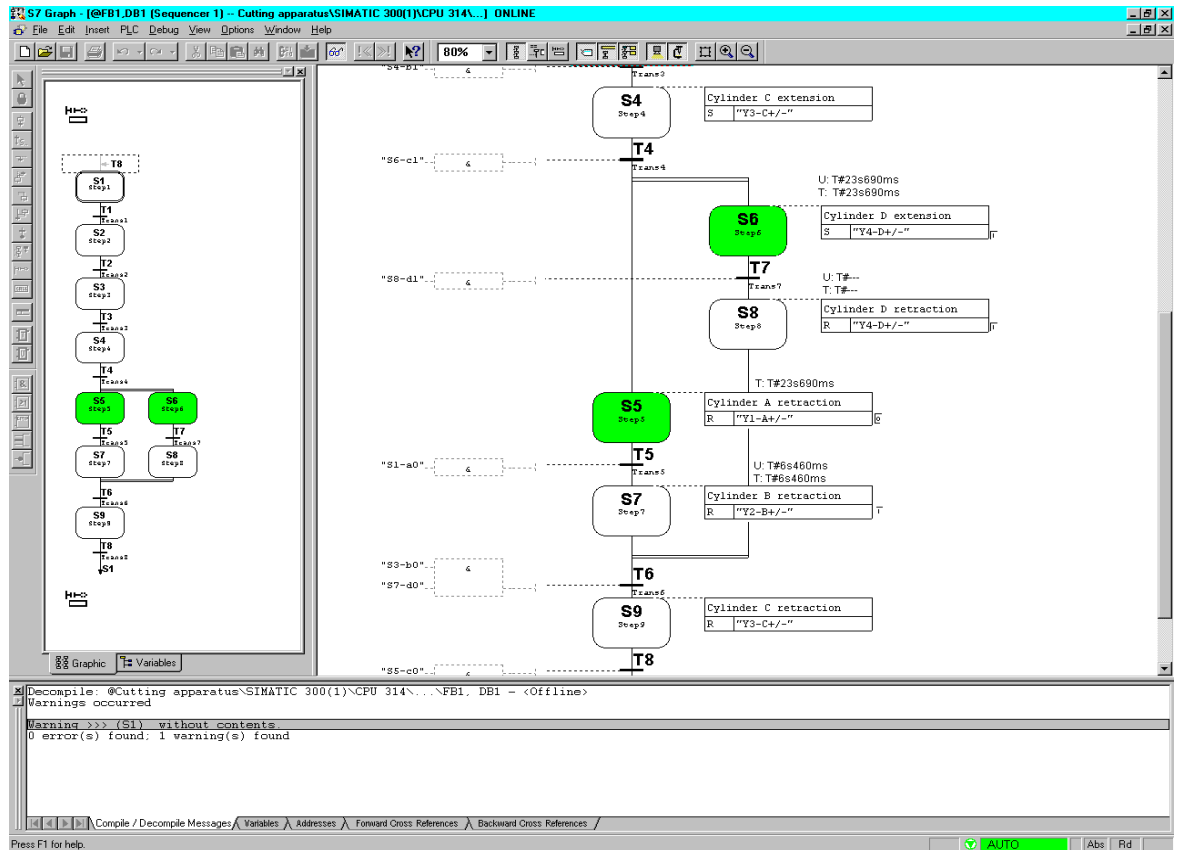## 8. DEBUG- AND DIAGNOSTIC FUNCTIONS

### 8.1 Monitoring of the sequencer

ℹ️ The function block can be tested with S7-GRAPH. After the opening of the FBs, the step by step execution can be watched e.g. with the function **Monitor**.

It displays the signal state of the input and output variables. The active steps can be recognized in color.



### 8.2 Variable Monitor/Modify

ℹ️ Under the menu **PLC**, you will find the program to observe and modify variables. After the generation of a variable table and the adjustment for the trigger, one can intervene in the running process in order to carry through with debugging functions.

Forward  Installation  Sequent. control system  Representation  Configuration  **Debug functions**  Marginal conditions  FB- Parameters

**8.3** **Control sequencer**

In the menu **Debug,** you will find the debug function **Control Sequencer**, with which the S7-GRAPH sequential control system can be debugged in all operation types. All inputs and adjustments of the dialog boxes operate themselves like the according FB-Parameters.
The entries in the **Sequencer Control** dialog box can vary from the settings which you used to compile the sequencers. The settings that are dealt with here have priority over the other settings that were set by the compilation of the sequence.
To be able to make modifications, the mode selector on the CPU must be set to the RUN-P position.

**Adjustment of the Operation Type**
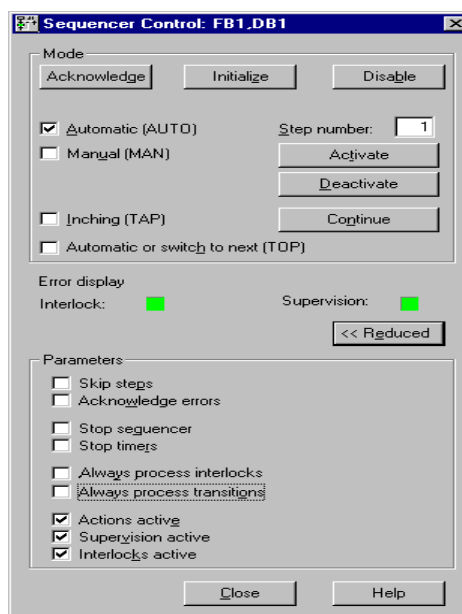


Through the activation of one of the round options' field, you can switch the running sequence into the chosen operation type. So you could let e.g. your sequencer run in automatic or manual mode. In manual mode, you can activate or deactivate each and every step.
Proceed to the following measures:

1. Queue the step number of the step in which editing will be done in the box "Step Number" or simply click on the desired step.
2. Choose the action that should be followed through with this step:
   - **Enable**: The chosen step is activated when the previous step is not accomplished.
   - **Disable**: The chosen step is deactivated.

Note that you must deactivate the present active step before activating a step since in a linear sequence only one step should be active. You can activate the desired step only if the current active step is deactivated. If a new mode of operation is set, the original mode of operation is marked by bold print. After you control a sequence in manual mode, you can return to automatic mode and close the dialog box "Sequencer Control."

If the command button "More" is activated, then additional parameters can be controlled.

Forward  Installation  Sequent. control system  Representation  Configuration  **Debug functions**  Marginal conditions  FB- Parameters

T I A  Training document
Last revision: 02/2002

Page 36 of 66

Module C1
Sequencer programming with S7-GRAPH

### 8.4 Synchronization

S7-GRAPH helps you locate possible synchronization points between the process and sequencer. A process is no longer synchronized, if it is manually brought into another condition. This can, for example, be the result when you change to manual mode in which you can activate any step even if the previous transition is not satisfied. To be able to continue the process automatically and to locate possible synchronization points, you can start the synchronization function. S7-GRAPH indicates all steps that meet the following conditions:

**The transition before the step is satisfied and the transition following the step is not satisfied.**

#### 8.4.1 Requirements

The sequencer is being controlled in manual mode.

-. The block is complied with the Option "Synchronization".
   (You can find this option in the tab "Compile/ Save"
   in the menu under **Block Settings**).

#### 8.4.2 Starting synchronization

Follow the following measurements, in order to let synchronization run:

1. Select the menu command **Debug, Synchronization**.
   S7-GRAPH now searches for all steps that meet the synchronization condition (transition before the step is satisfied and transition after the step is not satisfied). All steps found are marked yellow.
2. Select one or more of these steps to be selected using the mouse pointer that changes to a crosshair. You can also select other steps that are not marked yellow.
3. Activate the selected steps with the command button "Activate".
4. Now switch the sequencer back to automatic mode.

**Note**
In a simultaneous branch, each path must contain a step to be activated.

---

Forward  Installation  Sequent. control system  Representation  Configuration  **Debug functions**  Marginal conditions  FB- Parameters
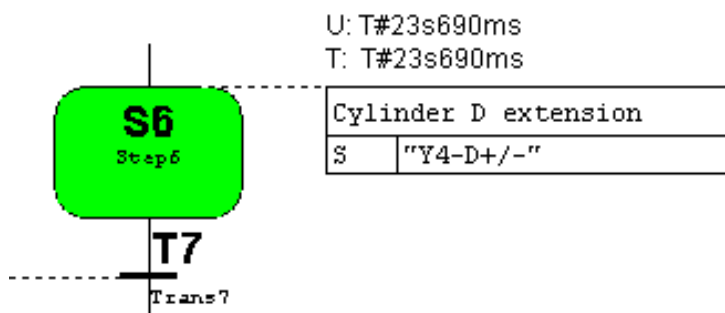
### 8.4.3    Synchronization run through and activating a new step

1. Highlight the step with the mouse.
2. Click **Activate**.
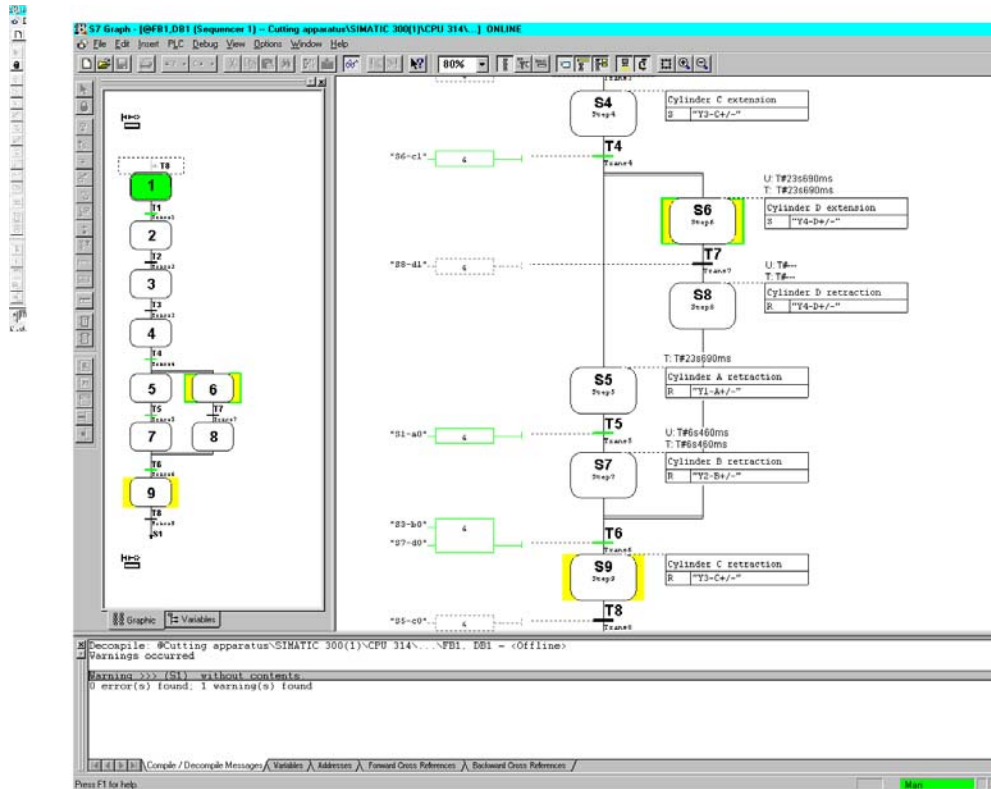


Only the chosen step is now active.  Previously activated steps(e.g. Step S1) are deactivated.



