

Middleware für verteilte industrielle Umgebungen

Hardware in der Automatisierungstechnik
Programmierung nach IEC 61131-3



IEC 61131-3 Beispiel

- Verknüpfung von 4 binären Signalen mit den 4 Grundsprachen von IEC 61131-3 sowie einem Beispiel für die Ablaufsteuerung.

- $E = (A \text{ or } B) \text{ and } (C \text{ or } D);$



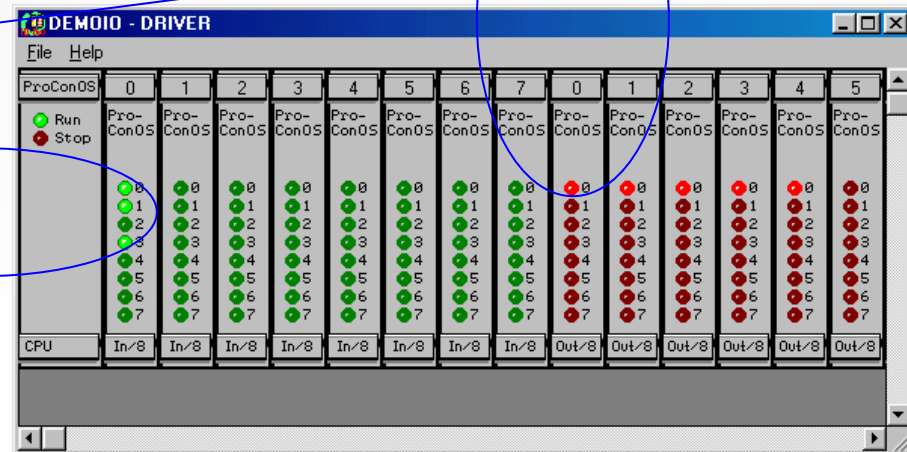
IEC 61131 - Einführungsbeispiel

Programmierung und Testung der Funktion

$$E = (A \text{ or } B) \text{ and } (C \text{ or } D);$$

in den IEC 61131-3 Sprachen

E ist ein binärer Ausgang
A, B, C, D sind binäre Eingänge
(Mausklick)



IEC 61131 - Entwicklungsumgebung

Projektsicht

The screenshot displays the MULTIPROG development environment. The window title is "MULTIPROG wt - at1_97_04". The menu bar includes "Datei", "Bearbeiten", "Ansicht", "Projekt", "Code", "Online", and "Extras". The toolbar contains various icons for file operations and simulation. The left pane shows a project tree with the following structure:

- Projekt
 - Bibliotheken
 - Datentypen
 - Logische POEs
 - AS_01
 - ST_01
 - FBS_01
 - KOP_01
 - AWL_01
 - Physical Hardware
 - Simulation: IPC_30
 - R_Sim: PCOS_NT
 - Tasks
 - Global_Variables
 - IO_Configuration

Two blue ovals highlight the "Logische POEs" and "Simulation: IPC_30" sections of the tree. Two white callout boxes with blue arrows point to these sections:

- "Programmorganisationseinheiten" points to the "Logische POEs" section.
- "Steuerung (hier Simulation)" points to the "Simulation: IPC_30" section.

The bottom status bar shows "Code", "Fehler", "Warnungen", "Infos", "SPS-Fehler", and "Drucken". The system tray indicates "C: >2GB".



IEC 61131 - Entwicklungsumgebung

POU – AWL-Programm

Projekt

- Bibliotheken
- Datentypen
- Logische POEs
 - AS_01
 - ST_01
 - FBS_01
 - KOP_01
 - AWL_01
 - AWL_01T
 - AWL_01V
 - AWL_01
- Physical Hardware
- Simulation : IPC_30
 - Sim : PCOS_NT
- Tasks
- Global_Variables
- ID_Configuration

```
1 LD VAR_A
2 OR VAR_B
3 AND (VAR_C
4 OR VAR_D
5 )
6 ST VAR_E
```

Programmcode

Eine Programmorganisationseinheit besteht aus:

- Dokumentation (AWL_01T) mit erklärendem Text
- Variable (AWL_01V)
- Programmtext (AWL_01) Quelltext

