

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.

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



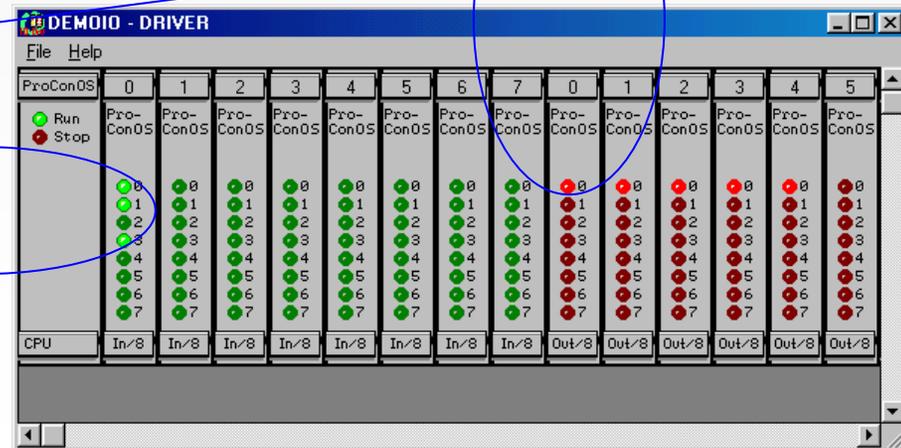
IEC 61131 - Einführungsbeispiel

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 /

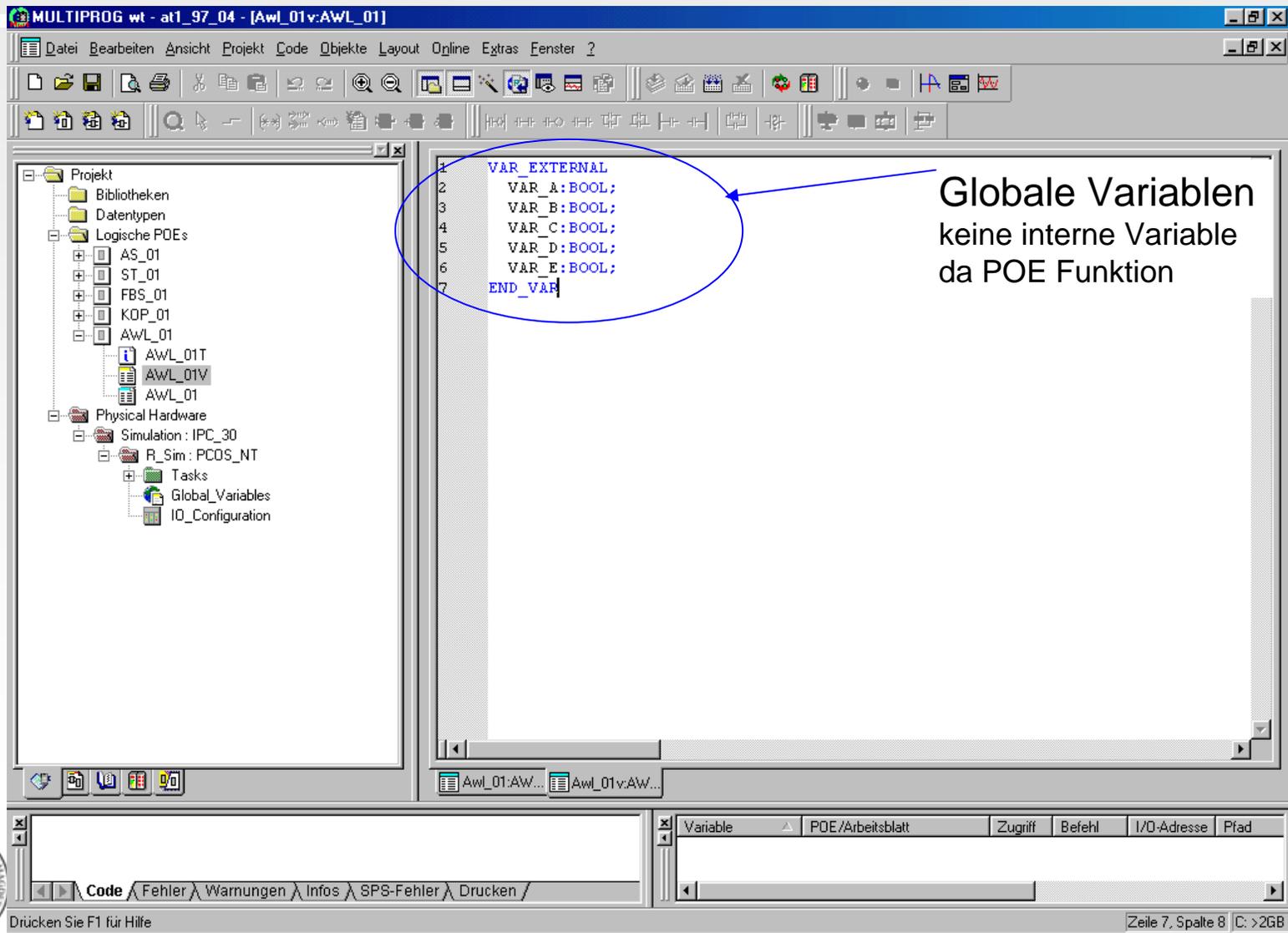
Drücken Sie F1 für Hilfe

Zeile 6, Spalte 6 | C: >2GB



IEC 61131 - Entwicklungsumgebung

POU – Globale Variable



The screenshot shows the MULTIPROG development environment. The left pane displays a project tree with folders for 'Projekt', 'Bibliotheken', 'Datentypen', 'Logische POEs', 'Physical Hardware', and 'Simulation'. The main editor window shows 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. The status bar at the bottom indicates '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

The main workspace displays a ladder logic network titled "Programmorganisationseinheit". The network consists of the following elements in series:

- Normally open contact: 001
- Parallel combination of normally open contacts: VAR_A and VAR_B
- Series combination of normally open contacts: VAR_C and VAR_D
- Normally closed contact: VAR_F
- Coil (output)

The status bar at the bottom shows the current file is "Kop_01:KO..." and the cursor is at "Zeile 7, Spalte 8 | C: >2GB".



