

Distributed Control System

38-009



Level & Flow Rig



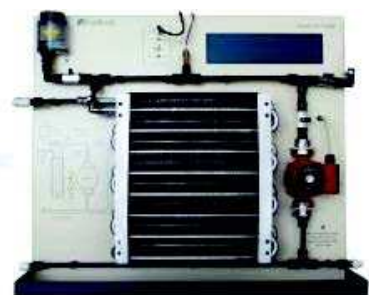
Temperature Rig



Distributed Control System (DCS)



Pressure Rig



Forced Air Cooler

Description

The Feedback Distributed Control System (DCS) trainer is a complete training solution that combines the operations of a leading commercial DCS process management package, namely Emerson's DeltaV, with an assortment of our proprietary training rigs. The training rigs offer a range of processes:

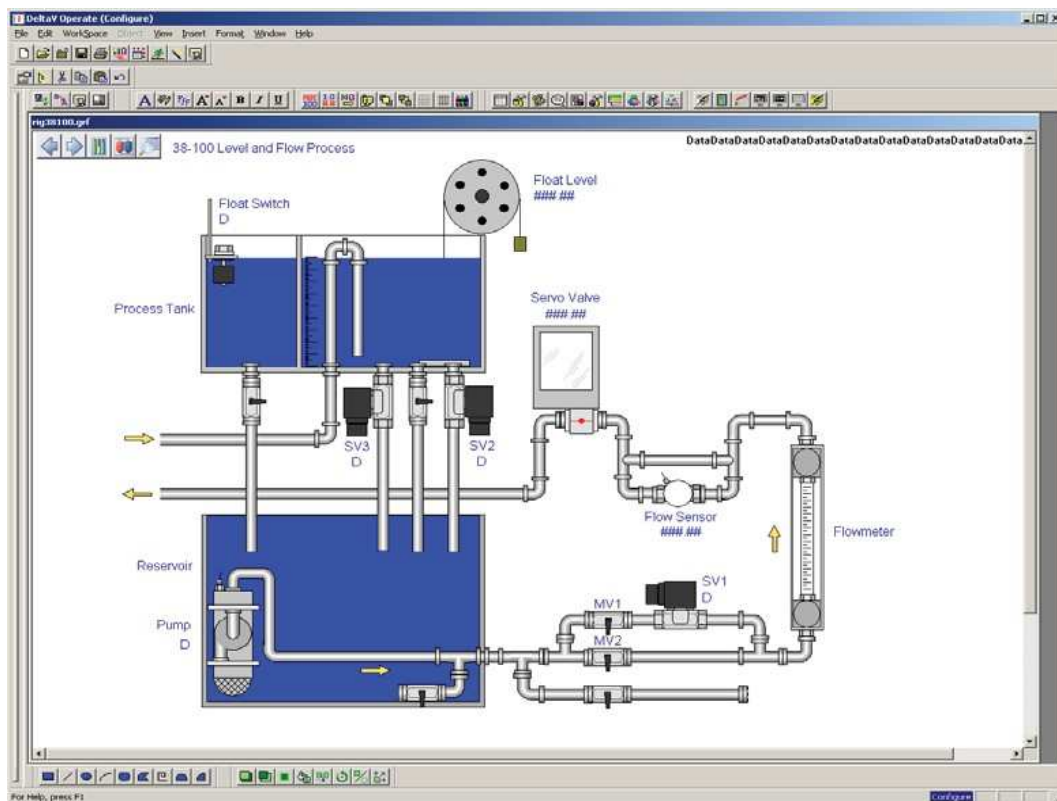
- **Level and Flow**
- **Temperature**
- **Pressure**
- **Forced Air Cooling**

These may be operated separately or combined to produce a multi-process, multi-loop system. The trainer is supplied complete with the PC, software, controller and I/O modules that are needed to monitor and control the process rigs. A control cabinet houses the components that provide the interface between the PC and the rigs. The control cabinet is easily connected to the PC and rigs using the supplied cables.

