PC-based Control with SIMATIC WinAC

SIMATIC WinAC is the PC-based control system from Siemens and is available in two versions – as a slot PLC with hardware support or as a software PLC *). Thanks to their short innovation cycles and favorable price/performance ratio, PCs are used today not just in the office world but also increasingly for automation tasks such as operator control and monitoring and data processing. Frequently, this does not exhaust the resources of these increasingly powerful devices. So why not open-loop and closed-loop control with the PC as well?

Thanks to the ruggedness of industrial PCs, this is no problem. And the openness of the PC allows simple connection of all the necessary hardware and software components. Optimal system integration on the one hand, and openness to third-party components on the other are not a contradiction with Totally Integrated Automation. So what could be more obvious than to solve all tasks in a single device and thus utilize the benefits of PC-based technology within Totally Integrated Automation?

A SIMATIC S7 is integrated into the PC to produce a cost-optimized total solution in which all the components are available from a single source, if desired. Developers and users profit here from the experience and the global service network of the market leader Siemens and from the high quality of the SIMATIC products and systems. PC-based controllers are configured and programmed with the STEP 7 standard software, in exactly the same way as S7 Controllers. User programs can run on a PLC (programmable controller) or a PC according to customer wishes, and finished S7 programs can be adopted for PC-based solutions.

### Highlights

- Cost savings through integration of all automation components on the industrial PC (IPC)
- Utilization of the continuous level of innovation and performance improvement of PCs
- Simple communication through low-cost, integral network interfaces
- Simple use of business software (e.g. MS Office) and creation of proprietary user software with powerful software tools (C++, VB, etc.)
- Wide, standardized range of hardware
- Large choice of products
- Investment security in the use of IPCs with long-term availability

*) PLC stands for “Programmable Logic Controller”

Open, PC-based Control based on Windows

SIMATIC WinAC enables control on the PC. WinAC – the SIMATIC S7 in the PC – is eminently suitable when, in addition to control and visualization functions, tasks with high data volumes and high-speed technological functions have to be solved on a PC platform. SIMATIC WinAC can easily be combined with any non-Siemens components and integrated into the office world via the standard OPC (OLE for Process Control) interface. SIMATIC WinAC hardware and software can be used on SIMATIC PCs and on most commercially available PCs with the Professional versions of Windows 2000/XP. The latest PC trends and operating system versions are supported.

Use of SIMATIC know-how

WinAC is programmed with the usual SIMATIC programming tools – with STEP 7 or, if required, also with the field-proven Engineering Tools such as the IEC 61131-3-compliant languages S7-SCL (textual high-level language) or S7-GRAPH (graphical configuring for sequential controls).

All configuration information for a PC-based application are created, managed and saved centrally. In doing so, both centralized engineering via Industrial Ethernet or PROFIBUS and engineering on target are possible, with STEP 7 then installed direct on the control PC.

SIMATIC WinAC is code-compatible with SIMATIC S7-400, that is, program sections created for SIMATIC S7-300 and S7-400 can continue to be used in WinAC and vice versa. Existing investments in software are thus protected. In conjunction with the familiar and field-proven configuring using STEP 7, accumulated SIMATIC know-how can be used extremely well with WinAC.
Simple integration of technological functions

SIMATIC WinAC also enables simple integration of technological functions for, say, counting, positioning and closed-loop control tasks.

On the one hand, there are intelligent function modules of the SIMATIC ET 200 distributed I/O devices available for this that are connected via PROFINET DP.

On the other hand, different SIMATIC software packages enable the solution of simple technological tasks such as standard PID control for general closed-loop control purposes, and Easy Motion Control with its block library in accordance with the PLCopen Motion Control standard for traversing linear or rotary axes.

Open data interfaces to the office world and other PC applications

SIMATIC WinAC offers an open data interface to the standard software of the office world for vertical integration on the basis of OPC. In the case of visualization and data processing, simple and symbolic access to the process data can be made via this open interface. The integral SIMATIC NET OPC server enables vendor-independent industrial communication with all OPC client applications such as visualization systems from other manufacturers.

SIMATIC WinCC and WinCC flexible can be connected via a SIMATIC interface to enable use of extensive diagnostics functions and of the shared database, for example. PG/OP communication allows connection of SIMATIC programming devices and operator panels.