**Note**

Since Step S6 is found in a simultaneous branch,  Step S5 or Step S7 must also be activated in addition.(When they are not highlighted yellow).

In order to follow through with synchronization, the CPU switch must be in the position RUN-P.

Forward  Installation  Sequent. control system  Representation  Configuration  **Debug functions**  Marginal conditions  FB- Parameters

### 8.5 Diagnostic functions

The following diagnostic functions are available for further analysis of the sequential control system. Please note, however, that not all the functions available provide information about an S7-GRAPH sequential control system:

- · Query the module state
- · Query the operating mode
- · Evaluate CPU messages
- · Create reference data
- · Create process diagnostic data.

These functions provide you with further methods of debugging and supply important information about the use of blocks and addresses. You can also select these test functions directly in the SIMATIC Manager.

**Note**
If you require more detailed information about these topics, view the help texts relating to the menu commands in the SIMATIC Manager.

### 8.5.1 Querying module information and the operating mode

In the menu **PLC** under **Operation Mode**, you can request different information about the modules. As additional  information on the sequential control system, the content of the diagnostic buffer and the current utilization of the work and load memory can be particularly interesting.
You can, for example, find out the reasons for errors using the **Diagnostic Buffer** and **Stacks** tabs.  With the menu command **PLC**  under **Operating Mode**, you can query and modify the current mode of your CPU, for example restart.
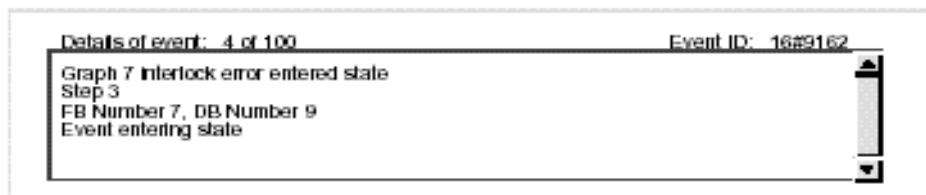
### 8.5.2 Evaluating the diagnostic buffer

If the option **Messages with WR_USMSG (SFC52)** is set in **Options** under **Block Settings** in the register **Messages**, S7-GRAPH enters the following messages into the diagnostic buffer.

- · Interlock errors entering/leaving state

- · Monitoring errors (execution errors) entering/leaving

From the detailed information about the message, you can find out where the error occurred.



---

Forward  Installation  Sequent. control system  Representation  Configuration  **Debug functions**  Marginal conditions  FB- Parameters

### 8.5.3 Evaluating the CPU messages

| i | In the SIMATIC Manager, you can use the menu command **CPU Messages** under **PLC** to display event and alarm messages. |

### 8.5.4 Displaying reference data

| i | To test the sequential control system, you can call up a variety of reference data.
You create the reference data as follows: |

When you save the FB, reference data is created if you have selected this function in the "General" tab which you can display with the menu command **Application Settings** under **Options**. The "Generate Reference Data" option must be selected. With the menu command **Reference Data** under **Options**, the reference data is created when required. Following this, S7-GRAPH calls the STEP 7 dialog box to display the reference data.

The following table shows the information available:

| List | Content of the list |
|---|---|
| Cross-reference | Overview of the use of addresses in the memory areas I, Q, M, P, T, C and DB within the user program. |
| Program structure | Call hierarchy of the blocks within a user program and overview of the blocks used and their interdependencies. |
| Reference list | Shows the use of the following:<br>• Inputs, outputs and memory bits<br>• Timers and counters |
| List of unused addresses | Overview of all the symbols found in the symbol table but not used in the parts of the user program for which reference data exist. |
| List of addresses without symbols | Overview of all the absolute addresses that are used in parts of the user program for which reference data exist but for which there is no symbol defined in the symbol table. |

If the reference data **Program Structure** or **Cross-Reference List** are displayed, you can jump to the point in the user program at which a selected block or addresses is used.

### 8.5.5 Generating diagnostic data

| i | Diagnostic data is generated when you save the FB if you select the **Generate PDIAG Data** option in the **General** tab of the **Application Settings** dialog box. You must also select the **Message with ALARM_SQ/ALARM_S** option in the **Messages** tab of the **Block Settings** dialog box. |

### 8.5.6 Updating diagnostic data after the rewiring

| i | If you have modified addresses in the SIMATIC manager using the menu command **Rewire**, and the addresses are also used by the sequencer, the corresponding diagnostic data is only updated when you open the corresponding S7-GRAPH FB again and save it. |

Forward  Installation  Sequent. control system  Representation  Configuration  **Debug functions**  Marginal conditions  FB- Parameters

9.      DEVELOPMENT OF THE CUTTING APPARATUS WITH ADDITIONAL MARGINAL CONDITIONS

| i | The working execution of the cutting apparatus is already present as a S7-GRAPH sequential control system. Here the extended functions from S7-GRAPH should be obtained through a modification of tasks with additional marginal conditions. |
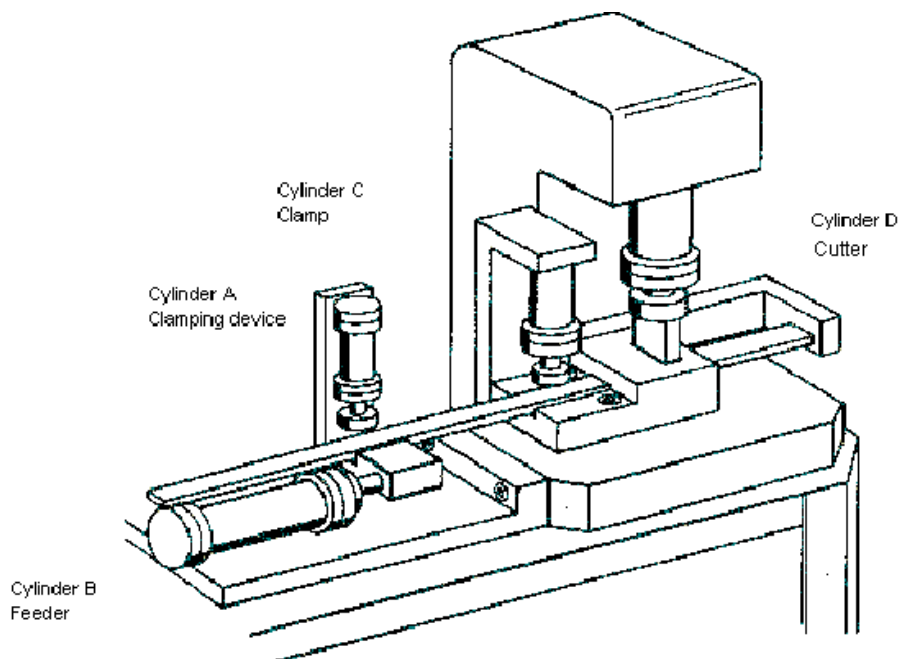


9.1      Description of the marginal conditions

| i | 1. Options between "Automatic" or "Manual". One switches from automatic to manual in the current cycle, then the control stays in execution. After restarting in automatic mode, the cycle runs further only after the Start-button was activated. |

2. With the pre-selection of "Automatic", the option between "Single Scan" or "Continuous Scan" exists. The continuous scan should be deleted through a switch to a single scan. An already started cycle runs to completion. Start follows by the activation of the Start-button.
3.  By the option "Manual", the control can be adjusted over an Adjust-button into the initial state. With the Start-button, it is possible in manual mode to clock through the control step by step.
4. The shaped material is scanned over a limit switch. If the rod material is at it's end, the cutting apparatus must halt in the initial state and the continuous cycle must be interrupted. After inserting new material, the control can be newly started through the activation of the Start-button.
5. By power failure and recovery, the system should not automatically run further, but must be started once again through the starting signal.
6. After the activation of the Emergency Stop-button, the system should halt. A new start is only possible after the cutting apparatus was adjusted in the initial state.
7. The operation type "Manual", "Automatic", "Continuous Scan" and "Emergency Stop" should be displayed over the indicator lights H1 through H4.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

T I A  Training document                                   Page 41 of 66                                             Module C1
Last revision: 02/2002                                                                        Sequencer programming with S7-GRAPH

### 9.2 Assigning the signal elements

| I1.1 | MAN/AUTO | Manual-Automatic switch | Signal 1 = Automatic operation mode |
| I1.2 | SS/CS | Single Scan-continuous Scan switch | Signal 1 = Continuous Scan |
| I1.7 | EMSTOP | Emergency Stop-button (NC) | Signal 0 = Emergency Stop |
| I1.6 | ADJUST | Adjust-button | |
| I1.3 | PART | Material type | |
| I1.0 | S0-Start | Start-button | |
| I0.0 | S1-a0 | Limit switch cyl. A retraction | |
| I0.1 | S2-a1 | Limit switch cyl. A extension | |
| I0.2 | S3-b0 | Limit switch cyl. B retraction | Normally Open |
| I0.3 | S4-b1 | Limit switch cyl. B extension | |
| I0.4 | S5-c0 | Limit switch cyl. C retraction | |
| I0.5 | S6-c1 | Limit switch cyl. C extension | |
| I0.6 | S7-d0 | Limit switch cyl. D retraction | |
| I0.7 | S8-d1 | Limit switch cyl. D extension | |

### 9.3 Assigning the work elements and indicator lights

| Q4.0 | Y1-A+/- | Valve for cylinder A ext/ret |
| Q4.1 | Y2-B+/- | Valve for cylinder B ext/ret |
| Q4.2 | Y3-C+/- | Valve for cylinder C ext/ret |
| Q4.3 | Y4-D+/- | Valve for cylinder D ext/ret |
| Q4.4 | H1-Man | Indicator light for manual operation mode |
| Q4.5 | H2-Auto | Indicator light for automatic operation mode |
| Q4.6 | H3-CS | Indicator light for continuous scan |
| Q4.7 | H4-EM | Indicator light for emergency stop |

**Note**
First add the symbol table in your S7-Project "Cutting apparatus".

---

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

**9.4 Inserting marginal conditions in the control problem**

S7-GRAPH offers the possibility of generating function blocks with additional variables in the block settings through the changing of the FB parameters. With the help of these functional modules, it is possible to activate all functions of the sequencer control over input signals. Over output variables different states of the sequencer can be displayed. Besides these conditions, interlocks and supervisions can be programmed in the single step representation. Interlock and supervision errors are registered in the diagnostic buffer of the CPU and can be displayed by requirement. With the help of these additional functions, a safe execution of the sequencer is ensured. In this way nearly all marginal conditions of the cutting apparatus are programmable.

