Section 22. Servo Driver Module

22-1. Description

Steam turbines are used in many electrical power generation plants. The electrical load on a steam turbine's electric generator fluctuates as the electric power consumption increases or decreases. The Digital Electro-Hydraulic (DEH) control system provides turbine control to adjust steam turbine shaft rotational speed in response to varying electric generator loads. Very large amounts of force are required to move valves on large turbines. Therefore, an interposing device is required between the DEH control system and the controlled valves.

The Ovation Servo Driver module provides an interface between an Ovation Controller and an electro-hydraulic servo valve actuator. Each controlled turbine valve is connected to an electro-hydraulic actuator (servo-motor). A servo-motor is a fluid operated piston. Admission of high pressure hydraulic fluid to the piston cylinder is regulated by a smaller pilot valve. The pilot valve passes hydraulic fluid underneath the piston to raise it and the controlled valve, or it diverts hydraulic fluid to the upper side of the piston to lower it and the controlled valve.

A valve position set point is maintained by the Ovation Servo Driver Electronics module. The set point is normally altered by the Ovation Controller via the I/O bus. Inside the Electronics module, a microcontroller provides closed loop proportional-plus-integral (PI) control for real time valve position control.

Note

The firmware level for the Servo Driver module must be Version 0B or later.

The valve position set point causes the Servo Driver module to generate an output control signal that drives the electro-hydraulic servo valve actuator coil. The feedback loop is closed with the valve's position measurement being obtained from a DC-LVDT or an AC-LVT that is mounted on the valve stem.

The electronics module will interface two Electro-Hydraulic (EH) actuators in the field. The module provides two independent channels that are electrically isolated from each other.

The Servo Driver Module is NOT applicable for CE Mark Certified Systems.

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22-2. Operation

The Servo Driver module operates as a two-channel closed-loop servo card, or as a single-channel closed loop servo card that accommodates dual LVDTs. A configuration flag is set/reset to select the option.

The dual-channel option uses a single sine-wave or DC feedback to detect valve position for each channel. The feedback signal's amplitude is proportional to valve position. A programmable gain amplifier is used to increase the resolution of the feedback signal and is adjusted for optimum performance during a calibration sequence.

When a sine-wave input is used as the feedback, it is assumed that the feedback signal provided is proportional to valve position, and linear. The sine-wave input is rectified and the result is uni-polar. The input can accommodate a signal of increasing or decreasing amplitude as the valve is stroked from 0 to 100%. Depending on the customer mechanical hookup, a failed signal would then appear to the card as a valve flying open, or a valve flying closed, and the resulting control action would be to close the valve, or to open the valve.

The single channel option executes only one PI loop in the microcontroller firmware. Prior to executing the PI loop, the feedback positions from each channel are high selected.

Another option is the "failInPlaceFlag" option. If the option is set and the Controller stops updating the module, the target position remains at the most recent position. If the "failInPlaceFlag" option is not set, the target position is set to -5%.

Another important option is the proportional output option. If this option is selected, the output voltage is set equal to demand position. The result is that 0 to 100% demand gives 0 to 10.2 volts on the output.

The proportional output, failInPlaceFlag, and redundant LVDT options are single flags that affect both channels.

22-2.1. AD/DA Conversion and Timing

The Servo Driver operates on a basic 5 millisecond period. During the 5 millisecond period, four interrupts occur. During each of the first three interrupts, AD readings of position feedback are recorded for each channel. After the third AD reading is taken, the three values are middle-selected and the PI algorithm is called.

The fourth interrupt in the 5 millisecond period handles watchdog timing, contingency timing, and sequencing of diagnostics.

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22-3. Module Groups

22-3.1. Electronics Modules

There are three Electronics module groups for the Servo Driver module:

- 1C31199G01 provides 16 Volts DC to a DC LVDT.
- 1C31199G02 provides 19 Volts AC peak-to-peak 1 KHz to an LVT.
- 1C31199G03 provides 19 Volts AC peak-to-peak 3 KHz to an LVT.

22-3.2. Personality Modules

There are two Personality module groups for the Servo Driver module:

- 1C31201G01 has an RJ-45 modular jack to provide access to a local RS-232 serial port. Both field interface channels contain three resistors connected in series that are used to provide a single coil drive output.
- 1C31201G02 has an RJ-45 modular jack to provide access to a local RS-232 serial port. Both field interface channels contains two coil drive outputs, each output with its own series resistor.

