</td>
</tr>
<tr>
<td>Description</td>
<td>com_port refers to the COM port number which ranges from 1 to 3. It can be either a variable or a constant. This function is used to clear the input and output buffers associated with the COM port.</td>
</tr>
</tbody>
</table>

| Example | macro_command main()
int com_port=3
PURGE (com_port)
PURGE (1) |
|---------|--------------------------------------------------|

### SetRTS

<table>
<thead>
<tr>
<th>Name</th>
<th>SetRTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>SetRTS(com_port, source)</td>
</tr>
</tbody>
</table>
| Description | Set RTS state for RS232.
com_port refers to the COM port number. It can be either a variable or a constant. source can be either a variable or a constant.
This command raise RTS signal while the value of source is greater than 0 and lower RTS signal while the value of source equals to 0. |

| Example | macro_command main()
char com_port=1
char value=1

SetRTS(com_port, value) // raise RTS signal of COM1 while value>0
SetRTS(1, 0) // lower RTS signal of COM1 |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>GetCTS</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Syntax</td>
<td>GetCTS(com_port, result)</td>
</tr>
<tr>
<td>Description</td>
<td>Get CTS state for RS232. com_port refers to the COM port number. It can be either a variable or a constant. result is used for receiving the CTS signal. It must be a variable. This command receives CTS signal and stores the received data in the result variable. When the CTS signal is pulled high, it writes 1 to result, otherwise, it writes 0.</td>
</tr>
</tbody>
</table>
| Example    | macro_command main()  
char com_port=1  
char result  
GetCTS(com_port, result) // get CTS signal of COM1  
GetCTS (1, result) // get CTS signal of COM1  
end macro_command |

<table>
<thead>
<tr>
<th>Name</th>
<th>GetCnvTagArrayIndex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>GetCnvTagArrayIndex(array_index)</td>
</tr>
<tr>
<td>Description</td>
<td>When an user-defined conversion tag uses array, the GetCnvTagArrayIndex() function of [Read conversion] subroutine can get the relative array index before doing conversion.</td>
</tr>
</tbody>
</table>
| Example    | Sub short newfun(short param)  
Int index  
GetCnvTagArrayIndex(index)  
If index is 2, the third data record in the array will be converted.  
return param  
end sub |

### 18.7.6. String Operation Functions

<table>
<thead>
<tr>
<th>Name</th>
<th>StringGet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>StringGet(read_data[start], device_name, device_type, address_offset, data_count)</td>
</tr>
<tr>
<td>Description</td>
<td>Receives data from the PLC. The String data is stored into read_data[start]~read_data[start + data_count - 1]. read_data must be a one-dimensional char array. Data_count is the number of received characters, it can be either a constant or a variable. Device_name is the PLC name enclosed in the double quotation marks (&quot;), and this name has been defined in the device list of system parameters as follows (see FATEK KB Series):</td>
</tr>
</tbody>
</table>
Device_type is the device type and encoding method (binary or BCD) of the PLC data. For example, if device_type is LW_BIN, it means the register is LW and the encoding method is binary. If use BIN encoding method, "_BIN" can be ignored. If device_type is LW_BCD, it means the register is LW and the encoding method is BCD.

Address_offset is the address offset in the PLC.
For example, StringGet(read_data_1[0], "FATEK KB Series", RT, 5, 1) represents that the address offset is 5.
If address_offset uses the format – “N#AAAAA”, N indicates that PLC’s station number is N. AAAAA represents the address offset. This format is used while multiple PLCs or controllers are connected to a single serial port. For example, StringGet(read_data_1[0], "FATEK KB Series", RT, 2#5, 1) represents that the PLC’s station number is 2. If StringGet() uses the default station number defined in the device list as follows, it is not necessary to define station number in address_offset.

The number of registers actually read from depends on the value of the
number of `data_count` since that the `read_data` is restricted to char array.

<table>
<thead>
<tr>
<th>type of read_data</th>
<th>data_count</th>
<th>actual number of 16-bit register read</th>
</tr>
</thead>
<tbody>
<tr>
<td>char (8-bit)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>char (8-bit)</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

1 WORD register (16-bit) equals to the size of 2 ASCII characters. According to the above table, reading 2 ASCII characters is actually reading the content of one 16-bit register.

**Example**

```c
macro_command main()
char str1[20]

// read 10 words from LW-0~LW-9 to the variables str1[0] to str1[19]
// since that 1 word can store 2 ASCII characters, reading 20 ASCII
// characters is actually reading 10 words of register
StringGet(str1[0], "Local HMI", LW, 0, 20)
end macro_command
```

<table>
<thead>
<tr>
<th>Name</th>
<th>StringGetEx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td><code>StringGetEx(read_data[start], device_name, device_type, address_offset, data_count)</code></td>
</tr>
<tr>
<td>Description</td>
<td>Receives data from the PLC and continue executing next command even if no response from this device. Descriptions of <code>read_data</code>, <code>device_name</code>, <code>device_type</code>, <code>address_offset</code> and <code>data_count</code> are the same as <code>GetData</code>.</td>
</tr>
</tbody>
</table>
| Example    | `macro_command main()
char str1[20]
short test=0

// macro will continue executing test = 1 even if the MODBUS device is // not responding
StringGetEx(str1[0], "MODBUS RTU", 4x, 0, 20)
test = 1

// macro will not continue executing test = 2 until MODBUS device responds
StringGet(str1[0], "MODBUS RTU", 4x, 0, 20)
test = 2
end macro_command` |
Macro Reference

Name | StringSet
---|---

Syntax | StringSet(send_data[start], device_name, device_type, address_offset, data_count)

Description | Send data to the PLC. Data is defined in send_data[start]~send_data[start + data_count - 1]. send_data must be a one-dimensional char array. data_count is the number of sent characters, it can be either a constant or a variable.

device_name is the PLC name enclosed in the double quotation marks (" ) and this name has been defined in the device list of system parameters.

device_type is the device type and encoding method (binary or BCD) of the PLC data. For example, if device_type is LW_BIN, it means the register is LW and the encoding method is binary. If use BIN encoding method, "_BIN" can be ignored.

If device_type is LW_BCD, it means the register is LW and the encoding method is BCD.

address_offset is the address offset in the PLC.

For example, StringSet(read_data_1[0], "FATEK KB Series", RT, 5, 1) represents that the address offset is 5.

If address_offset uses the format — "N#AAAAA" , N indicates that PLC’s station number is N. AAAAA represents the address offset. This format is used while multiple PLCs or controllers are connected to a single serial port. For example, StringSet(read_data_1[0], "FATEK KB Series", RT, 2#5, 1) represents that the PLC’s station number is 2. If SetData () uses the default station number defined in the device list, it is not necessary to define station number in address_offset.

The number of registers actually sends to depends on the value of the number of data_count, since that send_data is restricted to char array.

<table>
<thead>
<tr>
<th>type of read_data</th>
<th>data_count</th>
<th>actual number of 16-bit register send</th>
</tr>
</thead>
<tbody>
<tr>
<td>char (8-bit)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>char (8-bit)</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

1 WORD register(16-bit) equals to the size of 2 ASCII characters. According to the above table, sending 2 ASCII characters is actually writing to one 16-bit register. The ASCII characters are stored into the WORD register from low byte to high byte. While using the ASCII Display object to display the string data stored in the registers, data_count must be a multiple of 2 in order to display full string content. For example:

macro_command main()
char src1[10]="abcde"
StringSet(src1[0], "Local HMI", LW, 0, 5)
end macro_command
The ASCII Display object shows:

```
abcd
```

If `data_count` is an even number that is greater than or equal to the length of the string, the content of string can be completely shown:

```c
macro_command main()
char src1[10]="abcde"
StringSet(src1[0], "Local HMI", LW, 0, 6)
end macro_command
```

```
abcde
```

**Example**

```c
macro_command main()

char str1[10]="abcde"

// Send 3 words to LW-0~LW-2
// Data are being sent until the end of string is reached.
// Even though the value of `data_count` is larger than the length of string
// , the function will automatically stop.
StringSet(str1[0], "Local HMI", LW, 0, 10)

data_count
```

```
```

**Name**  
StringSetEx

**Syntax**  
StringSetEx (send_data[start], device_name, device_type, address_offset, data_count)

**Description**  
Send data to the PLC and continue executing next command even if no response from this device.
Descriptions of `send_data`, `device_name`, `device_type`, `address_offset` and `data_count` are the same as StringSet.

**Example**

```c
macro_command main()
char str1[20]="abcde"
short test=0

// macro will continue executing test = 1 even if the MODBUS device is not responding
StringSetEx(str1[0], "MODBUS RTU", 4x, 0, 20)
test = 1

// macro will not continue executing test = 2 until MODBUS device responds
StringSet(str1[0], "MODBUS RTU", 4x, 0, 20)
test = 2
```
### StringCopy

**Syntax**

```c
success = StringCopy ("source", destination[start])
or
success = StringCopy (source[start], destination[start])
```

**Description**

Copy one string to another. This function copies a static string (which is enclosed in quotes) or a string that is stored in an array to the destination buffer.

The source string parameter accepts both static string (in the form: “source”) and char array (in the form: source[start]).

destination[start] must be an one-dimensional char array.

This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of source string exceeds the max. size of destination buffer, it returns false and the content of destination remains the same.

The success field is optional.

