



Weatherford®

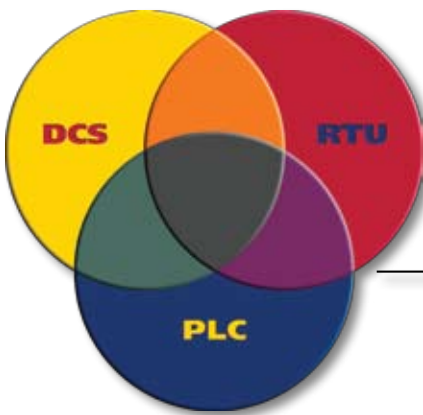
CS7X™ Control System



Real-time process control and monitoring of oil and gas production facilities.

CS7X Control System

Weatherford's CS7X control system is an Internet ready, modular and scalable system designed to provide real time process control and monitoring of oil and gas production facilities. An integral web server supports direct viewing of process data using off-the-shelf browsers such as Internet Explorer®. A flash file system supports FTP file transfer of system configuration and HTML files.



CS7X Single Solution

Weatherford's engineering team has taken the best functional characteristics from the most used industrial control systems in industry today and combined them into one versatile state-of-the-art control system.

CS7X Distributed Control System (DCS) Functions

- Distributed inputs/outputs (I/O)
- Capable of handling a large number of I/O
- Fast I/O scan rates
- Communication between the central processing unit (CPU) and I/O modules over a redundant network
- Scalable
- System configuration
 - Flat
 - Hierarchal
 - Flexible, easy to add future hardware and functionality
- Open system
- Redundant CPUs
- Built-in Internet capabilities
- Report by exception

Internet Explorer is a registered trademark of Microsoft Corporation.

CS7X Remote Terminal Unit (RTU) Functions

- Standard I/O monitoring and control
- Operates in environmentally harsh locations
- Data-logging
- Historical trending
- Variety of communication links: radio, hardwire, fiber optic, etc.
- User defined text-based programming
- Proportional-integral-derivative (PID) control logic
- Local control display
- Flow calculations

CS7X Programmable Logic Controller (PLC) Functions

- Ladder logic programming
- Fail-safe shutdown sequencing

The core of the CS7X system is an event driven database designed for autonomous local control. The CS7X system architecture is based on a 32-bit CPU, named **Phoebus™** control module (PCM), and a highly reliable, redundant serial bus using controller area network (CAN) technology. The system uses state-of-the-art web technology for human machine interface (HMI), local/remote control, maintenance and routing.

Supported applications include valve and motor control, AGA3/AGA8 gas flow calculations, continuous loop PID control and emergency shutdown capabilities. Redundant processors, hot-swappable components, global database architecture and multiple communication channels achieve high availability of the unit. I/O modules are available in either a 6U rack or DIN rail mount configuration. It can be implemented with one or two PCM(s) in a hot-standby configuration.

The CS7X system can be configured to provide redundancy at the PCM, power supply and I/O (control) level for applications that require high levels of system reliability. System architecture permits redundancy to be implemented for each segregated process node allowing critical processes to be redundant. Non-critical processes can use the unit in a non-redundant mode to optimize overall system costs.



CS7X Control System

CS7X System Features

- Low power requirements make the CS7X system suitable for solar power installation
- Event driven operation minimizes processor utilization time and improves response time to initiate an action
- Remote configurability
- CAN technology
- Highly scalable
- Hot back-up for processor and I/Os
- Built-in applications
- Open connectivity
- Multiple solution capability

Applications

The CS7X system is easy to configure and flexible enough to adapt to any application. Built-in ready-to-go applications that do not require extra programming are provided by the unit. Each of these applications are field-proven and based on actual installation needs.

- High frequency data-logger; the CS7X system collects and stores data and makes it available to SCADA or other polling systems
- **Automatic Control Logic™ (ACL)** software module; provides the ability to program the unit for those situations where applications require specifications different from the available firmware, supports up to 64 procedures that can perform various tasks and functions and complies with IEC 1131-3 standards
- LLIP; ladder logic
- PID; up to 12 control loops per controller
- Local control display; up to four per system can be configured to display process data with a variable scroll rate
- Accumulator; up to ten per system
- Data concentrator; the CS7X system can scan other devices in the area using industry standard Modbus® protocol and include the scanned data in its database
- Gas flow calculations; up to eight AGA calculations per PCM are included in the CS7X system

