

SIMOTION

Frequently asked Questions

DebugLineNumber

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e.g.:

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- Trained or instructed according to the latest safety standards in the care and use of the appropriate safety equipment.
- Trained in rendering first aid.

There is no explicit warning information in this documentation. However, reference is made to warning information and instructions in the Operating Instructions for the particular product.

Reference regarding export codes

AL: N

ECCN: N

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1 Question

Goal of the application

The function block `_FB_DebugTraceLinenumber` gives support when debugging while the ST programs are running. The function block is called in the source code after branching or queries. This makes it possible to trace back exactly which program parts have already been executed or where a program has not been run as desired.

The FB writes a comment into an array with every call (per unit):

- The code line in which it has been called
- A free selectable information number
- The system time

Thus, the sequence of large program sections can be traced back. This helps to save a lot of time when debugging, especially for complex programs.

Main content of this application

The following essential points are treated in this application:

- Debug-FB
- Array with entries of the function block
- Trigger function
- Abort function
- Search for line numbers in the array

Demarcation

This application does not contain / does not give a description of

- Structured text (ST) programming
- SIMOTION Scout

Fundamental knowledge in these subjects is required.

2 Description of the function

Content

Here, you can get an overview of the function block `_FB_DebugTraceLinenumber`. You learn about the used components

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(standard hardware and software components as well as the specially created user software).

The described key data show the performance of the present application.

3 Basic information

3.1 Preconditions

3.1.1 Target group

The standard function block is meant for all programmers who intend to debug simply and quickly a created Structured Text (ST) source code by means of SIMOTION.

3.1.2 Technical environment

The present sample application can only be applied without changes in connection with the SIMOTION D and the SINAMICS demonstration case. The contained function block can be applied to every ST code under SIMOTION.

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3.2 Goal and purpose of this application

3.2.1 Task definition

With SIMOTION SCOUT only small program sections of ST-Units can be observed online. This makes it difficult to trace the process of an ST-program after several function calls. Thus, the search for errors is very difficult and time-consuming. For a better tracing of the program sequence, a function block that can be called at strategic points shall be made available to document the process.

3.2.2 Solving problems with the help of the standard application

The function block `_FB_DebugTraceLinenum` is made available by the unit `aSqDebug`. In the Unit `aSqDebug`, a separate constant is defined for all ST units that are used in the program. During the compilation, a debug array of all defined units of the user program is created in the `aSqDebug`. Now, the user defines an instance of the `_FB_DebugTraceLinenum` in every unit and integrates it in certain positions in his program. With every call, the instance of the Debug-FBs enters in this debug array the unit constant, the line number in which the FB has been called and the system time. By this, the program sequence can be traced in the symbol browser of the `aSqDebug` via the debug array.

3.2.3 Advantages of the standard application

By a specific application, the function block can make it considerably easier to find errors. The user can install a call for the Debug-FBs and define how many entries shall be made in the debug array. The call for the FB can be controlled via a Boolean variable or, via a compiler switch, be integrated in the program only with the compilation. Doing so, the functionality can be connected, if necessary, and does not stress the program operation time.

3.3 Components in the standard application

Apart from the documentation of the call positions in the debug array, the FB still offers further functions:

- Trigger function

By means of a variable in the symbol browser of the `aSqDebug`, you can define a code line of a unit, where the recording in the array is to start. With another variable you can define how many calls are to be entered in the array after the trigger point.

- Abort function

With an indication of a code line, you can abort the recording of the FB calls at a certain position in the program. Here, it is also possible to increase the number of array entries by means of a variable.

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- Search for line numbers in the array

With input parameters of the Debug-FBs, you can search for a line number in the array. Then, the FB returns the index of the array elements as output parameters. This makes it easier to find certain entries in the debug array.

- ST function to focus on parts of debug array

With the function `_FC_DebugTraceLinenumCopyInFokusArray`, you can cut a certain part of the debug array and insert it in a different array. For example, this function can be used to search within a debug array by means of an HMI so that it is not necessary to indicate all entries.

- Array with entries in all units

When calling the FB `DebugLinenum`, you can determine with a Boolean variable if the line number is entered in the single arrays of the units or if all entries are filed in one big array. With the big array, you can observe the whole process of the program. The constant of the unit is entered in the array and thus shows when the program changes from one unit to the next one.

Note

Due to parallel processes of the multitasking systems, some entries may originate from other tasks and therefore have not necessarily been realized by the currently running code of a unit. However, this makes it possible to observe effects caused by parallel processes (e.g. common access of different tasks to one resource) and to detect possible problems.

