USB Explorer 260 Generator

User Guide
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This manual is populated throughout with screens captured from a specific version of Ellisys USB Explorer 260 software. All the information contained in the screens are samples and serve as instructional purposes only.

Document Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
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<td>2.8</td>
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About this Manual

Typographic Conventions

**Bold** is used to indicate menu commands, buttons, and tabs.

*Italics* are used to indicate fields, pane names, window names and cross references.

**Fixed width** is used to indicate system file names, text typed and code snippets.

A warning symbol describes a possible critical situation and how to avoid it.

An information symbol tells you how to respond to a situation that may arise.

A tip symbol tells you information that will help you carry out a procedure.

Where to Find More Help

Go to the Ellisys website and the following pages for the latest information:

- Application notes and white papers - Go to [www.ellisys.com/technology/](http://www.ellisys.com/technology/) to find up-to-date information about the technology.
- Distributors - Go to [www.ellisys.com/sales/](http://www.ellisys.com/sales/) to find a list of Ellisys distributors.
- Technical support - Go to [www.ellisys.com/support/](http://www.ellisys.com/support/) to send a question directly to the Ellisys support team.
1 Product Overview

1.1 Overview

The USB Explorer 260 Generator is a generator for the Universal Serial Bus and protocols based on USB. The USB Explorer 260 Generator verifies product and component reliability by generating reproducible traffic, timing and error scenarios.

The USB Explorer 260 Generator contains a specialized processor specifically designed for the USB protocol. The USB Explorer 260 Generator produces sequences of arbitrary packets with programmable inter-packet delay and can wait for any kind of response packet or event. The processor's instruction set enables you to emulate USB hosts and devices.

1.2 Main Features

The USB Explorer 260 Generator enables you to:

• Emulate most USB equipment, including USB hosts and USB devices.
• Perform functional validation and stress testing of protocol stacks.
• Generate arbitrary packets with full control of the packet raw data down to the PHY layer.
• Generate sequences of packets with programmable inter-packet delay.
• Use exported scripts from protocol analysis software to play back error scenarios.
• Test error recovery mechanisms by generating frames with incorrect content or timing.


The USB Explorer 260 Generator’s software allows you to quickly and easily create, edit, and debug scripts. Traces previously recorded by an Ellisys USB Explorer 260 Analyzer can be exported to a script and played back by the generator. This will allow you to quickly understand and fix issues that may arise during device, driver or software development.
2 Installing the Ellisys USB Explorer 260

Before installing the Ellisys USB Explorer 260 ensure your computer meets the following requirements:

- Microsoft Windows Installer 3.0 or later. If the installation does not run smoothly, or if the system indicates that there is a version error, update your Windows Installer.
- Pentium 4, 1.8 GHz or compatible processor, or better.
- 512 MBytes of RAM or more.
- 1024x768 screen display resolution with 256 colors or better.
- USB 2.0 host controller.

2.1 Software Prerequisites

The USB Explorer 260 software requires several software components. Ellisys recommends that you visit the following web pages to update your version of Microsoft .Net Framework and Windows:

- [windowsupdate.microsoft.com](http://windowsupdate.microsoft.com) to update your version of Windows. When using the Windows update service it will automatically download and install the Microsoft .Net Framework version 2.0.

See your System Administrator for more information about updating Microsoft .Net Framework and Windows.
2.2 Installing Software

To install the USB Explorer 260's software:

1. Insert the Ellisys USB Explorer 260 installation CD-ROM that accompanies the product into the computer's CD-ROM drive.

The USB Explorer 260 Setup Wizard screen appears:

If the USB Explorer 260 Setup Wizard screen does not appear automatically; Click Start | Run, type d:\setup.exe (change d: to match the drive letter of your CD-ROM) and click on OK.
2. Read the *Warning* note and click on **Next**.

The USB Explorer 260 *Licence Agreement* screen appears:

![License Agreement Screen](image)

3. Read the licence agreement carefully and select **I Agree**.
4. Click on **Next**.

The *Select Installation Folder* screen appears:

5. The default installation folder appears in the *Folder* field. Ellisys recommend that you use the default folder, however if you wish to change this folder click on *Browse* and navigate to the folder required.

6. Select whether anyone or only the user currently logged on can access the software by selecting either **Everyone** or **Just me**.
7. Click on **Next**.

The *Confirm Installation* screen appears:

![Confirm Installation screen](image)

The installer is ready to install Ellisys USB Explorer 260 Generator on your computer.

Click "Next" to start the installation.
8. Click on **Next** to continue the software’s installation.

An *Installation Progress* screen appears.
When the software has been installed, the *Installation Complete* screen appears:

![Installation Complete Screen](image)

Ellisys USB Explorer 260 Generator has been successfully installed.
Click "Close" to exit.

Please use Windows Update to check for any critical updates to the .NET Framework.

9. Click on **Close**.

The USB Explorer 260 software is now installed.

After installing USB Explorer 260 software a new Hardware Wizard may appear. Refer to *2.5, Connecting to the Computer*, on page 19 for more information about installing the USB driver.
2.3 Front Panel Overview

Ellisys USB Explorer 260’s front panel:

- **Power**
  - The *Power* LED is illuminated constant green when connected to a USB 2.0 host controller and working normally.
  - The *Power* LED is illuminated constant red when connected via a USB 1.1 host controller and working normally. Performance may not be optimal.
  - The *Power* LED blinks green when connected to a USB 2.0 host controller and the driver is not yet fully installed.
  - The *Power* LED blinks red when connected to a USB 1.1 host controller and the driver is not yet fully installed.

- **Activity**
  - The *Activity* LED blinks green when traffic is detected. The blink rate depends on the amount of traffic detected, the faster the blink rate the greater amount of traffic detected.
  - The *Activity* LED blinks red when traffic is recorded or generated.

- **Trigger**
  - The *Trigger* LED blinks green when waiting for an event to occur.
  - The *Trigger* LED is illuminated red for a short period when the expected event occurs.
2.4 Back Panel Overview

Ellisys USB Explorer 260’s back panel:

A USB cable must be connected between the Computer connector and the computer on which the software runs.

When connecting the USB cable DO NOT force the connector into the USB Explorer 260. The metal part of the connector should not be inserted completely into the connection port. Forcing the connector or inserting all of the metal part of the connector may break the port connection and is not covered by the warranty.

2.5 Connecting to the Computer

The USB Explorer 260 connects on a USB port, allowing the use of any notebook or desktop computer. The unit is powered by USB and does not require an external adapter. A driver needs to be installed on the computer to ensure proper operation.

Although the USB Explorer 260 can upload or download data on a full speed USB 1.1 connection, Ellisys strongly recommends that you connect it to a high speed USB 2.0 port to obtain optimal performance. If you experience problems with the USB Explorer 260, please ensure it is connected on a high speed USB 2.0 enabled host controller before contacting technical support.

Follow the steps below to install the USB driver:

1. Connect the USB Explorer 260.
   If you are connecting the USB Explorer 260 for the first time wait until Windows displays a message saying a new device has been discovered and go to Step 3.
2. If you want to update a previously installed device driver:
   • Open the Device Manager window: Start | Control Panel.
   • Double-click the System icon.
   • Click the Hardware tab.
   • Click on Device Manager.
   • Click on Ellisys protocol analyzers.
   • Right-click and select Update Driver.

The Hardware Update Wizard window appears:

3. Select **No, not this time**.
4. Click on **Next**.

The *Found New Hardware* window appears:

![Found New Hardware Wizard](image)

4. **This wizard helps you install software for:**
   - Ellisys USB Explorer 260

4. **If your hardware came with an installation CD or floppy disk, insert it now.**

4. **What do you want the wizard to do?**
   - [ ] Install the software automatically (Recommended)
   - [ ] Install from a list or specific location (Advanced)

4. **Click Next to continue.**

5. Select **Install the software automatically (Recommended)**.
6. Click on **Next**.

The *Please wait while the wizard installs the software* window appears:

![Hardware Update Wizard](image)

Windows installs the driver.
When the installation is complete The wizard has finished installing the software window appears:

7. Click on Finish.

The installation is complete.
3 User Interface Reference

The user interface of the Ellisys USB Explorer 260 Generator software contains a number of panes, menus, toolbars and other visual elements.

The USB Explorer 260 Generator has several default panes. Each pane displays specific information or allows you to interact with the software for a given task:

- **Script Editor** - Shows the current script. The Script Editor also allows editing the script, setting or clearing breakpoints, and placing bookmark to navigate through the script.

- **Output pane** - Shows messages about a script after compiling. If there is an error in the script the Output pane will show an error description and the error’s position: file, line and column.

- **Register pane** - Shows the contents of the variables, see **3.14, Working with Registers**, on page 45 for more information.
3.1 Organizing Panes

To open or display a pane:
1. Select View in the menu and click on the pane required in the View menu.

The selected pane opens.

To close a pane:
1. Click on Close (X) positioned on the top right-hand corner of the title bar of the pane.

The pane closes.

To hide a pane:
1. Click on Auto Hide (bar) positioned on the top right-hand corner of the title bar.

The pane is hidden and the pane's name appears as a tab at the side of the screen.

To move a pane or window:
1. Click on the title bar of a pane or window.
2. Press and hold the left mouse button and drag the pane or window.

A window placer appears:

3. Keep the mouse button pressed and point to one of the following:
   • Center to open a pane as a floating window in the screen.
   • Top to move the pane to the top of the screen or pane group.
   • Right to move the pane to the right of the screen or pane group.
• **Left** to move the pane to the left of the screen or pane group.

• **Bottom** to move the pane to the bottom of the screen or pane group.

### 3.2 Main Toolbar

The table below shows the USB Explorer 260 Generator toolbar buttons and their actions.

<table>
<thead>
<tr>
<th>Button</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Document</strong></td>
<td>Opens a new document.</td>
</tr>
<tr>
<td><strong>Open Document</strong></td>
<td>Opens a folder to allow you open a previous saved file.</td>
</tr>
<tr>
<td><strong>Save Document</strong></td>
<td>Saves a document.</td>
</tr>
<tr>
<td><strong>Print</strong></td>
<td>Opens print options to allow you to print a document.</td>
</tr>
<tr>
<td><strong>Print Preview</strong></td>
<td>Opens the print preview window.</td>
</tr>
<tr>
<td><strong>Cut</strong></td>
<td>Cuts a selection of text.</td>
</tr>
<tr>
<td><strong>Copy</strong></td>
<td>Copies a selection of text.</td>
</tr>
<tr>
<td><strong>Paste</strong></td>
<td>Pastes a selection of copied or cut text.</td>
</tr>
<tr>
<td><strong>Undo</strong></td>
<td>Undoes the previous action.</td>
</tr>
<tr>
<td><strong>Redo</strong></td>
<td>Redoes the previous action.</td>
</tr>
</tbody>
</table>
Find/Replace
Opens the find and replace window.