Category	Feature	Benefit
Architecture	Redundant PCM	for mission critical applications, the overall system provides greater reliability
	Multiple hierarchy	Unparalleled scalability
	Event driven model	Highly responsive system (less than 240 ms response time on changes in I/O)
I/O	CANON interface	High speed reliable transfer from I/O to the main processor
	24-bit A/I	Improved accuracy
	Expandable	Easy to add and configure I/O
Standard Applications	Programmed for industry standard applications	Built-in support; no need for additional hardware or software
Data Logging	Multiple devices	Large memory capacity for logging of multiple channels
Connectivity	Built-in web server	Easy to access using multiple devices
Solutions	Platform control system	Critical shutdown and platform power management
	Well pad manager	Single device data logger and information concentrator
	Pipeline block valve control	Remote low powered monitoring and control
	Well testing	Multiple run data flow calculations and accumulators

Modbus is a registered trademark of Modicon.

Controller Area Network

CAN technology was developed for mission critical applications. In the CS7X system, it provides highly secure and reliable communications between the PCM and the controller area network operations node (CANON) module I/O sub system. It offers high-speed communication rates up to 1-Mb per second. In addition, the error confinement and detection features make it more reliable in noise critical environments.

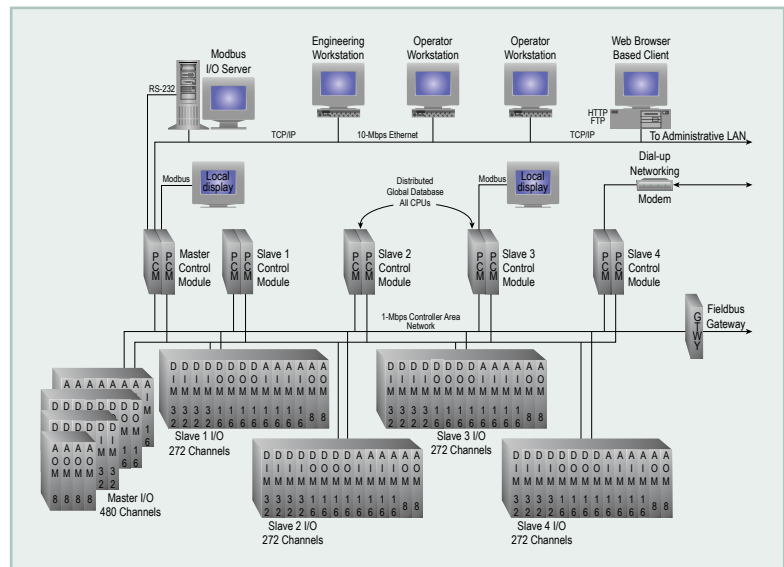
CAN is used for communications between PCM(s) and I/O boards within a local module. Adding additional I/O is simply a matter of plugging in another I/O module. The personality card of the added I/O module communicates with the PCM and becomes an active module with its own address and configuration.

In a hierarchical system, the CAN interface to each CANON module and sub-level PCM is global across the system allowing data sharing with fast response times. Each CANON module has a unique address and data structure allowing for hot replacement and auto configuration for field replaced or new modules. CANON modules can be packaged either for 19" rack mount on 6U cards or DIN rail mount.

Each CANON module consists of a termination board, a personality card and a brain board. The termination and brain boards are common to all I/O types. The personality card is I/O specific for each type of module (i.e. Ain, Aout, Din, Dout).

Standard features of CANON modules are:

- Redundant CAN ports on all modules
- Hot pluggable on CAN network
- Auto configuration of new or field replaced modules and synchronization into the system
- Time tagged data stamping to 2 mSec
- Time synchronization (system wide) to 1 mSec resolution for clock synchronization
- Event driven communications to PCM, continuous I/O polling is not required
- Change of status reporting to PCM, updates change of status within 1 mSec