**5 Hierarchy of the control conditions**

For the programming of the demanding marginal conditions, priority order should be considered. The input signals of the buttons and switches cannot often be directly used, because they allow themselves to be affected only under certain conditions (e.g. manual operation mode).

The priority rank and the posed conditions are as follows:

**1. "Emergency Stop" (Running circuit)**

In electronics, the entire system is usually shut down with the occurrence of an emergency stop signal. This has achieved success in use of pneumatic power components, because of the compressibility of air and rarely missing automatic locking. One is forced to regard the possible danger moments of each individual power component and to specify for each element, emergency stop conditions (e.g. a clamping cylinder should not to be made unpressurized).

For an emergency stop situation of the cutting device, consider the following statements:
- The program must be immediately interrupted.
- The sequencer is shut off.
- The work elements remain in their position.
- All operation types (Manual, automatic, continuous scan etc.) are functionless.
- All signal generators are ineffective.
- The emergency stop light (H4-EM) lights.

**2. Operation Mode „Manual"**

In manual mode, the automatic mode is ineffective and manual mode can run through the function "Adjust". With help of the Start-button, the control can be clocked through step by step. The lamp for manual operating mode(H1-Man) lights.

Forward  Installation  Sequent. control system  Representation  Configuration  Debug functions  **Marginal conditions**  FB_Parameters

### 3. "Adjust"

Over the Adjust-button, the system can be adjusted in the initial state. For the adjustment of the cutting apparatus, let the following states be met:
- The sequencer is initialized.
- All work elements go into the initial state.
      (Cylinder C first after all other cylinders are retracted).
- Error acknowledging (when an acknowledgement requirement would be programmed).

**Note**
Adjust should only be possible in the operation mode "Manual".
After an emergency stop, the system must be adjusted.

### 4. Operation Mode "Automatic"

In automatic operation mode, all functions of the manual operation mode are ineffective. The operation types "Single Scan" or "Continuous Scan" are possible. Through the activation of the Start-button, the previously written program runs through automatically. Then the automatic lamp (H2-Auto) lights.

### 5. Operation Mode "Single scan"

After the most recent start, the program scan cycle will run through one time and the system remains in the initial state.

### 6. Operation Mode "Continuous Scan"

After the most recent start, the program scan cycle repeats until a switch to single scan, or the continuous scan is deleted, or there is no more shaped material available in the cutting apparatus. Then the light for the continuous scan (H3-CS) lights.

### 7. "Start-button"

For the function of the Start-button, let the following states be met:
-. In manual operation mode, the sequencer clocks through step by step with the Start-button.
-. In automatic operation mode, the sequential control system will start with the Start-button.
-. The restarting of the automatic operation mode is accomplished with the Start-button.
-. The insertion of a new material rod is activated with the start signal.
-. After power failure, the control can reload into the set operation mode with the Start-button.

### 8. "Material Query"

The shaped material is scanned over a limit switch at the feed station. If there is no longer material available, the continuous scan is interrupted and the system runs to the end of the already begun cycle.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

T I A  Training document
Last revision: 02/2002

Page 44 of 66

Module C1
Sequencer programming with S7-GRAPH

**10.        PROGRAMMING OF THE ADDITIONAL MARGINAL CONDITIONS**

**10.1        Opening a symbol table and adding symbols**

1. In the S7-Program(1) folder, double click on **Symbols**.
2. Amend the symbol table.

| | Symbol | Address | | Data type | Comment |
|---|---|---|---|---|---|
| 1 | ADJUST | I | 1.6 | BOOL | Adjust-button |
| 2 | AM | M | 0.0 | BOOL | Adjust memory bit |
| 3 | AS | M | 0.1 | BOOL | Automatic memory |
| 4 | CSS | M | 0.2 | BOOL | Continuous scan memory |
| 5 | EMSTOP | I | 1.7 | BOOL | Emergency stop-button (NC) |
| 6 | ES | M | 70.0 | BOOL | Energy memory |
| 7 | H1-Man | Q | 4.4 | BOOL | Indicator light for Manual operation mode |
| 8 | H2-Auto | Q | 4.5 | BOOL | Indicator light for Automatic operation mode |
| 9 | H3-CS | Q | 4.6 | BOOL | Indicator light for continuous scan |
| 10 | H4-EM | Q | 4.7 | BOOL | Indicator light for Emercency stop |
| 11 | MAN/AUTO | I | 1.1 | BOOL | Manual-Automatic switch |
| 12 | PART | I | 1.3 | BOOL | Material type |
| 13 | S0-Start | I | 1.0 | BOOL | Start-button |
| 14 | S1-a0 | I | 0.0 | BOOL | Limit switch cyl.A retraction |
| 15 | S2-a1 | I | 0.1 | BOOL | Limit switch cyl.A extension |
| 16 | S3-b0 | I | 0.2 | BOOL | Limit switch cyl.B retraction |
| 17 | S4-b1 | I | 0.3 | BOOL | Limit switch cyl.B extension |
| 18 | S5-c0 | I | 0.4 | BOOL | Limit switch cyl.C retraction |
| 19 | S6-c1 | I | 0.5 | BOOL | Limit switch cyl.C extension |
| 20 | S7-d0 | I | 0.6 | BOOL | Limit switch cyl.D retraction |
| 21 | S8-d1 | I | 0.7 | BOOL | Limit switch cyl.D extension |
| 22 | SM | M | 0.3 | BOOL | Start memory bit |
| 23 | SS/CS | I | 1.2 | BOOL | Single scan-continuous scan switch |
| 24 | TIME_TCK | SFC | 64 | SFC 64 | Read the System Time |
| 25 | WR_USMSG | SFC | 52 | SFC 52 | Write a User-Defined Diagnostic Event to the |
| 26 | Y1-A+/- | Q | 4.0 | BOOL | Solenoid valve cylinder A |
| 27 | Y2-B+/- | Q | 4.1 | BOOL | Solenoid valve cylinder B |
| 28 | Y3-C+/- | Q | 4.2 | BOOL | Solenoid valve cylinder C |
| 29 | Y4-D+/- | Q | 4.3 | BOOL | Solenoid valve cylinder D |

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

**10.2     Generation of a function FC1 for the marginal conditions**

Create and open an S7-Block in the SIMATIC Manager

1. Click on folder **Blocks**.
2. Click on menu **Insert**.
3. Choose **S7-Block**.
4. Double click on **Function**.
5. Choose **FBD** as Created in Language.
6. Click on **OK**.
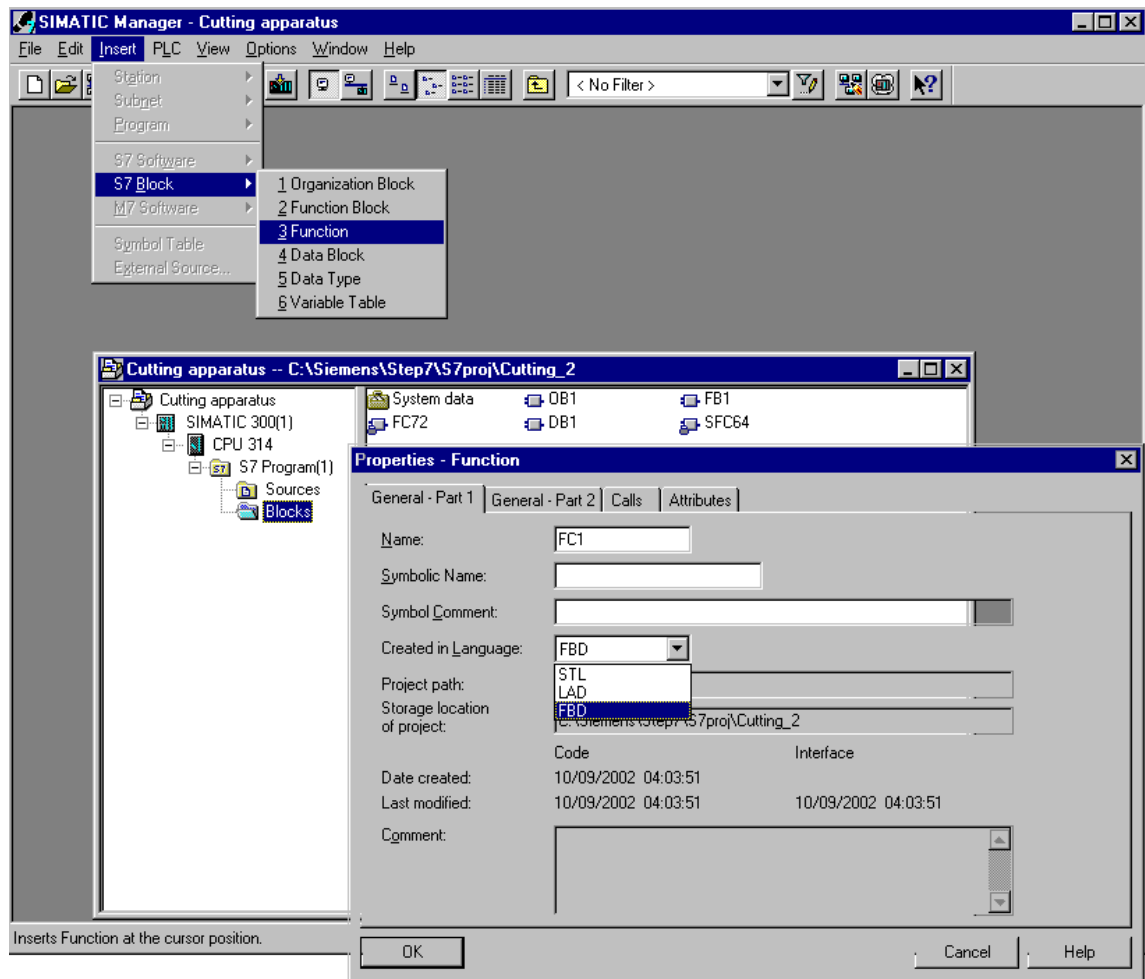
Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions**  FB_Parameters

T I A  Training document          Page 46 of 66                          Module C1
Last revision: 02/2002                                   Sequencer programming with S7-GRAPH

### 10.3 Opening function FC1 and carrying out modifications

### 10.3.1 Entering Network 1 and adding symbol tables

1. Double click on **FC1**.
2. Enter Network 1.
3. Click on **M0.0** with the right mouse button and choose **Edit Symbol**.
4. Enter symbol and comment.
5. Click on **OK**.