Comment Selection
Comments out one or more lines.

Uncomment Selection
Uncomment one or more lines.

Toggle Bookmark
Toggles a bookmark at a selected line.

Previous Bookmark
Finds the previous bookmark.

Next Bookmark
Finds the next bookmark.

Clear Bookmarks
Clears all bookmarks.

Compile
Compiles a script.

Run
Runs a stopped or paused script.

Break
Pauses a script when running.

Stop
Stops a running script.

Restart
Stops and restarts a script from the beginning.

Step
Steps from line to line in the script.
3.3 Main Menu

The table below shows the USB Explorer 260 Generator main menu options and their actions.

File

- **New**
  - (CTRL + N)
  - Creates a new file.

- **Open**
  - (CTRL + O)
  - Opens a previous saved file.

- **Save**
  - (CTRL + S)
  - Saves a file.

- **Save As**
  - Saves a file with a new name.

- **Page Setup**
  - Opens the Page Setup dialog box that lets you set the page margins and other parameters.

- **Print Preview**
  - Opens the Print Preview window.

- **Print**
  - (CTRL + P)
  - Prints a file.

- **Exit**
  - Exits the software.

Edit

- **Undo**
  - (CTRL + Z)
  - Undoes the previous action.

- **Redo**
  - (CTRL + Y)
  - Redoes the previous action.

- **Cut**
  - (CTRL + X)
  - Cuts a selection of text.

- **Copy**
  - (CTRL + C)
  - Copies a selection of text.
**Paste**  
*(CTRL + V)*  
Pastes a selection of copied or cut text.

**Edit | Advanced**

- **Mark Line Modifications**  
  Marks line modifications in the file.
- **Highlight Current Line**  
  Highlights the current line in the script.
- **Show Column 80 Guide**  
  Displays the column guide in the script.
- **Comment Selection**  
  Adds a comment to the current selected line.
- **Uncomment Selection**  
  Removes the comment from the selected line.
- **Make Uppercase**  
  *(CTRL + SHIFT + U)*  
  Changes selected lowercase text to uppercase text.
- **Make Lowercase**  
  *(CTRL + U)*  
  Changes selected uppercase text to lowercase text.

**Edit | Bookmarks**

- **Toggle Bookmark**  
  Toggles a bookmark at a selected line.
- **Enable Bookmark**  
  Enables the selected bookmark.
- **Previous Bookmark**  
  Finds the previous bookmark.
- **Next Bookmark**  
  Finds the next bookmark.
- **Clear Bookmarks**  
  Clears all bookmarks.
- **Insert Snippet Code**  
  *(CTRL + I)*  
  Opens the Insert Snippet code list.
View

Output window
Opens or closes the Output window.

Registers window
Opens or closes the Registers window.

Search

Find/Replace
Opens the Find/Replace window.
(CTRL + F)

Find Next
Finds the text previously entered in the Find/Replace window.
F3

Find Previous
Finds the text previously entered in the Find/Replace window.
(SHIFT + F3)

Go To Line
Opens the Go To Line window.
(CTRL + G)

Script

Compile
Compiles a script.
(F7)

Run
Runs a stopped or paused script.
(F5)

Break
Pauses a script when running.

Stop
Stops a running script.
(SHIFT + F5)

Restart
Stops and restarts a script from the beginning.

Step
Steps from line to line in the script.
(F10)

Toggle Breakpoint
Toggles a breakpoint at a selected line.
(F9)
| **Clear all Breakpoints** (CTRL+SHIFT +F9) | Removes all breakpoints in the script. |
| **Select a Generator** | Opens the Available Generators window. |

**Help**

| **User Guide** | Opens the online user guide. |
| **Ellisys website** | Opens the Ellisys website in your default internet browser. |
| **Contact support** | Opens a form to contact the technical support. |
| **About** | Opens the About window. |
3.4 Opening a File

To open a file:

1. Select File | Open in the menu or click on Open Document.

The Open File window appears:

2. Select the file required and click on Open.

The selected file opens in the software.

3.5 Saving a File

To save a file:

1. Select File | Save in the menu or click on Save Document.

The file is saved.
To save a file with a new name:

1. Select **File | Save As** in the menu.

The Save As window appears:

2. Navigate to the directory where the file is to be saved.

3. Enter the required name of the file in the *File name* field and click on *Save*.

The file is saved with the required name and the original file is not modified.

### 3.6 Printing a File

Use the Page Setup option, **File | Page Setup**, to setup how the file should be printed. This option will depend on the printer, please see your printer’s documentation for more information.

A file can be very large therefore it is advisable to check the size of the file before trying to print the file.
To print a file:

1. Select **File | Print** in the menu or click on **Print** 📑.

The **Print** window appears:

2. Select the printer and printer setup if required.
3. Click on **OK**.

The file is printed.

### 3.7 Editing a Script

The USB Explorer 260 Generator includes several specialized instructions. Example code for these instructions can be inserted to help you write instructions. An example code is called a code snippet.

A full description of the specialized instructions can be found in *Chapter 5, Instruction Set Reference*, on page 63.

To insert a code snippet:

1. Click on the point in the script where the code snippet is to be inserted.
2. Select **Edit | Insert Code Snippet** in the menu.
   or
   Press CTRL + I.
The Code Snippet list appears:

3. Select the code snippet required from the list.
4. Double-click on the code snippet required.
   or
   Select the snippet required and press ENTER.

The selected code snippet is inserted into the script and can be modified.

3.8 Advanced Editing Features

All the USB Explorer 260 Generator’s advanced editing features can be accessed by clicking **Edit | Advanced** in the menu.

To mark or unmark line modifications:
1. Select **Edit | Advanced | Mark Line Modifications** in the menu.

All lines that have been modified are marked with a yellow mark beside the line.

To highlight the current line:
1. Select **Edit | Advanced | Highlighting Current Line** in the menu.

The line with the cursor is highlighted.

To display the column 80 guide:
1. Select **Edit | Advanced | Show 80 Column Guide** in the menu.

The 80 column guide appears as a line in the main script pane.

To comment a selection in a script:
1. Select the lines you want to comment.
2. Click on **Comment Selection** or
   Select **Edit | Advanced | Comment Selection** in the menu.

Comment markers are inserted before the selected lines.

**To uncomment a selection in a script:**
1. Select the commented lines you want to uncomment.

2. Click on **Uncomment Selection** or
   Select **Edit | Advanced | Uncomment Selection** in the menu.

Comment markers are removed from the selected lines.

**To change text case:**
1. Select the text required in the script.
2. Select **Edit | Advanced | Make Uppercase** to change the text's case from lowercase to uppercase.

or

3. Select **Edit | Advanced | Make Lowercase** to change the text's case from uppercase to lowercase.

### 3.9 Searching

Search, find and replace options can be accessed by clicking **Search** in the menu.

**To search text:**
1. Click on **Find/Replace** or
   Select **Search | Find** in the menu.
   or
   Press CTRL + F.
The *Find/Replace* window appears:

![Find/Replace window]

2. Enter what you need to be found in the *Find what* field.

or

3. Select the **Use** check box if you want to use Regular expression or Wildcards.

   Regular expressions or Wildcards can be selected as an option.

4. If you selected the **Use** check box, select *Regular expression* or *Wildcards* from the drop-down list. The **Right Arrow** beside the *Find What* field becomes enabled.
5. Click on **Right Arrow**. If *Wildcards* has been selected from the *Use* drop-down list a *Wildcard list* appears:

![Find and Replace dialog box with wildcard options](image)

6. Select the Wildcard required.

If *Regular expression* has been selected from the *Use* drop-down list a *Regular expression list* appears:

![Find and Replace dialog box with regular expression options](image)

7. Select the Regular expression required.
8. Select the required search options check boxes.
9. Click on the required button: **Find Next** to find the next occurrence or **Bookmark All** to bookmark all occurrences.

The selected search is performed.
To replace text:

1. Click on **Find/Replace** and then click **Quick Replace** or Select **Search | Replace** in the menu. or Press CTRL + H.

The **Find/Replace** window appears:

2. Enter what you need to be found in the **Find what** field.
3. Enter the replacement text in the **Replace with** field.
4. Select the required search options check boxes.
5. Click on the required button: **Find Next** to find the next occurrence or **Replace or Replace All** to respectively replace the next occurrence or all occurrences.

The selected replacement is performed.

### 3.10 Working with Bookmarks

A bookmark is a useful tool that enables you to mark lines of code to help you navigate through a script.

All the bookmark options can be accessed by selecting **Edit | Bookmarks** in the menu.

**To toggle a bookmark:**

1. Select a line where the bookmark is to be inserted.
2. Click on **Toggle Bookmark** or
   Select **Edit | Bookmarks | Toggle Bookmark** in the menu.

   The bookmark is inserted beside the selected line.

   **To enable a bookmark:**
   1. Click on the line beside the bookmark.
   2. Select **Edit | Bookmarks | Enable Bookmark** in the menu.

   The selected bookmark is enabled.

   **To move to the next or previous bookmark:**
   1. Click on **Next Bookmark** or
      Select **Edit | Bookmarks | Next Bookmark** in the menu.

      A flashing cursor appears beside the next bookmark.

   2. Click on **Previous Bookmark** or
      Select **Edit | Bookmarks | Previous Bookmark** in the menu.

      A flashing cursor appears beside the previous bookmark.

   **To remove all bookmarks:**
   1. Click on **Clear Bookmark** or
      Select **Edit | Bookmarks | Clear Bookmark** in the menu.

      All bookmarks in the script are removed.

### 3.11 Working with Breakpoints

A breakpoint is a point in a program which is used to temporarily halt the execution of that program.

**To insert a breakpoint:**
1. Select a line where the breakpoint is to be inserted.
2. Select **Script | Toggle Breakpoint** in the menu or
   Press F9.
A breakpoint is inserted beside the selected line.

To remove all breakpoints:
1. Select **Script | Clear All Breakpoint** in the menu.