**Example**

```c
macro_command main()
char src1[5]="abcde"
char dest1[5]
bool success1
success1 = StringCopy(src1[0], dest1[0])
// success1=true, dest1="abcde"

char dest2[5]
bool success2
success2 = StringCopy("12345", dest2[0])
// success2=true, dest2="12345"

char src3[10]="abcdefghij"
char dest3[5]
bool success3
success3 = StringCopy(src3[0], dest3[0])
// success3=false, dest3 remains the same.

char src4[10]="abcdefghij"
char dest4[5]
bool success4
success4 = StringCopy(src4[5], dest4[0])
// success4=true, dest4="fghij"

end macro_command
```
<table>
<thead>
<tr>
<th>Name</th>
<th>StringDecAsc2Bin</th>
</tr>
</thead>
</table>
| Syntax                | success = StringDecAsc2Bin(source[start], destination)  
or success = StringDecAsc2Bin("source", destination) |
| Description           | This function converts a decimal string to an integer. It converts the decimal string in source parameter into an integer, and stores it in the destination variable. The source string parameter accepts both static string (in the form: “source”) and char array (in the form: source[start]). Destination must be a variable, to store the result of conversion. This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the source string contains characters other than ‘+’ or ‘-’ and ‘0’ to ‘9’, it returns false. The success field is optional. |
| Example               | macro_command main()  
char src1[5]="12345"  
int result1  
bool success1  
success1 = StringDecAsc2Bin(src1[0], result1)  
// success1=true, result1 is 12345  
char src2[5] = "-6789"  
short result2  
bool success2  
success2 = StringDecAsc2Bin(src2[0], result2)  
// success2 = true, result2 is ssult2  
char result3  
bool success3  
success3 = StringDecAsc2Bin("32768", result3)  
// success3=true, but the result exceeds the data range of result3  
char src4[2]="4b"  
char result4  
bool success4  
success4 = StringDecAsc2Bin (src4[0], result4)  
// success4=false, because src4 contains characters other than ‘+’ or ‘-’ and ‘0’ to ‘9’  
end macro_command |
<table>
<thead>
<tr>
<th>Name</th>
<th>StringBin2DecAsc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>success = StringBin2DecAsc (source, destination[start])</td>
</tr>
<tr>
<td>Description</td>
<td>This function converts an integer to a decimal string. It converts the integer in source parameter into a decimal string, and stores it in the destination buffer. Source can be either a constant or a variable. Destination must be an one-dimensional char array, to store the result of conversion. This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of decimal string after conversion exceeds the size of destination buffer, it returns false. The success field is optional.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>int src1 = 2147483647</td>
</tr>
<tr>
<td></td>
<td>char dest1[20]</td>
</tr>
<tr>
<td></td>
<td>bool success1</td>
</tr>
<tr>
<td></td>
<td>success1 = StringBin2DecAsc(src1, dest1[0])</td>
</tr>
<tr>
<td></td>
<td>// success1=true, dest1=&quot;2147483647&quot;</td>
</tr>
<tr>
<td></td>
<td>short src2 = 0x3c</td>
</tr>
<tr>
<td></td>
<td>char dest2[20]</td>
</tr>
<tr>
<td></td>
<td>bool success2</td>
</tr>
<tr>
<td></td>
<td>success2 = StringBin2DecAsc(src2, dest2[0])</td>
</tr>
<tr>
<td></td>
<td>// success2=true, dest2=&quot;60&quot;</td>
</tr>
<tr>
<td></td>
<td>int src3 = 2147483647</td>
</tr>
<tr>
<td></td>
<td>char dest3[5]</td>
</tr>
<tr>
<td></td>
<td>bool success</td>
</tr>
<tr>
<td></td>
<td>success3 = StringBin2DecAsc(src3, dest3[0])</td>
</tr>
<tr>
<td></td>
<td>// success3=false, dest3 remains the same.</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
<tr>
<td>Name</td>
<td>StringDecAsc2Float</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| Syntax          | success = StringDecAsc2Float (source[start], destination)  
|                 | or                   
|                 | success = StringDecAsc2Float ("source", destination)       |
| Description     | This function converts a decimal string to floats. It converts the decimal string in source parameter into float, and stores it in the destination variable. The source string parameter accepts both static string (in the form: "source") and char array (in the form: source[start]). Destination must be a variable, to store the result of conversion. This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the source string contains characters other than ‘0’ to ‘9’ or ‘.’, it returns false. The success field is optional. |
| Example         | macro_command main()  
|                 | char src1[10]="12.345"  
|                 | float result1  
|                 | bool success1  
|                 | success1 = StringDecAsc2Float[src1[0], result1]  
|                 | // success1=true, result1 is 12.345  
|                 | float result2  
|                 | bool success2  
|                 | success2 = StringDecAsc2Float("1.234567890", result2)  
|                 | // success2=true, but the result exceeds the data range of result2, which // might result in loss of precision  
|                 | char src3[2]="4b"  
|                 | float result3  
|                 | bool success3  
|                 | success3 = StringDecAsc2Float[src3[0], result3]  
|                 | // success3=false, because src3 contains characters other than ‘0’ to ‘9’ or ‘.’  
<p>|                 | end macro_command |</p>
<table>
<thead>
<tr>
<th><strong>Name</strong></th>
<th>StringFloat2DecAsc</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Syntax</strong></td>
<td><code>success = StringFloat2DecAsc(source, destination[start])</code></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>This function converts a float to a decimal string. It converts the float in <code>source</code> parameter into a decimal string, and stores it in the <code>destination</code> buffer. <code>Source</code> can be either a constant or a variable. <code>Destination</code> must be an one-dimensional char array, to store the result of conversion. This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of decimal string after conversion exceeds the size of destination buffer, it returns false. The success field is optional.</td>
</tr>
</tbody>
</table>

**Example**

```cpp
macro_command main()
    float src1 = 1.2345
    char dest1[20]
    bool success1
    success1 = StringFloat2DecAsc(src1, dest1[0])
    // success1=true, dest1="1.2345"

    float src2 = 1.23456789
    char dest2[20]
    bool success2
    success2 = StringFloat2DecAsc(src2, dest2[0])
    // success2=true, but it might lose precision

    float src3 = 1.2345
    char dest3[5]
    bool success3
    success3 = StringFloat2DecAsc(src3, dest3[0])
    // success3=false, dest3 remains the same.
end macro_command
```
<table>
<thead>
<tr>
<th>Name</th>
<th>StringHexAsc2Bin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>success = StringHexAsc2Bin (source[start], destination) or success = StringHexAsc2Bin (&quot;source&quot;, destination)</td>
</tr>
<tr>
<td>Description</td>
<td>This function converts a hexadecimal string to binary data. It converts the hexadecimal string in source parameter into binary data, and stores it in the destination variable. The source string parameter accepts both static string (in the form: “source”) and char array (in the form: source[start]). Destination must be a variable, to store the result of conversion. This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the source string contains characters other than ‘0’ to ‘9’, ‘a’ to ‘f’ or ‘A’ to ‘F’, it returns false. The success field is optional.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main() char src1[5]=&quot;0x3c&quot; int result1 bool success1 success1 = StringHexAsc2Bin(src1[0], result1) // success1=true, result1 is 3c short result2 bool success2 success2 = StringDecAsc2Bin(&quot;1a2b3c4d&quot;, result2) // success2=true, result2=3c4d. The result exceeds the data range of // result2 char src3[2]=&quot;4g&quot; char result3 bool success3 success3 = StringDecAsc2Bin (src3[0], result3) // success3=false, because src3 contains characters other than ‘0’ to ‘9’ // , ‘a’ to ‘f’ or ‘A’ to ‘F’ end macro_command</td>
</tr>
<tr>
<td>Name</td>
<td>StringBin2HexAsc</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Syntax</td>
<td>success = StringBin2HexAsc (source, destination[start])</td>
</tr>
<tr>
<td>Description</td>
<td>This function converts binary data to a hexadecimal string. It converts the binary data in source parameter into a hexadecimal string, and stores it in the destination buffer. Source can be either a constant or a variable. Destination must be an one-dimensional char array, to store the result of conversion. This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of hexadecimal string after conversion exceeds the size of destination buffer, it returns false. The success field is optional. Please note that this function cannot convert negative values.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>int src1 = 20</td>
</tr>
<tr>
<td></td>
<td>char dest1[20]</td>
</tr>
<tr>
<td></td>
<td>bool success1</td>
</tr>
<tr>
<td></td>
<td>success1 = StringBin2HexAsc(src1, dest1[0])</td>
</tr>
<tr>
<td></td>
<td>// success1=true, dest1=&quot;14&quot;</td>
</tr>
<tr>
<td></td>
<td>short src2 = 0x3c</td>
</tr>
<tr>
<td></td>
<td>char dest2[20]</td>
</tr>
<tr>
<td></td>
<td>bool success2</td>
</tr>
<tr>
<td></td>
<td>success2 = StringBin2HexAsc(src2, dest2[0])</td>
</tr>
<tr>
<td></td>
<td>// success2=true, dest2=&quot;3c&quot;</td>
</tr>
<tr>
<td></td>
<td>int src3 = 0x1a2b3c4d</td>
</tr>
<tr>
<td></td>
<td>char dest3[6]</td>
</tr>
<tr>
<td></td>
<td>bool success3</td>
</tr>
<tr>
<td></td>
<td>success3 = StringBin2HexAsc(src3, dest3[0])</td>
</tr>
<tr>
<td></td>
<td>// success3=false, dest3 remains the same.</td>
</tr>
</tbody>
</table>

end macro_command
<table>
<thead>
<tr>
<th>Name</th>
<th>StringMid</th>
</tr>
</thead>
</table>
| Syntax | success = StringMid (source[start], count, destination[start])  
or  
success = StringMid ("string", start, count, destination[start]) |
| Description | Retrieve a character sequence from the specified offset of the source string and store it in the destination buffer.  
The source string parameter accepts both static string (in the form: "source") and char array (in the form: source[start]). For source[start], the start offset of the substring is specified by the index value. For static source string("source"), the second parameter(start) specifies the start offset of the substring.  
The count parameter specifies the length of substring being retrieved.  
Destination must be an one-dimensional char array, to store the retrieved substring.  
This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of retrieved substring exceeds the size of destination buffer, it returns false.  
The success field is optional. |
| Example | macro_command main()  
char src1[20]="abcdefghijlkmnopqrstuvwxyz"  
char dest1[20]  
bool success1  
success1 = StringMid(src1[5], 6, dest1[0])  
// success1=true, dest1="fghijk"  
char src2[20]="abcdefghijlkmnopqrstuvwxyz"  
char dest2[5]  
bool success2  
success2 = StringMid(src2[5], 6, dest2[0])  
// success2=false, dest2 remains the same.  
char dest3[20]="12345678901234567890"  
bool success3  
success3 = StringMid("abcdefghijlkmnopqrstuvwxyz", 5, 5, dest3[15])  
// success3= true, dest3="123456789012345fghij"  
end macro_command |
<table>
<thead>
<tr>
<th>Name</th>
<th>StringLength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>length = StringLength (source[start])&lt;br&gt;or&lt;br&gt;length = StringLength (&quot;source&quot;)</td>
</tr>
<tr>
<td>Description</td>
<td>Obtain the length of a string. It returns the length of source string and stores it in the length field on the left-hand side of ‘=’ operator. The source string parameter accepts both static string (in the form: &quot;source&quot;) and char array (in the form: source[start]). The return value of this function indicates the length of the source string.</td>
</tr>
</tbody>
</table>
| Example    | macro_command main()<br>char src1[20]="abcde"<br>int length1<br>length1= StringLength(src1[0])<br>  // length1=5<br>  <br>char src2[20]={'a', 'b', 'c', 'd', 'e'}<br>int length2<br>length2= StringLength(src2[0])<br>  // length2=5<br>  <br>char src3[20]="abcdefgij"
<p>| int length3&lt;br&gt;length3= StringLength(src3 [2])&lt;br&gt;  // length3=8&lt;br&gt;end macro_command |</p>
<table>
<thead>
<tr>
<th>Name</th>
<th>StringCat</th>
</tr>
</thead>
</table>
| Syntax   | success = StringCat (source[start], destination[start])  
or               | success = StringCat ("source", destination[start]) |
| Description | This function appends source string to destination string. It adds the contents of source string to the last of the contents of destination string.  
The source string parameter accepts both static string (in the form: "source") and char array (in the form: source[start]).  
Destination must be an one-dimensional char array.  
This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of result string after concatenation exceeds the max. size of destination buffer, it returns false.  
The success field is optional. |
| Example  | macro_command main()  
char src1[20]="abcdefghij"  
char dest1[20]="1234567890"  
bool success1  
success1= StringCat(src1[0], dest1[0])  
// success1=true, dest1="123456790abcdefghij"  

char dest2 [10]="1234567890"  
bool success2  
success2= StringCat("abcde", dest2 [0])  
// success2=false, dest2 remains the same.  

char src3[20]="abcdefghij"  
char dest3[20]  
bool success3  
success3= StringCat(src3[0], dest3[15])  
// success3=false, dest3 remains the same.  
end macro_command |
<table>
<thead>
<tr>
<th><strong>Name</strong></th>
<th>StringCompare</th>
</tr>
</thead>
</table>
| **Syntax** | ret = StringCompare (str1[start], str2[start])  
ret = StringCompare ("string1", str2[start])  
ret = StringCompare (str1[start], "string2")  
ret = StringCompare ("string1", "string2") |
| **Description** | Do a case-sensitive comparison of two strings.  
The two string parameters accept both static string (in the form: "string1") and char array (in the form: str1[start]).  
This function returns a Boolean indicating the result of comparison. If two strings are identical, it returns true. Otherwise it returns false.  
The ret field is optional. |
| **Example** | macro_command main()  
char a1[20]="abcde"  
char b1[20]="ABCDE"  
bool ret1  
ret1= StringCompare(a1[0], b1[0])  
  // ret1=false  
char a2[20]="abcde"  
char b2[20]="abcde"  
bool ret2  
ret2= StringCompare(a2[0], b2[0])  
  // ret2=true  
char a3 [20]="abcde"  
char b3[20]="abcdefg"  
bool ret3  
ret3= StringCompare(a3[0], b3[0])  
  // ret3=false  
end macro_command |
**Name**  
StringCompareNoCase

**Syntax**
- `ret = StringCompareNoCase(str1[start], str2[start])`
- `ret = StringCompareNoCase("string1", str2[start])`
- `ret = StringCompareNoCase(str1[start], "string2")`
- `ret = StringCompareNoCase("string1", "string2")`

**Description**
Do a case-insensitive comparison of two strings. The two string parameters accept both static string (in the form: "string1") and char array (in the form: str1[start]). This function returns a Boolean indicating the result of comparison. If two strings are identical, it returns true. Otherwise it returns false. The ret field is optional.