Variable	POE/Arbeitsblatt	Zugriff	Befehl	I/O-Adresse	Pfad

Code Fehler Warnungen Infos SPS-Fehler Drucken /

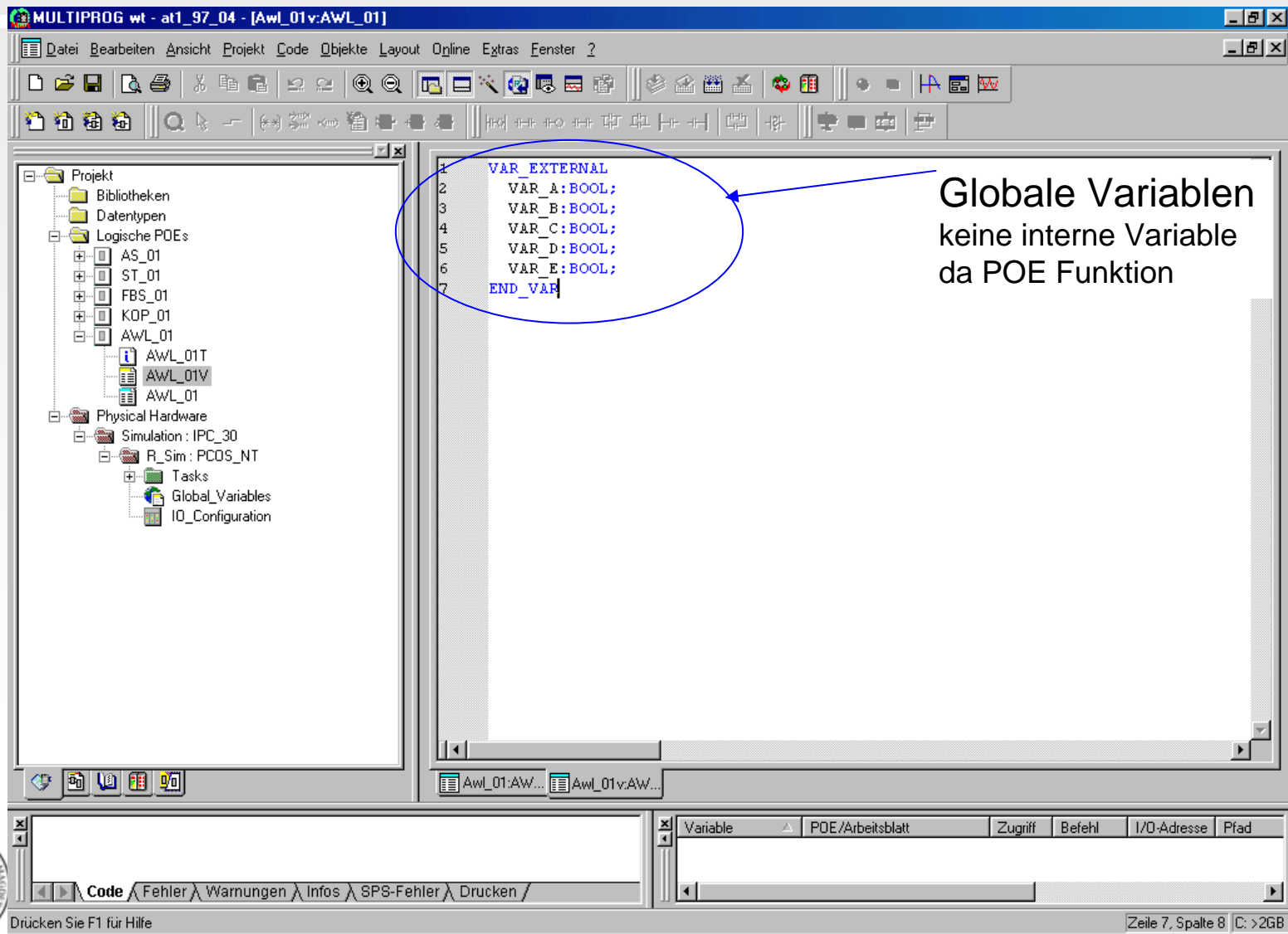
Drücken Sie F1 für Hilfe

Zeile 6, Spalte 6 | C: >2GB



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POU – Globale Variable



The screenshot shows the MULTIPROG development environment. The main window displays the following code:

```
1  VAR_EXTERNAL  
2  VAR_A:BOOL;  
3  VAR_B:BOOL;  
4  VAR_C:BOOL;  
5  VAR_D:BOOL;  
6  VAR_E:BOOL;  
7  END_VAR
```

A blue oval highlights the code block, and a blue arrow points from the text "Globale Variablen keine interne Variable da POE Funktion" to it.