All breakpoints in the script are removed.

### 3.12 Compiling a Script

To compile a script:
1. Open a script file as described in **3.4, Opening a File**, on page 33.
   or
   Create a new script file and save it.

2. Click on **Compile**
   or
   Select **Script | Compile** in the menu.

The USB Explorer 260 Generator compiles the script.

If the compilation is successful a ‘Compilation Succeeded’ message will appear in the **Output** pane.
If the compilation is unsuccessful a 'Compilation Failed’ message will appear in the Output pane. A list of errors will also be listed in the Output pane.

To find an error in a compiled script:
1. Compile a script as described in 3.12, Compiling a Script, on page 42.

The compilation errors are listed in the Output pane under the Message column.

2. Double-click on the error description you require in the Output pane.

The line that contains the error is highlighted in the main script pane.

3.13 Running a Script

To select a generator:
1. Select Script | Select a generator in the menu.

The Available Generators window appears:
2. Select the required generator and click on **OK**.

![Check mark]

It is advisable to select a generator as the default generator by clicking the **Use this generator by default** check box. This will stop the **Available Generators** window appearing every time you run the software.

The generator is selected.

**To run a script:**
1. Open a script file as described in **3.4, Opening a File**, on page 33 or Create a new script file and save it.

2. Click on **Run** or Select **Script | Run** in the menu.

If you did not select a generator as a default generator then the **Available Generators** window appears:

![Available Generators window]

3. Select on the required generator and click on **OK**.

The script runs using the selected generator.

**To break or pause a script:**
1. Run a script as described in **3.13, Running a Script**, on page 43.

2. Click on **Break** or Select **Script | Break** in the menu.

The script is paused.
To stop a script:
1. Run a script as described in 3.13, Running a Script, on page 43.
2. Click on Stop or
   Select Script | Stop in the menu.

The script stops.

To restart a script:
1. Click on Restart or
   Select Script | Restart in the menu.

The script is restarted.

To step a script:
1. Click on Step or
   Select Script | Step in the menu.
   or
   Press F10.

The script is run command by command.

3.14 Working with Registers

This section describes how you can work with registers. For more information about registers see 4.10, Counters, on page 53.

All registers are displayed in the Registers pane.

To select a register format:
1. Right-click on one of the registers in the Registers pane.
The *Format* submenu appears:

2. Click on the format require; **Dec**, **Hex** or **Bin**.

The register format is changed to the selected format and the numbers are displayed.
4 Language Reference

4.1 Comments

Single line comments are done using the // characters.

```cpp
void Main()
{
    // This is a single line comment
    CopyMemory(Src => [ 0x00, 0x00 ],
               Dst => Buffer,
               DstOffset => 200);
}
```

Multi line comments are open using the /* characters, and are closed using the */ characters.

```cpp
void Main()
{
    /* This is a multi line comment the prevents the following instruction to be executed

    CopyMemory(Src => [ 0x00, 0x00 ],
               Dst => Buffer,
               DstOffset => 200);

    */
}
```

4.2 Include Files

Files can be included using the include directive.

The example below shows a script that includes a file and use then the macro declared inside.

```cpp
include "MyInclude.esf"

void Main()
{
    // Calls a function declared in MyInclude.esf
    SendPulseAndWaitAnswer(10, 2s);
}
```
### 4.3 Constants Declaration

Constants can be declared with the `const` keyword.

The example below shows a script that defines two constants.

```javascript
const NormalState = StateMachine.Running;
const DefaultTimeout = 450ms;

void Main()
{
    WaitForState(State => NormalState,
                   Timeout => DefaultTimeout);
}
```

### 4.4 Variables Declaration

Variables are instantiated with the `var` keyword. The variable can be initialized at declaration with a value. If no initial value is specified the variable will not be initialized.

```javascript
var myVar;
var myVar1 = 10;
var myVar2 = CounterB;
var myVar3 = myVar1 * myVar2;
```

There is no restriction on variables declaration location. Variables can be declared anywhere in the script. The scope of the variable depends on the declaration location.

```javascript
var myGlobalVar = 0;
void MyMacro() { myGlobalVar = 10; }

void Main()
{
    var myVar = 0;

    for(var i=0; i<10; i++)
    {
        myVar += 1 << i;
    }

    Sleep( myVar );
}
```
4.5 Functions Declaration

Functions can be used to save typing and improve the understanding of a script. Functions accept parameters and can optionally return a value.

The example below shows a script that defines a function for sending a trigger pulse and waiting until an answer is received.

```c
void SendPulseAndWaitAnswer(MaxRetries, MaxTime)
{
    repeat(MaxRetries)
    {
        GenerateTriggerOut(Output => BncOut, Mode => PulseHigh);

        WaitTriggerIn(Input => BncIn, Condition => RisingEdge, Timeout => MaxTime);

        if(!TimeoutOccured)
        {
            exit;
        }
    }
}

void Main()
{
    SendPulseAndWaitAnswer(10, 2s);
    SendPulseAndWaitAnswer(100, 20ms);
    SendPulseAndWaitAnswer(10, 2s);
}
```

The following example shows a function returning a value based on a parameter:

```c
var ComputeSlotPosition(Index)
{
    return Index * 85;
}

TimerA = ComputeSlotPosition(CounterB);
```
4.6 Function Calls

The parameters of functions calls are explicit. The syntax for specifying parameters values is `param => value`. The parameters order is thus not relevant as the parameter is fully identified by its name. The examples below shows a function with two parameters `Param1` and `Param2`; the value 10 is assigned to `Param1` and the value 20 is assigned to `Param2`:

```cpp
SampleMacro( Param1 => 10, Param2 => 20 );
SampleMacro( Param2 => 20, Param1 => 10 );
```

When an instruction, a function has only one parameter its name can be omitted. For example:

```cpp
Sleep( Duration => 10us );
```

can also be written as:

```cpp
Sleep( 10us );
```

Parameters are optional when they have a default value. If the parameter is not specified in the call, the default value is used. The example below defines a macro with two parameters. `Param1` is mandatory and `Param2` has a default value of 0. Since `Param2` is not specified in the call, the value 0 will be used as default.

```cpp
void SampleFunction(Param1, Param2 = 0)
{
    Sleep( Param 1 + Param2 );
}

void Main()
{
    SampleFunction( Param1 => 10us );
}
```
4.7 Enumerations Declarations

Enumerations can be used to give names to known values. The example below shows a script that defines several error codes.

```plaintext
define ErrorCode
{
    NoError = 0,
    Timeout = 1,
    SequenceMismatch = 2,
    Unspecified = 3
}
```

The example below shows a script that declares a unique number for each state of a state machine.

```plaintext
define StateMachine
{
    Stopped,
    Paused,
    Running,
    Unspecified
}
```

```plaintext
void main()
{
    var currentState = GetMachineState();
    if (currentState == StateMachine.Unspecified)
    {
        currentState = StateMachine.Stopped;
    }
    SetMachineState(currentState);
}
```
4.8 Namespaces Declarations

Namespaces can be used to isolate some portions of code to avoid name collision in big scripts.

The example below shows a script that declares a namespace and then use functions defined by this namespace.

```csharp
namespace UtilityFunctions
{
    void WaitSpecialEvent(Event, Timeout)
    { /* ... */ }

    void GenerateSpecialEvent(Event, Param = 0)
    { /* ... */ }
}

void WaitAndGenerate(Event)
{
    UtilityFunctions.WaitSpecialEvent(Event, 50ms);
    UtilityFunctions.GenerateSpecialEvent(Event);
}

using UtilityFunctions;

void main()
{
    WaitSpecialEvent(Event, 200ms);
    WaitAndGenerate(Event);
}
```

The example below shows a scripts that declare two namespaces, each with a function that has the same name.

```csharp
namespace TimingFunctions
{
    void WaitAnswer(Timeout) { /* ... */ }
}

namespace ProtocolFunctions
{
    void WaitAnswer(AnswerId) { /* ... */ }
}

void main()
{
    TimingFunctions.WaitAnswer(400ms);
    ProtocolFunctions.WaitAnswer(Handshake);
}
4.9 Buffer Usage

The hardware contains a buffer of 8192 bytes available for memory comparison and copy operations. It can be accessed with the Buffer keyword for reading as well as for writing. Example:

Buffer[0 to 3] = [ 0, 1, 2, 3 ];
Buffer[0 for 4] = CounterB;
CounterA = Buffer[10 for 4];

The last received packet can be accessed with the LastRxPacket keyword. LastRxPacket is read only. Example:

Buffer[2 to CounterB] = LastRxPacket[2 to CounterB];
CounterC = LastRxPacket[5];

4.10 Counters

Counters are useful for example to count errors, special conditions, etc. Several counters are available in the generator, namely CounterA to CounterH. The value of the counters is indicated in the Registers window.

The example below shows a script that repetitively sends a pulse on the output BNC connector and waits for a rising edge on the input BNC connector. If the rising edge is not detected within 500 milliseconds the script increments CounterA.

```
repeat(1000)
{
    GenerateTriggerOut(Output => BncOut, Mode => PulseHigh);

    WaitTriggerIn(Input => BncIn, Condition => RisingEdge, Timeout => 500ms);

    if(TimeoutOccurred)
    {
        // Keep the error count in Counter
        CounterA++;
    }
}
```
4.11 Timers

Timers are useful for example to measure or generate precise timing sequences. Several timers are available in the generator. Timers can be started, stopped or modified. It is possible to wait until a timer reaches a specified value or to change the current value of a timer.

The example below shows a script that measure the duration of a trigger pulse and generates one that lasts three times this duration.

```plaintext
Timer0 = 0;
Timer1 = 0;

WaitTriggerIn(Input => BncIn,
               Condition => RisingEdge);

StartTimer(0);

GenerateTriggerOut(Output => BncOut,
                    Mode   => ForceHigh);

WaitTriggerIn(Input => BncIn,
               Condition => FallingEdge);

StartTimer(1);
StopTimer(0);

WaitTimer(Index         => 1,
           TargetValue   => Timer0 * 2,
           TimingRespect => Hard);

GenerateTriggerOut(Output => BncOut,
                    Mode   => ForceLow);

StopTimer(1);
```
4.12 Stop Keyword

The `stop` keyword stops the execution of the generator. This is useful for example to stop the generator when a required condition is not met.

