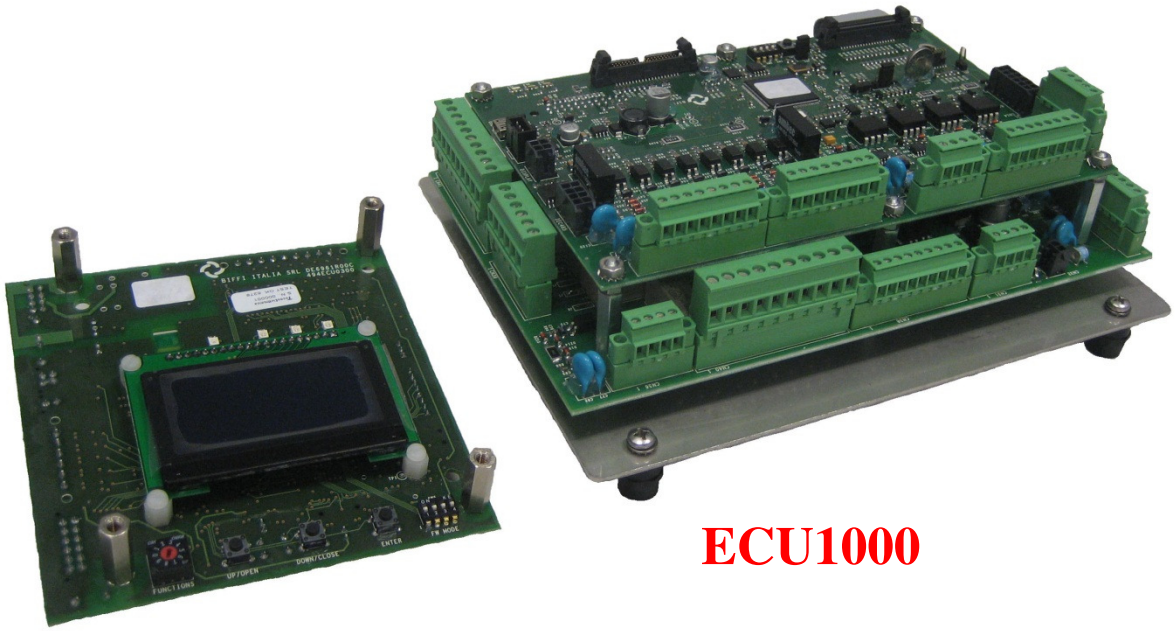
Smart Actuation

ECU 1000
Electronic Control Unit
for
Electro-Hydraulic Actuator



ECU1000

DTDE 300

INDICE

REV.	DATE	PREPARED	APPROVED	NOTES
0	**13/07/2011**	**M. Giuliani**	**A.Affaticati**	**Issue**
1	**04/09/2012**	**M. Giuliani**	**A.Affaticati**	**Rev.1**
2	**05/10/2012**	**M. Giuliani**	**A.Affaticati**	**Rev.2**
3	**11/10/2012**	**M. Giuliani**	**A.Affaticati**	**Rev.3**
4	**05/10/2012**	**M. Giuliani**	**A.Affaticati**	**Rev.4**
5	**11/02/2013**	**M. Giuliani**	**A.Affaticati**	**Rev.5**
6	**24/05/2013**	**M. Giuliani**	**A.Affaticati**	**Rev.6**
7	**01/09/2013**	**M. Giuliani**	**A.Affaticati**	**Rev.7**
8	**09/06/2014**	**M. Giuliani**	**A. Affaticati**	**Rev.8**

1 Smart actuation concept

Smart ***Electro-Hydraulic Actuator*** is the system obtained by the combination of Hydraulic Actuator (**HA**), Hydraulic Control Unit (**HCU**), Hydraulic Power Unit (**HPU**) and Electronic Control Unit (**ECU**). The main characteristics of complete system are:

- quick operation and stored energy typical of hydraulic actuator
- multiplicity of controlling and monitoring typical of electrical actuator
- optimal customized adjustment of characteristics due to Electronics
- reliable safe features due to spring and accumulator