> **Note**
>
> In this way addresses can be provided directly with symbols. The symbols are inserted into the symbol table automatically and are available immediately.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions**  FB_Parameters
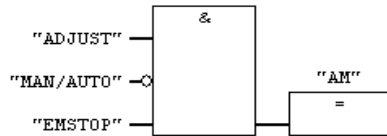
### 10.3.2 Entering FC1 control program NW1 to NW3

FC1 : Marginal conditions

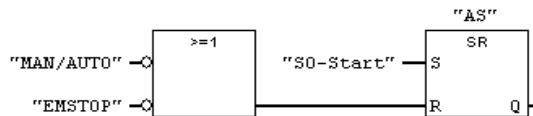Comment:

**Network 1**: Adjust Memory bit AM

Comment:

```
"ADJUST"  ──┐  &  ┌──
"MAN/AUTO" ─○│     │   "AM"
            │     │    =
"EMSTOP"   ─┘     └──
```

Symbol information:

| I1.6 | ADJUST | Adjust-button |
|------|--------|---------------|
| I1.1 | MAN/AUTO | Manual-Automatic switch |
| I1.7 | EMSTOP | Emergency out- switch (NC) |
| M0.0 | AM | Adjust memory bit |

**Network 2**: Automatic memory

Comment:

```
                              "AS"
             >=1              SR
"MAN/AUTO" ─○│   │ "S0-Start" ─S
             │   │
"EMSTOP"   ─○│   │             R    Q
```

Symbol information:

| I1.1 | MAN/AUTO | Manual-Automatic switch |
|------|----------|-------------------------|
| I1.7 | EMSTOP | Emergency out- switch (NC) |
| M0.1 | AS | Automatic memory |
| I1.0 | S0-Start | Start-button |

**Network 3**: Continuous scan memory

Comment:

```
             &           "CSS"
"S0-Start" ──┐           SR
"MAN/AUTO" ──┘          ─S

             >=1
"PART"     ─○┐
"SS/CS"    ─○│
"AM"       ──│
"EMSTOP"   ─○┘         ─R    Q
```
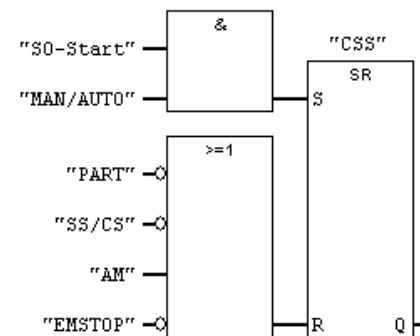
Symbol information:

| I1.0 | S0-Start | Start-button |
|------|----------|--------------|
| I1.1 | MAN/AUTO | Manual-Automatic switch |
| I1.3 | PART | Material type |
| I1.2 | SS/CS | Single scan-continuous scan switch |
| M0.0 | AM | Adjust memory bit |
| I1.7 | EMSTOP | Emergency out- switch (NC) |
| M0.2 | CSS | Continuous scan memory |

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

### 10.3.3 Entering FC1 control program NW4 to NW7

**Network 4** : Start memory bit

Comment:

```
"S0-Start" ─────┐  &
"PART" ─────────┤
"SS/CS" ───────○┤              >=1
"EMSTOP" ───────┤    "CSS" ────┤         "SM"
                └─────────────────────────┤ =
```
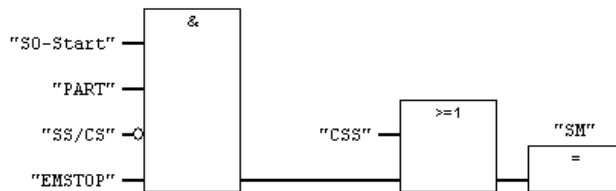
Symbol information:

| I1.0 | S0-Start | Start-button |
|------|----------|--------------|
| I1.3 | PART | Material type |
| I1.2 | SS/CS | Single scan-continuous scan switch |
| I1.7 | EMSTOP | Emergency out- switch (NC) |
| M0.2 | CSS | Continuous scan memory |
| M0.3 | SM | Start memory bit |

**Network 5** : Energy memory

Comment:

```
                          "ES"
"S0-Start" ──┤ & ├────┤ S ├
```
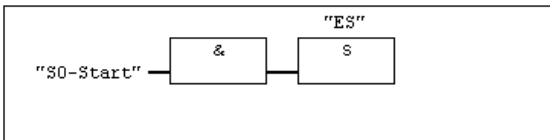
Symbol information:

| I1.0 | S0-Start | Start-button |
|------|----------|--------------|
| M70.0 | ES | Energy memory |

**Network 6** : Continuous scan lamp

Comment:

```
"SS/CS" ─────┐  &
"MAN/AUTO" ──┤         "H3-CS"
"EMSTOP" ────┤       ──┤ = ├
```
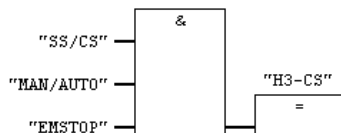
Symbol information:

| I1.2 | SS/CS | Single scan-continuous scan switch |
|------|-------|------------------------------------|
| I1.1 | MAN/AUTO | Manual-Automatic switch |
| I1.7 | EMSTOP | Emergency out- switch (NC) |
| Q4.6 | H3-CS | Indicator light for continuous scan |

**Network 7** : Emergency stop lamp

Comment:

```
                       "H4-EM"
"EMSTOP" ─○┤ & ├────┤ = ├
```
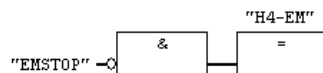
Symbol information:

| I1.7 | EMSTOP | Emergency out- switch (NC) |
|------|--------|----------------------------|
| Q4.7 | H4-EM | Indicator light for Emercency out |

After the entry of all networks, save function FC1 and close the program window.
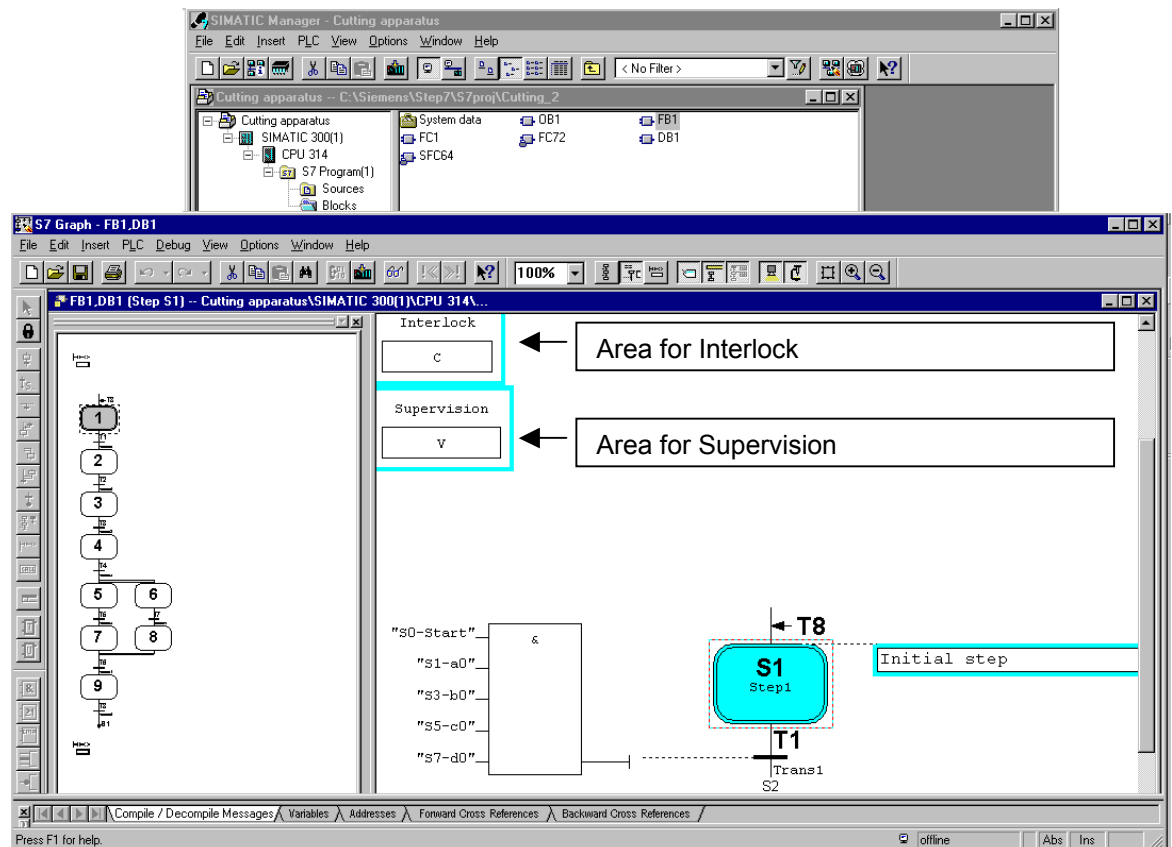
Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

### 10.4        Opening Function Block FB1 and carrying out modifications

### 10.4.1     Displaying Step S1 in Single Step representation

1. Click on the folder **Blocks**.
2. Double click on **FB1**.
3. Choose **Step S1**.
4. Click on **Single Step representation**.



In the single step representation type, all areas are displayed in which actions and conditions can be programmed.
Interlocks and supervisions are entered here.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

### 10.4.2 Step S1 with interlock programming

In the first step, the initial state is programmed. When adjusting the cutting device, the sequencer is initialized i.e. the initial Step S1 is activated. The work elements are to be proceeded in the output position. Note that cylinder C retracts only if all other cylinders are retracted. This condition is programmed with an interlock. An interlock is a programmable condition which affects the execution of individual actions.