**Example**
```c
macro_command main()
char a1[20]="abcde"
char b1[20]="ABCDE"
bool ret1
ret1= StringCompareNoCase(a1[0], b1[0])
   // ret1=true

cchar a2[20]="abcde"
cchar b2[20]="abcde"
cbool ret2
ret2= StringCompareNoCase(a2[0], b2[0])
   // ret2=true

cchar a3 [20]="abcde"
cchar b3[20]="abcdefg"
cbool ret3
ret3= StringCompareNoCase(a3[0], b3[0])
   // ret3=false

dend macro_command
```
<table>
<thead>
<tr>
<th>Name</th>
<th>StringFind</th>
</tr>
</thead>
</table>

**Syntax**

position = StringFind (source[start], target[start])
position = StringFind ("source", target[start])
position = StringFind (source[start], "target")
position = StringFind ("source", "target")

**Description**

Return the position of the first occurrence of target string in the source string. The two string parameters accept both static string (in the form: “source”) and char array (in the form: source[start]). This function returns the zero-based index of the first character of substring in the source string that matches the target string. Notice that the entire sequence of characters to find must be matched. If there is no matched substring, it returns -1.

**Example**

```macro_command
main()
char src1[20]="abcde"
char target1[20]="cd"
short pos1
pos1= StringFind(src1[0], target1[0])
  // pos1=2

char target2[20]="ce"
short pos2
pos2= StringFind("abcde", target2[0])
  // pos2=-1

char src3[20]="abcde"
short pos3
pos3= StringFind(src3[3], "cd")
  // pos3=-1
end macro_command```


<table>
<thead>
<tr>
<th>Name</th>
<th>StringReverseFind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>position = StringReverseFind (source[start], target[start])&lt;br&gt;position = StringReverseFind (&quot;source&quot;, target[start])&lt;br&gt;position = StringReverseFind (source[start], &quot;target&quot;)&lt;br&gt;position = StringReverseFind (&quot;source&quot;, &quot;target&quot;)</td>
</tr>
<tr>
<td>Description</td>
<td>Return the position of the last occurrence of target string in the source string. The two string parameters accept both static string (in the form: &quot;source&quot;) and char array (in the form: source[start]). This function returns the zero-based index of the first character of substring in the source string that matches the target string. Notice that the entire sequence of characters to find must be matched. If there exists multiple substrings that matches the target string, function will return the position of the last matched substring. If there is no matched substring, it returns -1.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()&lt;br&gt;char src1[20]=&quot;abcdeabcde&quot;&lt;br&gt;char target1[20]=&quot;cd&quot;&lt;br&gt;short pos1&lt;br&gt;pos1 = StringReverseFind(src1[0], target1[0])&lt;br&gt;    // pos1=7&lt;br&gt;char target2[20]=&quot;ce&quot;&lt;br&gt;short pos2&lt;br&gt;pos2 = StringReverseFind(&quot;abcdeabcde&quot;, target2[0])&lt;br&gt;    // pos2=-1&lt;br&gt;char src3[20]=&quot;abcdeabcde&quot;&lt;br&gt;short pos3&lt;br&gt;pos3 = StringReverseFind(src3[6], &quot;ab&quot;)&lt;br&gt;    // pos3=-1&lt;br&gt;end macro_command</td>
</tr>
<tr>
<td><strong>Name</strong></td>
<td>StringFindOneOf</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------</td>
</tr>
</tbody>
</table>
| **Syntax**  | position = StringFindOneOf (source[start], target[start])
|             | position = StringFindOneOf ("source", target[start])
|             | position = StringFindOneOf (source[start], "target")
|             | position = StringFindOneOf ("source", "target") |
| **Description** | Return the position of the first character in the source string that matches any character contained in the target string. The two string parameters accept both static string (in the form: "source") and char array (in the form: source[start]). This function returns the zero-based index of the first character in the source string that is also in the target string. If there is no match, it returns -1. |
| **Example** | macro_command main()
|             | char src1[20]="abcdeabcde"
|             | char target1[20]="sdf"
|             | short pos1
|             | pos1= StringFindOneOf(src1[0], target1[0])
|             | // pos1=3
|             | char src2[20]="abcdeabcde"
|             | short pos2
|             | pos2= StringFindOneOf(src2[1], "agi")
|             | // pos2=4
|             | char target3 [20]="bus"
|             | short pos3
|             | pos3= StringFindOneOf("abcdeabcde", target3[1])
|             | // pos3=-1
<p>|             | end macro_command |</p>
<table>
<thead>
<tr>
<th>Name</th>
<th>StringIncluding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>success = StringIncluding (source[start], set[start], destination[start])</td>
</tr>
<tr>
<td></td>
<td>success = StringIncluding (&quot;source&quot;, set[start], destination[start])</td>
</tr>
<tr>
<td></td>
<td>success = StringIncluding (source[start], &quot;set&quot;, destination[start])</td>
</tr>
<tr>
<td></td>
<td>success = StringIncluding (&quot;source&quot;, &quot;set&quot;, destination[start])</td>
</tr>
<tr>
<td>Description</td>
<td>Retrieve a substring of the source string that contains characters in the set string, beginning with the first character in the source string and ending when a character is found in the source string that is not in the target string. The source string and set string parameters accept both static string (in the form: &quot;source&quot;) and char array (in the form: source[start]). This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of retrieved substring exceeds the size of destination buffer, it returns false.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>char src1[20]=&quot;cabbageabc&quot;</td>
</tr>
<tr>
<td></td>
<td>char set1[20]=&quot;abc&quot;</td>
</tr>
<tr>
<td></td>
<td>char dest1[20]</td>
</tr>
<tr>
<td></td>
<td>bool success1</td>
</tr>
<tr>
<td></td>
<td>success1 = StringIncluding(src1[0], set1[0], dest1[0])</td>
</tr>
<tr>
<td></td>
<td>// success1=true, dest1=&quot;cabba&quot;</td>
</tr>
<tr>
<td></td>
<td>char src2[20]=&quot;gecabba&quot;</td>
</tr>
<tr>
<td></td>
<td>char dest2[20]</td>
</tr>
<tr>
<td></td>
<td>bool success2</td>
</tr>
<tr>
<td></td>
<td>success2 = StringIncluding(src2[0], &quot;abc&quot;, dest2[0])</td>
</tr>
<tr>
<td></td>
<td>// success2=true, dest2=&quot;&quot;</td>
</tr>
<tr>
<td></td>
<td>char set3[20]=&quot;abc&quot;</td>
</tr>
<tr>
<td></td>
<td>char dest3[4]</td>
</tr>
<tr>
<td></td>
<td>bool success3</td>
</tr>
<tr>
<td></td>
<td>success3 = StringIncluding(&quot;cabbage&quot;, set3[0], dest3[0])</td>
</tr>
<tr>
<td></td>
<td>// success3=false, dest3 remains the same.</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>
### Name
StringExcluding

### Syntax
success = StringExcluding (source[0], set[0], destination[0])
success = StringExcluding ("source", set[0], destination[0])
success = StringExcluding (source[0], "set", destination[0])
success = StringExcluding ("source", "set", destination[0])

### Description
Retrieve a substring of the source string that contains characters that are not in the set string, beginning with the first character in the source string and ending when a character is found in the source string that is also in the target string. The source string and set string parameters accept both static string (in the form: "source") and char array (in the form: source[0]). This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of retrieved substring exceeds the size of destination buffer, it returns false.

### Example
```cpp
macro_command main()
    char src1[20]="cabbageabc"
    char set1[20]="ge"
    char dest1[20]
    bool success1
    success1 = StringExcluding(src1[0], set1[0], dest1[0])
    // success1=true, dest1="cabba"

    char src2[20]="cabbage"
    char dest2[20]
    bool success2
    success2 = StringExcluding(src2[0], "abc", dest2[0])
    // success2=true, dest2=""

    char set3[20]="ge"
    char dest3[4]
    bool success3
    success3 = StringExcluding("cabbage", set3[0], dest3[0])
    // success3=false, dest3 remains the same.
end macro_command
```
### StringToUpper

**Name**  
StringToUpper

**Syntax**  
```python
success = StringToUpper (source[start], destination[start])  
success = StringToUpper ("source", destination[start])
```

**Description**  
Convert all the characters in the source string to uppercase characters and store the result in the destination buffer. The source string parameter accepts both static string (in the form: "source") and char array (in the form: source[start]). This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of result string after conversion exceeds the size of destination buffer, it returns false.

**Example**  
```python
macro_command main()  
char src1[20]="aBcDe"  
char dest1[20]  
bool success1  
success1 = StringToUpper(src1[0], dest1[0])  
    // success1=true, dest1="ABCDE"  
    char dest2[4]  
    bool success2  
success2 = StringToUpper("aBcDe", dest2[0])  
    // success2=false, dest2 remains the same.
end macro_command
```

### StringToLower

**Name**  
StringToLower

**Syntax**  
```python
success = StringToLower (source[start], destination[start])  
success = StringToLower ("source", destination[start])
```

**Description**  
Convert all the characters in the source string to lowercase characters and store the result in the destination buffer. The source string parameter accepts both static string (in the form: "source") and char array (in the form: source[start]). This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of result string after conversion exceeds the size of destination buffer, it returns false.
Example

```cpp
macro_command main()
char src1[20]="aBcDe"
char dest1[20]
bool success1
success1 = StringToLower(src1[0], dest1[0])
// success1=true, dest1="abcde"

char dest2[4]
bool success2
success2 = StringToLower("aBcDe", dest2[0])
// success2=false, dest2 remains the same.
end macro_command
```

<table>
<thead>
<tr>
<th>Name</th>
<th>StringToReverse</th>
</tr>
</thead>
</table>
| Syntax        | success = StringToReverse (source[start], destination[start])
|               | success = StringToReverse ("source", destination[start]) |
| Description   | Reverse the characters in the source string and store it in the destination buffer. The source string parameter accepts both static string (in the form: "source") and char array (in the form: source[start]). This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of reversed string exceeds the size of destination buffer, it returns false. |
| Example       | macro_command main()
|               | char src1[20]="abcde"
|               | char dest1[20]
|               | bool success1
|               | success1 = StringToReverse(src1[0], dest1[0])
|               | // success1=true, dest1="edcba"
|               | char dest2[4]
|               | bool success2
|               | success2 = StringToReverse("abcde", dest2[0])
|               | // success2=false, dest2 remains the same. |
end macro_command
# StringTrimLeft

## Syntax

