

Series 8 Controller and I/O Specification



S803-150-520

Release 520

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3. C300 Controller

3.1. Overview

The Experion Series 8 C300 controller forms the heart of the Experion control system and deterministically executes control strategies, batch operations, interfaces to local and remote I/O and directly hosts custom programmable applications. The compact controller design does not require any additional Interface / communication modules and all control execution and communications are contained in the controller module.

The C300 controller runs the field proven, deterministic Control Execution Environment (CEE) which is the core C300 software that provides powerful and robust control for the distributed control system (DCS). The control strategies are configured and loaded to the C300 controller through the Control Builder, an easy and intuitive engineering tool.

The C300 Controller is constructed using the Series 8 form factor that employs an Input Output Termination Assembly (IOTA) and an electronics module which mounts and connects to the IOTA. One C300 Controller module and its IOTA contains all of the control and communication functionalities. The C300 IOTA contains only passive devices such as FTE address switches, FTE cable connectors and I/O Link cable connectors. Figure 1 below depicts the IOTA components.

The C300 Controller may operate in both non-redundant and redundant configurations. Redundant operation requires a second identical controller with its own IOTA and connecting redundancy cable. The C300 Controller supports Series 8 I/O modules. Two IO Link interfaces, which are redundant, provide connection between the C300 controller and associated I/O modules. The IO Link interface connectors are on the C300 IOTA.

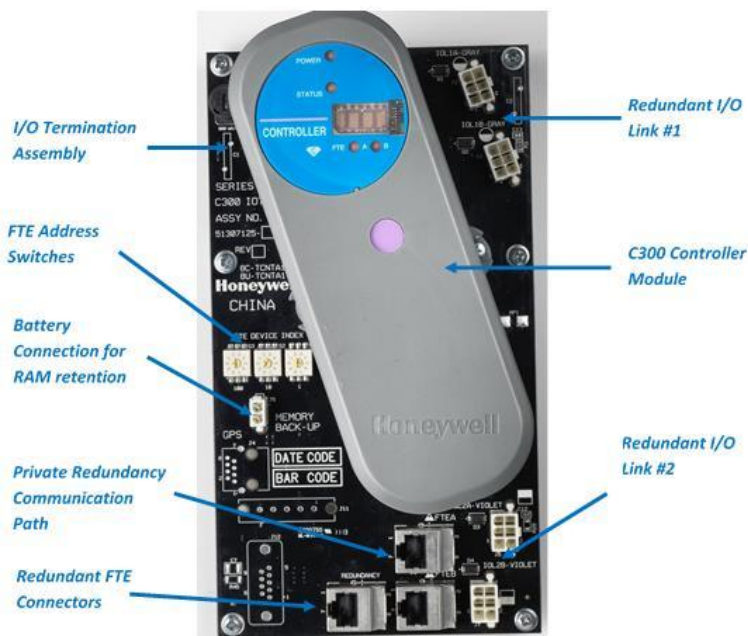


Figure 1 - C300 Controller

3.2. Model Numbers

The Model Numbers of C300 controller are shown as below:

Model Number	Description
8C-PCNT03	Series 8 C300 Controller, Coated ^{1,3,4}
8C-TCNTA1	Series 8 C300 Controller I/O Termination Assembly(IOTA), Coated ¹
51305980-836	Cable, Redundant C300 Controller ²
Note 1 – Conformal coating applied on the module and the IOTA Note 2 – Redundancy is implemented with two modules/IOTAs and a redundancy cable (51305980-836) Note 3 – Optional rechargeable battery pack for C300 Memory Backup is available, details are provided in section 5.4 Note 4 – 8C-PCNT02 part number is replaced by 8C-PCNT03. The new controller (8C-PCNT03) is compatible with all current and previous PC/LX releases.	