1. Enter a step comment.
2. Give a condition for interlock.
3. Replace S0-Start via Start memory bit SM .
4. Insert actions.
5. Enter actions or click with the right-mouse button and select **Object Properties**.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

T I A  Training document
Last revision: 02/2002

Page 51 of 66

Module C1
Sequencer programming with S7-GRAPH

### 10.4.3 Step S6 with supervision programming

In the sixth step the work piece is cut.  By the cutting process, the cutting tool can clamp the work piece.  Here a monitoring of the step time (maximum running time of a step) is to be programmed.  If this time is exceeded, then a monitoring error develops and it cannot be switched to the next step.  A further switching of the sequencer is possible only if the necessary transition is satisfied and the monitoring error was acknowledged over the adjust button.  These conditions are to be programmed with a supervision.  A supervision is a programmable condition for step by step monitoring, which affects further switching from one step to the next.

1. Choose **Step S6** and enter step comments.
2. Click on **Step S6** and symbol **Supervision V**.
3. Enter a time of  "**T#5S**".
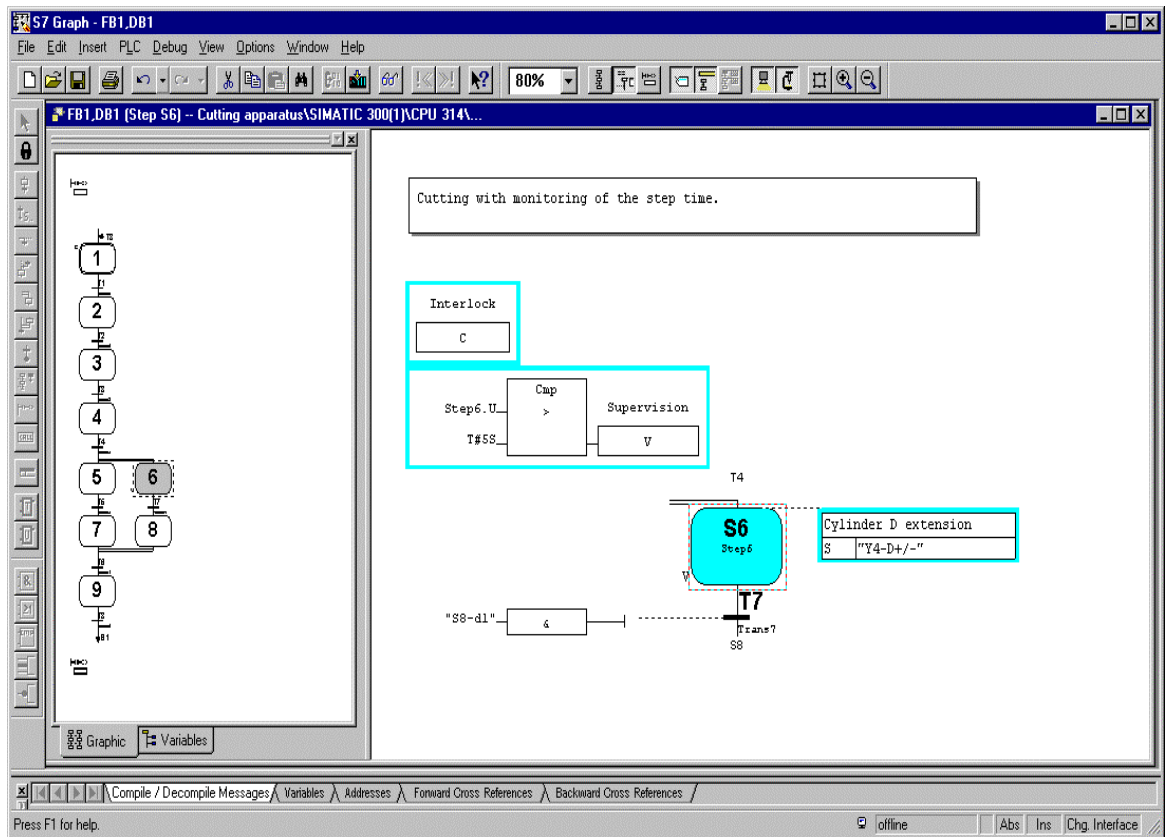


By time monitoring T, the whole step activation time will be used.
By time monitoring U, the uninterrupted step activation time will be used.

**Note**
In Inching mode, the step activation time must be further switched within the time monitoring.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

## 10.5 Additional actions and results

### 10.5.1 Standard actions - With and without interlock

All standard actions can be combined with an interlock. The actions are only executed when the conditions of the interlock are satisfied (letter C added).

Standard actions without interlock are executed as long as the step is active.

| Instruction | Address Identifier | Address Location | Meaning: |
|---|---|---|---|
| N[C] | Q,I,M,D | m.n | As long as the step is active [and interlock satisfied], the address is set to 1. |
| S[C] | Q,I,M,D | m.n | Set: As soon as the step is active [and the interlock is satisfied], the address is set to 1 and then remains set to 1 (latching) |
| R[C] | Q,I,M,D | m.n | Reset: As soon as the step is active [and the interlock is satisfied], the address is set to 0 and remains at 0 (latching). |
| D[C] | Q,I,M,D | m.n | On (Delay): n seconds after the step is activated, the address has signal 1 [if the interlock is satisfied] while the step is active. This does not apply if the step is active for a time shorter than n seconds (non-latching). |
|  | T#<const> |  | Time constant |
| L[C] | Q,I,M,D | m.n | Limited pulse: If the step is active [and the interlock is satisfied], the address is set to 1 for n seconds (non latching). |
|  | T#<const> |  | Time constant |
| CALL[C] | FB, FC, SFB, SFC | Block number | Block call: As long as the step is active [and the interlock is satisfied], the specified block is called. |

**Note**
All actions, which contain the operands D or L , requires a time indication. Time indications are programmed as constants with the syntax **T#<const>** and are arbitrarily combined.
**<const>=** nD (n Days), nH (n Hours), nM (n Minutes), nS (n Seconds), nMS (n Milliseconds), whereby n = number (integer values)
**Example:** T#2D3H: Time constants = 2 Days and 3 Hours

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  Marginal conditions  FB_Parameters

### 10.5.2 Event dependent actions

An action can be logically combined with an event. An event is the change in the signal state of a step, a supervision or an interlock or the acknowledgment of a message or a registration is set.  If an action is logically combined with an event, the signal state of the event is recognized by edge detection. This means that the instructions can only be executed in the cycle in which the event took place.
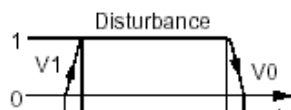
## Events and Signal Evaluation

### Step

- **S1**: Step becomes active

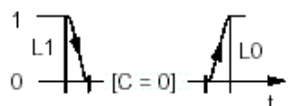- **S0**: Step is deactivated
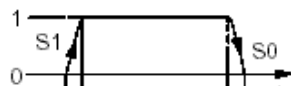


### Supervision

- **V1**: Supervision error occurred (disturbance)

- **V0**: Supervision error cleared (no disturbance)
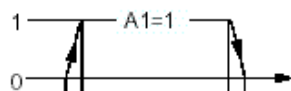


### Interlock

- **L0**: Interlock condition entering state

- **L1**: Interlock condition leaving state (for example disturbance)

- **C**: Interlock condition is satisfied



### Message and Registration

- **A1**: A message is acknowledged

- **R1**: A registration is set
  (rising edge at input REG_EF / REG_S)



You can find a detailed description of the actions and the conditions in the S7-GRAPH manual or in the S7-GRAPH programming sequential control systems manual.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

## 10.6    Setting block settings

**i**

The settings of the S7-GRAPH block must be changed.  In Block Settings Compile/Save, a standard block with more variables is set under FB Parameters.  With a standard block, the additional functions can program e.g. automatic and manual operation modes simply.

1. In the menu, double click on **Options, Block Properties**.
2. Set FB-Parameters to **Standard**.
3. Choose **Acknowledge errors**.
4. Click on the next tab **Messages**.



**Note**
Errors by monitoring (Supervision) must be acknowledged with the Adjust-button.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

### 10.7 Accepting block settings and saving Function Block FB1

1. Choose **Messages with WR_USMSG**.
2. Deactivate **And Send**.
3. Click on **OK**.
4. Save and update block.
5. Close S7-GRAPH.
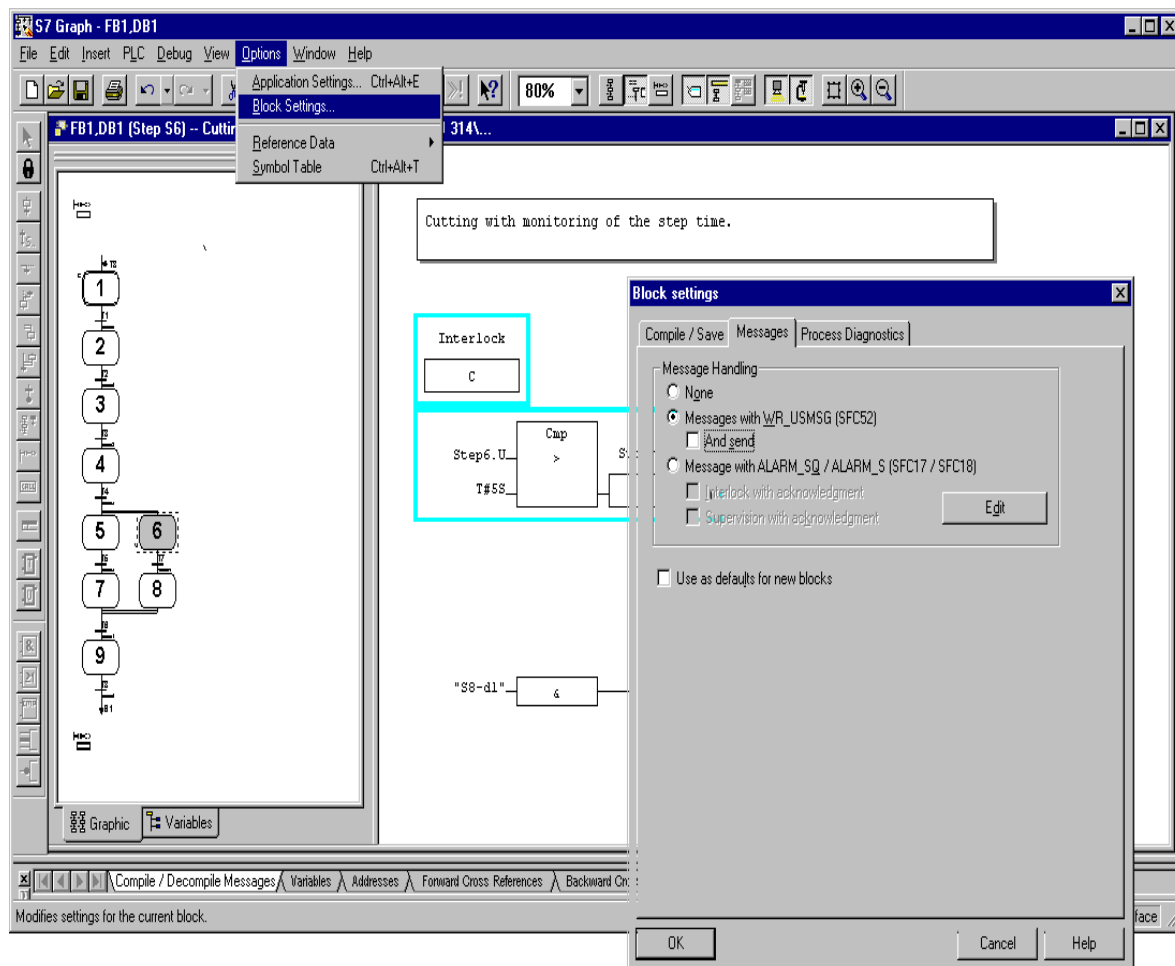