```c
success = StringTrimLeft (source[start], set[start], destination[start])
success = StringTrimLeft ("source", set[start], destination[start])
success = StringTrimLeft (source[start], "set", destination[start])
success = StringTrimLeft ("source", "set", destination[start])
```

## Description
Trim the leading specified characters in the set buffer from the source string. The source string and set string parameters accept both static string (in the form: “source”) and char array (in the form: source[start]). This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of trimmed string exceeds the size of destination buffer, it returns false.

## Example

```c
macro_command main()
    char src1[20]= '# *a*#bc'
    char set1[20]="# *
    char dest1[20]
    bool success1
    success1 = StringTrimLeft (src1[0], set1[0], dest1[0])
    // success1=true, dest1="a*#bc"

    char src2[20]=\{#', ', '*\}
    char dest2[4]
    bool success2
    success2 = StringTrimLeft ("# *a*#bc", set2[0], dest2[0])
    // success2=false, dest2 remains the same.

    char src3[20]="abc *#"
    char dest3[20]
    bool success3
    success3 = StringTrimLeft (src3[0], "# *", dest3[0])
    // success3=true, dest3="abc *#"

end macro_command
```
<table>
<thead>
<tr>
<th>Name</th>
<th>StringTrimRight</th>
</tr>
</thead>
</table>
| Syntax       | success = StringTrimRight (source[start], set[start], destination[start])  
success = StringTrimRight ("source", set[start], destination[start])  
success = StringTrimRight (source[start], "set", destination[start])  
success = StringTrimRight ("source", "set", destination[start]) |
| Description  | Trim the trailing specified characters in the set buffer from the source string. The source string and set string parameters accept both static string (in the form: “source”) and char array (in the form: source[start]). This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of trimmed string exceeds the size of destination buffer, it returns false. |
| Example      | macro_command main()  
char src1[20]="# *a*#bc# * "  
char set1[20]="# *"  
char dest1[20]  
bool success1  
success1 = StringTrimRight(src1[0], set1[0], dest1[0])  
// success1=true, dest1="# *a*#bc"  
char set2[20]={"#", ",", ",*"}  
char dest2[20]  
bool success2  
success2 = StringTrimRight("# *a*#bc", set2[0], dest2[0])  
// success2=true, dest2="# *a*#bc"  
char src3[20]="ab**c *#"  
char dest3[4]  
bool success3  
success3 = StringTrimRight(src3[0], "# *", dest3[0])  
// success3=false, dest3 remains the same.  
end macro_command |
<table>
<thead>
<tr>
<th>Name</th>
<th>StringInsert</th>
</tr>
</thead>
</table>
| Syntax       | success = StringInsert (pos, insert[start], destination[start])  
               success = StringInsert (pos, “insert”, destination[start])  
               success = StringInsert (pos, insert[start], length, destination[start])  
               success = StringInsert (pos, “insert”, length, destination[start]) |
| Description  | Insert a string in a specific location within the destination string content. The insert location is specified by the pos parameter. The insert string parameter accepts both static string (in the form: “source”) and char array (in the form: source[start]). The number of characters to insert can be specified by the length parameter. This function returns a Boolean indicating whether the process is successfully done or not. If successful, it returns true, otherwise it returns false. If the length of string after insertion exceeds the size of destination buffer, it returns false. |
| Example      | macro_command main() |
|              | char str1[20]="but the question is"  
               char str2[10]=", that is"  
               char dest[40]="to be or not to be"  
               bool success  
               success = StringInsert(18, str1[3], 13, dest[0])  
               // success=true, dest="to be or not to be the question" |
|              | success = StringInsert(18, str2[0], dest[0])  
               // success=true, dest="to be or not to be, that is the question" |
|              | success = StringInsert(0, "Hamlet:", dest[0])  
               // success=false, dest remains the same. |
|              | end macro_command |

<table>
<thead>
<tr>
<th>Name</th>
<th>String2Unicode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>result = String2Unicode(&quot;source&quot;, destination[start])</td>
</tr>
<tr>
<td>Description</td>
<td>Convert all the characters in the source string to Unicode and store the result in the destination buffer. The length of result string after conversion will be stored to result. Source must be a constant but not a variable.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
</tbody>
</table>
|              | char dest[20]  
               int result  
               result = String2Unicode("abcde", dest[0])  
               // "result" will be set to 10.  
               result = String2Unicode("abcdefghijklmno", dest[0])  
               // "result" will be set to 20.  
               // "result" will be the length of converted Unicode string |
18.7.7. Recipe Query Function

<table>
<thead>
<tr>
<th>Name</th>
<th>RecipeGetData</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>RecipeGetData(destination, recipe_address, record_ID)</td>
</tr>
<tr>
<td>Description</td>
<td>Get Recipe Data. The gained data will be stored in destination, and must be a variable. recipe_address consists of recipe name and item name: &quot;recipe_name.item_name&quot;. record_ID specifies the ID number of the record in recipe being gained.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>int data=0</td>
</tr>
<tr>
<td></td>
<td>char str[20]</td>
</tr>
<tr>
<td></td>
<td>int recordID</td>
</tr>
<tr>
<td></td>
<td>bool result</td>
</tr>
<tr>
<td></td>
<td>recordID = 0</td>
</tr>
<tr>
<td></td>
<td>result = RecipeGetData(data, &quot;TypeA.item_weight&quot;, recordID)</td>
</tr>
<tr>
<td></td>
<td>// From recipe &quot;TypeA&quot; get the data of the item &quot;item_weight&quot; in record 0.</td>
</tr>
<tr>
<td></td>
<td>recordID = 1</td>
</tr>
<tr>
<td></td>
<td>result = RecipeGetData(str[0], &quot;TypeB.item_name&quot;, recordID)</td>
</tr>
<tr>
<td></td>
<td>// From recipe &quot;TypeB&quot; get the data of the item &quot;item_name&quot; in record 1.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>RecipeQuery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>RecipeQuery (SQL_command, destination)</td>
</tr>
<tr>
<td>Description</td>
<td>Use SQL statement to query recipe data. The number of records of query result will be stored in the destination. This must be a variable. SQL command can be static string or char array. Example: RecipeQuery(&quot;SELECT * FROM TypeA&quot;, destination) or RecipeQuery(sql[0], destination) SQL statement must start with &quot;SELECT * FROM&quot; followed by recipe name and query condition.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>int total_row=0</td>
</tr>
<tr>
<td></td>
<td>char sql[100]=&quot;SELECT * FROM TypeB&quot;</td>
</tr>
<tr>
<td></td>
<td>short var</td>
</tr>
<tr>
<td></td>
<td>bool result</td>
</tr>
<tr>
<td></td>
<td>result = RecipeQuery(&quot;SELECT * FROM TypeA&quot;, total_row)</td>
</tr>
<tr>
<td></td>
<td>// Query Recipe &quot;TypeA&quot;. Store the number of records of query result in total_row.</td>
</tr>
</tbody>
</table>
result = RecipeQuery(sql[0], total_row)
// Query Recipe "TypeB". Store the number of records of query result in total_row.

result = RecipeQuery("SELECT * FROM Recipe WHERE Item >%(var)", total_row)
// Query "Recipe", where "Item" is larger than var. Store the number of records of query result in total_row.

dend macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>RecipeQueryGetData</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>RecipeQueryGetData (destination, recipe_address, result_row_no)</td>
</tr>
<tr>
<td>Description</td>
<td>Get the data in the query result obtained by RecipeQuery. This function must be called after calling RecipeQuery, and specify the same recipe name in recipe_address as RecipeQuery. result_row_no specifies the sequence row number in query result</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>int data=0</td>
</tr>
<tr>
<td></td>
<td>int total_row=0</td>
</tr>
<tr>
<td></td>
<td>int row_number=0</td>
</tr>
<tr>
<td></td>
<td>bool result_query</td>
</tr>
<tr>
<td></td>
<td>bool result_data</td>
</tr>
<tr>
<td></td>
<td>result_query = RecipeQuery(&quot;SELECT * FROM TypeA&quot;, total_row)</td>
</tr>
<tr>
<td></td>
<td>// Query Recipe &quot;TypeA&quot;. Store the number of records of query result in total_row.</td>
</tr>
<tr>
<td></td>
<td>if (result_query) then</td>
</tr>
<tr>
<td></td>
<td>for row_number=0 to total_row-1</td>
</tr>
<tr>
<td></td>
<td>result_data = RecipeQueryGetData(data, &quot;TypeA.item_weight&quot;, row_number)</td>
</tr>
<tr>
<td></td>
<td>next row_number</td>
</tr>
<tr>
<td></td>
<td>end if</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>RecipeQueryGetRecordID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>RecipeQueryGetRecordID (destination, result_row_no)</td>
</tr>
<tr>
<td>Description</td>
<td>Get the record ID numbers of those records gained by RecipeQuery. This function must be called after calling RecipeQuery. result_row_no specifies the sequence row number in query result, and write the obtained record ID to destination.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>int recordID=0</td>
</tr>
<tr>
<td></td>
<td>int total_row=0</td>
</tr>
<tr>
<td></td>
<td>int row_number=0</td>
</tr>
</tbody>
</table>
bool result_query
bool result_id

result_query = RecipeQuery("SELECT * FROM TypeA", total_row)
// Query Recipe "TypeA". Store the number of records of query result in total_row.
if (result_query) then
  for row_number=0 to total_row-1
    result_id = RecipeQueryGetRecordID(recordID, row_number)
  end for
end if

end macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>RecipeSetData</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>RecipeSetData(source, recipe address, record_ID)</td>
</tr>
<tr>
<td>Description</td>
<td>Write data to recipe. If success, returns true, else, returns false. recipe address consists of recipe name and item name: &quot;recipe_name.item_name&quot;. record_ID specifies the ID number of the record in recipe being modified.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>int data=99</td>
</tr>
<tr>
<td></td>
<td>char str[20]=&quot;abc&quot;</td>
</tr>
<tr>
<td></td>
<td>int recordID</td>
</tr>
<tr>
<td></td>
<td>bool result</td>
</tr>
<tr>
<td></td>
<td>recordID = 0</td>
</tr>
<tr>
<td></td>
<td>result = RecipeSetData(data, &quot;TypeA.item_weight&quot;, recordID)</td>
</tr>
<tr>
<td></td>
<td>// set data to recipe &quot;TypeA&quot;, where item name is &quot;item_weight&quot; and the record ID is 0.</td>
</tr>
<tr>
<td></td>
<td>recordID = 1</td>
</tr>
<tr>
<td></td>
<td>result = RecipeSetData(str[0], &quot;TypeB.item_name&quot;, recordID)</td>
</tr>
<tr>
<td></td>
<td>// set data to recipe &quot;TypeB&quot;, where item name is &quot;item_name&quot; and the record ID is 1.</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>

18.7.8. Miscellaneous

<table>
<thead>
<tr>
<th>Name</th>
<th>Beep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>Beep ()</td>
</tr>
<tr>
<td>Description</td>
<td>Plays beep sound. This command plays a beep sound with frequency of 800 hertz and duration of 30 milliseconds.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
</tbody>
</table>
### Beep()

eend macro_command

<table>
<thead>
<tr>
<th>Name</th>
<th>Buzzer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>Buzzer ()</td>
</tr>
<tr>
<td>Description</td>
<td>Turn ON / OFF the buzzer.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>char on = 1, off = 0</td>
</tr>
<tr>
<td></td>
<td>Buzzer(on) // turn on the buzzer</td>
</tr>
<tr>
<td></td>
<td>DELAY(1000) // delay 1 second</td>
</tr>
<tr>
<td></td>
<td>Buzzer(off) // turn off the buzzer</td>
</tr>
<tr>
<td></td>
<td>DELAY(500) // delay 500ms</td>
</tr>
<tr>
<td></td>
<td>Buzzer(1) // turn on the buzzer</td>
</tr>
<tr>
<td></td>
<td>DELAY(1000) // delay 1 second</td>
</tr>
<tr>
<td></td>
<td>Buzzer(0) // turn off the buzzer</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>

### SYNC_TRIG_MACRO

<table>
<thead>
<tr>
<th>Name</th>
<th>SYNC_TRIG_MACRO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>SYNC_TRIG_MACRO(macro_id or name)</td>
</tr>
<tr>
<td>Description</td>
<td>Trigger the execution of a macro synchronously (use macro_id or macro name to designate this macro) in a running macro. The current macro will pause until the end of execution of this called macro. macro_id can be a constant or a variable.</td>
</tr>
<tr>
<td>Example</td>
<td>macro_command main()</td>
</tr>
<tr>
<td></td>
<td>char ON = 1, OFF = 0</td>
</tr>
<tr>
<td></td>
<td>SetData(ON, &quot;Local HMI&quot;, LB, 0, 1)</td>
</tr>
<tr>
<td></td>
<td>SYNC_TRIG_MACRO(5) // call a macro (its ID is 5)</td>
</tr>
<tr>
<td></td>
<td>SYNC_TRIG_MACRO(&quot;macro_1&quot;) // call a macro (its name is macro_1)</td>
</tr>
<tr>
<td></td>
<td>SetData(OFF, &quot;Local HMI&quot;, LB, 0, 1)</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>
### NAME

<table>
<thead>
<tr>
<th>Name</th>
<th>ASYNC_TRIG_MACRO</th>
</tr>
</thead>
</table>

| Syntax        | ASYNC_TRIG_MACRO (macro_id or name) |

| Description   | Trigger the execution of a macro asynchronously (use macro_id or macro name to designate this macro) in a running macro. The current macro will continue executing the following instructions after triggering the designated macro; in other words, the two macros will be active simultaneously. macro_id can be a constant or a variable. |

<table>
<thead>
<tr>
<th>Example</th>
<th>macro_command main()</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>char ON = 1, OFF = 0</td>
</tr>
<tr>
<td></td>
<td>SetData(ON, &quot;Local HMI&quot;, LB, 0, 1)</td>
</tr>
<tr>
<td></td>
<td>ASYNC_TRIG_MACRO(5) // call a macro (its ID is 5)</td>
</tr>
<tr>
<td></td>
<td>ASYNC_TRIG_MACRO(&quot;macro_1&quot;) // call a macro (its name is macro_1)</td>
</tr>
<tr>
<td></td>
<td>SetData(OFF, &quot;Local HMI&quot;, LB, 0, 1)</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>

### NAME

<table>
<thead>
<tr>
<th>Name</th>
<th>TRACE</th>
</tr>
</thead>
</table>

| Syntax        | TRACE(format, argument) |

| Description   | Use this function to send specified string to the EasyDiagnoser. Users can print out the current value of variables during run-time of macro for debugging. When TRACE encounters the first format specification (if any), it converts the value of the first argument after format and outputs it accordingly. format refers to the format control of output string. A format specification, which consists of optional ([ ]) and required fields (in bold), has the following form: 

%[flags] [width] [.precision] type

Each field of the format specification is described as below: 

- **flags** (optional):
  - -
  - +

- **width** (optional):
  A nonnegative decimal integer controlling the minimum number of characters printed.

- **precision** (optional):
  A nonnegative decimal integer which specifies the precision and the number of characters to be printed.

- **type**:
  - C or c : specifies a single-byte character.
  - d : signed decimal integer.
  - i : signed decimal integer.
  - o : unsigned octal integer.
  - u : unsigned decimal integer.
  - X or x : unsigned hexadecimal integer. |

<table>
<thead>
<tr>
<th>Example</th>
<th>macro_command main()</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>char ON = 1, OFF = 0</td>
</tr>
<tr>
<td></td>
<td>SetData(ON, &quot;Local HMI&quot;, LB, 0, 1)</td>
</tr>
<tr>
<td></td>
<td>ASYNC_TRIG_MACRO(5) // call a macro (its ID is 5)</td>
</tr>
<tr>
<td></td>
<td>ASYNC_TRIG_MACRO(&quot;macro_1&quot;) // call a macro (its name is macro_1)</td>
</tr>
<tr>
<td></td>
<td>SetData(OFF, &quot;Local HMI&quot;, LB, 0, 1)</td>
</tr>
<tr>
<td></td>
<td>end macro_command</td>
</tr>
</tbody>
</table>
E or e  : Signed value having the form. [ − ]d.dddd e [sign]ddd where d is a single decimal digit, dddd is one or more decimal digits, ddd is exactly three decimal digits, and sign is + or −.

f     : Signed value having the form [ − ]ddd.dddd, where dddd is one or more decimal digits.

The length of output string is limited to 256 characters. The extra characters will be ignored.
The argument part is optional. One format specification converts exactly one argument.

Example

macro_command main()
    char c1 = 'a'
    short s1 = 32767
    float f1 = 1.234567
    TRACE("The results are") // output: The results are
    TRACE("c1 = %c, s1 = %d, f1 = %f", c1, s1, f1)
    // output: c1 = a, s1 = 32767, f1 = 1.234567
end macro_command

Name | FindDataSamplingDate

Syntax

return_value = FindDataSamplingDate (data_log_number, index, year, month, day)
or
FindDataSamplingDate (data_log_number, index, year, month, day)

Description

A query function for finding the date of specified data sampling file according to the data sampling no. and the file index. The date is stored into year, month and day respectively in the format of YYYY, MM and DD.

Data sampling no.

The directory of saved data: [Storage location]\[filename]\yyyyymmdd.dtl. The data sampling files under the same directory are sorted according to the file name and are indexed starting from 0. The most recently saved file has the smallest file index number. For example, if there are four data sampling files as follows:
20101210.dtl
20101230.dtl
20110110.dtl
20110111.dtl
The file index are:
20101210.dtl -> index is 3
20101230.dtl -> index is 2
20110110.dtl -> index is 1
20110111.dtl -> index is 0
**return_value** equals to 1 if referred data sampling file is successfully found, otherwise it equals to 0.

`data_log_number` and `index` can be constant or variable. `year`, `month`, `day` and `return_value` must be variable. `return_value` is optional.

**Example**