3.3. C300 Controller Specifications

3.3.1. C300 Control Execution Environment (CEE)

The C300 CEE provides an execution and scheduling environment in which Control Modules (CMs) and Sequential Control Modules (SCMs) execute user-configured control strategies. The CEE also support peer to peer communications with other C300 controllers and communication modules like Foundation Fieldbus and Profibus. The C300 CEE is configured using the Control Builder Engineering environment. The Control builder provides a graphical engineering environment where engineers can configure the Experion system and create control strategies by using the various function blocks available in the Library. The C300 CEE based control strategies can be configured with minimum execution rates of 50 msec.

3.3.2. C300 Hardware Specifications

Specifications	Limit
Power requirement	24 V (provided through cables by the Series 8 power system)
IOTA Dimension	220 mm (9 ") height, 120 mm (4,75 ") width
Program Memory	16MB
Processor	PowerPC 8270, 400 MHz, 32-bit
Features	
Module Removal and Insertion Under Power	Supported
Conformal Coated	Yes, G3 level of Harsh Environment (ANSI/ISAS71.04-1985 corrosion standard)
Redundancy	IOTA based design, no single point of failure for IOM, Termination, and Communication links (Downlink and Uplink)
RAM Retention	50 hour through rechargeable battery backup pack (Optional)

Programing Language	Function Block Design (FBD) via Experion Control Builder
Supported I/Os and Uplink Communication	
Supported I/O type	Series 8
Supported I/O Links	2 I/O Links, each I/O Link configurable for Series 8 I/Os
Supported I/O Link Speed	750 kbps
Supported number of I/O Modules per Controller	80 I/O Units (Redundant or Non-Redundant IOMs)
Supported number of I/O Modules per I/O Link	40 I/O Units (Redundant or Non-Redundant IOMs)
Maximum number of I/Os per Controller	2560 ¹
Number of Uplink (FTE) Connection	Dual uplink FTE ports, 100Mbps speed
Control Capacity	
Execution Units	5500 Execution Units (single or redundant)
Tagged Objects	4095 objects
Memory Units	16000 Memory Units
Execution Period	50 msec – 2000 msec (adjustable per control strategy, configurable)
Controller Communication	
CEE-based Platforms	Native peer to peer with other Series 8 C300s, C200 and ControlEdge UOC controllers ²
Supervisory Control Network	Fault Tolerant Ethernet (FTE)
Third party devices	Modbus Master
Modbus TCP devices	PCDI function block
Modbus RTU or ASCII	Via Modbus TCP/IP conversion gateway
Ethernet/IP	Native peer to peer
Foundation Fieldbus	Via Fieldbus Interface Module (FIM) gateway
Profibus DP	Via Profibus Gateway Module (PGM)
Optional C300 Memory Backup	
51454475-100	Series 8 C300 RAM Charger Module
51202330-300	Cable, Battery RAM charger, 30 in
51202330-200	Cable, Battery RAM charger, 84 in

Note 1 – When using full capacity with 32 channel digital IO module

Note 2 – C200 and ControlEdge UOC support available from Experion LX/PlantCruise R510 and onwards.

3.3.3. C300 Supported Function Blocks

Function Block	Function Block	Function Block	Function Block
General Purpose (Utility)	General	Ramp / Soak	Round
Alarm Window	Linearization	Ratio Bias	Square Root
Annpnel	Lead / Lag	Ratio Control	Subtract
Dig Acq	Rate of Change	Remote Cascade Support	Truncate
EXECTIMER	Signal Selector	Switch (8 input single pole)	Discrete Logic
First Out	Totalizer	Device Control	2oo3 (2 out of 3 voting)
Flag	PV Handling	Device Control (multi input, multi output, multi state)	AND
Flag Array	Data Acquisition	Custom Block Types	CHECKBAD
Operator Message	Regulatory Control	Custom Data Block	CHECKBOOL
Numeric	Auto Manual	Custom Algorithm Block	CHGEXEC
Numeric Array	Regulatory Calculator	Math	CONTACTMON
Push	Enhanced Regulatory Calculator	Absolute Value	DELAY
Text Array	Fan Out (1 input / up to 8 outputs)	Addition	EQ (Compare Equal)
Timer	Override Selector (4 inputs)	Divide	FTRIG (Falling Edge Trigger)
Type Convert	PID (Proportional, Integral, Derivative)	Exponent	GE (Compare Greater than or Equal)
PV Algorithms (Auxiliary)	PID with External Reset	LN	GT (Compare Greater Than)
PV Calculator	PID with Feed Forward	LOG	LE (Compare Less than or Equal)
Summer	Profit Loop	Modulo	LIMIT
Counter	Positional Proportional	Multiply	LT
Dead Time	Pulse Count	Negate	MAX
Enhanced PV Calculator	Pulse Length	Power	MAXPULSE
Enhanced General Linearization		Rolling Average	MIN
Flow Compensation			MINPULSE