```plaintext
WaitTriggerIn(Input => BncIn,
              Condition => FallingEdge,
              Timeout => 100ms);

if(TimeoutOccurred)
{
   // Condition not met: stop execution
   stop;
}
```

4.13 Breakpoint Keyword

The `breakpoint` keyword breaks the execution of the generator. The execution can be resumed by the user from the breakpoint.

```plaintext
WaitTriggerIn(Input => BncIn,
              Condition => FallingEdge,
              Timeout => 100ms);

if(TimeoutOccurred)
{
   // Condition not met: break execution
   breakpoint;
}
```

4.14 If Statement

The `if` statement executes instructions conditionally depending on a condition. Conditions are described in 4.21, Conditional expressions, on page 61.

The example below shows a script that increments `CounterA` if the button is pressed, and `CounterB` otherwise. When `CounterA` reaches 10, `CounterB` is reset to 0.

```plaintext
WaitButton(Index => 0,
            Timeout => 0ms,
            Condition => HighLevel);

if(MatchOccurred)
{
   CounterA++;
}
```
else
{
    CounterB++;
}

if(CounterA >= 10)
{
    CounterB = 0;
}

### 4.15 Switch Statement

The **switch** statement executes instructions conditionally depending on the value of the specified variable.

The example below shows a script that increments `CounterA` if the value of the variable is 0, increments `CounterB` if the value is 1 and resets both to zero in other cases.

```c
switch(CounterC)
{
    case 0:
        CounterA++;
        break;

    case 1:
        CounterB++;
        break;

    default:
        CounterA = 0;
        CounterB = 0;
        break;
}
```
4.16 Repeat Statement

The repeat statement executes instructions the specified count of times. A repeat statement can be stopped with the exit keyword. Up to four repeat statements can be imbricated.

The example below shows a script that pulses high the state of the output BNC connector for 200 milliseconds every second. It does this 10 times.

```
repeat(10)
{
    GenerateTriggerOut(Output => BncOut,
        Mode   => ForceHigh);

    Sleep(200ms);

    GenerateTriggerOut(Output => BncOut,
        Mode   => ForceLow);

    Sleep(800ms);
}
```

4.17 While Statement

The while statement executes instructions as long as a specified condition is true. The condition is checked before the instruction is executed. A while statement can be stopped with the exit keyword. Up to four while statements can be imbricated.

The example below shows a script that toggles the state of the output BNC connector every 200 milliseconds until the input BNC connector presents a high logic level.

```
while(true)
{
    GenerateTriggerOut(Output => BncOut,
        Mode   => Toggle);

    WaitTriggerIn(Input     => BncIn,
        Condition => HighLevel,
        Timeout   => 200ms);

    if(MatchOccurred) { exit; }
}
```
4.18 Do While Statement

The do while statement executes instructions as long as a specified condition is true. The condition is checked after the instruction is executed. A while statement can be stopped with the exit keyword. Up to four do while statements can be imbricated.

The example below shows a script that generates a pulse on the output BNC connector until the input BNC connectors presents a high logic level.

do
{
    GenerateTriggerOut(Output => BncOut,
                        Mode   => PulseHigh);
    WaitTriggerIn(Input     => BncIn,
                   Condition => LowLevel,
                   Timeout   => 0);
}
while(MatchOccurred);

4.19 For Statement

The for statement executes instructions in a loop a certain number of times. A for statement can be stopped with the exit keyword. Up to four for statements can be imbricated.

The example below shows a script that generates 20 pulses on the output BNC connector.

for(var i=0; i<20; i++)
{
    GenerateTriggerOut(Output => BncOut,
                         Mode   => PulseHigh);
}
4.20 Mathematical expressions

The Ellisys script language supports the following mathematical operators: +, −, *, /, %, &, |, ^, >> and <<.

The examples below show how to use these operators and how to combine them. In all these examples, a must be a variable; b and c can be variables or a literals.

The following example assigns the value 20 to a:

\[ a = 20; \]

The following example assigns the value 0xAB12 (43,794 in decimal) to a:

\[ a = 0xAB12; \]

The following example adds the value of b to the value of c and assigns the result to a:

\[ a = b + c; \]

The following example subtracts the value of c from the value of b and assigns the result to a:

\[ a = b - c; \]

The following example multiplies the value of b with the value of c and assigns the result to a:

\[ a = b * c; \]

The following example divides the value of b by the value of c and assigns the result to a:

\[ a = b / c; \]

The following example divides the value of b with the value of c and assigns the rest of the integer division to a:

\[ a = b \% c; \]

The following example performs a mathematical AND operation between the value of b and the value of c and assigns the result to a:

\[ a = b \& c; \]
The following example performs a mathematical OR operation between the value of \( b \) and the value of \( c \) and assigns the result to \( a \):

\[
a = b \mid c;
\]

The following example performs a mathematical XOR operation between the value of \( b \) and the value of \( c \) and assigns the result to \( a \):

\[
a = b \^ c;
\]

The following example performs a right shift operation between the value of \( b \) and the value of \( c \) and assigns the result to \( a \):

\[
a = b \gg c;
\]

The following example performs a left shift operation between the value of \( b \) and the value of \( c \) and assigns the result to \( a \):

\[
a = b \ll c;
\]

The following example demonstrates how to combine expressions to produce more complex results:

\[
a = ((b \& 0x0F) \times 12) \gg (c + 1);
\]
4.21 Conditional expressions

The conditions that can be tested are MatchOccurred and TimeoutOccurred. These two flags are set by instructions that wait specific conditions.

Conditional expressions can be used as condition of execution or termination with several statements, including if, while and do while.

The following example executes the specified code if \( a \) equals \( b \):
\[
\text{if}(a == b) \{ \text{/* insert code here */} \}
\]

The following example executes the specified code if \( a \) is different from \( b \):
\[
\text{if}(a != b) \{ \text{/* insert code here */} \}
\]

The following example executes the specified code if \( a \) is greater than \( b \):
\[
\text{if}(a > b) \{ \text{/* insert code here */} \}
\]

The following example executes the specified code if \( a \) is greater than or equal to \( b \):
\[
\text{if}(a >= b) \{ \text{/* insert code here */} \}
\]

The following example executes the specified code if \( a \) is less than \( b \):
\[
\text{if}(a < b) \{ \text{/* insert code here */} \}
\]

The following example executes the specified code if \( a \) is less than or equal to \( b \):
\[
\text{if}(a <= b) \{ \text{/* insert code here */} \}
\]
5 Instruction Set Reference

The Ellisys USB Explorer 260 Generator includes several specialized instructions. These instructions are divided into six distinct categories:

- Timing operations
- Buffer operations
- Trigger operations
- Link-oriented operations
- Packet-oriented operations
- Host-oriented operations

5.1 Sleep Instruction

The `Sleep` instruction waits a precise duration which can be specified in several units. The duration can be specified in units of time (seconds, milliseconds, microseconds and nanoseconds) or in 60 MHz clock cycles.

Example

```
Sleep ( Duration => 1.5ms );
Sleep ( 1.5ms );
```

Parameter List

<table>
<thead>
<tr>
<th>Duration</th>
<th>Description</th>
<th>Type</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Amount of time to wait.</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
<td>No default value; this parameter is mandatory.</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
5.2 StartCountdown Instruction

The StartCountdown instruction starts a countdown timer in the generator. Two countdown timers can run simultaneously.

Example
StartCountdown ( Index => 0, Duration => 65538us );
StartCountdown ( 65538us );

Parameter List

<table>
<thead>
<tr>
<th>Index</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>Index of the countdown timer.</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 2.</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
<tr>
<td>Example</td>
<td>0 to use the countdown timer with index 0. 1 to use the countdown timer with index 1.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Amount of time to wait.</td>
</tr>
<tr>
<td>Type</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
5.3 **WaitCountdownReached Instruction**

The **WaitCountdownReached** instruction waits the countdown timer reaches its nominal value.

**Example**

```c
WaitCountdownReached(
    Index => 0,
    Timeout => 500ms,
    TimingRespect => Hard);
```

**Parameter List**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Index</strong></td>
<td>Index of the countdown timer.</td>
<td>0 to 2</td>
<td>0</td>
<td>0 to use the countdown timer with index 0. 1 to use the countdown timer with index 1.</td>
</tr>
<tr>
<td><strong>Timeout</strong></td>
<td>Timeout after which the instruction is aborted.</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
<td>No default value; this parameter is mandatory.</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
### 5.4 StartTimer Instruction

The `StartTimer` instruction starts the specified timer.

**Example**