4 Program environment and interfaces

4.1 Call environment

The function block `_FB_DebugTraceLinenum` can be called in the motion tasks and the background task of the sequence system. The function block can also be used in the Ipo synchronous task. However, this might cause problems if two different tasks start the FB at the same time. In the motion tasks and the background task this is avoided by the system functions `_disableScheduler()` and `_enableScheduler()`.

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Note

The function block `_FB_DebugTraceLinenummer` uses the functions `_disableScheduler()` and `_enableScheduler()`. These functions have an effect on the sequence of the motion tasks and increase the IPO running times. Therefore, calls of the FB `DebugLinenummer` should be avoided during a standard operation of the user program. This can be controlled via If-queries or software switches (see figure 1).

Figure 1: Example call after IF-query of software switch (Unit 2)

```

43 //-----
44 // Example of call FB with IF-interrogation
45     ELSIF (Ablauf = 5)
46     THEN
47         Ablauf:=6;
48
49         IF ( debugarray[g_iCONST_PLI_DEBUG_UNIT_NUMBER_UNIT_2].bowithdebugarray = TRUE)
50         THEN
51             Inst_FB_Debug_Unit_2 (unit#line,0,g_iCONST_PLI_DEBUG_UNIT_NUMBER_UNIT_2,0);
52         END_IF;
53
54
55
56 //-----
57 // Example of call FB with preprocessor
58
59 // The property of the Unit has to be changed for this example.
60 // The check-box "use preprocessor" must be activated in register "Compiler"
61 // and the preprocessor statement "Debug" must be defined in register "Additional settings"
62     ELSIF (Ablauf = 6)
63     THEN
64         Ablauf:=1;
65
66 {
67 #ifdef Debug
68 }
69     Inst_FB_Debug_Unit_2 (unit#line,0,g_iCONST_PLI_DEBUG_UNIT_NUMBER_UNIT_2,0);
70 {
71 #endif
72 }

```

The call is done via an instance of the function block. An instance should be created for each unit so that it can be called at any position desired of the unit. Reasonable positions for the calls are:

- After If-queries
- In case instructions
- After While-, Repeat- or For-loops
- After function calls

If the sequence of the user program is disturbed too much by the system function `_disableScheduler()` and `_enableScheduler()`, the user can remove both system functions even from the FB `DebugLinenummer`. For this, the user has to consider that he calls every single instance of the function block in only one ST program. This ensures that always only one task wants to have access to the array for the instance of the FB `DebugLinenummer`.

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Note

If an instance is called three times in succession in a code line, the FB terminates the recordings in the array. This avoids that the whole array is filled with the same line number. Therefore, a single call in one program loop does not make sense.

During the compilation, the pre-processor instruction *unit#line* is replaced by the line number where the instruction is written. The instruction can be used for the input parameters. Doing so, the call for the Debug-FBs stays the same for every line in a unit.

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4.2 Interfaces

The function block `_FB_DebugTraceLineNumber` can be influenced by several parameters and interfaces, which are classified according to the following areas:

- Function block interfaces
- User interface in the range of global data

Via the module interface, the function block gets changing tasks. This is done by input and output parameters of the module. The call for the module is installed by the user during the programming of the SIMOTION software and remains in the program afterwards. The real control of the Debug-functions is done via the global data of the unit `aSqDebug`. Exception is made for the search of a line number in the debug array. For this, it is necessary to install an instance of the debug array in the cyclic part of the user program, which the user can initiate manually for each search function

Via the user interface in the global data area of the unit `aSqDebug`, the function block mainly gets trigger and abort data of the controlled unit. Furthermore, you can activate or deactivate the recording for each unit in the debug array by means of the Boolean variable „`boWithDebugArray`“.

Description of the global data area:




-  → The user has to adapt the values
-  → The user must not change the values
-  → The user is allowed to change the value during the running time

Table 4-1: user interface in the global data area of unit `aSqDebug`

Parameter	Data type	Initial value	Description
Limits of the debug arrays			
<code>g_iCONST_PLI_MIN_TRACE_NUMBER_OF_LINE</code>	INT	(freely selectable) 1	Defines the lower limit of the debug array
<code>g_iCONST_PLI_MAX_TRACE_NUMBER_OF_LINE</code>	INT	(freely selectable) 50	Defines the upper limit of the debug array
<code>g_iCONST_PLI_MAX_NUMBER_OF_LINE_ALL_ARRAY</code>	INT	(freely selectable) 200	Defines the upper limit of the debug all-array. (array via all units)

