

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.

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



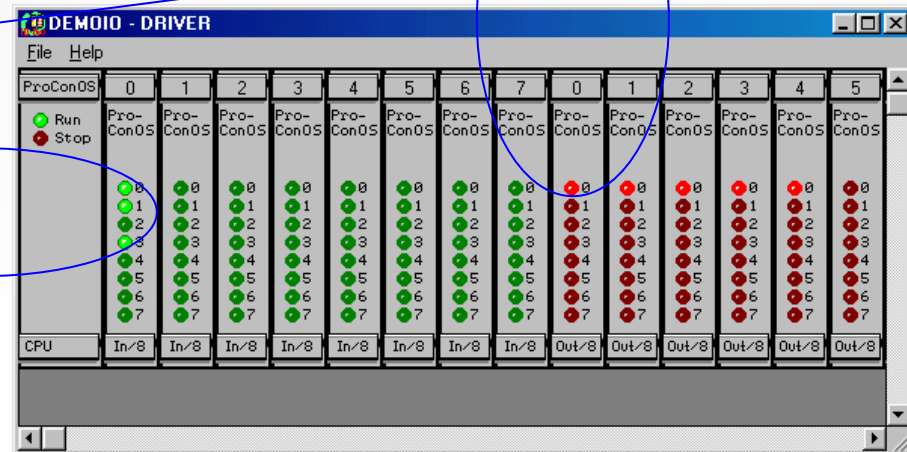
IEC 61131 - Einführungsbeispiel

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 development tools. 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 "Physical Hardware" 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 "Physical Hardware" section.

The main workspace is currently empty. 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 /

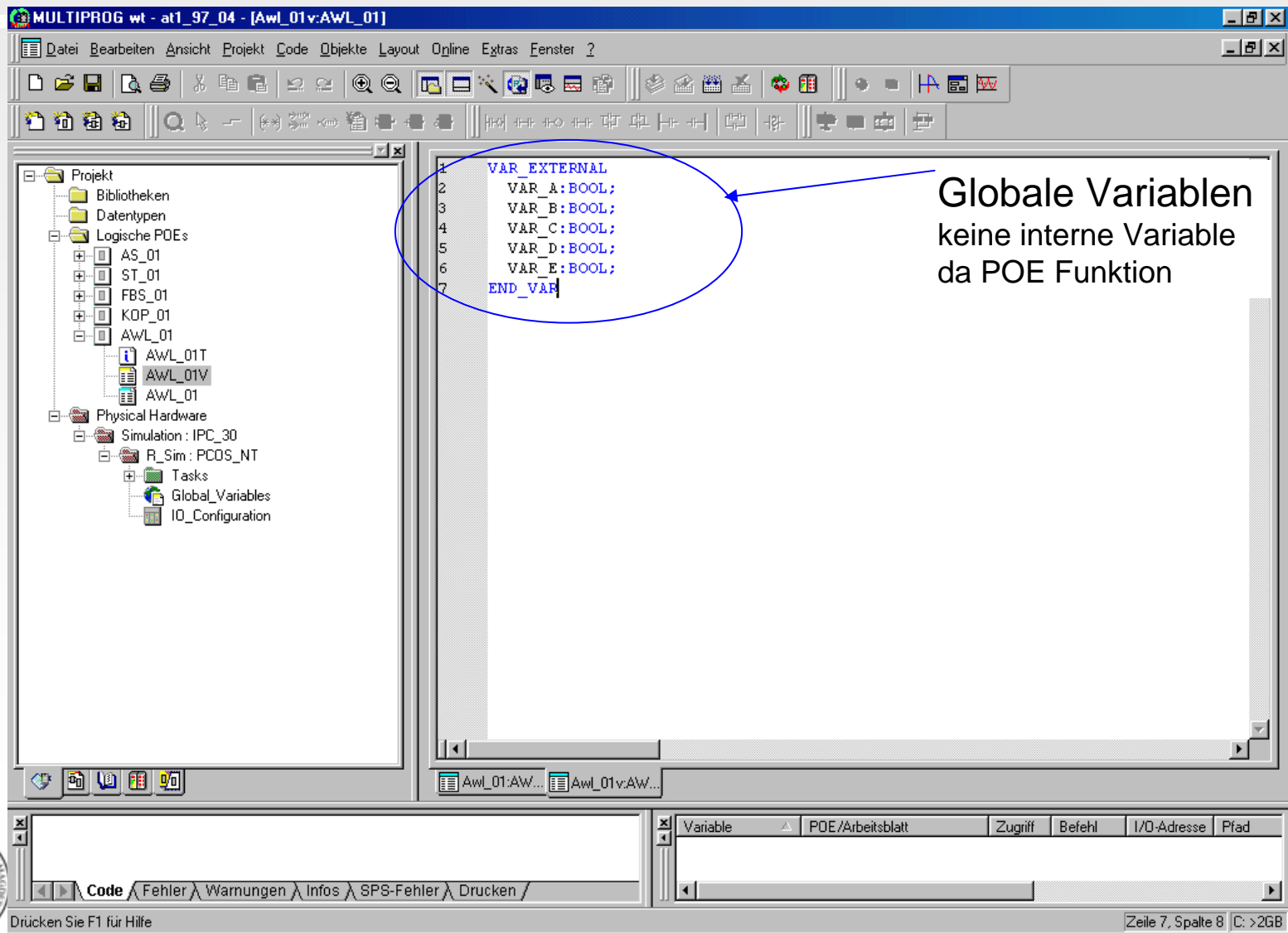
Drücken Sie F1 für Hilfe

Zeile 6, Spalte 6 | C: >2GB



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POU – Globale Variable



The screenshot shows the MULTIPROG development environment. The 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 sequence:

- 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".