**Note**
With the setting „Messages with WR_USMSG", the SFC52 is created. With this block, the error messages from interlocks and supervisions are inserted into the diagnostic buffer of the CPU .
With the function "Send", the messages are also sent to other network nodes e.g. OP´s sent.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

## 10.8 Organization Block OB1 modification

### 10.8.1 Opening OB1

1. Click on folder **Block** .
2. Double click on **OB1**.
3. Activate message with **OK**.
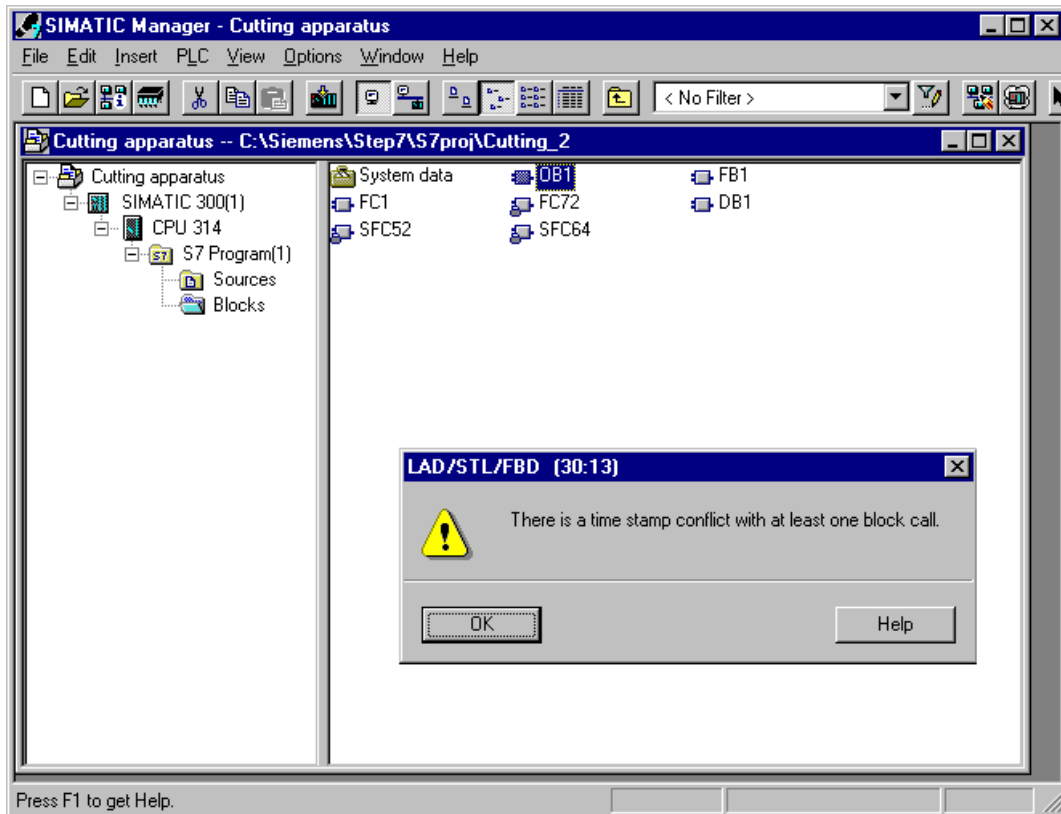


4. Click on block call in Network 1 and delete it.
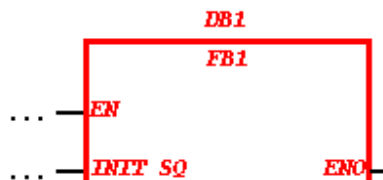


**Note**

The block call no longer complies with FB1. So, a new block call in OB1 must be programmed.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

### 10.8.2 Editing OB1, entering network 1

1. Call **FC1** in Network 1.
2. Call **FB1** in Network 2.
3. Enter network headings for NW1 and NW2.
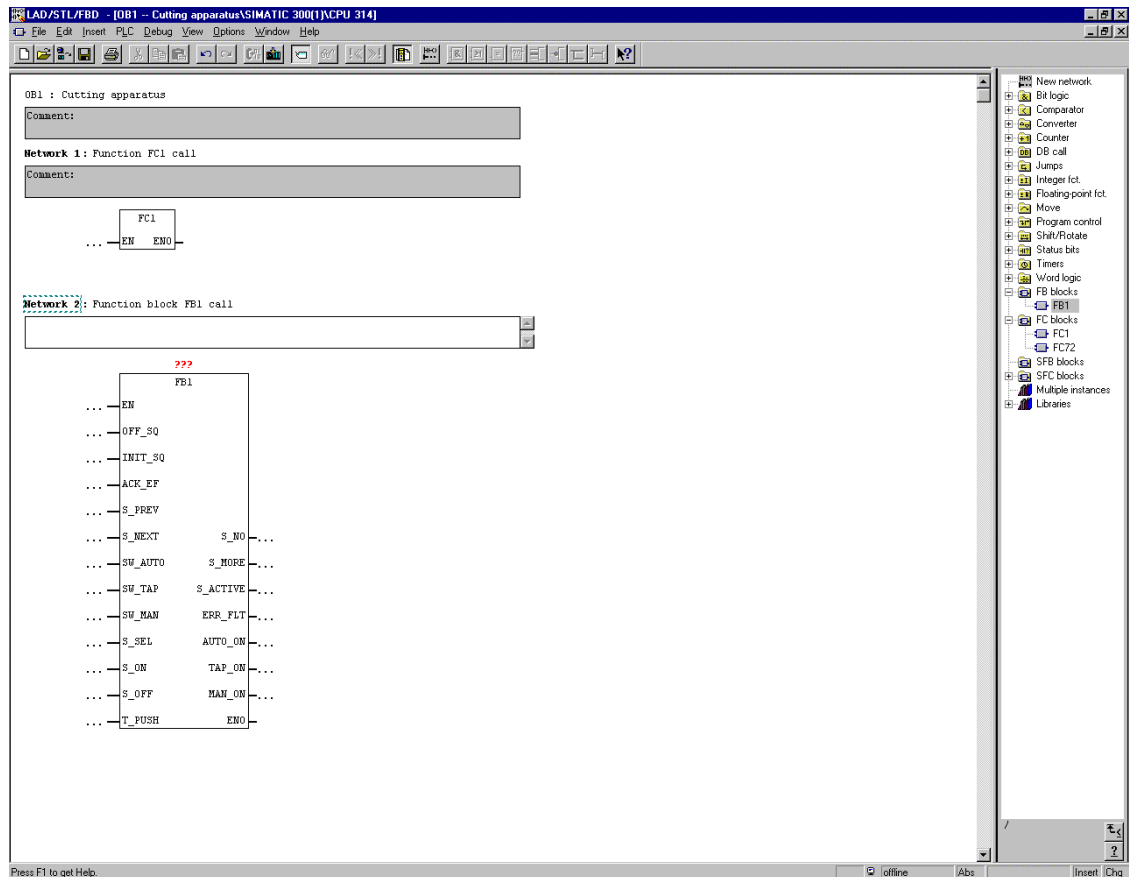


**Note**

The function block FB1 is now provided with standard parameters. Thus additional functions are programmable with the program call. However all parameters do not have to be programmed.

The advantage with the calling of blocks in the FBD is that logic functions can still be programmed before the parameters.

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions**  FB_Parameters

### 10.8.3    Network 2, entering parameters by the call of FB1

1. Enter DB1.
2. Enter parameters of the FB1.
3. Save OB1.
4. Close LAD/STL/FBD.
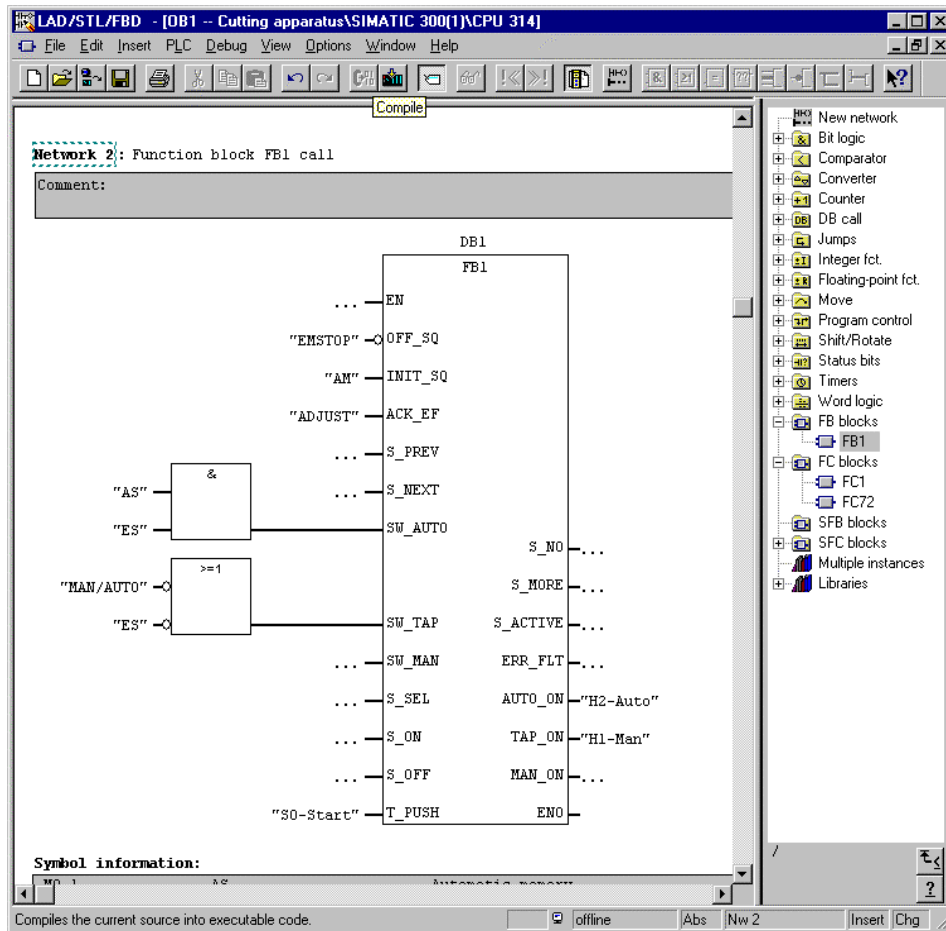


