

## Features and Benefits

- **Virtual Harmony Controls** designed by the OEM provides a more realistic replication of plant controls.
- **Realistic Training and Test Environment:** The simulator uses the actual plant control logic and operator interface. Control logics and operator graphics, faceplates, and dialogs are used without modification.
- **LifeCycle Simulator: Multi-functional** simulator can be used for design and engineering studies, Operator training, control logic testing and pre-tuning, and process optimization.
- **Interfaces for Process Model and Instructor Station:** Process models, ranging from high fidelity third party models to low-end models simulated through Symphony function block logic, work closely with the HTS package to provide desired levels of process dynamics.
- **Instructor Functionality:** HTS Manager supports a variety of instructor functionality such as Run, Freeze, Snapshot, Restore, Fast/Slow run-time.
- **Reduce simulator cost and footprint:** Virtual controls run in the windows environment instead of requiring duplicate control and I/O hardware, which minimizes cost without compromising training effectiveness.
- **Fidelity:** HTS can be used for both High and Low fidelity simulators.



Continuous pressures to reduce costs are balanced by a company's social responsibility to protect its people, property, environment, and the surrounding community from harm. While control systems are increasingly used to automate large sections of most plants, human error remains a critical contributor to most accidents. These risks, along with the number of unplanned shutdowns and outage start-ups can be reduced with a well-trained staff. Trained operators result in higher returns, as both product quality and productivity are improved.

By using a Harmony Training Simulator (HTS) solution, operators can master the process in a safe and realistic environment. In addition, engineers can fully test control modifications before transferring them to the actual plant environment.

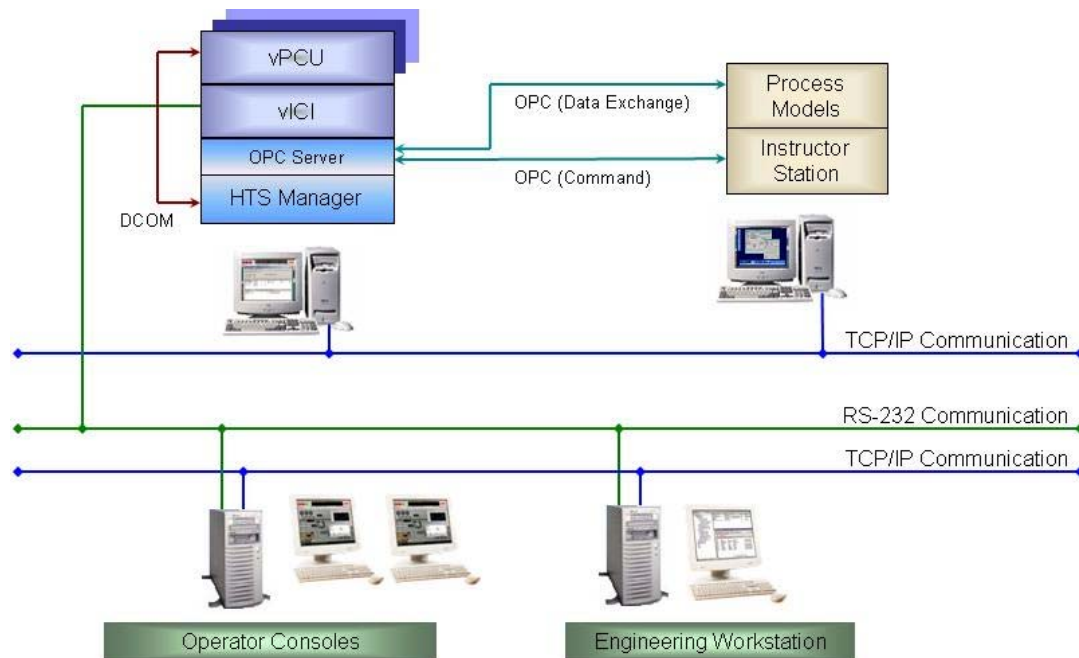
The HTS provides a natural extension to the Harmony control system and training environment by simulating real-time control dynamics. Because the HTS utilizes the same operator displays, control logic, and execution environment running in the plant, skills are 100% transferable. The HTS provides a "virtual" control system in a Windows computer environment.