The valves, transducers and transmitters associated with the training equipment are standard industrial components that operate using simple 4–20 mA current loop control, and 24 V d.c. The trainer can be used to perform a set of operations that will guide the student from the basics of field components in the process industry to the final control algorithms that are used in various applications.

The Feedback DCS learning environment provides:

- Background theory
- An introduction to DeltaV
- General instructions on how to operate the system
- Objectives for each assignment
- Practicals (hands-on experience) within each assignment
- Suggestions for conducting experiments
- A graphical user interface



Distributed Control System (DCS) Trainer 38-006

The system has the following general features:

- A Windows-based Workstation that provides a Graphical User Interface to the processes and System configuration functions.
- The DCS is controlled by an Emerson DeltaV Industrial Control system.
- The system includes a PC with speakers to provide graphical and audible alarms.
- Allows both continuous and sequential control of the processes.
- Uses Industry-standard 4-20 mA signals, and 24 V d.c. outputs.
- 16 Analogue and 8 Discrete (Digital) inputs
- 8 Analogue and 8 Discrete (Digital) outputs.

- Uses a simple interconnect system to ease installation and system configuration.
- The system displays graphical representations of the test rigs to mimic the processes and to simulate an industrial environment.
- The system has two modes: "Design" and "Run". It is possible to switch easily between these two modes. The Controller and interface system are housed in an industrial 19" rack.
- The software provides an integrated SCADA Environment with I/O tags held in a database.
- The system is a DCS learning environment which provides a range of experiments. These have both theory and practical elements.

The Emerson Delta V Controller contains the following:

- 1 x Controller
- 1 x System Power Supply (a.c./d.c.)
- 2-Wide Power/Controller Carrier
- 8-Wide I/O Interface Carrier with Carrier Shield Bar
- 2 x Analog Input Cards: 8 Channels
- 1 x Analog Output Card: 8 Channels
- 1 x Discrete Input Card: 8 Channels
- 1 x Discrete Output Card: 8 Channels
- Termination Blocks for each I/O card

Emerson DeltaV Controller Specification

The system should be configured as follows:

Control Network:	2 nodes (max 120)
Controllers:	1 (max 100)
Simplex/Redundancy Mode:	Simplex
Computers:	1 x DeltaV Professional PLUS workstation licensed for 25 DSTs (max 30,000).
DSTs:	21 allocated (max 750 per controller)
SCADA tags:	max 25,000

For the Professional PLUS workstation with appropriate licenses installed:

Open applications:	max 30 (not all can be database connections)
Records per event chronicle:	max 500,000
Open DeltaV Explorer applications:	max 1
Open Control Studio applications:	max 4
History values:	max 250
Open faceplates per module type:	max 4
Open detail displays:	max 1
Open pictures:	max 30 (for proper operation, do not exceed 25)
Workstation Object Identifiers:	max 16,000
Plant areas:	max 100
Modules per unit:	max 255
Named sets:	max 1000 (includes system enumeration sets. The number available to users is less.)
Alarm types:	max 255
DeltaV user accounts per system:	max 200
Parameters per security level:	150
Open engineering tasks:	max 60



System Power Supply

Input:	100 V a.c. to 264 V a.c., 47 Hz to 63 Hz, single-phase
Inrush (soft start):	230 V a.c. input at 35 A peak maximum for one cycle or less
Output power:	25 W total at 60° C
Output voltages:	(25 W maximum) +12 V d.c. at 2.1 A maximum, +5 V d.c. at 2.0 A maximum, +3.3 V d.c. at 0.5 A maximum, combined 5 V d.c. and 3.3 V d.c. output = 10 W maximum
Input protection:	Internally fused, non-replaceable fuses
Overvoltage protection:	Output protected at 110 % to 120 %
Hold-up time:	Output remains within 5 % of nominal at full load and 115 V a.c. input for 20 ms.
Mounting:	On either slot of 2-wide power/controller carrier, Primary power Input ac input, 3-wire Alarm contacts 2-wire normally open relays, relays are closed when outputs are within $\pm 4\%$ of nominal; 30 V dc at 2.0 A, 250 V a.c. at 2.0 A.