Function Block
MUX
MUXREAL
MVOTE
NAND
NE
nOON
NOR
NOT
OFFDELAY
ONDELAY
OR
PULSE
QOR
ROL

Function Block
ROR
RS
RTRIG
SEL
SELREAL
SHL
SHR
SR
STARTSIGNAL
TRIG
WATCHDOG
XOR
Power Related
GRPCAPRBK

Function Block
HTMOTOR
LEVELCOMP
LTMOTOR
MAINIBV
SOLENOID
VALVEDAMPER
Sequential Control Functions
Step
Transition
Synchronize
Handler
Phase

Function Block
Container Block Types
Control Module
Sequential Control Module
Recipe Control Module
Unit Control Module
IO Related
Series 8 I/O
PCDI
Profibus Interface
VCONE

4. Series 8 I/O Hardware

4.1. Overview and Features

Series 8 features an innovative design that supports enhanced heat management. This unique look provides a significant reduction in overall size for the equivalent function.

Both Series 8 IOM and IOTA are available with Conformal Coated feature. The term 'Coated' stands for hardware with conformal coating material applied to electronic circuitry for protection against moisture, dust, chemicals, and temperature extremes. Coated IOM and IOTA are recommended when electronics must withstand harsh environments and need to have added protection.

The unique features of the Series 8 I/O include:

- I/O Module and field terminations are combined in the same area. The I/O Module is plugged into the IOTA to eliminate the need for a separate chassis to hold the electronics assemblies
- Two level "detachable" terminals for landing the field wiring in the enclosure, providing easier plant installation and maintenance
- Field power can be supplied through the IOTA, with no need for extra power supplies and the associated craft wired marshalling
- Redundancy is available directly on the IOTA without any external cabling or redundancy control devices, by simply adding a second IOM to an IOTA
- The innovative styling is one of its unique features. This styling includes features to facilitate the effective use of control hardware in a systems environment. These features include:
 - Vertical mounting for more effective wiring since most field wiring applications require entry from the top or bottom of the systems cabinet
 - An "information circle" for a quick visual cue to draw the Maintenance Technician's eye to important status information
 - "Tilted" design for effective heat management within the cabinet enclosure. Since Series C allows for a significant increase in cabinet density, an effective heat management system is critical for high systems availability
 - Input and output circuits are protected from shorts to alleviate the need for in-line fusing, reducing installation and maintenance costs

Series 8 IOTAs combine multiple functions into a single piece of equipment:

- Single and redundant configurations
- On-board termination of process signals
- On-board signal conditioning
- On-board connection to appropriate networks (FTE, I/O LINK)
- Field power distribution without external marshalling
- IOM plugs into the IOTA and receives power from the IOTA
- The IOTA receives its power through cables from header board