At the bottom of the window, there is a table with the following columns: Variable, POU/Arbeitsblatt, Zugriff, Befehl, I/O-Adresse, Pfad.

The status bar at the bottom shows: Drücken Sie F1 für Hilfe and Zeile 7, Spalte 8 | C: >2GB



IEC 61131 - Entwicklungsumgebung

POU – KOP-Programm

The screenshot displays the SIMATIC Manager environment. The left pane shows a project tree with the following structure:

- Projekt
 - Bibliotheken
 - Datentypen
 - Logische PDEs
 - AS_01
 - ST_01
 - FBS_01
 - KOP_01** (highlighted with a blue oval)
 - KOP_01T
 - KOP_01V
 - KOP_01
 - AWL_01
 - AWL_01T
 - AWL_01V
 - AWL_01
 - Physical Hardware
 - Simulation : IPC_30
 - R_Sim : PCOS_NT
 - Tasks
 - Global_Variables
 - IO_Configuration



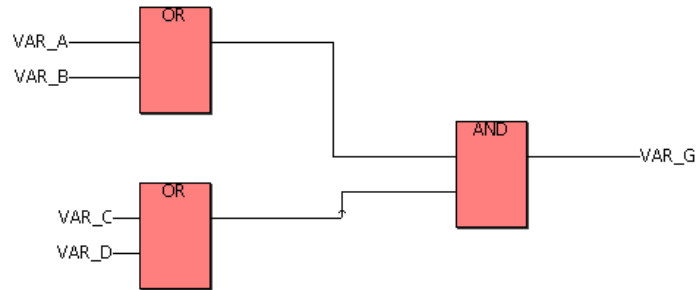
IEC 61131 - Entwicklungsumgebung

POU – FBS-Programm

The screenshot displays the MULTIPROG development environment. The left pane shows a project tree with the following structure:

- Projekt
 - Bibliotheken
 - Datentypen
 - Logische PDEs
 - AS_01
 - ST_01
 - FBS_01 (circled in blue)
 - FBS_01T
 - FBS_01V
 - FBS_01
 - KOP_01
 - KOP_01T
 - KOP_01V
 - KOP_01
 - AWL_01
 - AWL_01T
 - AWL_01V
 - AWL_01
 - Physical Hardware
 - Simulation : IPC_30
 - R_Sim : PCOS_NT
 - Tasks
 - Global_Variables
 - ID_Configuration

Programmorganisationseinheit



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POU – ST-Programm

The screenshot displays the MULTIPROG software interface. The title bar reads "MULTIPROG wt - at1_97_04 - [St_01:ST_01]". The menu bar includes "Datei", "Bearbeiten", "Ansicht", "Projekt", "Code", "Objekte", "Layout", "Online", "Extras", and "Fenster". The toolbar contains various icons for file operations, editing, and simulation. The left pane shows a project tree with the following structure:

- Projekt
 - Bibliotheken
 - Datentypen
 - Logische POEs
 - AS_01
 - ST_01
 - ST_01T
 - ST_01V
 - ST_01
 - FBS_01
 - KOP_01
 - AWL_01
 - Physical Hardware
 - Simulation : IPC_30
 - R_Sim : PCDS_NT
 - Tasks
 - Global_Variables
 - IO_Configuration

The main editor window shows a single line of IEC 61131-3 ST (Structured Text) code:

```
1 VAR_H := (VAR_A OR VAR_B) AND (VAR_C OR VAR_D) ;
```

The bottom status bar includes a menu with "Code", "Fehler", "Warnungen", "Infos", "SPS-Fehler", and "Drucken". The status text reads "Drücken Sie F1 für Hilfe" and "Zeile 1, Spalte 45 C: >2GB".