In addition, SIMATIC WinAC also enables simple horizontal integration of technological applications such as barcode readers, image processing, measured value acquisition, and numerical controls. A supplementary product (ODK, Open Development Kit) is available for this purpose, providing access to all hardware and software components of the PC thanks to the integration of C/C++ programs into the WinAC control program, and thus enabling a high degree of flexibility.
Maximum performance and utilization of the PC RAM
With SIMATIC WinAC Software PLCs, your PC-based automation solution profits from the high performance power of modern PCs. High processor clock rates result immediately in a high-performance WinAC solution. Using the PC RAM effectively removes any size restrictions on your user programs.

Communication and diagnostics across all levels
SIMATIC WinAC offers the full performance range of S7 Communication with S7 controllers and other WinAC stations over the MPI, PROFIBUS and Industrial Ethernet networks. Any data areas can be sent and received with S7 Communication. WinAC stations are handled identically to other S7-CPU stations here. An extremely flexible network concept can be implemented with the help of several independent PROFIBUS connections (e.g. CP 5613) and by activating/deactivating PROFIBUS slaves. Support of PROFIBUS DP V1 also allows the integration of intelligent field devices with complex functions. Direct access to all DP slaves and their components from a central control desk across network boundaries is possible with SIMATIC WinAC especially for diagnostics purposes – even for remote diagnostics via Teleservice. This powerful routing function indicates the status of the individual (sub)modules of the slaves distributed on-site, that is, faults can be diagnosed precisely in the control room.

PC-based Automation Competence Centers
Our Competence Centers offer you a comprehensive range of selective services - from workshops and feasibility studies to the handling of specific development tasks.

Weltweite Kompetenz in PC-based Automation

Competence Center für PC-based Automation
Köln  Mailand  Shanghai

■ Northern Europe: CCCologne@siemens.com
■ Southern Europe: CCMilano@siemens.it
■ Asia: pcba@pek1.siemens.com.cn

Highlights
WinAC (Windows Automation Center) – the PC-based Control solution of Totally Integrated Automation – offers decisive benefits:
■ Open, PC-based Control based on Windows
■ Use of SIMATIC know-how
■ Simple integration of technological functions
■ Open data interfaces to the office world and other PC applications
■ Maximum performance and utilization of the PC RAM
■ Communication and diagnostics across all levels
SIMATIC WinAC Slot PLC

Enhanced availability and operational safety

The WinAC Slot PLCs are used when increased availability and operational safety are required in PC-based solutions.

The performance and instruction sets of the WinAC Slot PLCs are based on the powerful S7-400 CPUs and enable control independently of Windows.

The Slot PLCs are capable of instruction-specific restart and continue the user program immediately from the point of interruption. Thanks to an external 24V supply, the user program of the Slot PLC can be processed completely independently of the PC. Thanks to battery backup, all data areas can be retentive. Thanks to the rugged configuration and deterministic behavior, applications with increased availability and operational safety can be implemented.

The Slot PLCs have an integral MPI/DP interface and a DP interface for communication with other CPUs and for connecting distributed I/O, for example. In addition, the Slot PLCs support the isochronous mode functionality to enable distributed solutions for high-speed, time-dependent tasks. Programs can be archived and dearchived via the hard disk of the PC.

The WinAC Panel on the PC offers the display and operator input functions of the Slot PLC – comparable with those of an S7-CPU.

Up to four Slot PLCs (one PCI slot each) can be operated in one PC. In addition, a Software PLC can also be combined with up to three Slot PLCs. An automation solution can thus be structured more compactly with fewer PCs, thus reducing space requirements and hardware costs.

The firmware is updated immediately by downloading a file without having to store it on a memory card. Loading the firmware in the installed state from any PC memory medium (hard disk, USB stick, CD-ROM) simplifies and accelerates service and maintenance.

WinAC Slot is available in two different versions:
- WinAC Slot 412 based on the CPU 412-2 with 128 KB memory for code and 128 KB memory for data
- WinAC Slot 416 based on the CPU 416-2 with 1.6 MB memory for code and 1.6 MB memory for data
SIMATIC WinAC RTX 2005 SP2—
Increased flexibility and openness

WinAC RTX 2005 SP2 is used when high performance, high data volume, and simultaneous real time are required for the automation task. The optimized runtime system supports the processing of extensive and demanding PC applications in parallel with the control task. It runs under Windows 2000 or XP Professional and uses the real-time core Ardence RTX to guarantee real time and deterministic behavior.

Operator interface for establishing the priorities of control program and Windows application

Deterministic behavior

Deterministic behavior means the control program is executed in a fixed cycle and any Windows applications running in parallel will be interrupted if required—such as in drive controls, for example. The time remaining after execution of the control program at the end of the cycle time is available to Windows.