HTS is designed to be an integral part of a cost effective comprehensive program for operator training, control logic development and testing, and control logic and operator verification. By combining these capabilities into one system, the investment in a simulation solution is maximized.

## Highlights

The Harmony Training Simulator (HTS) creates a simulator system with the identical view and logic as the plant control system. The HTS replaces the Symphony controller modules and communication modules in the training simulator. This product application allows the Symphony controller module configuration to operate in a “virtual” environment on one or more PCs. The HTS software also handles module bus communications, PCU to PCU communications, and communications via semAPI with ABB consoles.

The simulator uses the same control logic (i.e., function block configuration) and HMI displays that are implemented in the actual plant control scheme. The use of the actual control logic and HMI displays provides an identical control room and plant environment, which insures that the skills learned on the simulators are directly transferable to the operating environment.



## Lifecycle Simulator

The HTS is a multi-functional simulation system that provides support throughout the entire plant lifecycle. This allows plant personnel to maximize their investment, improve uptime through optimized performance, and reduce the risk associated with process modifications.



Plant lifecycle stages supported by the HTS include:

- Design and engineering: Dynamic simulation models can be developed in parallel with process design and used for control logic verification. This helps ensure design quality, eliminates major rework, and reduces verification time.
- Control system test: The use of a realistic simulation environment allows more accurate pre-tuning and shortens commissioning time.

- Operator training: Realistic operator training in a safe, non-production environment prior to start-up or during the operation phase, increases safety and reduces the number of operator induced trips.
- Process modifications and optimization: The HTS environment can be used to verify changes to process areas and train operators accordingly. In addition, it enables performance optimization studies by allowing the effects of process changes to be verified in a non-production environment.

## Simulator Components

The Harmony Training Simulator incorporates industry standard operator training simulator functionality into the Harmony control system. The virtual simulation system is comprised of the six (6) major functional components listed in detail below:

- **HTS Manager:** The HTS manager coordinates the overall operations of the Harmony Training Simulator. It automatically manages the simulation network by monitoring the status of the simulation devices and initiating the startup commands for each individual vPCU upon receipt of the start command from the application. HTS Manager establishes communications between vPCUs, vICIs and the OPC servers. It manages the exchange of data, via DCOM communication, between the OPC server and the vPCUs as well as the exchange of data between the OPC server and clients, using standard OPC protocol. In addition the HTS Manager processes the instructor station commands, passing them on to all vPCUs as needed, coordinating run-time rates and data exchange rates, and organizing the snapshot data in specified directories for saving and restoring.

The HTS manager also supplies a set of basic instructor station commands in its menus that can be used as a low fidelity simulator instructor station.

PCU/ICI	Hostname	Loop	Node	Status	Run State	Run Rate	CycTime, msec
PCU01P002	localhost	1	2	Good	Run	1.00	0.41
PCU01P003	localhost	1	3	Good	Run	1.00	0.10
ICI_1_12	localhost	1	12				
ICI_1_15	localhost	1	15				

Controller	Loop	PCU	Module	Config File
Module_1_2_2	1	2	2	C:\configs\10202.CFG
Module_1_2_4	1	2	4	C:\configs\10204.CFG

- **vPCU:** An integral part of the simulator is the plant control configuration. The vPCU allows the actual plant control logics, which typically resides in numerous controllers, to be loaded directly to a Windows computer for execution. Each control module's configuration will be executed by a vPCU in a virtual environment identical to a hardware controller. The utilization of vPCUs results in minimized hardware costs, and eliminates the need to translate the logic into another form of simulation.

The HTS has no special requirements for configuration of supported functions codes. The compiled Composer (or WinCAD) CFG files are copied to a designated subdirectory and the HTS system starts each vPCU (there is no conversion required). Monitoring and tuning of the function block logic is possible from Composer. Manual changes to logic are done in the Composer drawings, compiled and reloaded into the vPCU. Tuning changes are made and saved in Composer.

- **vICI:** In the actual DCS, the operator consoles are connected to the control network using standard interface units (CIU, ICI, or HCC). In the virtual simulator system the entire DCS communication system is emulated. The messaging between the vPCU and the console is identical to the messaging in the real system. All exception reporting, operator commands, alarm management, and tuning functions are handled by the vICI. The vICI communicates serially to the operator consoles.