The allocation of the input parameters for automatic and inching mode.

| Parameter | Data | Description |
|---|---|---|
| OFF_SQ | BOOL | All steps are immediately deactivated, in other words "Sequencer Off" |
| INIT_SQ | BOOL | Initialize sequencer, jump to initial step |
| ACK_EF | BOOL | Acknowledgment of a disturbance |
| S_PREV | BOOL | As for automatic |
| S_NEXT | BOOL | As for automatic |
| SW_AUTO | BOOL | Request the automatic mode |
| SW_MAN | BOOL | Request manual mode |
| SW_TOP | BOOL | Set automatic or switch to next mode |
| T_PUSH | BOOL | The transition passes control when its conditions are satisfied and there is a rising edge at T_PUSH. |

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

## 10.9 Transfer of the program into the module

1. Choose the folder **Blocks**.
2. Click **Download**.
3. Click on **All**.

It will transfer all blocks into the CPU. The CPU should be found in the operation mode STOP.
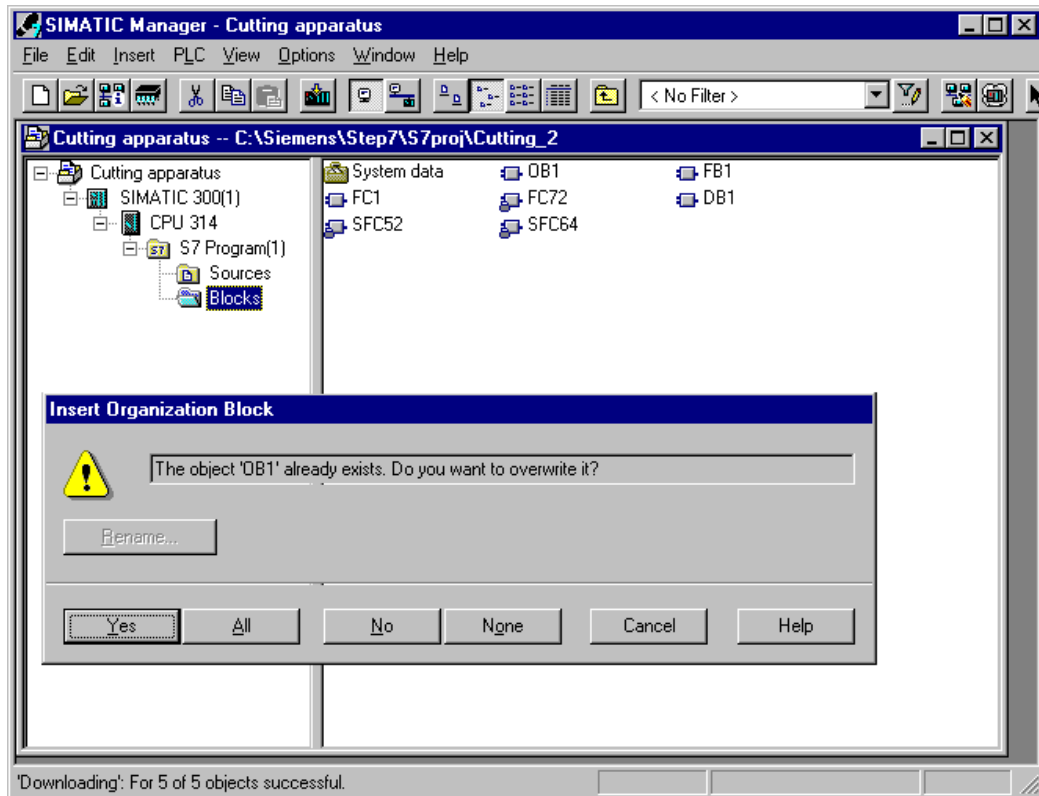


**Note**
After the transferring of the automation equipment into the CPU, the cutting apparatus can be debugged with the required marginal conditions.

The debug and diagnostic functions are explained in chapter 8.

---

Forward  Installation  Sequent. control system  Representation Configuration  Debug functions  **Marginal conditions** FB_Parameters

## 11. PARAMETERS OF THE S7-GRAPH-FB

### 11.1 Parameter sets of the FB



Note: The parameters marked with (*) are not available for FC73

Forward  Installation  Sequent. control system  Representation  Configuration  Debug functions  Marginal conditions  **FB- Parameters**

T I A  Training document                     Page 61 of 66                     Module C1
Last revision: 02/2002                                               Sequencer programming with S7-GRAPH
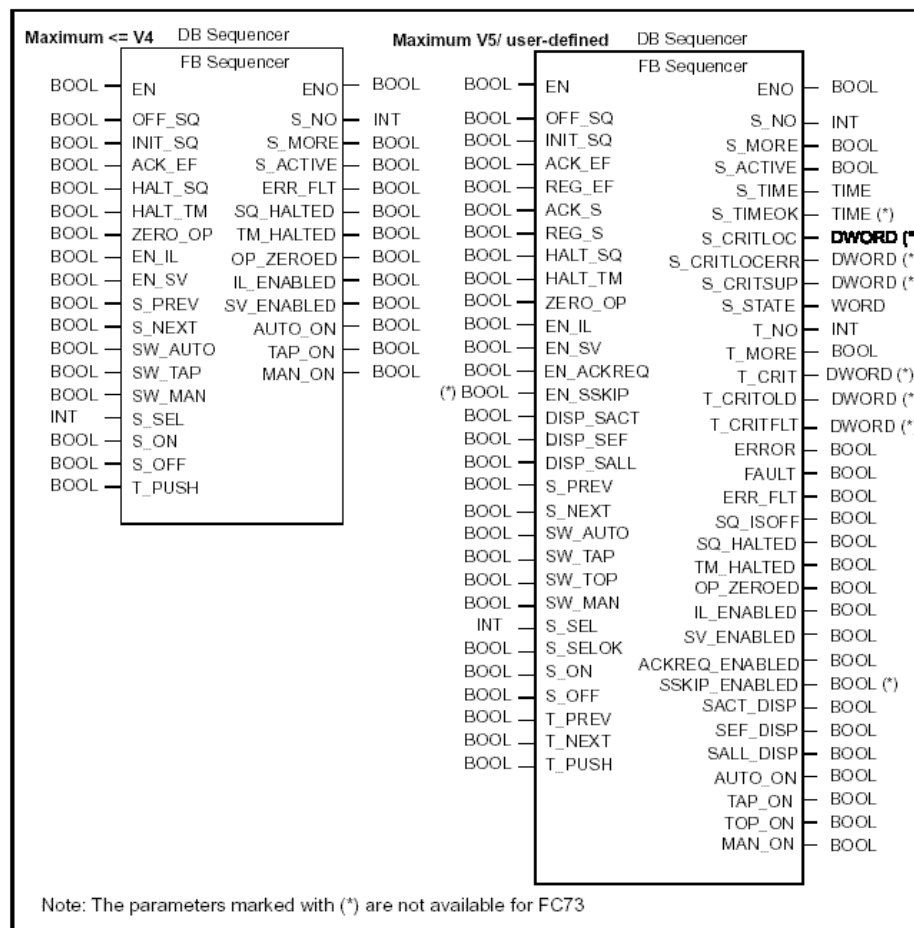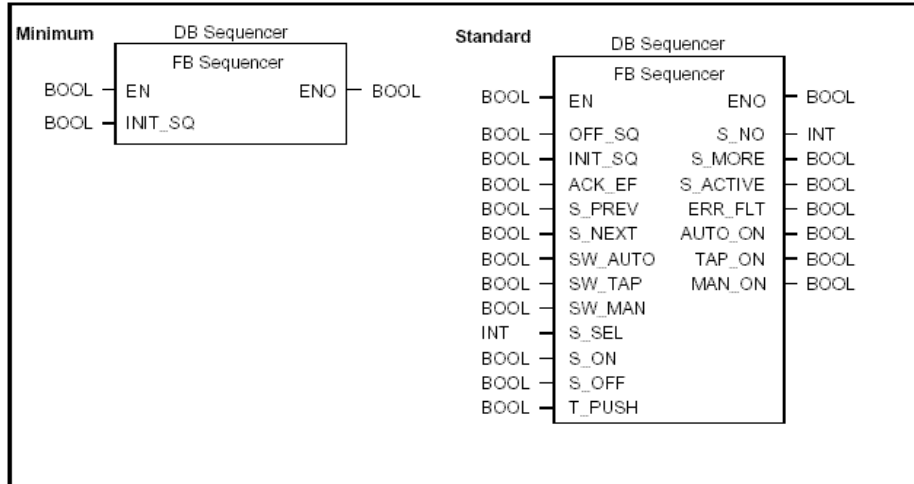
## 11.2 Input parameters of the S7-GRAPH-FB