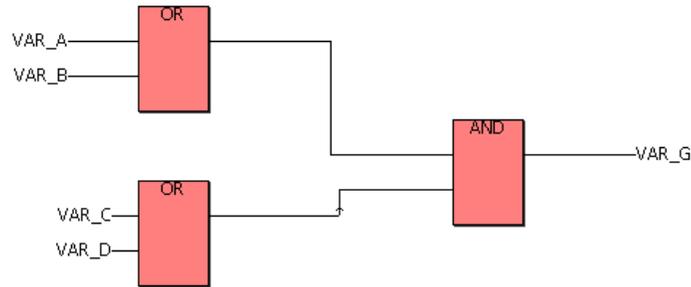
IEC 61131 - Entwicklungsumgebung

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



IEC 61131 - Entwicklungsumgebung

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: "Code", "Fehler", "Warnungen", "Infos", "SPS-Fehler", "Drucken". The status text reads "Drücken Sie F1 für Hilfe". The bottom right corner shows "Zeile 1, Spalte 45 C: >2GB".



IEC 61131 - Entwicklungsumgebung

POU – AS-Programm (anderes Beispiel)

The screenshot displays the MULTIPROG software interface. On the left, a project tree shows a hierarchy of files under 'Projekt' and 'Logische POEs'. A blue circle highlights the 'AS_01' folder, which contains sub-folders for 'AS_01T', 'AS_01V', 'AS_01', 'Transitionen', and 'Aktionen'. Blue arrows point from these folders to the corresponding elements in the ladder logic diagram on the right. The diagram, titled 'Programmorganisationseinheit', shows three parallel rungs. Each rung starts with a set coil (S001, S003, S004) and ends with a reset coil (R001, R003, R004). A common reset coil (R004) is connected to the end of the rungs. Transitions T001 and T002 are shown between the rungs. Variables VAR_IN_GELB and VAR_IN_GRUEN are connected to the rungs. The diagram is titled 'Programmorganisationseinheit'.