```plaintext
StartTimer(1);
```

**Parameter List**

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies the index of the timer to start.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>0 to 2.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>0 will use timer 0.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>TimingRespect</strong></th>
<th>Specifies if the processor breaks if the countdown value was already reached at the time the wait was called.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td><em>Soft</em> or <em>Hard</em>.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td><em>Soft</em></td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td><em>Soft</em> to continue even if the countdown value was already reached.</td>
</tr>
<tr>
<td></td>
<td><em>Hard</em> to break script execution if the countdown value was exceeded. This value helps detecting timing errors in scripts.</td>
</tr>
</tbody>
</table>
5.5 StopTimer Instruction

The StopTimer instruction stops the specified timer.

Example

StopTimer(2);

Parameter List

<table>
<thead>
<tr>
<th>Index</th>
<th>Description</th>
<th>Type</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Specifies the index of the timer to stop.</td>
<td>0 to 2.</td>
<td>No default value; this parameter is mandatory.</td>
<td>0 will use timer 0.</td>
</tr>
</tbody>
</table>

5.6 WaitTimer Instruction

The WaitTimer instruction waits until the specified timer reaches the specified value.

Example

WaitTimer(
    Index => 1,
    TargetValue => 60s);

Parameter List

<table>
<thead>
<tr>
<th>Index</th>
<th>Description</th>
<th>Type</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Specifies the index of the timer to wait on.</td>
<td>0 to 2.</td>
<td>No default value; this parameter is mandatory.</td>
<td>0 will use timer 0.</td>
</tr>
</tbody>
</table>
### TargetValue

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies the target value to wait on.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>10500 will match when the specified timer reaches value 10500. 200ms will match when the specified timer reaches value 12,000,000, which equals to 200ms at 60 MHz.</td>
</tr>
</tbody>
</table>

### Timeout

<table>
<thead>
<tr>
<th>Description</th>
<th>Timeout after which the instruction is aborted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>

### TimingRespect

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if the processor breaks if the countdown value was already reached at the time the wait was called.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Soft or Hard.</td>
</tr>
<tr>
<td>Default</td>
<td>Soft</td>
</tr>
<tr>
<td>Example</td>
<td>Soft to continue even if the countdown value was already reached. Hard to break script execution if the countdown value was exceeded. This value helps detecting timing errors in scripts.</td>
</tr>
</tbody>
</table>
5.7 CopyMemory Instruction

The CopyMemory instruction copies bytes from a location of the user buffer to another location.

Example

CopyMemory(
    Src => [ 0x00, 0x00 ],
    Dst => Buffer,
    DstOffset => 200);

CopyMemory(
    Src => Buffer,
    SrcOffset => 0,
    Dst => Buffer,
    DstOffset => 200,
    Length => 2);

CopyMemory(
    Src => LastRxPacket,
    SrcOffset => 15,
    Dst => Buffer,
    DstOffset => 15,
    Length => 60);

Parameter List

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Src</td>
<td>The source data to copy to the destination.</td>
<td>Inline bytes (max 8192 bytes) or Buffer or LastRxPacket.</td>
</tr>
<tr>
<td></td>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>[ 0x00, 0x09, 0x00, 0xE0, 0x00 ] to copy these bytes. Buffer to copy bytes from the user buffer.</td>
<td></td>
</tr>
</tbody>
</table>
### SrcOffset

<table>
<thead>
<tr>
<th>Description</th>
<th>Offset in the source data of the first byte to use.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 8191.</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
</tr>
<tr>
<td>Example</td>
<td>0 will copy from the beginning of the PHY header when LastRxPacket is specified or from offset 0 of the user buffer when Buffer is used. 5 will copy from the beginning of the MAC header when LastRxPacket is specified or from offset 5 of the user buffer when Buffer is used. 15 will copy from the beginning of the payload when LastRxPacket is specified or from offset 15 of the user buffer when Buffer is used.</td>
</tr>
</tbody>
</table>

### Dst

<table>
<thead>
<tr>
<th>Description</th>
<th>The destination where the source will be copied.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Buffer</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>Buffer is the only acceptable value.</td>
</tr>
</tbody>
</table>

### DstOffset

<table>
<thead>
<tr>
<th>Description</th>
<th>Offset in the destination buffer of the first data byte to copy.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 8191.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>0 will copy source bytes at offset 0 of the destination buffer. 22 will copy source bytes at offset 22 of the destination buffer.</td>
</tr>
</tbody>
</table>

### Length

<table>
<thead>
<tr>
<th>Description</th>
<th>Length of the data to copy.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 8192.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>5 will copy 5 bytes.</td>
</tr>
</tbody>
</table>
### 5.8 CompareMemory Instruction

The `CompareMemory` instruction compares bytes from a location of the user buffer to another.

**Example**

```plaintext
CompareMemory(
  Src               => Buffer,
  SrcOffset         => 60,
  Dst               => [ 0x00, 0x00 ]);

CompareMemory(
  Src               => Buffer,
  SrcOffset         => 0,
  Dst               => Buffer,
  DstOffset         => 200,
  Length            => 40);

CompareMemory(
  Src               => LastRxPacket,
  SrcOffset         => 5,
  Dst               => Buffer,
  DstOffset         => 5,
  Length            => 10);
```

**Parameter List**

<table>
<thead>
<tr>
<th><strong>Src</strong></th>
<th><strong>Description</strong></th>
<th><strong>Type</strong></th>
<th><strong>Default</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The first sequence of bytes to compare.</td>
<td>Inline bytes (max 8192 bytes) or Buffer or LastRxPacket.</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
</tbody>
</table>

**Example**

- `[ 0x00, 0x09, 0x00, 0xE0, 0x00 ]` to compare the specified bytes with the bytes specified in `Dst`.
- `Buffer` to compare bytes in the user buffer with the bytes specified in `Dst`. 
### SrcOffset

<table>
<thead>
<tr>
<th>Description</th>
<th>Offset in the source data of the first byte to compare.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>0 to 8191.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>0</td>
</tr>
</tbody>
</table>
| **Example**             | 0 will compare from the beginning of the PHY header when LastRxPacket is specified or from offset 0 of the user buffer when Buffer is used.  
5 will compare from the beginning of the MAC header when LastRxPacket is specified or from offset 5 of the user buffer when Buffer is used.  
15 will compare from the beginning of the payload when LastRxPacket is specified or from offset 15 of the user buffer when Buffer is used. |

### Dst

<table>
<thead>
<tr>
<th>Description</th>
<th>The second sequence of bytes to compare.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Buffer or LastRxPacket.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>No default value; this parameter is mandatory.</td>
</tr>
</tbody>
</table>
| **Example**             | Buffer to compare bytes defined in Src with data in the user buffer.  
LastRxPacket to compare bytes defined in Src with data contained in the last received packet. |

### DstOffset

<table>
<thead>
<tr>
<th>Description</th>
<th>Offset in the destination buffer of the first data byte to compare.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>0 to 2047.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>No default value; this parameter is mandatory.</td>
</tr>
</tbody>
</table>
| **Example**             | 0 will compare from offset 0 of the user buffer when Buffer or LastRxPacket is used.  
200 will compare from offset 200 of the user buffer when Buffer or LastRxPacket is used. |
### Mask

<table>
<thead>
<tr>
<th>Description</th>
<th>Mask to apply on each byte of the data to compare. The mask is applied with an AND operator.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Inline bytes (max 8192 bytes).</td>
</tr>
<tr>
<td>Default</td>
<td>$0xFF$ for all bytes specified in Data.</td>
</tr>
<tr>
<td>Example</td>
<td>[ 0x0F, 0x0F, 0xFF, 0xF0, 0xFF ] will use these bytes for the mask.</td>
</tr>
</tbody>
</table>

### Length

<table>
<thead>
<tr>
<th>Description</th>
<th>Length of the data to compare.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 2047.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>5 will copy 5 bytes.</td>
</tr>
</tbody>
</table>
5.9  **WaitButtonPressed Instruction**

The `WaitButtonPressed` instruction waits on user action on the specified button of the trigger board.

**Example**

```c
WaitButtonPressed(
    Index => 0,
    Timeout => 10s);
```

**Parameter List**

<table>
<thead>
<tr>
<th><strong>Index</strong></th>
<th><strong>Description</strong></th>
<th><strong>Range</strong></th>
<th><strong>Default</strong></th>
<th><strong>Example</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Selects the button to wait on.</td>
<td>0 to 1.</td>
<td>No default value; this parameter is mandatory.</td>
<td>0 will wait until Button0 is pressed on the trigger board. 1 will wait until Button1 is pressed on the trigger board.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Timeout</strong></th>
<th><strong>Description</strong></th>
<th><strong>Type</strong></th>
<th><strong>Range</strong></th>
<th><strong>Default</strong></th>
<th><strong>Example</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Timeout after which the instruction is aborted.</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
<td>No default value; this parameter is mandatory.</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
5.10 WaitTriggerIn Instruction

The **WaitTriggerIn** instruction waits on the specified input of the trigger board.

**Example**

```plaintext
WaitTriggerIn(
    Input => BncIn,
    Condition => RisingEdge,
    Timeout => 5s);
```

**Parameter List**

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Selects the input on which the condition should be waited on.</td>
<td>Any, BncIn, DigitalIn0 to DigitalIn3.</td>
<td>No default value; this parameter is mandatory.</td>
<td>Any waits on any inputs of the trigger board. BncIn waits on the BNC input of the trigger board.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies the trigger condition.</td>
<td>RisingEdge, FallingEdge, HighLevel, LowLevel.</td>
<td>No default value; this parameter is mandatory.</td>
<td>RisingEdge waits on a rising edge condition. HighLevel waits on a high level condition.</td>
</tr>
</tbody>
</table>
### Timeout

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th>Timeout after which the instruction is aborted.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>No default value; this parameter is mandatory.</td>
</tr>
</tbody>
</table>
| **Example**      | 1.32ms means 1,320 microseconds or 79,200 clock cycles.  
620ns will be floored down to 37 clock cycles.  
3960clk means 3,960 clock cycles or 66 microseconds.  
1000 (without unity) is not allowed and will generate a warning. |
5.11 GenerateTriggerOut Instruction

The GenerateTriggerOut instruction generates a condition on the specified output of the trigger board.

Example

GenerateTriggerOut(
    Output => BncOut,
    Mode  => PulseHigh);

Parameter List

<table>
<thead>
<tr>
<th>Output</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>Selects the output to generate the trigger on.</td>
<td>All, BncOut, DigitalOut0 to DigitalOut3.</td>
<td>No default value; this parameter is mandatory.</td>
<td>All generates the condition on all outputs of the trigger board. BncOut generates the condition on the BNC output.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>Specifies the trigger mode.</td>
<td>PulseHigh, PulseLow, ForceHigh, ForceLow, Toggle.</td>
<td>No default value; this parameter is mandatory.</td>
<td>PulseHigh generates a positive pulse on the output. ForceLow forces a low-level on the output. Toggle inverts the current level of the output.</td>
</tr>
</tbody>
</table>
5.12 ConfigureGenerator Instruction

The ConfigureGenerator instruction configures the generator in host or device mode.

Example

ConfigureGenerator(
    Mode => Device,
    Speed => HighSpeed);

ConfigureGenerator(
    Mode => Host,
    Speed => Chirp);

Parameter List

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode</td>
<td>Specifies the generator mode.</td>
<td>Host, Device or ErrorInjection.</td>
<td>No default value; this parameter is mandatory.</td>
<td>Host will configure the hardware for Host emulation. Device will configure the hardware for Device emulation. ErrorInjection will configure the hardware for error injection.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>Specifies the link speed.</td>
<td>LowSpeed, FullSpeed, HighSpeed or Chirp.</td>
<td>No default value; this parameter is mandatory.</td>
<td>LowSpeed will configure the link for low speed (1.5 Mbit/s). FullSpeed will configure the link for full speed (12 Mbit/s). HighSpeed will configure the link for high speed (480 Mbit/s). Chirp will configure the link for high speed chirp.</td>
</tr>
</tbody>
</table>
5.13 ForceLinesState Instruction

The ForceLinesState instruction sets the link lines to the specified state.

Example
ForceLinesState(J);
ForceLinesState(State => SE0);

Parameter List

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Specifies the state to be set on the link.</td>
<td>SE0, J or K.</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td></td>
<td>SE0 will wait until a SE0 state appears on the link.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>J will wait until a J state appears on the link.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>K will wait until a J state appears on the link.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.14 ReleaseLinesState Instruction

The ReleaseLinesState instruction releases the link lines state.

Example
ReleaseLinesState();

Parameter List

This instruction does not take any parameters.
5.15 WaitLinesState Instruction

The **WaitLinesState** instruction waits for the specified lines state.

Example