ℹ️

| Parameter | Data Type | Description | Min. | Std. | Max. | User-def. |
|---|---|---|---|---|---|---|
| EN | BOOL | Controls execution of the FB (enable input). If EN is not connected, the FB is always executed. | ✓ | ✓ | ✓ | ✓ |
| OFF_SQ | BOOL | OFF_SEQUENCE: Sequencer off, in other words deactivate all steps | | ✓ | ✓ | ✓ |
| INIT_SQ | BOOL | INIT_SEQUENCE: Activate initial steps (reset sequencer) | ✓ | ✓ | ✓ | ✓ |
| ACK_EF | BOOL | ACKNOWLEDGE_ERROR_FAULT: Acknowledgment of a disturbance, force switching to next step | | ✓ | ✓ | ✓ |
| REG_EF | BOOL | REGISTRATE_ERROR_FAULT: Register all errors and disturbances | | | | ✓ |
| ACK_S | BOOL | ACKNOWLEDGE_STEP: Acknowledge step indicated in S_NO | | | | ✓ |
| REG_S | BOOL | REGISTRATE_STEP: Register step indicated in S_NO | | | | ✓ |
| HALT_SQ | BOOL | HALT_SEQUENCE: Stop/reactivate sequencer | | | ✓ | ✓ |
| HALT_TM | BOOL | HALT_TIMES: Stop/reactivate all step activation times and time-dependent instructions (L and D) of the sequencer | | | ✓ | ✓ |
| ZERO_OP | BOOL | ZERO_OPERANDS: Reset all addresses of the instructions N, D, L in active steps to zero and do not execute CALL instructions in actions/reactivate addresses and CALL instructions. | | | ✓ | ✓ |
| EN_IL | BOOL | ENABLE_INTERLOCKS: Deactivate/reactivate interlocks (the sequencer behaves as if interlocks were satisfied) | | | ✓ | ✓ |
| EN_SV | BOOL | ENABLE_SUPERVISIONS: Deactivate/reactivate supervision conditions (the sequencer behaves as if supervision conditions were not satisfied) | | | ✓ | ✓ |
| EN_ACKREQ | BOOL | ENABLE_ACKNOWLEDGE_REQUIRED: Activate mandatory acknowledgment | | | | ✓ |
| DISP_SACT | BOOL | DISPLAY_ACTIVE_STEPS: Display active steps only | | | | ✓ |
| DISP_SEF | BOOL | DISPLAY_STEPS_WITH_ERROR_OR_FAULT: Display steps with errors and disturbed steps only | | | | ✓ |
| DISP_SALL | BOOL | DISPLAY_ALL_STEPS: Display all steps | | | | ✓ |

Forward  Installation  Sequent. control system  Representation  Configuration  Debug functions  Marginal conditions  **FB- Parameters**

T I A  Training document
Last revision: 02/2002

Page 62 of 66

Module C1
Sequencer programming with S7-GRAPH

| Parameter | Data Type | Description | Min. | Std. | Max. | User-def. |
|---|---|---|---|---|---|---|
| S_PREV | BOOL | PREVIOUS_STEP: Automatic mode: Pages back through the currently active steps. The step number is indicated in S_NO. Manual mode: Indicate previous step (next lower number) in S_NO. | | ✓ | ✓ | ✓ |
| S_NEXT | BOOL | NEXT_STEP: Automatic mode: Page forwards through the currently active steps. The step number is indicated in S_NO. Manual mode: Indicates the number of the next step (next higher number) in S_NO. | | ✓ | ✓ | ✓ |
| SW_AUTO | BOOL | SWITCH_MODE_AUTOMATIC: Mode change: Automatic mode: | | ✓ | ✓ | ✓ |
| SW_TAP | BOOL | SWITCH_MODE_TRANSITION_AND_PUSH: Mode change: Inching mode ("semi-automatic") | | ✓ | ✓ | ✓ |
| SW_TOP | BOOL | SWITCH_MODE_TRANSITION_OR_PUSH: Mode change: Automatic or switch to next | | | | ✓ |
| SW_MAN | BOOL | SWITCH_MODE_MANUAL: Mode change: Manual mode (automatic execution is not triggered) | | ✓ | ✓ | ✓ |
| S_SEL | INT | STEP_SELECT: Selects a specific step for the output parameter S_NO. Activate/deactivate in the manual mode with S_ON, S_OFF. | | ✓ | ✓ | ✓ |
| S_SELOK | BOOL | STEP_SELECT_OK: Use value in S_SEL for S_NO | | | | ✓ |
| S_ON | BOOL | STEP_ON: Manual mode: Activate the displayed step | | ✓ | ✓ | ✓ |
| S_OFF | BOOL | STEP_OFF: Manual mode: Deactivate the displayed step | | ✓ | ✓ | ✓ |
| T_PREV | BOOL | PREVIOUS_TRANSITION: Display previous valid transition in T_NO | | | | ✓ |
| T_NEXT | BOOL | NEXT_TRANSITION: Display next valid transition in T_NO | | | | ✓ |

Forward  Installation  Sequent. control system  Representation  Configuration  Debug functions  Marginal conditions  **FB- Parameters**

**i**

| Parameter | Data Type | Description | Min. | Std. | Max. | User-def. |
|-----------|-----------|-------------|------|------|------|-----------|
| T_PUSH | BOOL | PUSH_TRANSITION:<br>Transition passes control when the condition is satisfied and T_PUSH (edge)<br><br>Requirement: Inching (SW_TAP) or automatic or step –by-step (SW_TOP) mode<br><br>If the block is Version V4 (or earlier), the first valid transition switches. If the block is Version V5 and if the input parameter T_NO is specified, the transition whose number is displayed switches. Otherwise, the first valid transition switches. | | ✓ | ✓ | ✓ |
| EN_SSKIP | BOOL | ENABLE_STEP _SKIPPING:<br>Activate skip step | | | | ✓ |
| Parameter set: Min. = Minimum; Std. = Standard; Max. = Maximum; User-def. User-defined | | | | | | |

Forward  Installation  Sequent. control system  Representation  Configuration  Debug functions  Marginal conditions  **FB- Parameters**

T I A  Training document
Last revision: 02/2002

Page 64 of 66

Module C1
Sequencer programming with S7-GRAPH

### 11.3 Output parameters of the S7-GRAPH-FB

| Parameter | Data Type | Description | Min. | Std. | Max. | User-def. |
|---|---|---|---|---|---|---|
| ENO | BOOL | Enable output. When the FB is active and no error has occurred, ENO has the value 1, otherwise 0 | ✓ | ✓ | ✓ | ✓ |
| S_NO | INT | STEP_NUMBER Display step number | | ✓ | ✓ | ✓ |
| S_MORE | BOOL | MORE_STEPS: Other steps are active | | ✓ | ✓ | ✓ |
| S_ACTIVE | BOOL | STEP_ACTIVE Displayed step is active | | ✓ | ✓ | ✓ |
| S_TIME | TIME | STEP_TIME Step activation time | | | | ✓ |
| S_TIMEOK | TIME | STEP_TIME_OK: No error in step activation time | | | | ✓ |
| S_CRITLOC | DWORD | STEP_CRITERIA Interlock criteria bits | | | | ✓ |
| S_CRITLOC ERR | DWORD | S_CRITERIA_IL_LAST_ERROR: Interlock criteria bits for event L1 | | | | ✓ |
| S_CRITSUP | DWORD | STEP_CRITERIA Supervision criteria bits | | | | ✓ |
| S_STATE | WORD | STEP_STATE: Step state bits | | | | ✓ |
| T_NO | INT | TRANSITION_NUMBER: Valid transition number | | | | ✓ |
| T_MORE | BOOL | MORE_TRANSITIONS: Other valid transitions available for display | | | | ✓ |
| T_CRIT | DWORD | TRANSITION_CRITERIA: Transition criteria bits | | | | ✓ |
| T_CRITOLD | DWORD | T_CRITERIA_LAST_CYCLE: Transition criteria bits from last cycle | | | | ✓ |
| T_CRITFLT | DWORD | T_CRITERIA_LAST_FAULT: Transition criteria bits for event V1 | | | | ✓ |
| ERROR | BOOL | INTERLOCK_ERROR: Interlock error (any step) | | | | ✓ |
| FAULT | BOOL | SUPERVISION_FAULT: Supervision error (any step) | | | | ✓ |
| ERR_FLT | BOOL | IL_ERROR_OR_SV_FAULT: Group disturbance | | ✓ | ✓ | ✓ |
| SQ_ISOFF | BOOL | SEQUENCE_IS_OFF: Sequencer idle (no step active) | | | | ✓ |
| SQ_HALTED | BOOL | SEQUENCE_IS_HALTED: Sequencer stopped | | | ✓ | ✓ |
| TM_HALTED | BOOL | TIMES_ARE_HALTED: Timers stopped | | | ✓ | ✓ |
| OP_ZEROED | BOOL | OPERANDS_ARE_ZEROED: Addresses reset | | | ✓ | ✓ |

Forward  Installation  Sequent. control system  Representation  Configuration  Debug functions  Marginal conditions  **FB- Parameters**

T I A  Training document                          Page 65 of 66                          Module C1
Last revision: 02/2002                                                     Sequencer programming with S7-GRAPH

| Parameter | Data Type | Description | Min. | Std. | Max. | User-def. |
|---|---|---|---|---|---|---|
| IL_ENABLED | BOOL | INTERLOCK_IS_ENABLED:<br>Interlock enabled | | | ✓ | ✓ |
| SV_ENABLED | BOOL | SUPERVISION_IS_ENABLED:<br>Supervision enabled | | | ✓ | ✓ |
| ACKREQ_EN ABLED | BOOL | ACKNOWLEDGE_REQUIRED_IS_<br>ENABLED:<br>Mandatory acknowledgment activated | | | | ✓ |
| SSKIP_EN ABLED | BOOL | STEP_SKIPPING_IS_ENABLED:<br>Skip step activated | | | | ✓ |
| SACT_DISP | BOOL | ACTIVE_STEPS _WERE_DISPLAYED:<br>Display active steps only in S_NO | | | | ✓ |
| SEF_DISP | BOOL | STEPS_WITH_ERROR_FAULT_WERE_<br>DISPLAYED:<br>Display only steps with error and disturbed steps in S_NO | | | | ✓ |
| SALL_DISP | BOOL | ALL_STEPS_WERE_DISPLAYED:<br>Display all steps in S_NO | | | | ✓ |
| AUTO_ON | BOOL | AUTOMATIC_IS_ON:<br>Indicates the automatic mode | | ✓ | ✓ | ✓ |
| TAP_ON | BOOL | T_AND_PUSH_IS_ON:<br>Indicates the inching mode | | ✓ | ✓ | ✓ |
| TOP_ON | BOOL | T_OR_PUSH_IS_ON:<br>Display SW_TOP mode | | | | ✓ |
| MAN_ON | BOOL | MANUAL_IS_ON:<br>Indicates the manual mode | | ✓ | ✓ | ✓ |
| Parameter set: Min. = Minimum; Std. = Standard; Max. = Maximum; User-def. = User-defined | | | | | | |

Forward  Installation  Sequent. control system  Representation  Configuration  Debug functions  Marginal conditions  **FB- Parameters**

T I A  Training document                Page 66 of 66                        Module C1
Last revision: 02/2002                                    Sequencer programming with S7-GRAPH