CS7X Control System

Input/Output Module Specifications

		Digital Input		Digital Output		Analog Input		Analog Output	
		DIM1-6U	DIM1-D	DOM1-6U	DOM1-D	AIM1-6U	AIM1-D	AOM1-6U	AOM1-D
Field Input/Output									
Number of Inputs or Outputs	32 per node, 64 per module	✓							
	32 per module		✓						
	16 per node, 32 per module			✓		✓			
	16 per module				✓		✓		
	8 per node, 16 per module							✓	
	8 per module								✓
Input Type	32-curr., 32-Volt, 16-RTD, 28 thermocouple, & 1 cold junction temp.					✓			
	16-curr., 16-Volt, 8-RTD, 14 thermocouple, & 1 cold junction temp.						✓		
Output Type	Up to 2-Amps continuous, 1-mA leakage open circuit			✓	✓				
	0- to 25-mA, isolated and floating							✓	✓
	0- to 5-V, single-ended, ground referenced, 1-KOhm impedance							✓	✓
Input Contact Type	Mechanical contacts or open-collector transistor switch, dry contact type	✓	✓						
Output Contact Type	Form "A" solid-state switch dry contact			✓	✓				
Input Voltage Range	Current: 0- to 25-mA, Voltage: 0- to 5-V, RTD: 100-Ohm to 1-KOhm, 0.385-Ohms/°C 3-wire type, all thermocouple types supported, loop power is current limited					✓	✓		
Output Voltage Range	Open: 60-Vdc max. circ. working volt., closed: 1-V drop across output			✓	✓				
Wetting	Nominal 12- to 24-Vdc per system configuration	✓	✓						
Open Circuit Voltage	Open circuit indicates "OFF"/0	✓	✓						
Closed Circuit Current	3-mA controlled constant current, closed circuit indicates "ON"/1	✓	✓						
Protection	Complies with C37-90.1 (IEEE 472)	✓	✓	✓	✓	✓	✓	✓	✓
Common Mode Rejection	Nominal 100-dB					✓	✓		
	Isolation 3750 V ^{RMS} optical isolation	✓	✓	✓	✓			✓	✓
Field Load & Contact Operation Sensing	Open output switch: leakage curr. of 1-mA through optical coupler allows sensing load presence; Closed output switch: sense voltage shorted out and closed contact state is sensed			✓	✓				
Voltage Drop in Loop	5-Vdc							✓	✓
Current Output	4- to 20-mA nominal							✓	✓
Offset Zeroing	0 produces 4-mA ±1 count self-calibrated							✓	✓
Gain Error	4095 ±5 counts produces 24-mA with no adjustments							✓	✓
CPU									
Microcontroller	Siemens C505C 8-bit processor	✓	✓	✓	✓	✓	✓	✓	✓
Processor Speed	Crystal frequency 16-MHz	✓	✓	✓	✓	✓	✓	✓	✓
Watchdog Timer	Internal	✓	✓	✓	✓	✓	✓	✓	✓
Memory Resources	288-K Flash, 8-K SRAM	✓	✓	✓	✓	✓	✓	✓	✓
	128-Bytes EEPROM							✓	✓
Physical Form	6U rack mount	✓		✓		✓		✓	
	DIN rail mount		✓		✓		✓		✓
Points per Module	64 points on 2 nodes	✓							
	32 points on 2 nodes			✓		✓			
	32 points on 1 node		✓						
	16 points on 2 nodes							✓	
	16 points on 1 node				✓		✓		
	8 points on 1 node								✓
Terminations	Mass termination cable	✓		✓		✓		✓	
	Screw terminal		✓		✓		✓		✓
Power Consumption (per node)	10- to 32-Vdc nominal 0.54-Watts	✓	✓	✓	✓	✓	✓		
	10- to 32-Vdc nominal 1.2-Watts							✓	✓
Loop Power (per node)	160-mA max.								✓
	192-mA max.	✓	✓						
	320-mA max. (all channels at 20-mA)						✓	✓	
	640-mA max. (all channels at 20-mA)								
Dimensions	Euro 6U height slides into 10.5"x19" rack chassis, 1.5" W	✓		✓		✓		✓	
	6.5"L x 3.3"W x 2.8"H		✓		✓		✓		✓