The performance of WinAC RTX 2005 SP2 can be scaled across the PC platform. Applications range from machine-level control tasks with rugged embedded PCs to high-end applications on PCs with the latest technology. Especially the use on embedded PC platforms, such as the SIMATIC Microbox PC 420 with Windows XP Embedded, results in cost-effective and highly rugged solutions. The Microbox PC 420 is characterized by fan-free and diskless operation.

WinAC RTX 2005 SP2 uses the main memory of the PCs and offers program backup on the hard disk. Non-cyclic data such as production parameters or recipe data can be stored permanently on the PC’s hard disk with the help of system functions (SFC 82 – 84). In addition, all data can be held retainably in conjunction with an uninterruptible power supply (UPS).
The I/O is connected via PROFIBUS DP at up to 12 Mbit/s via the integral DP interface of the SIMATIC PCs or via communications processors (CP 5611 A2/5613 A2). Up to four PROFIBUS lines can be operated with up to 500 slaves.

In addition, WinAC RTX 2005 SP2 supports the system function isochronous mode with the CP 5613 A2. With isochronous mode, high-speed, time-dependent applications such as closed-loop controls can also be implemented with distributed I/O. This means that in addition to the control job other functions can be integrated into a PC or smaller, more economical PCs can be used for the same job.

On exiting, WinAC RTX 2005 SP2 saves all the data declared as retentive to the hard disk. In order to ensure a defined shutdown of the Software PLC in the event of an unexpected failure of the PC voltage supply, an uninterruptible power supply (UPS, e.g. SITOP DC UPS) can be used.

With Service Pack 1 and higher, WinAC RTX 2005 SP2 also supports the integral, battery-backed SRAM of the SIMATIC Microbox PC 420 as an alternative, in order to retain to 25 KB of data in the event of a power failure.
**Open Development Kit (ODK)**

**Integrating special tasks**

PC-based solutions typically include technological tasks such as image processing, measured value acquisition and numerical controls. The new WinAC option Open Development Kit (ODK) allows flexible use of all PC resources from the control program via three different interfaces in order to provide high-performance expansion of the PLC functionality. All the operating system functions and system resources of Windows are available to the programmer for this purpose, also providing access to external hardware and software components.

The new ODK version integrates the functions of the previous supplementary packages ODK (old version for the Software PLCs) and T-Kit (for the Slot PLCs) into a single development package. Software developments can therefore be used repeatedly because such software can now be used on all WinAC PLCs. The new ODK version is also compatible with the predecessor versions so that existing applications can continue to be used.

An ODK application is developed with a standard development environment for C-/C++ programming, such as Microsoft Visual Developer’s Studio. This provides the application developer with the familiar environment tailored to Windows applications.

C++ programming knowledge is not required for integrating such applications into the WinAC control program. The ODK applications can be used like normal system functions in the STEP 7 program.

Developers of C++ applications can get support from the WinAC Competence Center:

www.siemens.com/pcbasedautomation/cc

WinAC ODK offers three interfaces for the following applications:

- Custom Code Extension Interface (CCX) for calling your own C/C++ programs from the WinAC control program
- Shared Memory Extension Interface (SMX) for high-speed WinAC data exchange with Windows applications
- Controller Management Interface (CMI) for integrating the WinAC Panel functionality into a Windows application

The table shows which interfaces are available for which WinAC versions:

<table>
<thead>
<tr>
<th>Interfaces</th>
<th>Soft</th>
<th>Slot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custom Code Extension (CCX)</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>Shared Memory Extension (SMX)</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Controller Management (CMI)</td>
<td>■</td>
<td>■</td>
</tr>
</tbody>
</table>
Custom Code Extension Interface (CCX)

ODK includes an application wizard and a class library for simple programming in Microsoft Visual C++. The C++ program running outside WinAC is called via the CCX from the PLC program with the help of two system functions (SFC 65_000, SFC 65_001). The C program can be executed in three different ways:

- Synchronously, that is, processed as part of the PLC cycle
- Asynchronously, that is, started by the PLC program and terminated in the background
- Continuously, that is, processed parallel to the PLC program

This allows diverse applications to be implemented. Some examples include:

- Connection of fieldbus cards to WinAC
- Integration of robot control software into WinAC
- Direct access to Windows file system
- Implementation of special communications protocols
- Complex calculations for control of the quality of packaging film
Open Development Kit (ODK)

Shared Memory Extension Interface (SMX)

Via SMX, ODK supports the development of applications requiring data exchange between Windows applications such as Visual C++ and the WinAC PLCs, as is the case, for example, in closed-loop control or image processing tasks. This data exchange is especially fast via the a dual-port RAM (DPR) or shared memory, accessed by both the external C++ program and the PLC program. ODK includes libraries for reading and writing to this DPR according to the polling method. From the viewpoint of the WinAC PLC, the DPR represents a 4KB I/O area that can be accessed with load/transfer commands.