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 main editor window shows 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".



IEC 61131 - Entwicklungsumgebung

POU – AS - Transition

The screenshot displays the MULTIPROG development environment. The title bar reads "MULTIPROG wt - at1_97_04 - [T001: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, editing, and simulation. The left pane shows a project tree with the following structure:

- Projekt
 - Bibliotheken
 - Datentypen
 - Logische PDEs
 - AS_01
 - AS_01T
 - AS_01V
 - AS_01
 - Transitionen
 - T001
 - 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 right pane shows a code editor with the following text:

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

The status bar at the bottom indicates "Zeile 1, Spalte 20 | C: >2GB".



IEC 61131 - Entwicklungsumgebung

Programmsimulation (I)

Erzeugung eines ablauffähigen Programms

Simulation des Steuerungsprogramms

Arbeitschritte:

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, checkboxes for 'OPC-Daten einbeziehen', 'Anwender_Bibl. einbeziehen', and 'Seitenlayout einbeziehen', and buttons for 'Programmquelle senden' and 'Programmquelle am Ziel'. 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. The control panel also features buttons for 'Stop', 'Kalt', 'Reset', 'Warm', 'Heiß', 'Hochladen', 'Fehler', 'Info', 'Schließen', and 'Hilfe'. The status is 'Betrieb'. Below the dialog, a ladder logic diagram shows an 'OR' gate with inputs 'VAR_C' (0) and 'VAR_D' (1), and an 'AND' gate with input 'VAR_G' (1). The status bar at the bottom shows 'Initialisierungscode wird erstellt...' and '0 Fehler, 0 Warnung(en)'. The task title bar reads 'MULTIPROG wt - at1_97_04 - [Fbs_01:FBS_01 - Simulation.R_Sim.Task01.FBS_01.FBS_01]'.

Laden des Steuerungsprogrammes

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 simulation results for various Pro-ConOS units (0-5) across multiple channels (0-7). The table includes columns for "Run" (green/red dots) and "Stop" (red dots). Below the table, there are labels for "CPU", "In-/8", and "Out-/8".

Two callout boxes highlight specific parts of the table:

- "Steuerungseingänge" (Control Inputs) points to the "In-/8" columns.
- "Steuerungsausgänge" (Control Outputs) points to the "Out-/8" columns.

On the left, a project tree shows the simulation structure:

- 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
 - AWL_01

In the center, a logic diagram shows:

- Two OR gates. The top one has inputs VAR_A_1 and VAR_B_1. The bottom one has inputs VAR_C_0 and VAR_D_1.
- The outputs of these two OR gates are connected to an AND gate.
- The output of the AND gate is labeled VAR_G_1.

At the bottom right, a control panel window titled "R_Sim" is shown with the status "Betrieb" (Operation). It contains several buttons:

- Stop
- Kalt (Cold)
- Reset
- Warm (Warm)
- Heiß (Hot)
- Senden (Send)
- Hochladen (Load)
- Fehler (Error)
- Info

A callout box labeled "Steuerungsbedienung" (Control Operation) points to this control panel.

At the bottom left, a status bar shows:

- Initialisierungscode wird erstellt...
- 0 Fehler, 0 Warnung(en)
- Code / Fehler / Warnungen / Infos / SPS-Fehler / Drucken

- Arbeitsschritte:**
3. Aktivieren DemoIO Driver (in Windows Fußleiste)
 4. Kaltstart des Programms



IEC 61131 - Entwicklungsumgebung

Programmsimulation (IV)

Arbeitschritte:
4. optional
Debug-Modus

Erzeugung eines ablauffähigen Programms

Debug-Modus des geladenen Steuerungsprogramms

Simulation des Steuerungsprogramms

Steuerungsbedienung

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

Code Fehler Warnungen Infos SPS-Fehler Drucken