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Definition of the unit			
g_iCONST_PLI_MIN_DEBUG_UNITS	INT	(freely selectable) 1	Defines the lower limit of the array via the units
g_iCONST_PLI_MAX_DEBUG_UNITS	INT	(freely selectable) 2	Defines the upper limit of the array via the units
Definition of the unit constant			
g_iCONST_PLI_DEBUG_UNIT_NUMBER_...	INT	Defines the index of the UNIT-array	For each unit of the user program, a constant should be defined that contains the index of the unit array. When calling the debug-FBs, this constant is transmitted and defined in which the array the entry will be made.
Matrix of the applied arrays			
Structure sTraceLineNumber			
iLinenummer	DINT	0	Entry of the line number when calling the FB
iInfo	DINT	0	Information can be transmitted when the FB is called and is available for individual additional information such as variable value.
dtSystemtime	DT	DT#0001-01-01-0:0:0.0	Time stamp for calling FB
Structure sDebugLineNumber			
bolnitDebugarray	BOOL	FALSE	TRUE: with the next call for FB, the DebugArray is initialized once and then set to FALSE
iNextCounter	DINT	1	Pointer for next entry in the FB
iTriggerLineNumber	INT	0	With >0, the unit is triggered on this line number. (Supposing that the Debug-FB is called in this line)
iCountDebugAfterTrigger	INT	0	Number of entries being allowed after triggering.
boWithDebugArray	BOOL	FALSE	TRUE: FB makes entries in debug array (is set

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			automatically by triggering)
aElement	ARRAY		Elements of the debug array (structure sTraceLineNumber)
iLineAbort	DINT	0	With >0 in this line number, boWithDebugArray is set to FALSE and the recording is terminated
iCountDebugAfterAbort	DINT	0	Increases the number of entries by this value after an abort
iAbortCounter	DINT	0	When iCountDebugAfterAbort >0 and value = iNextCounter, the abort is triggered
boWaitForAbort	BOOL	FALSE	TRUE: FB is waiting for abort line
boTriggerFoundActive	BOOL	FALSE	TRUE: Trigger line found
boTriggerFoundReady	BOOL	FALSE	TRUE: Trigger line found and number achieved in iCountDebugAfterTrigger
boOnlyInit	BOOL	FALSE	TRUE: when boInitDebugArray = TRUE, the FB is only initialized
Structure sDebugLineNumber			
g_rtcActTime	RTC		
DebugArray	ARRAY		Unit array (structure sDebugLineNumber)
iDebugArrayAllIndexFocus	INT	0	Transmission value for Focus-array
iDebugArrayAllCopyStart	INT	0	Beginning of the focus range (Index of the debug array selected via iDebugArrayAllIndexFocus)
iDebugArrayAllCopyEnd	INT	0	End of the focus range (index of the debug array selected via iDebugArrayAllIndexFocus)

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4.3 Parameter description _FB_DebugTraceLinenumber

4.3.1 Input parameters

Table 4-2: Input parameters of the function block _FB_DebugTraceLinenumber

Input parameters	Data type	Initial value	Description
iLinenumber	DINT	0	Line number where the FB has been called (being realized by <i>unit#line</i>)
iInfo	DINT	0	Free selectable information
iUnitNumber	INT	0	Number (constant) of the unit where the FB has been called
iIndexToLineNumber	DINT	0	After this line number, the FB searches in the debug array at the next call. With every new call for the FBs with the same line number, the next entry in the debug array is searched

4.3.2 Output parameters

Table 4-3: Output parameters of the function block _FB_DebugTraceLinenumber

Output parameters	Data type	Initial Value	Description
iIndexNumber	INT	0	Element (Index) of the debug arrays with the line number where the iIndexToLineNumber was entered. 0: line was not found or array was run through one time

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4.4 Parameter description _FC_DebugTraceLineNumberCopyInFocusArray

4.4.1 Input parameters

Table 4-4: Input parameters of the function block _FB_DebugTraceLineNumber

Input parameters	Data type	Initial Value	Description
DebugArrayIndexFocus	DINT	0	Number (index) of the debug array to be focused

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Sample application as demonstration system

Content

This part explains all necessary steps for the start-up of the standard function block `_FB_DebugTraceLinenumber` as demonstration system.

Conditions:

- SIMOTION Scout ≥ 4.0
- Demonstration case SIMOTION D435 with SINAMICS double motor module

5 Installation of the application software

The project for the sample application exists as an archived SIMOTION project. The files `DebugDemo.zip` has to be dearchived with the configuration software Scout first.

