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1 Overview

SCA (Safety Code Analysis) is a software tool. In order to be able to use ST (structured text) for safety programming in CODESYS 2.3, you have to follow certain coding guidelines. SCA can read your CODESYS project and check it against those guidelines, flagging any rule violations.

Many of the guidelines can be applied to the other programming languages available in CODESYS, too, and SCA is able to check FBD (function block diagram) and LD (ladder diagram) code for you.

The user interface of SCA resembles that of relevant CODESYS parts very closely.

2 Release Notes of SCA V1.1.0

Functional changes and new features

1. A grouping feature has been integrated to be able to group error messages / warnings / manual check items. All messages can be assigned into two groups A and B. Group A messages are displayed first, then followed by Group B messages (in the message window and in the generated reports). Therefore, a new menu item "Options > Set groups" has been added.
The graphical user interface has been re-arranged with the goal to offer a more convenient user handling.
2. An additional note has been added for message E0260: POINTER TO <arg> shall be used whenever possible for functions like ADR.
3. PROFIsafe functions (eg. CallbackInit, InitPROFIsafe, etc.) are ignored during analysis even if they are not deselected when creating the CODESYS export file. The relating messages are no longer shown in the check result.
4. An additional note has been added for message E0150c: The divisor shall not contain unnecessary parentheses.
5. An additional note has been added for message E0150c: A boundary check shall not contain unnecessary parentheses.
6. An additional section "Graphical user interface" has been added within the "Short introduction" help text.

Fixed issues

- ST instructions inside FBD programs
- "\$" characters in the path direction when parsing CODESYS projects
- CODESYS programs containing mixed actions (ST, FBD and LD)
- CODESYS programs containing both LD and FBD code
- IF instruction containing the terms "REAL#0" or "REAL#0.0"

3 Installation Notes

System Requirements:

Any standard PC with Windows 7 or Windows 10 will support the installation of SCA. Your PC shall have adequate memory (SCA needs around 2 MB only) and necessary administrator

rights. SCA works as a stand-alone software and takes only a few seconds to complete the installation.

Click on the provided “.exe” file to start the installation process. Make sure that the necessary “.msi” file is located in the same directory with the “.exe” file. You will be guided by the software to complete the simple installation process.

While installing, a message might be shown that the setup requires a certain .NET Framework version. The message is shown if you do not have an installed .NET Framework on your system. Click “Yes” and the .NET Framework download website opens. Important: Install .NET Framework **V3.5 SP1**, not any newer or other version. After .NET framework installation and Windows reboot, start SCA installation process again.

4 Workflow

- Export from CODESYS
 - In the CODESYS main menu, select "Project > Build".
 - Make sure that CODESYS reports no errors or warnings.
 - In the main menu, select "Project > Export".
 - There is no more need to unselect the pre-certified PROFIsafe functions (POUs CallbackInit, CallbackReadInputs, CallbackWriteOutputs, InitPROFIsafe, ReadPROFIsafeInputs and WritePROFIsafeOutputs). These functions are automatically ignored during the SCA check. Note: There is no further information provided in the SCA report to indicate that these PROFIsafe related functions are ignored.
 - Select a location and filename to save the export to, and click "Save".
- Open export in SCA
 - In SCA, press "Ctrl-O", or
 - in the main menu, select "File > Open CODESYS export...", or
 - click the "Open" button on the far left of the toolbar.
 - In the file open dialog, select the file just exported from CODESYS.
 - You can also drag and drop a file onto the SCA window instead.
- SCA immediately analyses your project and displays any found issues in the message list on the bottom.
 - Click on a message to display the source of the affected module and to highlight the exact location where this issue occurred.
 - Hover the mouse pointer over the selected message to see a resolution suggestion. (You may need to select "Options > Enable tooltips" first.)
 - Press F1, or select "Help > Help on this message" from the main menu, to call up a help page on the issue selected. You can also right-click on any message and select "Help" from the context menu.
 - If you want to concentrate on the more serious issues first, select "Options > Show only errors" from the main menu. (This will add a message stating that you disabled warnings to remind you.)
 - If you want to tackle all issues of the same type together, select "Sort > by message number" from the main menu.
- Apply any changes required to your sources in CODESYS. You don't have to close the export in SCA in order to do this.
- Repeat until SCA doesn't show issues any more.
 - To reopen the export last opened:

- Type "Ctrl-N", or
- in the main menu, select "File > Reopen", or
- click on the file name displayed in the toolbar.
- To open an export recently opened:
 - In the main menu, select it under "File > Open recently used", or
 - click on the small arrow next to the file name displayed in the toolbar, and select the export from the list displayed.
- Print reports as needed.

5 Format of the messages

5.1 Example

Error 0180: Datatypes (H 9): Direct complex type declarations in variable lists are not allowed.

5.2 Explanation

Each message contains the following parts:

- Severity - this may be one of
 - "Error" - major rule violation that you must remove;
 - "Warning" - minor rule violation that you must remove;
 - "Manual" - a situation where SCA cannot determine whether a rule violation really exists or not. Print the "Manual check items" report and manually check for these issues;
 - "Remark" - additional information.
- Message type number.
- Location, given by
 - name of the POU, global variable list, or type declaration, followed by
 - line or network number in parentheses. If the issue occurred in a POU,
 - "H" indicates a line number in the declaration header,
 - "B" indicates a line number in the body of an ST POU, and
 - "N" indicates a network number in an FBD or LD POU.
- The message text.

6 Library definition files

In order to be able to correctly check certain of the coding guidelines, SCA needs to know the definitions of POUs and variables contained in libraries. The following libraries are known to SCA by default:

- Safety_Standard.lib
- Safety_SysLibTime.lib
- SafetyBase_PROFIsafe_AC500_V22.lib
- SafetyBase_PROFIsafe_AC500_V22_Ext.lib

- SafetyBlocks_PLCOpen_AC500_V22.lib
- SafetyExt_AC500_V22.lib
- SafetyUtil_CoDeSys_AC500_V22.lib
- SafetyBase_PROFIsafe_LV200_AC500_V22.lib
- SafetyDeviceExt_LV100_PROFIsafe_AC500_V27.lib
- SafetyExt2_LV100_AC500_V27.lib

If your project references libraries other than the standard libraries named above, you must provide the information contained in these libraries to SCA as follows.

- Open your library project in CODESYS 2.3.
- Make sure the library project compiles without errors and warnings.
- Export the complete library project from CODESYS, as described above.
- Open the export file in SCA.
- In the main menu, select "File > Save library definition...".
 - The save dialog opens in the "Library definitions" subfolder of the directory where SCA is installed. Save the library definition file only here, as SCA will otherwise not be able to find it.
 - If, in projects using the library, it is referenced by a different name, replace the name provided by SCA by that name.
- Click "Save" to save the library definition.



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