```c
WaitLinesState(
    State => J,
    Timeout => 20us);
```

Parameter List

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
</table>
| State     | Specifies the state to wait for. | SE0, J or K. | No default value; this parameter is mandatory. | SE0 will wait until a SE0 state appears on the link. J will wait until a J state appears on the link. K will wait until a J state appears on the link.
| Timeout   | Timeout after which the instruction is aborted. | 0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds. | Waits for ever if not specified. | 1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning. |
5.16 SendPacket Instruction

The SendPacket instruction sends a raw USB packet using the mode and speed specified with the ConfigureGenerator instruction.

Example

SendPacket(
    RawData => [ 0x69, 0x81, 0x58 ],
    Interval => 17.554us,
    ComputeFcs => false);

SendPacket(
    RawData => Buffer,
    RawDataOffset => 20,
    RawDataLength => 12,
    Spacing => 1us,
    ComputeFcs => true);

Parameter List

<table>
<thead>
<tr>
<th>RawData</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td><strong>Default</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RawDataLength</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Range</strong></td>
</tr>
<tr>
<td><strong>Default</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
</tr>
</tbody>
</table>
### RawDataOffset

<table>
<thead>
<tr>
<th>Description</th>
<th>Offset of the data bytes in the Buffer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 8191.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory when <code>Buffer</code> is used in <code>RawData</code>. This parameter cannot be used when inline bytes are specified in <code>RawData</code>.</td>
</tr>
<tr>
<td>Example</td>
<td>0 will send a packet from offset 0 in the Buffer. 1024 will send a packet from offset 1024 in the Buffer.</td>
</tr>
</tbody>
</table>

### PrefixPid

<table>
<thead>
<tr>
<th>Description</th>
<th>PID to be added to the specified data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 255.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; the packet will not be prefixed with a PID if this parameter is not specified.</td>
</tr>
<tr>
<td>Example</td>
<td>0xC3 will send a DATA0 PID.</td>
</tr>
</tbody>
</table>

### Interval

<table>
<thead>
<tr>
<th>Description</th>
<th>Delay between the beginning of this instruction and the beginning of the next instruction.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td>Default</td>
<td>0.</td>
</tr>
<tr>
<td>Example</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
### Spacing

<table>
<thead>
<tr>
<th>Description</th>
<th>Delay between the end of this instruction and the beginning of the next instruction.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td>Default</td>
<td>0.</td>
</tr>
<tr>
<td>Example</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>

### ComputeCrc

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if the CRC should be computed automatically by the hardware instead of using the specified value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td>True to replace the specified CRC bytes with the computed CRC. False to leave the specified CRC bytes as is.</td>
</tr>
</tbody>
</table>
5.17 WaitPacket Instruction

The WaitPacket instruction waits for a packet matching the specified criteria.

Example
WaitPacket(
    Timeout => 1ms,
    MatchOnlyValidCrc => true);

Parameter List

<table>
<thead>
<tr>
<th>MatchOnlyValidCrc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Default</td>
</tr>
<tr>
<td>Example</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>StoreRxPacket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Default</td>
</tr>
<tr>
<td>Example</td>
</tr>
</tbody>
</table>
### Timeout

<table>
<thead>
<tr>
<th>Description</th>
<th>Timeout after which the instruction is aborted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td>Default</td>
<td>Waits for ever if not specified.</td>
</tr>
<tr>
<td>Example</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
5.18 WaitTokenPacket Instruction

The WaitTokenPacket instruction waits for a token packet matching the specified criteria.

Example

WaitTokenPacket(
    SetupPid          => True,
    DeviceAddress     => DevAddr,
    EndpointNumber    => 0,
    Timeout           => 100ms,
    MatchOnlyValidCrc => true);

Parameter List

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Type</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>OutPid</td>
<td>Specifies if a OUT token packet will match.</td>
<td>Boolean (True or False).</td>
<td>False</td>
<td><strong>True</strong> will match OUT tokens.  <strong>False</strong> will not match OUT tokens.</td>
</tr>
<tr>
<td>InPid</td>
<td>Specifies if a IN token packet will match.</td>
<td>Boolean (True or False).</td>
<td>False</td>
<td><strong>True</strong> will match IN tokens.  <strong>False</strong> will not match IN tokens.</td>
</tr>
</tbody>
</table>
### SetupPid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a SETUP token packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><strong>True</strong> will match SETUP tokens.</td>
</tr>
<tr>
<td></td>
<td><strong>False</strong> will not match SETUP tokens.</td>
</tr>
</tbody>
</table>

### PingPid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a PING token packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><strong>True</strong> will match PING tokens.</td>
</tr>
<tr>
<td></td>
<td><strong>False</strong> will not match PING tokens.</td>
</tr>
</tbody>
</table>

### ExtPid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if an EXT token packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><strong>True</strong> will match EXT tokens.</td>
</tr>
<tr>
<td></td>
<td><strong>False</strong> will not match EXT tokens.</td>
</tr>
</tbody>
</table>

### DeviceAddress

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies the device address to match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 127.</td>
</tr>
<tr>
<td>Default</td>
<td>Match all device addresses.</td>
</tr>
<tr>
<td>Example</td>
<td><strong>4</strong> will match the specified tokens only if they are sent to device address 4.</td>
</tr>
<tr>
<td></td>
<td><strong>0</strong> will match the specified tokens only if they are sent to the default device address.</td>
</tr>
</tbody>
</table>
### EndpointNumber

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies the endpoint number to match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 15</td>
</tr>
<tr>
<td>Default</td>
<td>Match all endpoint numbers.</td>
</tr>
<tr>
<td>Example</td>
<td>2 will match the specified tokens only if they are sent to endpoint number 2. 0 will match the specified tokens only if they are sent to the default control endpoint number.</td>
</tr>
</tbody>
</table>

### MatchOnlyValidCrc

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if the instruction will only match packets with a valid CRC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td>True will match only if the FCS of the received packet is valid.</td>
</tr>
<tr>
<td></td>
<td>False will match all packets independently of their FCS value.</td>
</tr>
</tbody>
</table>

### Timeout

<table>
<thead>
<tr>
<th>Description</th>
<th>Timeout after which the instruction is aborted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td>Default</td>
<td>Waits for ever if not specified.</td>
</tr>
<tr>
<td>Example</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
5.19 WaitDataPacket Instruction

The WaitDataPacket instruction waits for a data packet matching the specified criteria.

Example

```
WaitDataPacket(
    Data0 => CurrentDataToggle,
    Data1 => !CurrentDataToggle,
    Timeout => 1ms,
    MatchOnlyValidCrc => true);
```

Parameter List

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Type</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data0Pid</td>
<td>Specifies if a DATA0 packet will match.</td>
<td>Boolean (True or False)</td>
<td>False</td>
<td>True will match DATA0 packets. False will not match DATA0 packets.</td>
</tr>
<tr>
<td>Data1Pid</td>
<td>Specifies if a DATA1 packet will match.</td>
<td>Boolean (True or False)</td>
<td>False</td>
<td>True will match DATA1 packets. False will not match DATA1 packets.</td>
</tr>
<tr>
<td>Data2Pid</td>
<td>Specifies if a DATA2 packet will match.</td>
<td>Boolean (True or False)</td>
<td>False</td>
<td>True will match DATA2 packets. False will not match DATA2 packets.</td>
</tr>
</tbody>
</table>
### MDataPid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a MDATA packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match MDATA packets.</td>
</tr>
<tr>
<td></td>
<td>False will not match MDATA packets.</td>
</tr>
</tbody>
</table>

### MatchOnlyValidCrc

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if the instruction will only match packets with a valid CRC.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match only if the FCS of the received packet is valid.</td>
</tr>
<tr>
<td></td>
<td>False will match all packets independently of their FCS value.</td>
</tr>
</tbody>
</table>

### Timeout

<table>
<thead>
<tr>
<th>Description</th>
<th>Timeout after which the instruction is aborted.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>Waits for ever if not specified.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles.</td>
</tr>
<tr>
<td></td>
<td>620ns will be floored down to 37 clock cycles.</td>
</tr>
<tr>
<td></td>
<td>3960clk means 3,960 clock cycles or 66 microseconds.</td>
</tr>
<tr>
<td></td>
<td>1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
### 5.20 WaitHandshakePacket Instruction

The `WaitHandshakePacket` instruction waits for a handshake packet matching the specified criteria.

#### Example