```cpp
macro_command main()
    short data_log_number = 1, index = 2, year, month, day
    short success

    // if there exists a data sampling file named 20101230.dtl, with data sampling number 1 and file index 2.
    // the result after execution: success == 1, year == 2010, month == 12 and day == 30
    success = FindDataSamplingDate(data_log_number, index, year, month, day)
end macro_command
```

**Name** FindDataSamplingIndex

**Syntax**

```
return_value = FindDataSamplingIndex (data_log_number, year, month, day, index)
or
FindDataSamplingIndex (data_log_number, year, month, day, index)
```

**Description**

A query function for finding the file index of specified data sampling file according to the data sampling no. and the date. The file index is stored into index. year, month and day are in the format of YYYY, MM and DD respectively.

The directory of saved data: [Storage location]\[filename]\yyyymmdd.dtl. The data sampling files under the same directory are sorted according to the file name and are indexed starting from 0. The most recently saved file has the smallest file index number. For example, if there are four data sampling files as follows:

- 20101210.dtl
- 20101230.dtl
- 20110110.dtl
- 20110111.dtl

The file index are:

- 20101210.dtl -> index is 3
- 20101230.dtl -> index is 2
- 20110110.dtl -> index is 1
- 20110111.dtl -> index is 0

`return_value` equals to 1 if referred data sampling file is successfully found, otherwise it equals to 0.

`data_log_number`, `year`, `month` and `day` can be constant or variable. `index` and `return_value` must be variable. `return_value` is optional.
Example

```c
macro_command main()
short data_log_number = 1, year = 2010, month = 12, day = 10, index
short success

// if there exists a data sampling file named 20101210.dtl, with data sampling //
// number 1 and file index 2.
// the result after execution: success == 1 and index == 2
success = FindDataSamplingIndex (data_log_number, year, month, day, index)
end macro_command
```

Name | FindEventLogDate
--- | ---
Syntax | return_value = FindEventLogDate (index, year, month, day)
 | or
 | FindEventLogDate (index, year, month, day)

Description

A query function for finding the date of specified event log file according to file index. The date is stored into year, month and day respectively in the format of YYYY, MM and DD.

The event log files stored in the designated position (such as HMI memory storage or external memory device) are sorted according to the file name and are indexed starting from 0. The most recently saved file has the smallest file index number. For example, if there are four event log files as follows:

- EL_20101210.evt
- EL_20101230.evt
- EL_20110110.evt
- EL_20110111.evt

The file index are:

- EL_20101210.evt -> index is 3
- EL_20101230.evt -> index is 2
- EL_20110110.evt -> index is 1
- EL_20110111.evt -> index is 0

`return_value` equals to 1 if referred data sampling file is successfully found, otherwise it equals to 0.

`index` can be constant or variable. `year, month, day` and `return_value` must be variable. `return_value` is optional.

Example