The demonstration application consists of the units `aSqDebug`, `Unit_1` and `Unit_2`. `ASqDebug` has been adapted to the application. `Unit_1` and `Unit_2` show an example of how to apply the `Debug-FB`.

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6 Operation of the example application

6.1 Brief instruction for demonstration

With the watch table *Watchtable_1*, you can control and observe the entire functionality of the example application. With the values 1-6, the variable for the global device *step* controls several steps in *Unit_1*. Via *step* = 5, the *Motiontask_1* is started and thus *Unit_2*.

After setting *DebugArray[1].boWithDebugArray* and *DebugArray[2].boWithDebugArray* to **TRUE**, the recording of the program sequences starts in both debug arrays.

6.2 Operating instructions

In the example application, an instance of the *_FB_DebugTraceLinenummer* has already been called at different places in the program. Table 4-1 shows how to operate the global variables to start processes in the program and how to trigger calls for the *_FB_DebugTraceLinenummer*.

Table 6-1: Operation of the parameters via watchtable

Parameter	Data type	Initial value	Description
Watch table_1			
step	INT	0	Step controls a case instruction in <i>Unit_1</i> 0: no action 1: enable axis_blue 2: _move axis_blue 3: _stop axis_blue 4: _disable axis_blue 5: start <i>Motiontask_1</i> 6: search for line number in debug array
indextolinenummer	DINT	0	Return value with step = 6. (searching for a line number)
linenummer	DINT	0	line number which shall be searched for with step = 6
unitnummer	INT	0	Unit number which shall be searched for with step = 6
sequence	INT	1	Step counter of <i>Unit_2</i> . Has to be set to 1 for a restart

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Parameter	Data type	Initial value	Description
debugarray[1]	array		See table 2-1 structure sDebugLineNumber
debugarray[2]	array		See table 2-1 structure sDebugLineNumber

6.2.1 Entry in the debug array

Table 4-2 gives an example of how to work with the tool. This way, all calls of the instance of the function block `_FB_DebugTraceLinenummer` are documented.

Table 6-2: Process example: Entry in the debug array of the Unit 1

No.	Action	Remark																																																																																																																								
1.	<pre> 23 CASE (schritt) OF 24 1:// enable Achse_Blau 25 myRetDINT := _enableaxis(26 axis:=Achse_Blau, 27 enablemode:=ALL, 28 servocontrolmode:=ACTIVE, 29 servocommandtoactualmode:=INACTIVE, 30 nextcommand:=IMMEDIATELY, 31 forcecontrolmode:=INACTIVE, 32 stwbitset:=0 33); 34 @schritt:= 0; 35 Inst_FB_Debug_Unit_1 (unit#line, 0,g_iCONST_PLI_DEBUG_UNIT_NUMBER_UNIT_1,0); 36 </pre>	In Unit_1, the instance <i>Inst_FB_Debug_Unit_1</i> is called in line 35. During the compilation, by using <i>unit#line</i> , the preprocessor transmits the line number 35 to the FB.																																																																																																																								
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DebugLineNumber

6.2.2 Entry in the DebugArrayAll

After having set the variable boWriteOnlyInBigArray to TRUE, all entries are saved in a big array (DebugArrayAll) by calls for the FB DebugTraceLinenummer. The example in table 4-3 shows the process of entries in DebugArrayAll.

Table 6-3: Sample process: debug array-All

No.	Action	Remark																																																																																																																																																																																																																																																
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DebugLineNumber

6.2.3 Function _FC_DebugTraceLinenumberCopyInFokusArray

The function `_FC_DebugTraceLinenumberCopyInFokusArray` is mainly interesting for indicating the entries on an HMI. Here, the display list becomes quickly confusing as soon as all entries of all debug arrays are indicated. To avoid this, you can use this function.

For instance, it is possible to indicate on the HMI the variables `iNextCounter` and `iActLinenumber` of every single unit. With a switch, you can control the Boolean variable `boWithDebugArray` and, by this, switch on the `FB_DebugTraceLinenumber`. If the user wants to see further details of a `DebugArray`, he starts from a selection list the function `_FC_DebugTraceLinenumberCopyInFokusArray` for exactly this unit. Before that, the user can determine which area he wants to focus on, depending on the variable `iNextCounter` (current entry = `iNextCounter-1`). The area is defined by the variables `iDebugArrayAllCopyStart` and `iDebugArrayAllCopyEnd`. Figure 4-2 shows an example with ProTool.