4.2. I/O Module Functions

- **High Level Analog Input /HART Input Module (16pt)** – The High Level Analog Input Module supports both high level analog and HART inputs. Analog inputs are typically 4-20mA DC for both traditional and HART devices. HART data can be used for status and configuration. HART data, such as the secondary and tertiary variables, can also be used as process control variables. Two versions Single ended and Differential type are available.
- **High Level Analog Input w/o HART (16pt)** – The High Level Analog Input Module supports high level analog inputs Analog inputs are typically 4-20mA DC for traditional devices.
- **Analog Output/HART Output Module (16pt)** – The Analog Output Module supports both standard 4-20mA DC outputs and HART transmitter outputs.
- **Analog Output w/o HART (16pt)** – The Analog Output Module supports standard 4-20mA DC outputs.
- **Digital Input 24 VDC (32pt)** – Digital input sensing for 24V signals
- **Digital Input Sequence of Events (32pt)** – Accepts 24VDC discrete signals as discrete inputs. The inputs can be time tagged to support 1ms resolution Sequence of Events.
- **Digital Input Pulse Accumulation (32pt)** – Accepts 24VDC discrete signals as discrete inputs. The first 16 channels can be configured as Pulse accumulation to support Pulse Accumulation and frequency measurement on per channel basis. Channels 17 – 32 can be configured as DI.
- **Digital Output 24 VDC (32pt)** – Current sinking digital outputs. Outputs are electronically short-circuit protected.
- **DO Relay Extension Board (32pt)** – Digital output with NO or NC dry contacts. It can be used for low power or high power applications.
- **Low Level Analog Input – RTD & TC (16pt)** – Provides thermocouple (TC) and resistance temperature device (RTD) inputs.

4.3. Series 8 I/O Sizing

In virtually all configurations, the C300 controller and Series 8 I/O provides useful, maintainable process equipment connections in a smaller footprint than existing competitors and Honeywell equivalent products. Installing Series 8 I/O modules contributes to overall total installed cost savings.

IOTA sizes vary based on the application. In general, an analog module has 16 points and resides on a 6 inch (152mm) IOTA for non-redundant applications and a 12 inch (304mm) IOTA for redundant applications. A discrete module has 32 points and resides on a 9-inch (228mm) IOTA for non-redundant applications and a 12 inch (304mm) IOTA for redundant applications. Specific information on the size of a particular module is described in the Model Number Table.

4.3.1. Series 8 Field connections

Series 8 Field connections use a standard modular connector. The connector modularity allows for removal and insertion of the field wiring. This significantly reduces installation and maintenance procedures and can assist in field check out. Series 8 field connectors accept up to 12 AWG / 2.5 mm² stranded wire.

4.3.2. I/O Module Sizes

IOTA Sizing is nominal (6in = 152mm, 9in = 228mm, 12in = 304mm). I/O modules are associated with their respective IOTAs in the table below. The I/O Module is supported by one or more IOTAs. Below section also provides an overview of various available IO modules, IOTA, IOTA size and redundancy features.

I/O Module (Coated)	IOTA (Coated)	Description	Circuits	Size (in “)	Red.
8C-PAIH54		High-level AI HART, Differential	16		✓
	8C-TAIDA1	AI IOTA		9	
	8C-TAIDB1	AI IOTA Redundant		12	✓
8C-PAIHA1		High-level AI HART, Single-ended	16		✓
8C-PAINA1		High-level AI w/o HART, Single-ended	16		✓
	8C-TAIXA1	AI IOTA		6	
	8C-TAIXB1	AI IOTA Redundant		12	✓
8C-PAIMA1		Low-level AI – RTD & TC	16		
	8C-TAIMA1	Low-level AI IOTA		9	
8C-PAOHA1		Analog Output HART	16		✓
8C-PAONA1		Analog Output w/o HART	16		✓
	8C-TAOXA1	AO IOTA		6	
	8C-TAOXB1	AO IOTA Redundant		12	✓
8C-PDILA1		Digital Input 24V	32		✓
8C-PDISA1		Digital Input Sequence of Events	32		✓
8C-PDIPA1		Digital Input 24V Pulse Accumulation	32		✓
	8C-TDILA1	DI 24V IOTA		9	
	8C-TDILB1	DI 24V IOTA Redundant		12	✓
8C-PDODA1		DO 24V Bussed Out	32		✓
	8C-TDODA1	DO 24V Bussed IOTA		9	
	8C-TDODB1	DO 24V Bussed IOTA Redundant		12	✓
	8C-SDOX01	DO Relay Extension ¹		15	✓

Note 1- DO Relay Extension board is used along with DO IO module with IOTA (Redundant or non-redundant). Refer Section [4.4.11](#) for more details.