- **Operator Console:** The operator interface is provided by standard human machine interfaces (HMI), which contain graphic configurations identical to that of the actual control system. Consequently, all of the operational skills learned through simulator training are fully transferable to the actual control system. (The human system interfaces operate in real-time, independently of the simulation system time-synchronization.)

- **Process Models:** The physical process I/O in the plant control system is replaced by software signals that are stimulated by a dynamic process model. A process model is a set of equations that define the dynamics of the process being controlled. These process models range from simple, low-end simulated by Symphony function block logic, to complex, high-fidelity third-party process model from a modeling vendor.
- **Instructor's Station:** The instructor's station (IS) supervises the overall training experience by setting up the training exercises and effectively monitoring the trainees. From the IS the instructor is able to initiate commands to the simulator system such as load initial conditions, save snapshots, set the execution rate, and freeze the system. The instructor console is typically supplied by a third-party simulation developer. For low fidelity simulation the HTS manager can be used as the instructor station.

## Simulator Functions

Setup and operation of simulator training sessions are performed via the Instructor's station. Through this workstation a wide variety of specific runtime simulator functions are available. The HTS supports the following functionality.

- Initialization
- Establishing PCU models
- Process I/O
- Run / Freeze
- Save Snapshot / Initial Conditions
- Dynamic Restore Snapshot / Initial Conditions
- Full Restore of Snapshot / Initial Conditions
- Set Simulation Run-rate (fast and slow)

## HTS Technical Specification

Property	Description
Maximum number of PCUs	Unlimited. Computer CPU and memory requirements are dependent upon the number and size of PCUs being emulated.
Number of controllers per PC	Typically 10 medium size controllers per PC. The number of controllers that can run on a PC is limited by the computer CPU and memory as well as the size of the controller configuration.
Run-rate time range (Fast/Slow)	0.1 to 10 times real time. (Note: Fast time capabilities are dependent on the computer CPU size and number and size of PCUs.)
Data Exchange Rate	50 ms to 1000 ms
Maximum number of Snapshots	65,000; Limited by computer storage space. HTS instructor station commands limited to 999.
Maximum number of consoles	Unlimited. The number of vICIs needed impacts the computer CPU and memory requirements and required number of serial ports.
Supported consoles	PPB, PPA, Conductor NT, Conductor VMS
Operating system	Windows XP, Windows 2003 Server
Computer specifications	Typical computer is 3 gigahertz Pentium IV with 1 Gigabytes RAM. Computer specification is determined by the size of the control configuration, the number of I/O points and the number of PCUs and ICIs. The PCs used are typically current specification workstation PCs (rather than expensive server-class PCs).
Function Codes	HTS supports all of the commonly used functions codes, 140 are supported. At this time ABB does not plan to support some of the very old module types such as COM and AMM modules or some function codes which are seldom used in ABB Power Plant applications. Seldom used function codes include batch language support and User Defined Function (UDF) codes. Custom C language applications are not supported but serial FDI applications use some of the C language function blocks that are supported. Only the I/O functionality is supported for SOE function codes. For up-to-date information on function code support please contact ABB.

## Conclusion

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The most important benefits realized from the investment in a simulator come from training operators to manage abnormal situations. What is the average cost in lost production and maintenance of tripping your plant?

Improved understanding of the plant under normal operating conditions can also yield significant returns. What is the difference in economic terms between your best and worst operators' performance? Simulators can also be valuable tools for your engineers and technicians to safely and cost-effectively evaluate process, operation and control system changes and to demonstrate them to management.

For new plant or upgrade projects, a simulation system can dramatically reduce commissioning costs by permitting evaluations of operating procedures, thorough testing and pre-tuning of control systems, and pre-training of the operations staff.

The Harmony Training Simulator product solution provides a virtual simulation that reduces the size of simulator footprint while still maintaining the stimulated integrity of the controls.



As part of its on-going product improvement, ABB reserves the right to modify the characteristics or the products described in this document. The information given is non-contractual. For further details please contact the ABB company marketing these products in your country.

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