```c
macro_command main()
short index = 1, year, month, day
short success

// if there exists an event log file named EL_20101230.evt with index 1
// the result after execution: success == 1, year == 2010, month == 12, day //==
// 30
success = FindEventLogDate (index, year, month, day)
end macro_command
```
<table>
<thead>
<tr>
<th>Name</th>
<th>FindEventLogIndex</th>
</tr>
</thead>
</table>
| Syntax             | return_value = FindEventLogIndex (year, month, day, index)  
or
|                    | FindEventLogIndex (year, month, day, index) |
| Description        | A query function for finding the file index of specified event log file according to date. The file index is stored into index. year, month and day are in the format of YYYY, MM and DD respectively. The event log files stored in the designated position (such as HMI memory storage or external memory device) are sorted according to the file name and are indexed starting from 0. The most recently saved file has the smallest file index number. For example, if there are four event log files as follows: EL_20101210.evt  
EL_20101230.evt  
EL_20110110.evt  
EL_20110111.evt  
The file index are: EL_20101210.evt -> index is 3  
EL_20101230.evt -> index is 2  
EL_20110110.evt -> index is 1  
EL_20110111.evt -> index is 0  
return_value equals to 1 if referred data sampling file is successfully found, otherwise it equals to 0. index can be constant or variable. year, month, day and return_value must be variable. return_value is optional. |
| Example            | macro_command main()  
short year = 2010, month = 12, day = 10, index  
short success  
// if there exists an event log file named EL_20101210.evt, with index 2  
// the result after execution: success == 1, index == 2  
success = FindEventLogIndex (year, month, day, index)  
end macro_command |

### 18.8. How to Create and Execute a Macro

#### 18.8.1. How to Create a Macro

Please follow the steps below to create a macro.

1. Click [Project] » [Macro] to open Macro Manager dialog box.
In Macro Manager, all macros compiled successfully are displayed in “Macro list”, and all macros under development or cannot be compiled are displayed in “Macro under development”. The following is a description of the various buttons.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>Opens a blank “WorkSpace” editor for creating a new macro.</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the selected macro.</td>
</tr>
<tr>
<td>Edit</td>
<td>Opens the “WorkSpace” editor, and loads the selected macro.</td>
</tr>
<tr>
<td>Copy</td>
<td>Copies the selected macro into the clipboard.</td>
</tr>
<tr>
<td>Paste</td>
<td>Pastes the macro in the clipboard into the list, and creates a new name for the macro.</td>
</tr>
<tr>
<td>Export</td>
<td>Save the selected macro as *.edm file.</td>
</tr>
<tr>
<td>Import</td>
<td>Import an *.edm file to the project.</td>
</tr>
<tr>
<td>Library</td>
<td>Open Macro Function Library managing dialog.</td>
</tr>
</tbody>
</table>
2. Press the [New] button to create an empty macro and open the macro editor. Every macro has a unique number defined at [Macro ID], and must have a macro name, otherwise an error will appear while compiling.

3. Design your macro. To use built-in functions (like SetData() or GetData()), press [Get/Set FN...] button to open API dialog box and select the function and set essential parameters.
4. After the completion of a new macro, press [Compile] button to compile the macro.

5. If there is no error, press [Exit] button and a new macro “macro_test” will be in “Macro list”.
18.8.2. Execute a Macro

There are several ways to execute a macro.

- Use a PLC Control object
  1. Open [PLC Control] and add one PLC Control object with the [Type of control] as [Execute macro program].
  2. Select the macro in [Macro name]. Choose a bit and select a trigger condition to trigger the macro. In order to guarantee that the macro will run only once, consider latching the trigger bit, and then resetting the trigger condition within the macro.
  3. Use a [Set Bit] or Toggle Switch object to change the bit to activate the macro.

- Use a [Set Bit] or Toggle Switch object
  2. Select the macro to execute. The macro will be executed one time when the button is activated.

- Use a Function Key object
  2. Select the macro to execute. The macro will execute one time when the button is activated.

- In macro editor, use
  1. [Periodical Execution]: Macro will be triggered periodically.
  2. [Execute one time when HMI starts]: Macro will be executed once HMI starts.

- In Window Settings, Macro group box
  1. [Open]: When the window opens, run the selected macro once.
  2. [Cycle]: When the window opens, run the selected macro every 0.5 second.
  3. [Close]: When the window closes, run the selected macro once.

18.9. User Defined Macro Function

When editing Macro, to save time of defining functions, user may search for the needed from built-in Macro Function Library. However, certain functions, though frequently used, may not be found there. In this case, user may define the needed function and save it for future use. Next time when the same function is required, the saved functions can be called from [Macro Function Library] for easier editing. Additionally, [Macro Function Library] greatly enhances the portability of user-defined functions. Before building a function please check the built-in
functions or online function library to see if it exists.

18.9.1. Import Function Library File

Open a project in HMI programming software, the default Function Library File will be read automatically and the function information will be loaded in. At this moment if a user-defined function is called, the relevant .mlb file must be imported first.

1. Default Function Library File Name: MacroLibrary (without filename extension)
2. Function Library Directory: HMI programming software installation directory\library (folder)
3. \library (folder) contains two types of function library files:
   Without filename extension: MacroLibrary, the Default Function Library for HMI programming software to read at the beginning.
   With filename extension (.mlb): Such as "math.mlb". The files to be read / written when users import / export. These files are portable and can be called from the folder when
needed.

4. When opening HMI programming software, only the functions in Default Function Library will be loaded in, to use functions in .mlb files, please import them first.

18.9.2. How to Use Macro Function Library

1. Select the function directly from Macro Function Library.

2. In WorkSpace click [GET/SET FN...] to open API dialog box.
3. At least check one from [Library] or [Build-in] and select the function to be used.

4. The description displayed in API dialog box is the same as written in Function Editor.
5. Select the function to be used, fill in the corresponding variables according to the data type.

```plaintext
macro_command main()
short a
int b, result
add2(short, int)  \(\rightarrow\) result = add2(a, b)
end macro_command
```

6. Upon completion of the steps above, user-defined functions can be used freely without defining the same functions repeatedly.

18.9.3. **Function Library Management Interface**

2. A list of functions is shown. When the project is opened, the software will load all the functions in the Macro Function Library.

3. Each listed function has the following format:

```
return_type function_name ( parameter_type1, ..., parameter_typeN)
```

return_type indicates the type of the return value. If this value does not exist, this column will be omitted. function_name indicates the name of the function. “N” in parameter_typeN stands for the number of parameter types. If this function does not
need any parameter, this column will be omitted.

4. Macro function can be embedded in the project file. Select the function and then click [Copy To Project], then you can find this function in [Project] tab. When opening the project on another computer, this function can still be used. When compiling the project, the .exob file will included the functions that are used. Please note that decompiling the project will only produce the macro commands that are used.

18.9.3.1. Create a Function

1. Click [New] to enter Function Editor.
2. Edit function in Function Editor.

3. Edit the function description to describe what the specification is, how to use ... etc.

4. After editing, click [Compile] and [Save] to save this function to the Library. Otherwise, a warning is shown.

5. Successfully add a function into Macro Function Library.
Note

- The total size of data type can be declared in a function is 4096 bytes.
- Function name must only contain alphanumeric characters, and cannot start with a number.

18.9.3.2. Delete a Function

1. In function list select the function to be deleted and click [Delete].

2. Click [Yes] to confirm, [No] to cancel the deletion. Click [Yes] to delete MAX_SHORT function.
18.9.3.3. Modify a Function

1. Users can modify the functions exist in the Library.
2. Select a function to modify by clicking [Edit] to enter Function Editor.
3. Double click the function to be modified can also enter Function Editor.
4. After modifying, [Compile] then [Save] before leaving.

18.9.3.4. Import a Function

1. Functions can be imported using an external .mlb file.

2. For example, import a function library “math.mlb” which contains a function “test1”. Click [Open].
3. When importing a function which already exists in the Library, a confirmation pop-up will be shown. The buttons are:

- [OK]: Overwrite the existing function with the imported one.
- [NO]: Cancel the importing of the function with the same name.
- [Yes to all]: Overwrite using all the imported functions with the same name.
- [No to all]: Cancel the importing of all the functions with the same name.

4. The imported functions will be saved in Default Function Library, so if “math.mlb” file is deleted, “test1” will still exist in the Library, even restarting EasyBuilder Pro.
18.9.3.5. Export a Function

1. Export the function from Function Library and save as .mlb file. Click [Export].

2. Select the function to be exported, and click [Export].

3. A “math.mlb” file can be found under export directory. This file contains 4 functions: ADD, SUBS, MUL, and DIV.

4. The exported .mlb file can be imported on another PC. Open HMI programming software, import, then the functions in this file can be used.
18.10. Some Notes about Using the Macro

1. The maximum storage space of local variables in a macro is 4K bytes. So the maximum array size of different variable types are as follows:

   - `char` a[4096]
   - `bool` b[4096]
   - `short` c[2048]
   - `int` d[1024]
   - `float` e[1024]

2. A maximum of 255 macros are allowed in an EasyBuilder Pro project.
3. A macro may cause the HMI unresponsive. Possible reasons are:
   - A macro contains an infinite loop with no PLC communication.
   - The size of an array exceeds the storage space in a macro.
4. The PLC communication speed affects the running time for the macro to execute. Also, too many macros may slow down the communication between HMI and PLC.

18.11. Use the Free Protocol to Control a Device

If EasyBuilder Pro does not provide a driver for a specific device, users can use OUTPORT and INPORT built-in functions to control the device. The data sent by OUTPORT and INPORT must follow the communication protocol of the device. The following example explains how to use these two functions to control a MODBUS RTU device.

1. First, create a new device in the device table. The device type of the new device is set to “Free Protocol” and named with “MODBUS RTU device” as follows:
2. The interface of the device (PLC I/F) uses [RS-232]. If a MODBUS TCP/IP device is connected, the interface should be [Ethernet] with correct IP and port number as follows:

Suppose that the HMI will read the data of 4x_1 and 4x_2 on the device. First, utilize OUTPORT to send out a read request to the device. The format of OUTPORT is:

```
OUTPORT(command[start], device_name, cmd_count)
```

Since “MODBUS RTU device” is a MODBUS RTU device, the read request must follow MODBUS RTU protocol. The request uses “Reading Holding Registers (0x03)” command to read data. The following picture displays the content of the command. (The items of the station number (byte 0) and the last two bytes (CRC) are ignored).
Depending on the protocol, the content of a read command as follows (The total is 8 bytes):

- **command[0]**: station number  
  (BYTE 0)
- **command[1]**: function code  
  (BYTE 1)
- **command[2]**: high byte of starting address  
  (BYTE 2)
- **command[3]**: low byte of starting address  
  (BYTE 3)
- **command[4]**: high byte of quantity of registers  
  (BYTE 4)
- **command[5]**: low byte of quantity of registers  
  (BYTE 5)
- **command[6]**: low byte of 16-bit CRC  
  (BYTE 6)
- **command[7]**: high byte of 16-bit CRC  
  (BYTE 7)

So a read request is designed as follows:

```c
char command[32]  // initialize command[0]~command[31] to 0

command[0] = 0x1  // station number
command[1] = 0x3  // read holding registers (function code is 0x3)

address = // starting address (4x_1) is 0
HIBYTE(address, command[2])
LOBYTE(address, command[3])

read_no = 2  // the total words of reading is 2 words
HIBYTE(read_no, command[4])
LOBYTE(read_no, command[5])

CRC(command[0], checksum, 6)  // calculate 16-bit CRC

LOBYTE(checksum, command[6])
HIBYTE(checksum, command[7])
```

Lastly, use OUPORT to send out this read request to PLC.

```c
OUTPORT(command[0], ’MODBUS RTU Device’, 8)  // send read request
```

After sending out the request, use INPORT to get the response from PLC. Depending on the protocol, the content of the response is as follows (the total byte is 9):

<table>
<thead>
<tr>
<th>Response Field</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>1 Byte</td>
<td>0x03</td>
</tr>
<tr>
<td>Start Address</td>
<td>2 Bytes</td>
<td>0x0000 to 0xFFFF</td>
</tr>
<tr>
<td>Quantity of Registers</td>
<td>2 Bytes</td>
<td>1 to 125 (0x7D)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error code</td>
<td>1 Byte</td>
<td>0x83</td>
</tr>
<tr>
<td>Exception Code</td>
<td>1 Byte</td>
<td>01 or 02 or 03 or 04</td>
</tr>
</tbody>
</table>
command[0]: station number  (BYTE 0)
command[1]: function code   (BYTE 1)
command[2]: byte count       (BYTE 2)
command[3]: high byte of 4x_1 (BYTE 3)
command[4]: low byte of 4x_1  (BYTE 4)
command[5]: high byte of 4x_2 (BYTE 5)
command[6]: high byte of 4x_2 (BYTE 6)
command[7]: low byte of 16-bit CRC (BYTE 7)
command[8]: high byte of 16-bit CRC (BYTE 8)

The format of INPORT is:

```
INPORT(response[0], "MODBUS RTU Device", 9, return_value)  // read response
```

Where the real read count is restored to the variable return_value (unit is byte). If return_value is 0, it means reading fails in executing INPORT.

According to the MODBUS RTU protocol specification, the correct response[1] must be equal to 0x03. After getting correct response, calculate the data of 4x_1 and 4x_2 and put in the data into LW-100 and LW-101 of HMI.

```
If (return_value) >0 and response[1] == 0x3) then

    SetData(read_data[0], "Local HMI", LW, 100, 2)
endif
```

The complete macro is as follows:
The following example explains how to design a request to set the status of 0x_1. The request uses "Write Single Coil(0x5)" command.