4.4. Specifications for Series 8 I/O

Specifications for Series 8 I/O modules are shown below.

4.4.1. Analog Input with HART - Differential

Function

Analog Input Module accepts high level current or voltage inputs from transmitters and sensing devices.

Notable Features

- Extensive self-diagnostics
- Optional redundancy
- Supports either Single Ended / Differential Inputs
- HART-capable, multivariable instruments and multiple modems for fast collection of control variables
- Fast loop scan

Detailed Specification- Analog Input with HART - (8C-PAIH54)

Parameter	Specification		
Input / Output Module	8C-PAIH54 - Analog Input with HART (16), Coated		
IOTA Modules	8C-TAIDA1	Non Redundant, Coated	9"
	8C-TAIDB1	Redundant, Coated	12"
Input Type	Voltage, Current (2-wire or self-powered transmitters), Single ended or Differential inputs		
Input Channels ¹	16 Channels (All 16 Single Ended or Differential type)		
A/D Converter Resolution	16 bits		
Input Range ¹	0 to 5 V, 1 to 5 V, 0.4 to 2 V, 4-20 mA (through 250 Ω)		
Voltage Rating	24 VDC		
Module Current Rating	310 mA		
Common Mode Rejection Ratio, dc to 60 Hz (500 Ω source imbalance)	70 dB		
Common Mode Voltage, dc to 60 Hz	-6 to +5 V peak		
Normal Mode Rejection Ratio, at 60 Hz	19 dB		
Normal Mode Filter Response	Single-pole RC, -3 dB @ 6.5 Hz		
Crosstalk, dc to 60 Hz (channel-to-channel)	-60 dB		
Input Impedance (voltage inputs)	> 10 M Ω powered		
Maximum Normal Mode Input (any input referenced to common, no damage)	\pm 30 Volts		

Input Scan Rate	50 ms
Hardware Accuracy (@ CMV = 0 V)	$\pm 0.075\%$ of full-scale ($23.5^{\circ}\pm 2^{\circ}\text{C}$) $\pm 0.15\%$ of full-scale (0 to 60°C)
Module Removal and Insertion Under Power	Supported
Transmitter Field Power Conditioning	Individually Protected Current Limiting Circuits, No fuse required
Note 1 – 8C-PAIH54 supports voltage inputs for channels 1-16 when used with 8C-TAIDx1 IOTA. Each channel's 250-Ohm load resistor is connected to the input terminal through a wire jumper on the IOTA. This jumper should be cut by the user on channels to be used with voltage transmitters.	

4.4.5. Analog Output with HART

Function

The Analog Output (AO) Module delivers high-level constant current to actuators and recording/indicating devices.

Notable Features

- Extensive self-diagnostics
- Optional redundancy
- HART-capable, multivariable devices
- Safe-state (FAILOPT) behaviors configurable on a per channel basis

Safe-state Behavior (FAILOPT)

Series 8 AO module supports the FAILOPT parameter on a per channel basis. The user can configure each channel to either HOLD LAST VALUE, or SHED to a SAFE VALUE. The Output will always go to zero, the safe state, if the IOM device electronics fails.

Open-wire Detection

This Series 8 IO function can detect and annunciate open field wire with a Channel Soft Failure indication.

Detailed Specification- Analog Output with HART (8C-PAOHA1)

Parameter	Specification		
Input / Output Module	8C-PAOHA1 - Analog Output with HART, Coated		
IOTA Modules	8C-TAOXA1	Non-Redundant, Coated	6"
	8C-TAOXB1	Redundant, Coated	12"
Output Type	4-20 mA		
Output Channels	16		
Output Ripple	< 100 mV peak-to-peak at power line freq, across 250 Ω load		
Output Temperature Drift	0.005% of Full Scale/ $^{\circ}$ C		
Output Current Linearity	\pm 0.05% of Full Scale nominal		
Load Resistance (24 V supply = 22 VDC through 28 VDC)	50-800 Ω		
Voltage Rating	24 VDC		
Module current rating	205 mA		
Resolution	\pm 0.05% of Full Scale		
Calibrated Accuracy	\pm 0.2% of Full Scale (25 $^{\circ}$ C) including linearity		
Directly Settable Output Current Range	2.9 mA to 21.1 mA		
Maximum Output Compliant Voltage (24 V supply = 22 VDC through 28 VDC)	16 V		