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Table 22-1. Servo Driver Subsystem [1]

Range	Channels	Electronic Module	Personality Module
±16 Volts DC to a DC LVDT 60 mA into a 60 ohm coil (CD1) or 40 mA into an 80 ohm coil (CD2) or 40 mA into a 40 ohm (CD3) coil	6	1C31199G01	1C31201G01
19 Volts AC peak-to-peak 1 KHz to an AC LVT 8 mA into two 1000 ohm coils	6	1C31199G02	1C31201G02
19 Volts AC peak-to-peak 3 KHz to an AC LVT 8 mA into two 1000 ohm coils	6	1C31199G03	1C31201G02

When using the Point Builder to define points for a Servo Driver module, only the following point types are valid for each channel:

I/O Channel	Name	Type	Input Source or Output Destination	Terminal Block Connection [2]
1	Position Feedback (Device 1)	Input	Servo Driver	Not applicable
2	Position Feedback (Device 2)	Input	Servo Driver	Not applicable
3	Raw Demodulator Voltage (Device 1)	Input	Servo Driver	Not applicable
4	Raw Demodulator Voltage (Device 2)	Input	Servo Driver	Not applicable
5	Demand (Device 1)	Output	Controller	Not applicable
6	Demand (Device 2)	Output	Controller	Not applicable

[1] This module will interface to, and provide position control for, **TWO** Electro-Hydraulic (EH) actuators in the field.

[2] The terminal block connection depends upon the application being used. Refer to wiring diagrams.

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22-4. Specifications

Electronics Module (1C31199)
Personality Module (1C31201)

Table 22-2. Servo Driver Module Specifications

Description	Value
Servo driver field interface channels	Two
DC LVDT position feedback input range (1C31199G01)	Low Range Input 0 to 7.4 V DC (maximum range) 0 to 1.5 V DC (minimum range) High Range Input 0 to 15 V DC (maximum range) 0 to 5.0 V DC (minimum range)
AC LVT position feedback input range (1C31199G02, 1C31199G03)	Low Range Input 0.2 to 20 V AC peak-to-peak (maximum range) 0.2 to 5.0 V AC peak-to-peak (minimum range)
DC LVDT position feedback input impedance (1C31199G01)	Low Range Input 40 kΩ differential input with floating source 20 kΩ one input line referenced to common High Range Input 80 kΩ differential input with floating source 40 kΩ one input line referenced to common
AC LVT position feedback input impedance (1C31199G02, 1C31199G03)	Low Range Input 20 kΩ differential input with floating source 10 kΩ one input line referenced to common
DC LVDT supply output voltages (1C31199G01)	+16 V dc ± 5%, 30 mA max. load current (-)16 V dc ± 5%, 30 mA max. load current Supply output voltage matching: ±1.5% over temperature range
AC LVT excitation output voltage (1C31199G02, 1C31199G03)	19 V AC peak-to-peak ± 11% @ 1.0 kHz ± 10% (1C31199G02) 19 V AC peak-to-peak ± 11% @ 3.0 kHz ± 10% (1C31199G03) 500 Ω minimum load impedance
Peak servo valve coil output voltage (1C31199G01 DC LVDT)	CD1 100Ω output, 60 Ω coil, ±3.85 V or CD2 162Ω output, 80 Ω coil, ±3.4 V or CD3 210Ω output, 40 Ω coil, ±1.65 V
Peak servo valve coil output voltages (1C31199G02, 1C31199G03 AC LVT)	CDA output, 1000Ω coil, ± 8.55 V and CDB output, 1000Ω coil, ± 8.55 V
Servo valve coil output voltage accuracy (1C31199G01-G03)	0.4% of full scale output

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Table 22-2. Servo Driver Module Specifications (Cont'd)

Description	Value
Servo driver field interface dielectric isolation	±1000 V dc (for both channels) Both channels' field interface circuits have 50 V and 150 V short term isolation from the logic common/Ovation I/O bus. Each channel's field interface circuit has 50 V and 150 V short term isolation from the other channel's field interface circuit.
Serial port	RS-232, non-isolated
Serial port baud rate	9600
Module power	6.7 W typ. (1C31199G01 DC LVDT) 9.8 W max. (1C31199G01 DC LVDT) 5.3 W typ. (1C31199G02-G03 AC LVT) 6.3 W max. (1C31199G02-G03 AC LVT)
Logic board processor	80C196KB (16-bit microcontroller)
Operating temperature range	0 to 60˚C (32˚F to 140˚F)
Storage temperature range	-40˚C to 85˚C (-40˚F to 185˚F)
Humidity (non-condensing)	0 to 95%

22-5. Servo Driver Modes

The Servo Driver operates in various modes:

- Start mode
- Normal mode
- Local-Manual mode
- Calibrate mode

22-5.1. Start Mode

In start mode, the following occurs:

- Feedback position is determined.
- Diagnostics are executed.
- The module will typically transition into normal mode immediately.

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