CS7X Control System

		Digital Input		Digital Output		Analog Input		Analog Output	
		DIM1-6U	DIM1-D	DOM1-6U	DOM1-D	AIM1-6U	AIM1-D	AOM1-6U	AOM1-D
Environmental									
Oper./Storage Temperature	-40° to +85°C (-40° to +185°F)	✓	✓	✓	✓	✓	✓	✓	✓
Humidity	100% non-condensing	✓	✓	✓	✓	✓	✓	✓	✓
Conformal Coating	Standard	✓	✓	✓	✓	✓	✓	✓	✓
Communications									
Synchronization	PCM sends marker message once-per-second which synchronizes I/O modules to the same 1-ms mark	✓	✓	✓	✓	✓	✓	✓	✓
Dual CAN Communications	Two CAN network channels are accessible to the I/O module	✓	✓	✓	✓	✓	✓	✓	✓
User Configuration									
Accessibility	All user configurable parameters specified are accessible via CAN communications and are accessible from the host level	✓	✓	✓	✓	✓	✓	✓	✓
Per Point	Debounce	✓	✓						
	COS Report	✓	✓						
	Accumulator Count	✓	✓						
	Accumulator Report	✓	✓						
Signal Processing									
Sampling Rate	Digital or analog inputs are sampled each 1-ms	✓	✓			✓	✓		
Resolution	24-bit 12-bit					✓	✓	✓	✓
Input Filtering	60-Hz notch @ 7.5 samples/second					✓	✓		
Input Contact Debounce	Configurable on per point basis, can set up to 250-ms	✓							
Input Contact Extraneous Transitions	Debounce characteristic is user configurable per point, defines number of contiguous samples that must agree before new state of input accepted		✓						
Debounce Conf. Status Signals	Up to 250-ms can be set for very unstable sources		✓						
Debounce Upper Freq. Cut-Off cycle	When conf. with zero debounce max. rate-per-point is 250-Hz, 50% duty cycle	✓	✓						
Change of State (COS) Reporting	User configurable for reporting change immediately for: OFF to ON; ON to OFF; BOTH; NEITHER	✓	✓						
Accumulator-16-bit, 24-bit with Pre-scale	Each point user configurable for counting input changes: Max. rate of 250-Hz OFF to ON; ON to OFF; BOTH; NEITHER	✓	✓						
Accumulator Report	Each accumulator has conf. pre-scale & modulus values		✓						
Accumulator Pre-scale	A configurable pre-scale value allows for dividing the raw counts by 1 to 256 before they appear in the accumulator		✓						
Latched Output	Maintains the last commanded status while power is applied When power is interrupted & returned, module ladder logic can be conf. for returning to last or a pre-defined default state			✓	✓				
Retentive Output	Output state is retained/reset as configured in module fail sequence logic when power is lost			✓	✓				
Pulse Output	If not conf. for hardware SBE, each point is conf. for activation between 10- to 655,350-ms			✓	✓				
Duty Cycle Output (PWM)	Each point is conf. for activation in repeating cycles & duration from 10- to 10,000-ms			✓	✓				
Output Update Rate	All outputs are updated every 10-ms							✓	✓
Report Processing									
Report by Exception	Data reported when input exceeds per point conf. dead band					✓	✓		
Report on High High, High Low, & Low Low thresholds	Exception reports are generated when crossing any of these four thresholds					✓	✓		
Periodic Report	Data reported on min. interval conf. by user regardless of data change	✓	✓			✓	✓		
Rate Reporting									
Rate Report	With the accumulator report, time between pulses & number of pulses-per-second are each reported		✓						
Alarm Report Accumulator Rate Maximum	Maximum frequency or minimum period		✓						
Alarm Report Accumulator Rate Minimum	Minimum frequency or maximum period		✓						
Module Failsafe Logic									
Control Sequence on Communications Failure	DOM loss of comm. less than 14-sec. then alarm & pre-programmed shutdown			✓	✓				

CS7X Control System



Scalability / Distributed I/O

The personality card of the added I/O module communicates with the PCM and becomes an active module with its own address and configuration. The I/O can be expanded to over 2000 in a single installation.

In a hierarchical system composed of a master unit and one or more slave units, CAN is utilized to link the slave units back to the master permitting functional isolation so that slave modules can be dedicated to critical applications. This assures that the control intelligence is distributed in the slave unit or application modules where the operation and control decisions need to be made.

Connectivity

When a CS7X system is used in an installation, it can be the focal point for all data coming from a well pad, facility or field. With its pass-through capabilities, all controllers can feed data to the system and it then becomes the remote source for all the data coming from the well pad, facility or field.

The CS7X system has several connectivity options and is fully web enabled. All common protocols are supported including transmission control protocol/Internet protocol (TCP/IP), file transfer protocol (FTP) and point-to-point protocol (PPP). Several communication ports are provided for connecting external devices.

The CS7X system supports a wide range of protocols and connections such as:

- 10BaseT Ethernet
- Modbus and Modbus/TCP host protocols
- RS232 and RS485 serial communications
- TCP/IP networking via serial port PPP protocol
- CS7X system includes an embedded web server which permits connection by most popular browsers
- Dual controller area network
- Multiple hosts

Configurability

The CS7X system can be configured to act as a Modbus master or slave simultaneously including Modbus over TCP/IP.