I/O Specifications

All supplied I/O modules are equipped with I/O Terminal Block connections. These are pre-wired as standard to the Feedback interface unit which provides easy connection to the Feedback process rigs. Connection to other systems can be made via the I/O terminal blocks if required. Spare channels are available on all I/O cards.

Discrete Output Card: 8 Channels 24 V d.c., Isolated (1 card provided)

Number of channels:	Eight
Isolation:	Each channel is optically isolated from the system and from each other and factory tested to 1500 V d.c..
Output range:	2 V d.c. to 60 V d.c.
Output rating:	1.0 A (inrush 4.0 A for <100 ms; 6.0 A for <20 ms)
Off-state leakage:	1.2 mA maximum
Local Bus current (12 V d.c. nominal):	100 mA typical; 150 mA max.
Field circuit power:	None
<i>Configurable channel types:</i>	
Discrete Output:	Output stays in last state submitted by the controller.
Momentary Output:	Output is active for a pre-configured time period (100 ms to 100 s).
Continuous Pulse Output:	Output is active as a percentage of a pre-configured base time period (100 ms to 100 s). Resolution = 5 ms.
Mounting:	Assigned slot of I/O carrier

Discrete Input Card: 8 Channels 24 V d.c., Dry Contact, Series 2 (1 card provided)

Number of channels:	Eight
Isolation:	Each channel is optically isolated from the system and factory tested to 1500 V d.c.
Detection level for On:	> 2.2 mA
Detection level for Off:	< 1 mA
Impedance:	5 k ohm
Local Bus current (12 V d.c. nominal):	90 mA typical; 150 mA max.
Field circuit power:	40 mA at 24 V d.c. ($\pm 10\%$)
Mounting:	Assigned slot of I/O carrier

Analog Output Card: 8 Channels 4–20 mA HART, Series 2 (1 card provided)

Number of channels:	Eight
Isolation:	Each channel is optically isolated from the system and factory tested to 1500 V d.c..
Nominal signal range (span):	4 to 20 mA
Full signal range:	1 mA to 23 mA
Local Bus current (12 V d.c. nominal):	120 mA typical, 150 mA max.
Field circuit power:	300 mA maximum at 24 V d.c. ($\pm 10\%$)
Accuracy over temperature range:	0.25 % of span (0–60°C)
Resolution:	12 bits for AO, 8-channel, 4–20 mA
Output compliance:	20 mA at 21.6 V d.c. supply into 700 W load
Calibration:	Information stored on card
Mounting:	Assigned slot of I/O carrier

Analog Input Card: 8 Channels 4–20 mA HART, Series 2 (2 cards provided)

Number of channels:	Eight
Isolation:	Each channel is optically isolated from the system and factory tested to 1500 V d.c..
Nominal signal range (span):	4 to 20 mA
Full signal range:	1 to 22.5 mA, with over range checking
Valid range for LED indication:	0.75 to 23 mA
Local Bus current (12 V d.c. nominal):	120 mA typical, 150 mA maximum
Field circuit power:	300 mA maximum at 24 V d.c. ($\pm 10\%$)
Field circuit per channel:	32 mA maximum
Accuracy over temperature range:	0.1 % of span
Resolution:	16 bits
Repeatability:	0.05 % of span
Roll off frequency:	-3 dB at 2.7 Hz, -20.5dB at one-half the sampling frequency
Calibration:	None required
Mounting:	Assigned slot of I/O carrier

The I/O hardware should be housed in a free standing mini-rack cabinet. Cabling to the plant is provided with pre-terminated plugs for easy connection. The workstation (PC) should be attached to the controller by an Ethernet cross-over connection (cable provided).

To complement the student manual, a comprehensive online book should be included containing theory and background to industrial system design and techniques.



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