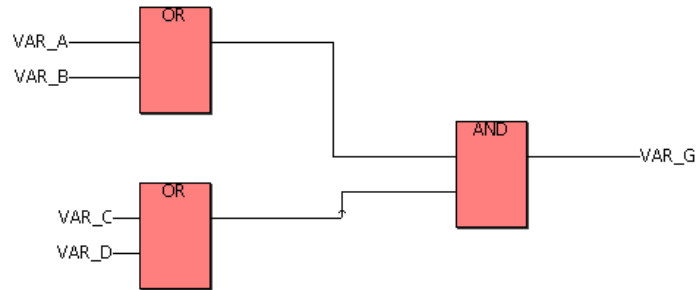
IEC 61131 - Entwicklungsumgebung

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



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POU – ST-Programm

The screenshot displays the MULTIPROG development environment. The window title is "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 displays 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 shows "Code", "Fehler", "Warnungen", "Infos", "SPS-Fehler", and "Drucken". The status text reads "Drücken Sie F1 für Hilfe" and "Zeile 1, Spalte 45 C: >2GB".



IEC 61131 - Entwicklungsumgebung

POU – AS-Programm (anderes Beispiel)

The screenshot displays the MULTIPROG development environment. The left pane shows a project tree with a blue circle around the 'Logische POEs' folder, which contains sub-folders for 'AS_01', 'ST_01', 'FBS_01', and 'KOP_01'. The 'AS_01' folder is further expanded to show 'AS_01T', 'AS_01V', 'AS_01', 'Transitionen' (T001), and 'Aktionen' (A001, A003, A004). The right pane shows a ladder logic diagram titled 'Programmorganisationseinheit'. It features three parallel rungs. The top rung has a set coil (S001) and a reset coil (R001) connected to a common reset coil (R004). The middle rung has a set coil (S003) and a reset coil (R003) connected to the same common reset coil (R004). The bottom rung has a set coil (S004) and a reset coil (R004) connected to the same common reset coil (R004). The rungs are labeled 'T001', 'VAR_IN_GELB', and 'VAR_IN_GRUEN'. The diagram is titled 'Programmorganisationseinheit'. The status bar at the bottom shows 'Code' selected, and the current position is 'Zeile 2, Spalte 20 | C: >2GB'.



IEC 61131 - Entwicklungsumgebung

POU – AS - Action Block

MULTIPROG wt - at1_97_04 - [A004:AS_01]

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

Projekt
Bibliotheken
Datentypen
Logische POEs
AS_01
AS_01T
AS_01V
AS_01
Transitionen
T001
Aktionen
A001
A003
A004
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

AwL_01:AW... AwL_01v:A... Kop_01:KO... Fbs_01:FB... St_01:ST_01 A004:AS_01

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

Code Fehler Warnungen Infos SPS-Fehler Drucken /

Drücken Sie F1 für Hilfe

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 is a code editor showing 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 titled 'Senden' and has a blue header. It is divided into two main sections: 'Projekt' (Project) and 'Bootprojekt' (Boot project). In the 'Projekt' section, the 'Senden' button is highlighted with a blue arrow. Below it are checkboxes for 'OPC-Daten einbeziehen', 'Anwender_Bibl. einbeziehen', and 'Seitenlayout einbeziehen', along with buttons for 'Programmquelle senden' and 'Programmquelle am Ziel'. The 'Bootprojekt' section contains buttons for 'Senden', 'Aktivieren', 'Am Ziel löschen', and 'Daten senden'. A white callout box with the text 'Laden des Steuerungsprogrammes' (Load the control program) is positioned over the 'Senden' button in the 'Projekt' section. Below the dialog, a ladder logic diagram is visible, featuring an 'OR' gate with inputs 'VAR_C' (0) and 'VAR_D' (1), and an 'AND' gate with input 'VAR_G' (1). A blue circle highlights a 'R_Sim' control panel in the bottom right corner, which includes buttons for 'Stop', 'Kalt', 'Reset', 'Warm', 'Heiß', 'Senden', 'Hochladen', 'Fehler', 'Info', 'Schließen', and 'Hilfe'. The status of the simulation is shown as 'Betrieb' (Operation). The bottom status bar indicates '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 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 with blue circles point to the "Run" and "Stop" columns, labeled "Steuerungseingänge" (Control Inputs) and "Steuerungsausgänge" (Control Outputs) respectively.

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 OR gate has inputs VAR_A_1 and VAR_B_1. The bottom OR gate has inputs VAR_C_0 and VAR_D_1. The outputs of both OR gates are connected to an AND gate, which has output VAR_G_1.

At the bottom right, a control panel window titled "R_Sim" is shown with a status of "Betrieb" (Operation). It contains buttons for "Stop", "Kalt" (Cold), "Reset", "Warm" (Warm), "Senden" (Send), "Hochladen" (Load), "Fehler" (Error), and "Info". A callout box with a blue circle points to this panel, labeled "Steuerungsbedienung" (Control Operation).

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

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