- One each 10 Mbps Ethernet port
- Two each configurable RS232/RS485 and two each RS232 serial ports

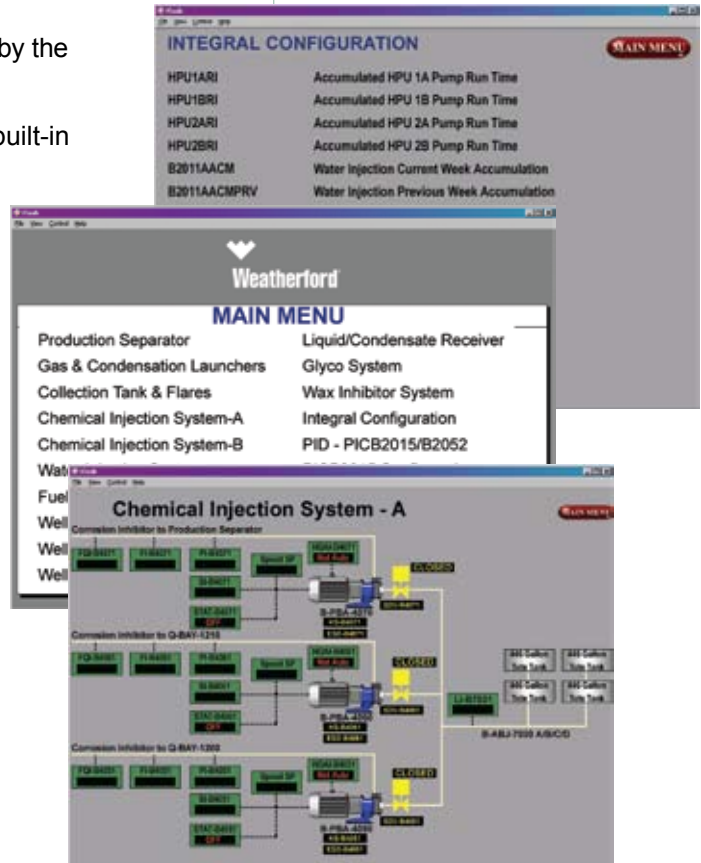
In addition to configuring the external devices for data retrieval and manipulation by the CS7X system, communication to the external devices can be configured as a data concentrator. This allows the system to be used as a data router for multiple devices, eliminating the need for additional communication paths from a host to each device.

Graphic user interface (GUI) pages, in Flash® format, permit dynamic data to be accessed and changed.

- Graphic displays illustrating the control process can be built using standard Windows® software
- Dynamic data incorporated in the graphic display can be easily linked to the controller database
- Graphic displays can be viewed using a standard Internet browser

Customized Flash pages can be developed to meet specifications by Weatherford's engineering staff or by the customer using the Flash program.

The combination of Flash and the CS7X system's built-in web server provides remote configurability.



Flash is a registered trademark of Adobe.
Windows is a registered trademark of Microsoft Corporation.

CS7X Control System



Specifications

Phoebus PCM

Physical Specifications	
Size	6U x 220 mm (9.1 x 8.6 in.)
Mounting type	Compact rack or flat mount with cover
Coating	Conformal type
Ambient Specifications	
Operating temperature (°F/°C)	-40 to 85 (-40 to 29.4)
Storage temperature (°F/°C)	-40 to 85 (-40 to 29.4)
Humidity	100% non-condensing (with coating)
Phoebus PCM Card	
Power required	10 to 32 VDC, 1.25 Watts, 1.6 Watts typical with Ethernet
Processor type	32-bit Motorola Coldfire
Processor speed	40 MHz
Data rate (PCM to PCM)	1 Mbps maximum
Communications	
Serial ports	One RS232 full modem (web serve, PPP) (RJ45 [port 3]) One RS232C (RJ45 [port 4] slave) Two RS485 or RS232C (RJ45 [port 1 host, port 2 slave])
Design Standards	
Surge protection	Withstand ANSI/IEEE C37.90A-1979/IEEE 472-1974 EExn IEC 1131
Hazardous Area Certifications*	
Certification	Non-incendive Class I, Division 2 Non-sparking Class I, Zone 2
Factory Mutual	NI Class I, Division 2, Groups A, B, C, & D T4 Ta=+85°C
SIRA	SIRA01ATEX4209X

*Factory Mutual and SIRA have certified the CS7X system to operate in Class I, Division 2 hazardous area locations

The CS7X system is designed to operate in harsh environmental conditions where low power requirements are imperative. This allows the control system to be used in virtually any remote location or plant environment. Due to its low power requirements and scalability, remote locations using solar power are ideal applications for the system.

CS7X Control System

Summary

The versatile CS7X control system is designed to handle any control requirements. The monitoring and control needs of new industrial facilities can be implemented cost effectively and efficiently using its state-of-the-art capabilities. It can be configured to replace existing RTUs and PLCs, providing the end user with a more reliable, easier to control system.

Typical dual PCM and 6U rack mounted CANON modules, dual PCM, and DIN rail mounted CANON module





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