Maximum Open Circuit Voltage	22 V
Response Time(DAC input code to output)	Settles to within 1% of final value within 80 ms
Gap (0 mA) of Output to Field on Switchover	10 ms maximum (applies to Redundancy only)
Module Removal and Insertion Under Power	Supported

4.4.6. Analog Output

Function

The Analog Output (AO) Module delivers high-level constant current to actuators and recording/indicating devices.

Notable Features

- Extensive self-diagnostics
- Optional redundancy
- Safe-state (FAILOPT) behaviors configurable on a per channel basis

Safe-state Behavior (FAILOPT)

Series 8 AO module supports the FAILOPT parameter on a per channel basis. The user can configure each channel to either HOLD LAST VALUE, or SHED to a SAFE VALUE. The Output will always go to zero, the safe state, if the IOM device electronics fails.

Open-wire Detection

This Series 8 IO function can detect and annunciate open field wire with a Channel Soft Failure indication.

Detailed Specification- Analog Output (8C-PAONA1)

Parameter	Specification		
Input / Output Module	8C-PAONA1 - Analog Output, Coated		
IOTA Modules	8C-TAOXA1	Non-Redundant, Coated	6"
	8C-TAOXB1	Redundant, Coated	12"
Output Type	4-20 mA		
Output Channels	16		
Output Ripple	<100 mV peak-to-peak at power line frequency, across 250 Ω load		
Output Temperature Drift	0.005% of Full Scale/ $^{\circ}$ C		
Output Current Linearity	\pm 0.05% of Full Scale nominal		
Load Resistance (24 V supply = 22 VDC through 28 VDC)	50-800 Ω		
Voltage Rating	24 VDC		
Module current rating	190 mA		
Resolution	\pm 0.05% of Full Scale		
Calibrated Accuracy	\pm 0.2% of Full Scale (25 $^{\circ}$ C) including linearity		
Directly Settable Output Current Range	2.9 mA to 21.1 mA		
Maximum Output Compliant Voltage (24 V supply = 22 VDC through 28 VDC)	16 V		

4.5. Series 8 IO Function Matrix

The following tables assist in selecting I/O Modules and IOTAs with similar functional characteristics:

AI Function Matrix

IOM	NR IOTA	Red IOTA	Function	
			AI 4-20 mA	HART
8C-PAIHA1	8C-TAIXA1	8C-TAIXB1	◆	◆
8C-PAINA1	8C-TAIXA1	8C-TAIXB1	◆	
8C-PAIH54	8C-TAIDA1	8C-TAIDB1	◆	◆

TC/RTD Function Matrix

IOM	NR IOTA	Red IOTA	Function	
			TC	RTD
8C-PAIMA1	8C-TAIMA1	NA	◆	◆

AO Function Matrix

IOM	NR IOTA	Red IOTA	Function	
			AIO 4-20 mA	HART
8C-PAOHA1	8C-TAOXA1	8C-TAOXB1	◆	◆
8C-PAONA1	8C-TAOXA1	8C-TAOXB1	◆	

DI Function Matrix

IOM	NR IOTA	Red IOTA	Function		
			DI	SOE	PA
8C-PDILA1	8C-TDILA1	8C-TDILB1	◆		
8C-PDISA1	8C-TDILA1	8C-TDILB1		◆	
8C-PDIPA1	8C-TDILA1	8C-TDILB1			◆

DO Function Matrix

IOM	NR IOTA	Red IOTA	Relay Extension	Source
8C-PDODA1	8C-TDODA1	8C-TDODB1	8C-SDOX01	◆