```c
// Read Holding Registers
macro_command main()

    char command[32], response[32]
    short address, checksum
    short read_no, return_value, read_data[2], i

    FILL(command[0], 0, 32) // initialize command[0]~command[31] to 0
    FILL(response[0], 0, 32)

    command[0] = 0x1 // station number
    command[1] = 0x3 // read holding registers (function code is 0x3)

    address = 0
    address = 0 // starting address (4x_1) is 0
    HIBYTE(address, command[2])
    LOBYTE(address, command[3])

    read_no = 2 // the total words of reading is 2 words
    HIBYTE(read_no, command[4])
    LOBYTE(read_no, command[5])

    CRC(command[0], checksum, 6) // calculate 16-bit CRC

    LOBYTE(checksum, command[6])
    HIBYTE(checksum, command[7])

    OUTPORT(command[0], "MODBUS RTU Device", 8) // send request
    INPORT(response[0], "MODBUS RTU Device", 9, return_value) // read response

    if (return_value > 0 and response[1] == 0x3) then

        SetData(read_data[0], "Local HMI", LW, 100, 2)
    end if
end macro_command
```
The complete macro is as follows:

```c
// Write Single Coil (ON)
macro_command main()

char command[32], response[32]
short address, checksum
short i, return_value

FILL(command[0], 0, 32) // initialize command[0]~command[31] to 0
FILL(response[0], 0, 32)

command[0] = 0x1 // station number
command[1] = 0x5 // function code: write single coil

address = 0
HIBYTE(address, command[2])
LOBYTE(address, command[3])

command[4] = 0xff // force 0x_1 on
command[5] = 0

CRC(command[0], checksum, 6)
LOBYTE(checksum, command[6])
HIBYTE(checksum, command[7])

OUTPORT(command[0], "MODBUS RTU Device", 8) // send request
INPORT(response[0], "MODBUS RTU Device", 8, return_value) // read response

end macro_command
```

### 18.12. Compiler Error Message

- **Error Message Format**
  
  error C# : error description

  (# is the error message number)
Example: error C37 : undeclared identifier : i
When there are compile errors, the description of the error can be found by the compiler error message number.

- Error Description
  (C1) syntax error : ‘identifier’
  There are many possibilities to cause compiler error.

  For example:
  ```
  macro_command main()
  char i, 123xyz    // this is an unsupported variable name
  end macro_command
  ```

  (C2) ‘identifier’ used without having been initialized
  Macro must define the size of an array during declaration.

  For example:
  ```
  macro_command main()
  char i
  int g[i]    // i must be a numeric constant
  end macro_command
  ```

  (C3) redefinition error : ‘identifier’
  The name of variable and function within its scope must be unique.

  For example:
  ```
  macro_command main()
  int g[10], g    // error
  end macro_command
  ```

  (C4) function name error : ‘identifier’
  Reserved keywords and constant cannot be the name of a function

  For example :
  ```
  sub int if()    // error
  ```

  (C5) parentheses have not come in pairs
  Statement missing “(“ or “)”
For example:
macro_command main ) // missing "("  

(C6) illegal expression without matching ‘if’
Missing expression in "if" statement

(C7) illegal expression (no ‘then’) without matching ‘if’
Missing “then” in “if” statement

(C8) illegal expression (no ‘end if’)
Missing “end if”

(C9) illegal ‘end if’ without matching ‘if’
Unfinished “If” statement before “End If”

(C10) illegal ‘else’
The format of “if” statement is:
if [logic expression] then
[ else [if [logic expression] then ] ]
end if

Any format other than this format will cause a compile error.

(C17) illegal expression (no 'for') without matching ‘next’
“for” statement error : missing “for” before “next”

(C18) illegal variable type (not integer or char)
Should be integer or char variable

(C19) variable type error
Missing assign statement

(C20) must be keyword ‘to’ or ‘down’
Missing keyword “to” or “down”

(C21) illegal expression (no 'next')
The format of “for” statement is:
for [variable] = [initial value] to [end value] [step]

next [variable]

Any format other than this format will cause a compile error.

(C22) ‘wend’ statement contains no ‘while’
“While” statement error : missing “while” before “Wend”

(C23) illegal expression without matching ‘wend’
The format of “While” statement is :

while [logic expression]

wend

Any format other than this format will cause a compile error.

(C24) syntax error : ‘break’
“break” statement can only be used in “for”, “while” statement.

(C25) syntax error : ‘continue’
“continue” statement can only be used in “for” statement, or “while” statement.

(C26) syntax error
Error in expression.

(C27) syntax error
The mismatch of an operation object in expression can cause a compile error.

For example :
macro_command main( )
int a, b
for a = 0 to 2
b = 4 + xyz // illegal : xyz is undefined
next a
end macro_command
(C28) must be ‘macro_command’
There must be ‘macro_command’

(C29) must be key word ‘sub’
The format of function declaration is:

sub [data type] function_name(...) 
...........
end sub

For example::
sub int pow(int exp)
........
end sub

format other than this format will cause a compile error.

(C30) number of parameters is incorrect
Mismatch of the number of parameters

(C31) parameter type is incorrect
Mismatch of data type of parameter. When a function is called, the data type and the number of parameters should match the declaration of function, otherwise it will cause a compile error.

(C32) variable is incorrect
The parameters of a function must be equivalent to the arguments passing to a function to avoid compile error.

(C33) function name : undeclared function

(C34) expected constant expression
Illegal array index format.

(C35) invalid array declaration

(C36) array index error

(C37) undeclared identifier : i ‘identifier’
Any variable or function should be declared before use.

(C38) un-supported PLC data address
The parameter of GetData( ...) , SetData( ...) should be legal PLC address. If the address is illegal, this error message will be shown.

(C39) ‘identifier’ must be integer, char or constant
The format of array is:
Declaration: array_name[constant] (constant is the size of the array)
Usage: array_name[integer, character or constant]
Any format other than this format will cause a compile error.

(C40) execution syntax should not exist before variable declaration or constant definition
For example:
macro_command main(    )
int a, b
for a = 0 To 2
   b = 4 + a
int h , k  //  illegal – definitions must occur before any statements or expressions
   //  for example, b = 4 + a
next a
end macro_command

(C41) float variables cannot be contained in shift calculation

(C42) function must return a value

(C43) function should not return a value

(C44) float variables cannot be contained in calculation

(C45) PLC address error

(C46) array size overflow (max. 4k)

(C47) macro command entry function is not only one
(C48) macro command entry function must be only one
The only one main entrance of macro is:
macro_command function_name( )
end macro_command

(C49) an extended addressee’s station number must be between 0 and 255
For example:
SetData(bits[0], ”PLC 1”, LB, 300#123, 100)
// illegal : 300#123 means the station number is 300, but the maximum is 255

(C50) an invalid PLC name
PLC name is not defined in the device list of system parameters.

(C51) macro command do not control a remote device
A macro can only control a local machine.

For example:
SetData(bits[0], ”PLC 1”, LB, 300#123, 100)
”PLC 1” is connected with the remote HMI ,so it cannot work.

18.13. Sample Macro Code

- “for” statement and other expressions (arithmetic, bitwise shift, logic and comparison)
macro_command main()
int a[10], b[10], i

b[0] = (400 + 400 << 2) / 401
b[1] = 22 * 2 - 30 % 7
b[2] = 111 >> 2
b[3] = 403 > 9 + 3 >= 9 + 3 < 4 + 3 <= 8 + 8 == 8
b[4] = not 8 + 1 and 2 + 1 or 0 + 1 xor 2
b[5] = 405 and 3 and not 0
b[6] = 8 & 4 + 4 & 4 + 8 | 4 + 8 ^ 4
b[7] = 6 – (~4)
b[8] = 0x11
b[9] = 409
for i = 0 to 4 step 1
    if (a[0] == 400) then
        GetData(a[0], "Device 1", 4x, 0,9)
        GetData(b[0], "Device 1", 4x, 11,10)
    end If
next i
end macro_command

“while”, “if” and “break” statements
macro_command main()
int b[10], i
i = 5
while i == 5 - 20 % 3
    GetData(b[1], "Device 1", 4x, 11, 1)
        if b[1] == 100 then
            break
        end if
wend
end macro_command

Global variables and function call
char g
sub int fun(int j, int k)
    int y

        SetData(j, "Local HMI", LB, 14, 1)
        GetData(y, "Local HMI", LB, 15, 1)
        g = y

        return y
end Sub

macro_command main()
int a, b, i

    a = 2
    b = 3
i = fun(a, b)
SetData(i, "Local HMI", LB, 16, 1)
end macro_command

- “if” statement

macro_command main()
    int k[10], j

    for j = 0 to 10
        k[j] = j
    next j

    if k[0] == 0 then
        SetData(k[1], "Device 1", 4x, 0, 1)
    end if

    if k[0] == 0 then
        SetData(k[1], "Device 1", 4x, 0, 1)
    else
        SetData(k[2], "Device 1", 4x, 0, 1)
    end if

    if k[0] == 0 then
        SetData(k[1], "Device 1", 4x, 0, 1)
    end If

    if k[0] == 0 then
        SetData(k[1], "Device 1", 4x, 0, 1)
    else if k[2] == 1 then
        SetData(k[3], "Device 1", 4x, 2, 1)
    end If

    if k[0] == 0 then
        SetData(k[1], "Device 1", 4x, 3, 1)
    else if k[2] == 2 then
        SetData(k[3], "Device 1", 4x, 4, 1)
    else
        SetData(k[4], "Device 1", 4x, 5, 1)
    end If
end macro_command

- “while” and “wend” statements
macro_command main()
char i = 0
int a[13], b[14], c = 4848

b[0] = 13

while b[0]
    a[i] = 20 + i * 10

    if a[i] == 120 then
        c = 200
        break
    end if

    i = i + 1
wend

SetData(c, "Device 1", 4x, 2, 1)
end macro_command

“break” and “continue” statements

macro_command main()
char i = 0
int a[13], b[14], c = 4848

b[0] = 13

while b[0]
    a[i] = 20 + i * 10

    if a[i] == 120 then
        c = 200
        i = i + 1
        continue
    end if

    i = i + 1
if c == 200 then
    SetData(c, "Device 1", 4x, 2, 1)
    break
wend
end if
end macro_command

Array
macro_command main()
int a[25], b[25], i

b[0] = 13

for i = 0 to b[0] step 1
    a[i] = 20 + i * 10
next i

SetData(a[0], "Device 1", 4x, 0, 13)
end macro_command
18.14. Macro TRACE Function

TRACE function can be used with EasyDiagnoser to show the current content of the variables. The following example illustrates how TRACE function could be used in macro.

1. First of all, add a new macro “macro_0” in the project, and in “macro_0” add TRACE (“LW = %d”, a). “%d” indicates display current value of LW in decimal format. The content of “macro_0” is as follows:

```c
macro_command main()

  short a
  GetData(a, "Local HMI", LW, 0, 1)
  a=a+1
  SetData(a, "Local HMI", LW, 0, 1)
  TRACE ("LW = %d", a)

end macro_command
```

2. Secondly, add a Numeric Display object and a Function Key object in window no. 10 of the project. The Function Key object is used to execute macro_0.

3. Lastly, compile the project and execute [Off-line simulation] or [On-line simulation].

4. When processing simulation on PC, right click and select “Run EasyDiagnoser” in the pop-up menu.
5. Afterwards, EasyDiagnoser will be started. [Logger] window displays whether EasyDiagnoser is able to connect with the HMI to be watched or not. [Output] window displays the output of the TRACE function. The illustration below shows that EasyDiagnoser succeeds in connecting with HMI.

![EasyDiagnoser connection illustration](image)

When EasyDiagnoser is not able to connect with HMI, [Logger] window displays content as shown in the following figure:

![Logger content illustration](image)

6. The possible reason of not being able to get connection with HMI can be failure in executing simulation on PC. Another reason is that the Port No. used in project for simulation on PC is incorrect (or occupied by system). Please change Port No. as shown, compile project then do simulation again.

![System Parameter Settings](image)

7. In EasyDiagnoser, the Port No. should be set the same as the Port No. in the project.
The three consecutive ports of the project port no. are preserved for HMI communication. In the setting above as an example, Port No. is set as 8005. Port 8005, 8006 and 8007 should be reserved. In this case when executing simulation on PC, please make sure that these ports are not occupied by other programs.

**TRACE Syntax List**

<table>
<thead>
<tr>
<th>Name</th>
<th>TRACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syntax</td>
<td>TRACE(format, argument)</td>
</tr>
</tbody>
</table>

**Description**

Use this function to send specified string to the EasyDiagnoser. Users can print out the current value of variables during run-time of macro for debugging. When TRACE encounters the first format specification (if any), it converts the value of the first argument after format and outputs it accordingly. format refers to the format control of output string. A format specification, which consists of optional (in [ ])) and required fields (in bold), has the following form:

```
%[flags] [width] [.precision] type
```

Each field of the format specification is described as below:

- **flags** (optional):
  - +

- **width** (optional):
  - A nonnegative decimal integer controlling the minimum number of characters printed.

- **precision** (optional):
  - A nonnegative decimal integer which specifies the precision and the number of characters to be printed.

- **type**:
  - C or c : specifies a single-byte character.
  - d : signed decimal integer.
  - i : signed decimal integer.
  - o : unsigned octal integer.
  - u : unsigned decimal integer.
  - X or x : unsigned hexadecimal integer.
  - E or e : Signed value having the form \([- ddddd .ddd]\) where d is a single decimal digit, dddd is one or more decimal digits, ddd i exactly three decimal digits, and sign is + or –.
  - f : Signed value having the form \([- ddddd .ddd]\), where dddd is one or more decimal digits.

The length of output string is limited to 256 characters.
The argument part is optional.

**Example**

```c
macro_command main()
    char c1 = 'a'
    short s1 = 32767
    float f1 = 1.234567

    TRACE("The results are") // output: The results are
    TRACE("c1 = %c, s1 = %d, f1 = %f", c1, s1, f1)
    // output: c1 = a, s1 = 32767, f1 = 1.234567
end macro_command
```

8. Use LB-9059 to disable MACRO TRACE function (when ON). When set ON, the output message of TRACE won't be sent to EasyDiagnoser.

9. Users can directly execute EasyDiagnoser.exe from Utility Manager. In Utility Manager, current HMI on line will be listed; users can simply select the HMI to be watched. Please note that Project Port should be the same as Port No. used in project file.

10. Download the project to HMI and start the project. If EasyDiagnoser is unable to get connection with the HMI to be watched, it is possible that HMI power is not ON, or Port No. is incorrect. This may cause EasyDiagnoser to connect then disconnect with HMI continuously. Please check the Port No. in EasyDiagnoser settings.

11. When EasyDiagnoser succeeds in connecting with HMI, simply execute macro_0, [Output] window will then display the output of the TRACE function.
## 18.15. Example of String Operation Functions

String operation functions are added to macro to provide a convenient way to operate strings. The term “string” means a sequence of ASCII characters, and each of them occupies 1 byte. The sequence of characters can be stored into 16-bit registers with least significant byte first. For example, create an ASCII Input object and setup as follows:

Run simulation and input “abcdef”:
The string “abcdef” is stored in LW-0~LW-2 as follows (LB represents low byte and HB represents high byte):

<table>
<thead>
<tr>
<th>HB</th>
<th>LB</th>
</tr>
</thead>
<tbody>
<tr>
<td>'B'</td>
<td>'A'</td>
</tr>
<tr>
<td>'D'</td>
<td>'C'</td>
</tr>
<tr>
<td>'F'</td>
<td>'E'</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The ASCII Input object reads 1 word (2 bytes) at a time as described in the previous chapter. Suppose an ASCII Input object is set to read 3 words as shown in the above example, it can actually read at most 6 ASCII characters since that one ASCII character occupies 1 byte.

The functionality of each string operation function is described in the following table:

<table>
<thead>
<tr>
<th>Function name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StringGet</td>
<td>Read string data from a device.</td>
</tr>
<tr>
<td>StringGetEx</td>
<td>Read string data from a device and continue executing next command even if no response from that device.</td>
</tr>
<tr>
<td>StringSet</td>
<td>Write string data to a device.</td>
</tr>
<tr>
<td>StringSetEx</td>
<td>Write string data to a device and continue executing next command even if no response from that device.</td>
</tr>
<tr>
<td>StringCopy</td>
<td>Copy one string to another.</td>
</tr>
<tr>
<td>StringMid</td>
<td>Retrieve a substring.</td>
</tr>
<tr>
<td>StringDecAsc2Bin</td>
<td>Convert a decimal string to an integer.</td>
</tr>
<tr>
<td>StringBin2DecAsc</td>
<td>Convert an integer to a decimal string.</td>
</tr>
<tr>
<td>StringDecAsc2Float</td>
<td>Convert a decimal string to floats.</td>
</tr>
<tr>
<td>StringFloat2DecAsc</td>
<td>Convert a float to a decimal string.</td>
</tr>
<tr>
<td>StringHexAsc2Bin</td>
<td>Convert a hexadecimal string to binary data.</td>
</tr>
<tr>
<td>StringBin2HexAsc</td>
<td>Convert binary data into a hexadecimal string.</td>
</tr>
<tr>
<td>StringLength</td>
<td>Obtain the length of a string.</td>
</tr>
<tr>
<td>StringCat</td>
<td>Append source string to destination string.</td>
</tr>
<tr>
<td>StringCompare</td>
<td>Do a case-sensitive comparison of two strings.</td>
</tr>
<tr>
<td>StringCompareNoCase</td>
<td>Do a case-insensitive comparison of two strings.</td>
</tr>
<tr>
<td>StringFind</td>
<td>Find a substring inside a larger string.</td>
</tr>
<tr>
<td>StringReverseFind</td>
<td>Find a substring inside a larger string; starts from the end.</td>
</tr>
<tr>
<td>StringFindOneOf</td>
<td>Find the first matching character from a set.</td>
</tr>
<tr>
<td>StringIncluding</td>
<td>Extracts a substring that contains only the characters in a set.</td>
</tr>
</tbody>
</table>
StringExcluding Extracts a substring that contains only the characters not in a set.

StringToUpper Convert the characters of a string to uppercase.

StringToLower Convert the characters of a string to lowercase.

StringReverse Reverse the characters of a string.

StringTrimLeft Trim the leading specified characters in a set from the source string.

StringTrimRight Trim the trailing specified characters in a set from the source string.

StringInsert Insert a string in a specific location within another string.

For more detailed information of the above string operation functions, please check out the “Built-In Function Block” section. In order to demonstrate the powerful usage of string operation functions, the following examples will show you step by step how to create executable project files using the new functions; starts from creating a macro, ends in executing simulation.

1. To read (or write) a string from a device:

   Create a new macro:

   ```
   macro_command main()
   char str[20]
   StringGet(str[0], "Local HMI", LW, 0, 20)
   StringSet(str[0], "Local HMI", LW, 50, 20)
   end macro_command
   ```

   The first function “StringGet” is used to read a string from LW-0~LW-19, and store it into the str array. The second function “StringSet” is used to output the content of str array.

   Add one ASCII Input object and one Function Key object in window 10 of the project. The settings of these objects are shown as below. Function Key object is used to execute macro_0.
ASCII Input object:

Function Key object:

Lastly, use [Compile] to compile the project and execute [Off-line simulation] or [On-line simulation]. Follow the steps below to operate the executing project:

Step 1. Input string.
Step 2. Press “GO” button.
Step 3. Output string.

2. Initialization of a string.
Create a new macro and edit the content:
The data enclosed in double quotation mark (" ") is viewed as a string. str1 is initialized as a string while str2 is initialized as a char array. The following snapshot of simulation shows the difference between str1 and str2 using two ASCII Input objects.

Macro compiler will add a terminating null character (\0) at the end of a string. The function “StringSet” will send each character of str1 to registers until a null character is reached. The extra characters following the null character will be ignored even if the data count is set to a larger value than the length of string.

On the contrary, macro compiler will not add a terminating null character (\0) at the end of a char array. The actual number of characters of str2 being sent to registers depends on the value of data count that is passed to the “StringSet” function.

3. A simple login page.

Create a new macro and edit the content, for example, Macro [ID:001] macro_1.
The first two “StringGet” functions will read the strings input by users and store them into arrays named name_input and password_input separately. Use the function “StringCompare” to check if the input account name and password are matched. If the account name is matched, name_match is set true; if the password is matched, password_match is set true. If both name_match and password_match are true, output the string “Success! Access Accepted.”. Otherwise, output the string “Fail! Access Denied.”.

Add ASCII Input and Function Key objects in window 10 of the project. The settings of these objects are shown as below. Function Key object is used to execute macro_1.

Object 1: Function Key

Select [Execute macro] and Macro: [ID:000] macro_1.
Lastly, use [Compile] to compile the project and execute [Off-line simulation] or [On-line simulation]. Follow the steps below to operate the executing project:
Step 1. Enter account name.

Step 2. Enter password and press [Login] button.

Step 3. Login succeeded or failed.
18.16. Macro Password Protection

On MACRO editing window there’s the [Password protect] selection, tick it and click [Set password...] to set a password less than or equals to 10 characters (support ASCII character only, ex. "a$#*hFds").

After setting MACRO password, users will have to input correct password when opening MACRO editing window. EasyBuilder Pro should be rebooted for typing the password again after 3 incorrect attempts.

![Password error dialog]

**Note**

- When MACRO is password protected, de-compilation of EXOB file will not be able to restore MACRO contents.

18.17. Reading / Writing CANbus Address Using Variable

In “CAN Bus 2.0A/2.0B General and SAE J1939” driver, two device types can be found: DATA and DATA_Bit, and the formats of these device types are shown in the following window.
### Device Type & Address Format

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Address Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA</td>
<td>HHHHHHHHHBbNN</td>
<td>H: ID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B: Byte position(1~8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b: Bit position (1~8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NN: Bit number(1~64)</td>
</tr>
<tr>
<td>DATA_Bit</td>
<td>HHHHHHHHHBb</td>
<td>H: ID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B: Byte position(1~8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b: Bit position(1~8)</td>
</tr>
</tbody>
</table>

The ID is represented in hexadecimal while the position and number are represented in decimal, please see the usage below.

**Examples:**

Variable is **not** used:
short f
GetData(f, “CAN Device”, DATA, 4e55108, 1)
GetData(f, “CAN Device”, DATA, 4e65108, 1)
Variable is used:
short f

unsigned int address = 0x4e55108
GetData(f, “CAN Device”, DATA, address, 1)
address = address + 0x10000//= 0x4e65108
GetData(f, “CAN Device”, DATA, address, 1)

Please note that:
1. Declare variable as “Unsigned int” and use hexadecimal to represent address.
   Since the size of Unsigned int is 4 bytes and Bb, NN take 1 byte respectively, when using a
   variable for address parameter to read/write DATA_Bit device type, the format will change
   to HHHHHHBb (Max. ID: 0xffff), and when using a variable for address parameter to
   read/write DATA device type, the format will change to HHHHBbNN (Max. ID: 0xffff).