```c
WaitHandshakePacket(
    AckPid            => True,
    NakPid            => True,
    Timeout           => 20ms,
    MatchOnlyValidCrc => true);
```

#### Parameter List

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Type</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AckPid</strong></td>
<td>Specifies if an ACK handshake packet will match.</td>
<td>Boolean (True or False).</td>
<td>False</td>
<td><strong>True</strong> will match ACK handshakes. <strong>False</strong> will not match ACK handshakes.</td>
</tr>
<tr>
<td><strong>NakPid</strong></td>
<td>Specifies if a NAK handshake packet will match.</td>
<td>Boolean (True or False).</td>
<td>False</td>
<td><strong>True</strong> will match NAK handshakes. <strong>False</strong> will not match NAK handshakes.</td>
</tr>
<tr>
<td><strong>StallPid</strong></td>
<td>Specifies if a STALL handshake packet will match.</td>
<td>Boolean (True or False).</td>
<td>False</td>
<td><strong>True</strong> will match STALL handshakes. <strong>False</strong> will not match STALL handshakes.</td>
</tr>
</tbody>
</table>
### NyetPid

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th>Specifies if a NYET handshake packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match NYET handshakes.</td>
</tr>
<tr>
<td></td>
<td>False will not match NYET handshakes.</td>
</tr>
</tbody>
</table>

### ErrPid

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th>Specifies if an ERR handshake packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match ERR handshakes.</td>
</tr>
<tr>
<td></td>
<td>False will not match ERR handshakes.</td>
</tr>
</tbody>
</table>

### Timeout

<table>
<thead>
<tr>
<th><strong>Description</strong></th>
<th>Timeout after which the instruction is aborted.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>Waits for ever if not specified.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles.</td>
</tr>
<tr>
<td></td>
<td>620ns will be floored down to 37 clock cycles.</td>
</tr>
<tr>
<td></td>
<td>3960c1k means 3,960 clock cycles or 66 microseconds.</td>
</tr>
<tr>
<td></td>
<td>1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
5.21 WaitAndSendPacket Instruction

The WaitAndSendPacket instruction waits for a packet matching the specified criteria. If the expected packet is received the instruction will send the specified packet.

Example

SendPacket(
    RawData        => Buffer,
    RawDataOffset  => TokenPacketBufferOffset,
    RawDataLength  => TokenPacketSize,
    ComputeCrc     => True);

WaitAndSendPacket(
    RxTimeout           => TransactionTimeout,
    RxMatchOnlyValidCrc => True,
    TxRawData           => [ pidACK ],
    SendIfData0Pid      => True,
    SendIfData1Pid      => True);

Parameter List

<table>
<thead>
<tr>
<th>RxDeviceAddress</th>
<th>Description</th>
<th>Range</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
</table>
|                 | Specifies the device address to match.| 0 to 127.  | Match all device addresses.                                            | 4 will match the specified tokens only if they are sent to device address 4.  
|                 |                                      |            |         | 0 will match the specified tokens only if they are sent to the default device address. |
### RxEndpointNumber

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies the endpoint number to match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 15.</td>
</tr>
<tr>
<td>Default</td>
<td>Match all endpoint numbers.</td>
</tr>
<tr>
<td>Example</td>
<td>2 will match the specified tokens only if they are sent to endpoint number 2. 0 will match the specified tokens only if they are sent to the default control endpoint number.</td>
</tr>
</tbody>
</table>

### RxMatchOnlyValidCrc

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if the instruction will only match packets with a valid CRC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td>True will match only if the FCS of the received packet is valid. False will match all packets independently of their FCS value.</td>
</tr>
</tbody>
</table>

### RxTimeout

<table>
<thead>
<tr>
<th>Description</th>
<th>Timeout after which the instruction is aborted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td>Default</td>
<td>Waits for ever if not specified.</td>
</tr>
<tr>
<td>Example</td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
### TxRawData

<table>
<thead>
<tr>
<th>Description</th>
<th>Raw data of the packet to send including PID, payload and CRC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Inline bytes (min 1 byte, max 8191 bytes) or Buffer.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>[ 0x69, 0x81, 0x58 ] to use these bytes for the instruction. Buffer to use bytes from the user buffer.</td>
</tr>
</tbody>
</table>

### TxRawDataLength

<table>
<thead>
<tr>
<th>Description</th>
<th>Length of the Buffer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>1 to 8191.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory when Buffer is used in RawData. This parameter cannot be used when inline bytes are specified in RawData.</td>
</tr>
<tr>
<td>Example</td>
<td>1 will sent a packet with a length of one byte. 500 will sent a packet with a length of 500 bytes.</td>
</tr>
</tbody>
</table>

### TxRawDataOffset

<table>
<thead>
<tr>
<th>Description</th>
<th>Offset of the data bytes in the Buffer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 8191.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory when Buffer is used in RawData. This parameter cannot be used when inline bytes are specified in RawData.</td>
</tr>
<tr>
<td>Example</td>
<td>0 will send a packet from offset 0 in the Buffer. 1024 will send a packet from offset 1024 in the Buffer.</td>
</tr>
</tbody>
</table>

### TxPrefixPid

<table>
<thead>
<tr>
<th>Description</th>
<th>PID to be added to the specified data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0 to 255.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; the packet will not be prefixed with a PID if this parameter is not specified.</td>
</tr>
<tr>
<td>Example</td>
<td>0xC3 will send a DATA0 PID.</td>
</tr>
</tbody>
</table>
### TxInterval

**Description**  
Delay between the beginning of this instruction and the beginning of the next instruction.

**Type**  
Time expressed in 60 MHz clock cycles or seconds.

**Range**  
0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.

**Default**  
0.

**Example**  
1.32ms means 1,320 microseconds or 79,200 clock cycles.  
620ns will be floored down to 37 clock cycles.  
3960clk means 3,960 clock cycles or 66 microseconds.  
1000 (without unity) is not allowed and will generate a warning.

### TxSpacing

**Description**  
Delay between the end of this instruction and the beginning of the next instruction.

**Type**  
Time expressed in 60 MHz clock cycles or seconds.

**Range**  
0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.

**Default**  
0.

**Example**  
1.32ms means 1,320 microseconds or 79,200 clock cycles.  
620ns will be floored down to 37 clock cycles.  
3960clk means 3,960 clock cycles or 66 microseconds.  
1000 (without unity) is not allowed and will generate a warning.

### TxComputeCrc

**Description**  
Specifies if the CRC should be computed automatically by the hardware instead of using the specified value.

**Type**  
Boolean (True or False).

**Default**  
False

**Example**  
True to replace the specified CRC bytes with the computed CRC.  
False to leave the specified CRC bytes as is.
### WaitOutPid
<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a OUT token packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match OUT tokens. False will not match OUT tokens.</td>
</tr>
</tbody>
</table>

### WaitInPid
<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a IN token packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match IN tokens. False will not match IN tokens.</td>
</tr>
</tbody>
</table>

### WaitSetupPid
<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a SETUP token packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match SETUP tokens. False will not match SETUP tokens.</td>
</tr>
</tbody>
</table>

### WaitPingPid
<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a PING token packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match PING tokens. False will not match PING tokens.</td>
</tr>
</tbody>
</table>
### WaitExtPid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if an EXT token packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td><strong>Boolean</strong> <em>(True or False)</em>.</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><em>True</em> will match EXT tokens.</td>
</tr>
<tr>
<td></td>
<td><em>False</em> will not match EXT tokens.</td>
</tr>
</tbody>
</table>

### WaitData0Pid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a DATA0 packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td><strong>Boolean</strong> <em>(True or False)</em>.</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><em>True</em> will match DATA0 packets.</td>
</tr>
<tr>
<td></td>
<td><em>False</em> will not match DATA0 packets.</td>
</tr>
</tbody>
</table>

### WaitData1Pid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a DATA1 packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td><strong>Boolean</strong> <em>(True or False)</em>.</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><em>True</em> will match DATA1 packets.</td>
</tr>
<tr>
<td></td>
<td><em>False</em> will not match DATA1 packets.</td>
</tr>
</tbody>
</table>

### WaitData2Pid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if a DATA2 packet will match.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td><strong>Boolean</strong> <em>(True or False)</em>.</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><em>True</em> will match DATA2 packets.</td>
</tr>
<tr>
<td></td>
<td><em>False</em> will not match DATA2 packets.</td>
</tr>
<tr>
<td><strong>WaitMDataPid</strong></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Specifies if a MDATA packet will match.</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match MDATA packets. False will not match MDATA packets.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>WaitAckPid</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies if an ACK handshake packet will match.</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match ACK handshakes. False will not match ACK handshakes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>WaitNakPid</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies if a NAK handshake packet will match.</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match NAK handshakes. False will not match NAK handshakes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>WaitStallPid</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies if a STALL handshake packet will match.</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>Boolean (True or False).</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>False</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>True will match STALL handshakes. False will not match STALL handshakes.</td>
</tr>
<tr>
<td><strong>WaitNyetPid</strong></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Specifies if a NYET handshake packet will match.</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td><strong>Boolean</strong> <em>(True or False).</em></td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td><strong>False</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td><strong>True</strong> will match NYET handshakes.</td>
</tr>
<tr>
<td></td>
<td><strong>False</strong> will not match NYET handshakes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>WaitErrPid</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies if an ERR handshake packet will match.</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td><strong>Boolean</strong> <em>(True or False).</em></td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td><strong>False</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td><strong>True</strong> will match ERR handshakes.</td>
</tr>
<tr>
<td></td>
<td><strong>False</strong> will not match ERR handshakes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SendIfOutPid</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies if the packet will be sent when a OUT PID is received.</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td><strong>Boolean</strong> <em>(True or False).</em></td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td><strong>False</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td><strong>True</strong> will send the packet when a OUT PID is received.</td>
</tr>
<tr>
<td></td>
<td><strong>False</strong> will not send the packet when a OUT PID is received.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SendIfInPid</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Specifies if the packet will be sent when a IN PID is received.</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td><strong>Boolean</strong> <em>(True or False).</em></td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td><strong>False</strong></td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td><strong>True</strong> will send the packet when a IN PID is received.</td>
</tr>
<tr>
<td></td>
<td><strong>False</strong> will not send the packet when a IN PID is received.</td>
</tr>
</tbody>
</table>
### SendIfSetupPid

**Description**  
Specifies if the packet will be sent when a SETUP PID is received.

**Type**  
Boolean (True or False).

**Default**  
False

**Example**  
True will send the packet when a SETUP PID is received.  
False will not send the packet when a SETUP PID is received.

### SendIfPingPid

**Description**  
Specifies if the packet will be sent when a PING PID is received.

**Type**  
Boolean (True or False).

**Default**  
False

**Example**  
True will send the packet when a PING PID is received.  
False will not send the packet when a PING PID is received.

### SendIfExtPid

**Description**  
Specifies if the packet will be sent when an EXT PID is received.

**Type**  
Boolean (True or False).

**Default**  
False

**Example**  
True will send the packet when a EXT PID is received.  
False will not send the packet when a EXT PID is received.

### SendIfData0Pid

**Description**  
Specifies if the packet will be sent when a DATA0 PID is received.

**Type**  
Boolean (True or False).

**Default**  
False

**Example**  
True will send the packet when a DATA0 PID is received.  
False will not send the packet when a DATA0 PID is received.
### SendIfData1Pid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if the packet will be sent when a DATA1 PID is received.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean <em>(True or False)</em>.</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><em>[True]</em> will send the packet when a DATA1 PID is received.</td>
</tr>
<tr>
<td></td>
<td><em>False</em> will not send the packet when a DATA1 PID is received.</td>
</tr>
</tbody>
</table>

### SendIfData2Pid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if the packet will be sent when a DATA2 PID is received.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean <em>(True or False)</em>.</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><em>[True]</em> will send the packet when a DATA2 PID is received.</td>
</tr>
<tr>
<td></td>
<td><em>False</em> will not send the packet when a DATA2 PID is received.</td>
</tr>
</tbody>
</table>

### SendIfMDataPid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if the packet will be sent when a MDATA PID is received.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean <em>(True or False)</em>.</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><em>[True]</em> will send the packet when a MDATA PID is received.</td>
</tr>
<tr>
<td></td>
<td><em>False</em> will not send the packet when a MDATA PID is received.</td>
</tr>
</tbody>
</table>

### SendIfAckPid

<table>
<thead>
<tr>
<th>Description</th>
<th>Specifies if the packet will be sent when an ACK PID is received.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Boolean <em>(True or False)</em>.</td>
</tr>
<tr>
<td>Default</td>
<td>False</td>
</tr>
<tr>
<td>Example</td>
<td><em>[True]</em> will send the packet when an ACK PID is received.</td>
</tr>
<tr>
<td></td>
<td><em>False</em> will not send the packet when an ACK PID is received.</td>
</tr>
</tbody>
</table>
### SendIfNakPid
**Description** Specifies if the packet will be sent when a NAK PID is received.
**Type** Boolean (True or False).
**Default** False
**Example**
- **True** will send the packet when a NAK PID is received.
- **False** will not send the packet when a NAK PID is received.

### SendIfStallPid
**Description** Specifies if the packet will be sent when a STALL PID is received.
**Type** Boolean (True or False).
**Default** False
**Example**
- **True** will send the packet when a STALL PID is received.
- **False** will not send the packet when a STALL PID is received.

### SendIfNyetPid
**Description** Specifies if the packet will be sent when a NYET PID is received.
**Type** Boolean (True or False).
**Default** False
**Example**
- **True** will send the packet when a NYET PID is received.
- **False** will not send the packet when a NYET PID is received.

### SendIfErrPid
**Description** Specifies if the packet will be sent when an ERR PID is received.
**Type** Boolean (True or False).
**Default** False
**Example**
- **True** will send the packet when an ERR PID is received.
- **False** will not send the packet when an ERR PID is received.
5.22 HostAutoGenerateSof Instruction

The HostAutoGenerateSof instruction starts or stops automatic Start-of-Frame generation.

Example
HostAutoGenerateSof();
HostAutoGenerateSof(False);

Parameter List

<table>
<thead>
<tr>
<th>Enable</th>
<th>Description</th>
<th>Type</th>
<th>Default</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Specifies if SOF are automatically generated.</td>
<td>Boolean (True or False).</td>
<td>True</td>
<td>True will automatically generate SOFs accordingly to the link speed. False will stop generating SOFs.</td>
</tr>
</tbody>
</table>
5.23 HostWaitGeneratedSof Instruction

The `HostWaitGeneratedSof` instruction synchronizes on a Start-of-Frame automatically generated by the hardware.

**Example**