Typical applications of the SMX:
- Connection of motion control systems
- Connection of systems for measured data acquisition and analysis
- Transfer and backup of large volumes of production and quality data
- Direct and high-performance integration of an order database

Controller Management Interface (CMI)

With ODK, the function of the WinAC Panels can be integrated into a Windows application (see figure). For this purpose, the CMI provides the application with the following functions of the WinAC Panel:
- LED status
- Start and stop of the PLC
- Subsequent loading of programs

Application examples:
- Integration of the WinAC Panel into an HMI application
- Remote operation of the PLC
- Implementation of specific user rights

The Controller Management Interface (CMI) integrates the WinAC Panel functionality into a Windows application.

The Shared Memory Extension Interface (SMX) enables data exchange between Slot PLCs or Software PLCs and Microsoft applications.
## Technical specifications SIMATIC WinAC

<table>
<thead>
<tr>
<th><strong>PC-based Control</strong></th>
<th><strong>Software PLC</strong></th>
<th><strong>Slot PLC</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WinAC RTX 2005 SP2</td>
<td>WinAC Slot 412 V4.0</td>
</tr>
<tr>
<td>Order No. group: 6ES7</td>
<td>671-0RC.</td>
<td>673-2CC.</td>
</tr>
<tr>
<td><strong>Basic features</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAM (integral) (code/data)</td>
<td>PC memory (non-paged)</td>
<td>192 KB/192 KB</td>
</tr>
<tr>
<td>Number of inputs/outputs in total</td>
<td>16/16 KB</td>
<td>4/4 KB</td>
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<tr>
<td>Bit memories</td>
<td>16 KB</td>
<td>4 KB</td>
</tr>
<tr>
<td>S7 counters/timers</td>
<td>512/512</td>
<td>2048/2048</td>
</tr>
<tr>
<td>Plug-in memory card</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of blocks (FBs, FCs, DBs)</td>
<td>Limited only by available PC RAM</td>
<td>256, 256, 511</td>
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<tr>
<td>Multiprocessor operation</td>
<td>1 Software PLC and up to 3 Slot PLCs</td>
<td>Up to four Slot PLCs</td>
</tr>
<tr>
<td>PLC programming software</td>
<td>STEP 7 from V5.2, Engineering Tools (optional)</td>
<td>STEP 7 from V5.2, Engineering Tools (optional)</td>
</tr>
<tr>
<td><strong>Retentivity</strong></td>
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<td></td>
</tr>
<tr>
<td>with UPS</td>
<td>All data</td>
<td>All data</td>
</tr>
<tr>
<td>with PS Extension Board and battery</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Instruction execution times</strong></td>
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<td></td>
</tr>
<tr>
<td>Bit operation</td>
<td>0.004 µs</td>
<td>0.1 µs</td>
</tr>
<tr>
<td>Integer operation</td>
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<td>0.1 µs</td>
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<tr>
<td>Floating-point operation</td>
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<td>0.3 µs</td>
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<tr>
<td>Reference platform</td>
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<td>PC-independent</td>
</tr>
<tr>
<td>Deterministic</td>
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<td></td>
</tr>
<tr>
<td><strong>DP connections</strong></td>
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<td></td>
</tr>
<tr>
<td>Total</td>
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<td>2</td>
</tr>
<tr>
<td>Integrated</td>
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<td></td>
</tr>
<tr>
<td>CPS5611/Integrated interface of SIMATIC PC, max.</td>
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<td></td>
</tr>
<tr>
<td>CPS5613-A2 max.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Communications functions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PG/OP communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S7 Communication</td>
<td></td>
<td></td>
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<tr>
<td>Process data access via OPC</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Easy Motion Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C/C++ link</td>
<td>with ODK</td>
<td>with ODK</td>
</tr>
<tr>
<td><strong>Operator control and monitoring via SIMATIC interface</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIMATIC WinCC/WinCC flexible</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Operating system</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows 2000 Professional</td>
<td>(&gt;= SP3)</td>
<td>(&gt;= SP3)</td>
</tr>
<tr>
<td>Windows XP Professional</td>
<td>(SP1 or SP2)</td>
<td>(SP1 or SP2)</td>
</tr>
<tr>
<td>Windows XP Embedded</td>
<td>(on MICROBOX PC 420)</td>
<td></td>
</tr>
</tbody>
</table>