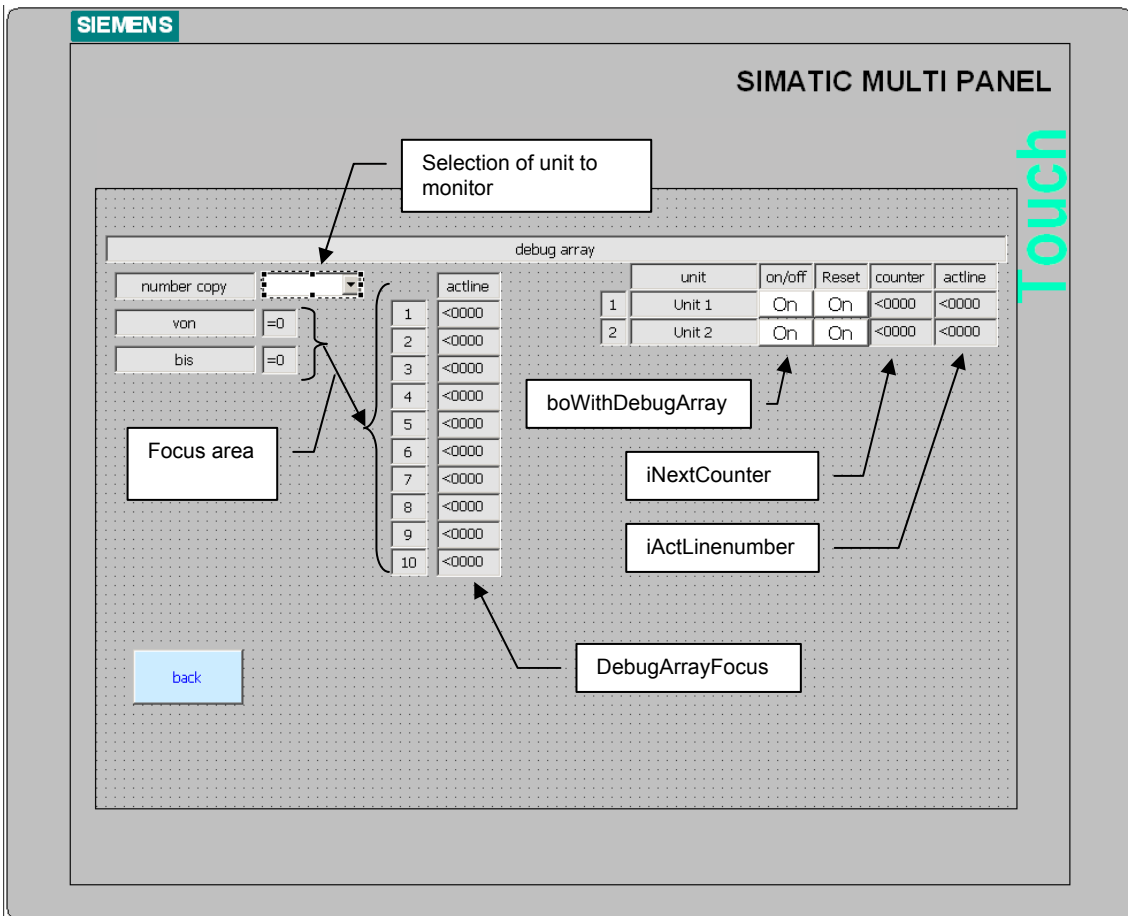
Figure 4-1 shows how to integrate the function in the cyclic part of the program, depending on the variable `iDebugArrayAllIndexFocus`. If a unit is selected via Combo-Box in figure 4-2, the adjusted focus area is indicated in this unit.

Figure 2

```
430
431 IF ( iDebugArrayAllIndexFocus <> 0 )
432 THEN
433   _FC_DebugTraceLinenumberCopyInFokusArray ( DebugArrayIndexFocus :=
434                                             iDebugArrayAllIndexFocus
435                                             );
436 END_IF;
437
```

DebugLineNumber

Figure 3: Sample screen _FC_DebugTraceLineNumberCopyInFokusArray



DebugLineNumber

Appendix

DebugLineNumber

7 Scope of delivery

The FAQ DebugLinenumber consists of:

- ST-source
- Documentation
- Sample application

8 Revision

Table 8-1: Revision/Authors

Version	Date/Revision
1.0	08/18/2007

DebugLineNumber

9 Contact partners

Application center

SIEMENS

Siemens AG
Automation & Drives
A&D MC PM APC
Frauenauracher Str. 80
Erlangen
Fax: 09131-98-1297
mailto: applications.erlf@siemens.com