```c
HostWaitGeneratedSof(
    Timeout => 150us);
```

**Parameter List**

<table>
<thead>
<tr>
<th>Description</th>
<th>Timeout after which the instruction is aborted.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td><strong>Default</strong></td>
<td>Waits for ever if not specified.</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>1.32ms means 1,320 microseconds or 79,200 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
5.24 HostSetMaxTransactionDuration Instruction

The HostSetMaxTransactionDuration instruction specifies the expected time needed to send a transaction. The host processor will automatically check if this time is large enough to fit the current frame. If not, the transaction will be delayed until the beginning of the next frame.

Example
HostSetMaxTransactionDuration(Duration => 60us);

Parameter List

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Computer duration of the transaction to be sent.</td>
</tr>
<tr>
<td>Type</td>
<td>Time expressed in 60 MHz clock cycles or seconds.</td>
</tr>
<tr>
<td>Range</td>
<td>0 to 4,294,967,295 clock cycles or 0 to 71 seconds with a precision of 16.66 nanoseconds.</td>
</tr>
<tr>
<td>Default</td>
<td>No default value; this parameter is mandatory.</td>
</tr>
<tr>
<td>Example</td>
<td>0.66ms means 0,660 microseconds or 39,600 clock cycles. 620ns will be floored down to 37 clock cycles. 3960clk means 3,960 clock cycles or 66 microseconds. 1000 (without unity) is not allowed and will generate a warning.</td>
</tr>
</tbody>
</table>
5.25 **HostResetMaxTransactionDuration Instruction**

The `HostResetMaxTransactionDuration` instruction resets the duration specified by `HostSetMaxTransactionDuration`. After this instruction is called, the processor will not delay a transaction if it is too close to a frame boundary.

**Example**

```c
HostResetMaxTransactionDuration();
```

**Parameter List**

This instruction does not take any parameters.
Frequently Asked Questions

Q The USB Explorer 260 transmits data using a USB 2.0 connection. Do I need a USB 2.0 host controller?
A Although the USB Explorer 260 can upload or download data on a full speed USB 1.1 connection, Ellisys strongly recommends that you connect it to a high speed USB 2.0 port to obtain optimal performance. If you experience problems with the USB Explorer 260, please ensure it is connected on a high speed USB 2.0 enabled host controller before contacting technical support.

Q I have got one host controller and I'd like to add a second one. How can I achieve this?
A Installing a USB extension card is the easiest way to add a host controller to your computer. Furthermore, nowadays most of these extension cards are USB 2.0-compatible, which will enable you to wholly gain from all your analyzer's power. Talk to your local dealer about getting a USB 2.0 host controller card.

Q What is the maximum amount of data that I can generate with the USB Explorer 260 Generator?
A The Generator uses its internal memory and hard disk to store data to be generated. The maximum quantity of data is therefore limited by the size of the internal memory.

Q Is it possible to upgrade the firmware of the USB Explorer 260?
A Yes, the firmware is automatically updated with each new software release. No user intervention is required; the latest version of the firmware will be downloaded when you run the most recent version of the software.
Q: What can I connect to the large connector on the back of the product?
A: The Auxiliary Equipment connector enables hardware extensions. Several options are currently available and others may be provided in the future. Please contact the Ellisys sales team for more information.

Q: I cannot run the software installation file, why?
A: The software installation file requires Microsoft Windows Installer 3.0 or higher, which is available for download from the Microsoft web site.

Q: I would like to connect the USB analyzer on a EHCI host controller but it seems that it doesn't work. What can I do?
A: We took note that several EHCI drivers supplied by manufacturers of USB 2.0 add-in cards could cause problem. We strongly recommend the use of the Microsoft EHCI driver. You can find more information on the installation of this driver at: http://www.usbman.com/USB%202%20News.htm.

Need more help?

Go to the Ellisys web site and the following pages for the latest information:

- Ellisys products page - Go to www.ellisys.com/products for the latest product information and documentation.
- Application notes and white papers - Go to www.ellisys.com/technology to find up-to-date information about the technology.
- Distributors - Go to www.ellisys.com/sales/ to find a list of Ellisys distributors.
- Technical support - Go to www.ellisys.com/support/ to send a question directly to the Ellisys support team.
**Glossary**

This glossary lists terminology terms, abbreviations and acronyms that you may come across while reading this User Guide and working with Ellisys products.

**ACK**  
Acknowledgment code - Usually sent at the end of successful transaction.

**Addr**  
Address - A field used to identify a given device.

**Analyzer**  
An instrument that capture traffic exchanged between devices.

**API**  
Application Programming Interface - A set of functions used by a program to communicate with another.

**Bandwidth**  
The transmission capacity of an electronic pathway such as a communication line, computer bus or computer channel.

**BIN**  
Binary - A representation of values that uses two symbols, typically 0 and 1.

**BER**  
Bit Error Rate - The number of bits in error divided by the total number of bits.

**BNC**  
Bayonet-Neill-Concelman - A connector for coaxial cables.

**Bookmark**  
A stored location for quick retrieval at a later date.

**bps**  
Bits per second - The measurement of the speed of data transfer in communication systems.

**Breakpoint**  
The location in a program used to temporarily halt the program for testing and debugging.

**Code Snippet**  
A small piece of program code usually used to guide the user.

**CSV**  
Comma-separated Values - A delimited data format that has fields separated by the comma character and records separated by new lines.

**Dec**  
Decimal - A representation of values that uses ten symbols, typically 0 to 9.

**DUT**  
Device Under Test - A device that is being analyzed or debugged.

**EDX**  
Ellisys index file - A file format used to index information found in another file.
**ESE**  
Ellisys settings file - A file format used to store user settings.

**EUI-48**  
Unique identifier partly assigned by the IEEE RAC and partly defined by the manufacturer of an equipment to uniquely identify a networking device.

**FCS**  
Frame Check Sequence - A number added to a stream of information that is used for error detection.

**FIFO**  
First In First Out - A storage method that retrieves first the item stored for the longest time.

**Gbps**  
Gigabits per second - 1,073,741,824 bits per second.

**GByte**  
Gigabytes - 1,073,741,824 bytes.

**Hex**  
Hexadecimal - A representation of values that uses sixteen symbols, typically 0 to 9 and A to F.

**Handshake**  
The resulting status of a data exchange.

**Host**  
A computer that acts as a source of information or signals.

**IDE-type connector**  
A type of electric connector usually attached to a flat ribbon cable.

**LED**  
Light Emitting Diode - Display and lighting technology commonly used on electronic equipment to indicate their status.

**Kbps**  
Kilobits per second - 1,024 bits per second.

**KByte**  
Kilobytes - 1,024 bytes.

**Loop**  
A repetition within a program or script.

**Mbps**  
Megabits per second - 1,048,576 bits per second.

**MByte**  
Megabytes - 1,048,576 bytes.

**NAK**  
Negative Acknowledgement - An answer to a request that can express anything but acceptance.

**Packet**  
A block of data that is transmitted over a communication link.

**Payload**  
The actual data in a packet minus all headers attached for transport and minus all descriptive metadata.

**Protocol**  
The format and procedures that govern the transmitting and receiving of data.

**RX**  
A communication abbreviation for receive.

**Script**  
A set of instructions that is executed without user interaction.
| **Snippet** | A small piece of program code that guides the user in how to write a specific instruction. |
| **SOF**     | Start of Frame - A packet used for USB time synchronization. |
| **TX**     | A communication abbreviation for transmit. |
| **USB**     | Universal Serial Bus - An interface that connects between a computer and peripheral devices (such as a keyboard, game controllers, telephone, printer, etc.). |
| **XML**     | Extensible Markup Language - A reasonably human-legible structured language aimed to facilitate the sharing of data across heterogeneous information systems. |
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