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POU – AS-Programm (anderes Beispiel)

Programmorganisationseinheit

The screenshot displays the MULTIPROG development environment. The left pane shows a project tree with a blue circle around the 'Logische POEs' section. The right pane shows a ladder logic diagram with three parallel rungs. The first rung has a set coil (S001) and a reset coil (R001) connected to A001. The second rung has a set coil (S003) and a reset coil (R003) connected to A003. The third rung has a set coil (S004) and a reset coil (R004) connected to A004. The rungs are labeled T001, VAR_IN_GELB, and VAR_IN_GRUEN. The project tree on the left shows a hierarchy of POUs: AS_01 (AS_01T, AS_01V, AS_01), Transitionen (T001), Aktionen (A001, A003, A004), ST_01 (ST_01T, ST_01V, ST_01), FBS_01 (FBS_01T, FBS_01V, FBS_01), KOP_01 (KOP_01T, KOP_01V, KOP_01), and AwL_01 (AwL_01T, AwL_01V). Blue arrows point from the circled elements in the project tree to the corresponding elements in the diagram.



IEC 61131 - Entwicklungsumgebung

POU – AS - Action Block

The screenshot displays the MULTIPROG development environment. The title bar reads "MULTIPROG wt - at1_97_04 - [A004:AS_01]". The menu bar includes "Datei", "Bearbeiten", "Ansicht", "Projekt", "Code", "Objekte", "Layout", "Online", "Extras", and "Fenster". The toolbar contains various icons for file operations and development tools. The left pane shows a project tree with the following structure:

- Projekt
 - Bibliotheken
 - Datentypen
 - Logische POEs
 - AS_01
 - AS_01T
 - AS_01V
 - AS_01
 - Transitionen
 - T001
 - Aktionen
 - A001
 - A003
 - A004
 - ST_01
 - ST_01T
 - ST_01V
 - ST_01
 - FBS_01
 - FBS_01T
 - FBS_01V
 - FBS_01
 - KOP_01
 - KOP_01T
 - KOP_01V
 - KOP_01
 - AwL_01
 - AwL_01T
 - AwL_01V

The right pane shows the code editor for action block A004, containing the following code:

```
1 VAR_OUT_GRUEN:=TRUE;  
2 VAR_OUT_GELB:=FALSE;
```

A blue arrow points from the "A004" node in the project tree to the code editor. The status bar at the bottom indicates "Drücken Sie F1 für Hilfe" and "Zeile 2, Spalte 20 | C: >2GB".



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POU – AS - Transition

The screenshot shows the SIMATIC Manager software interface. The main window displays the ladder logic for a POU (AS - Transition) named T001. The code is as follows:

```
1 T001 := VAR_IN_ROT;
```

The left pane shows the project tree structure:

- Projekt
 - Bibliotheken
 - Datentypen
 - Logische PDEs
 - AS_01
 - AS_01T
 - AS_01V
 - AS_01
 - Transitionen
 - T001
 - Aktionen
 - ST_01
 - ST_01T
 - ST_01V
 - ST_01
 - FBS_01
 - KOP_01
 - AWL_01
 - Physical Hardware
 - Simulation : IPC_30
 - R_Sim : PCOS_NT
 - Tasks
 - Global_Variables
 - IO_Configuration

The bottom status bar shows the current position is line 1, column 20.



IEC 61131 - Entwicklungsumgebung

Programmsimulation (I)

MULTIPROG wt - at1_97_04 - [Fbs_01:FBS_01 - Simulation.R_Sim.Task01.FBS_01.FBS_01]

Simulation: IPC_30

- R_Sim:PCOS_NT
 - Global_Variables
 - FUNCTIONS:FUNCTIONS
 - TASK02
 - AS_01:AS_01
 - KOP_01:KOP_01
 - Task01
 - ST_01:ST_01
 - FBS_01:FBS_01
 - FBS_01V
 - FBS_01
 - AWL_01:AWL_01
 - AWL_01V

Erzeugung eines ablauffähigen Programms

Simulation des Steuerungsprogramms

Arbeits Schritte:

1. Erzeugung eines Ablauffähigen Programms
2. Simulation eines ablauffähigen Programms
 - 2.1 Stop
 - 2.2 Senden aufrufen

Steuerungsbedienung



IEC 61131 - Entwicklungsumgebung

Programmsimulation (II)

The screenshot displays the 'Senden' (Send) dialog box in the IEC 61131 development environment. The dialog is divided into 'Projekt' (Project) and 'Bootprojekt' (Boot project) sections. The 'Projekt' section includes a 'Senden' button, a checkbox for 'OPC-Daten einbeziehen' (Include OPC data), a 'Programmquelle senden' (Send program source) button, a checkbox for 'Anwender-Bibl. einbeziehen' (Include user library), a checkbox for 'Seitenlayout einbeziehen' (Include page layout), and a 'Programmquelle am Ziel' (Program source at target) button. The 'Bootprojekt' section includes 'Senden', 'Aktivieren', 'Am Ziel löschen', and 'Daten senden' buttons. A blue arrow points from the 'Senden' button in the 'Projekt' section to the 'Senden' button in the 'R_Sim' control panel. A white callout box with the text 'Laden des Steuerungsprogrammes' (Load control program) is positioned over the 'Senden' button in the 'Projekt' section. The 'R_Sim' control panel shows 'Status: Betrieb' (Status: Operation) and buttons for 'Stop', 'Kalt', 'Reset', 'Warm', 'Heiß', 'Senden', 'Hochladen', 'Fehler', 'Info', 'Schließen', and 'Hilfe'. The main workspace shows a ladder logic diagram with an 'OR' gate and an 'AND' gate. The 'OR' gate has inputs 'VAR_C' (0) and 'VAR_D' (1). The 'AND' gate has input 'VAR_G' (1). The status bar at the bottom shows 'Initialisierungscode wird erstellt...' (Initialization code is being created...) and '0 Fehler, 0 Warnung(en)' (0 errors, 0 warnings).

Arbeitsschritte:
2.3 Senden

Steuerungs-
bedienung



IEC 61131 - Entwicklungsumgebung

Programmsimulation (III)

The screenshot displays the IEC 61131 development environment during a simulation. The main window is titled "DEMOIO - DRIVER" and shows a table of control outputs for 16 channels (0-15). The table is divided into two groups of 8 channels each. The first group (0-7) has green LEDs, while the second group (8-15) has red LEDs. The status of each channel is indicated by a small circle (green for 'Run', red for 'Stop').

Below the table, a logic diagram shows the control logic. It consists of two OR gates and one AND gate. The first OR gate has inputs VAR_A_1 and VAR_B_1. The second OR gate has inputs VAR_C_0 and VAR_D_1. The outputs of both OR gates are connected to the inputs of the AND gate, which has output VAR_G_1.

In the bottom right corner, a control panel window titled "R_Sim" is visible, showing the status "Betrieb" (Operation) and several control buttons: Stop, Kalt, Reset, Warm, Heiß, Senden, Hochladen, Fehler, and Info.

At the bottom of the main window, a status bar shows "Initialisierungscode wird erstellt..." and "0 Fehler, 0 Warnung(en)".

Steuerungseingänge

Steuerungsausgänge

Steuerungsbedienung

Arbeitsschritte:

3. Aktivieren DemoIO Driver (in Windows Fußleiste)
4. Kaltstart des Programms



IEC 61131 - Entwicklungsumgebung

Programmsimulation (IV)

Erzeugung eines ablauffähigen Programms

Debug-Modus des geladenen Steuerungsprogramms

Simulation des Steuerungsprogramms

Arbeitschritte:
4. optional
Debug-Modus

Initialisierungscode wird erstellt...
0 Fehler, 0 Warnung(en)

Code Fehler Warnungen Infos SPS-Fehler Drucken

Variable PDE/Arbeitsblatt

Steuerungsbedienung

Status: Betrieb	
Stop	Kalt
Reset	Warm
	Heiß
Senden	Hochladen
Fehler	Info
Schließen	Hilfe