HA + HCU

Hydraulic **A**ctuator
+
Hydraulic **C**ontrol **U**nit

+

ECU1000

Electronic **C**ontrol **U**nit

+

HPU

Hydraulic **P**ower **U**nit

=

Smart

Electro-

Hydraulic

Actuator

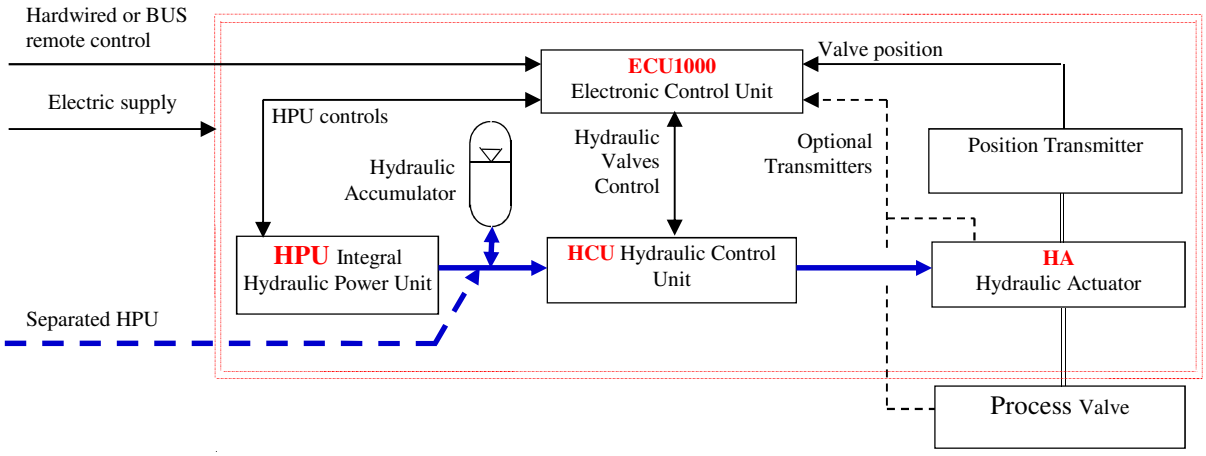
HA and **HCU:** **H**ydraulic **A**ctuator and **H**ydraulic **C**ontrol **U**nit
The Hydraulic Actuator **HA** transforms the hydraulic power in mechanical power, it can be quarter turn or linear, single and double acting, on-off and modulating service. The Hydraulic Control Unit **HCU** drives the hydraulic power by means of proportional valves, servovalves, on-off Solenoid Operated Valves (SOV's) to move the HA. Maximum torque 500 000 NM (higher upon request)

HPU: **H**ydraulic **P**ower **U**nit
It transforms the electrical power in hydraulic power to supply the actuator. It includes hydraulic tank, accumulator, pump, electric motors, oil filter, switches, and pressure / temperature / level sensors. It may include the HCU if it is not on board of the actuator.

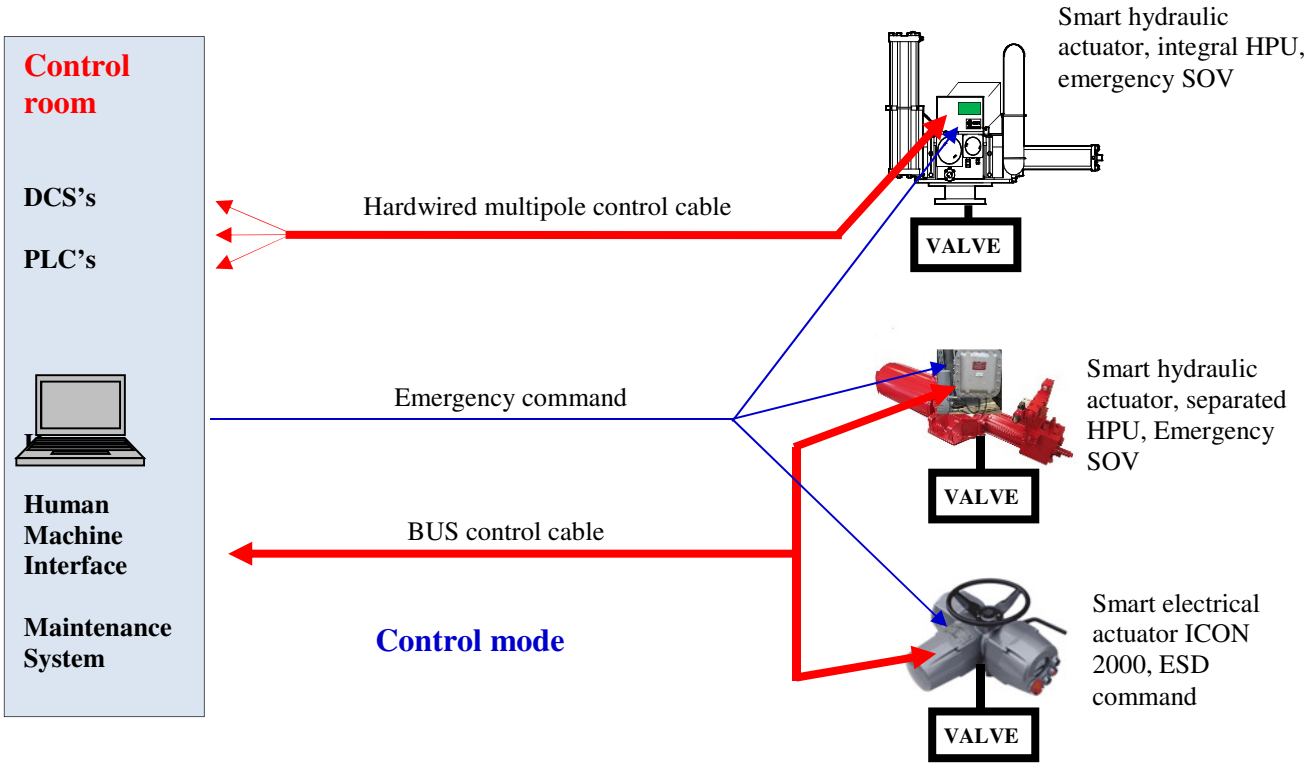
ECU 1000: **E**lectronic **C**ontrol **U**nit
It is the brain of the actuator, it controls all functional parameters and sends the commands to perform the requested functions (Positioning, Partial Stroke Test, HPU control, etc.). The main functions are:

- to acquire the feedbacks from HA, HCU, HPU sensors
- to acquire the setpoints from control room
- to process the acquired data and send operational commands to HA, HCU, integral HPU
- to monitor the complete system
- to send to control room signals relevant to status and alarms of complete system
- to log events and alarms

Block diagram of **S**mart **E**lectro-**H**ydraulic **A**ctuator

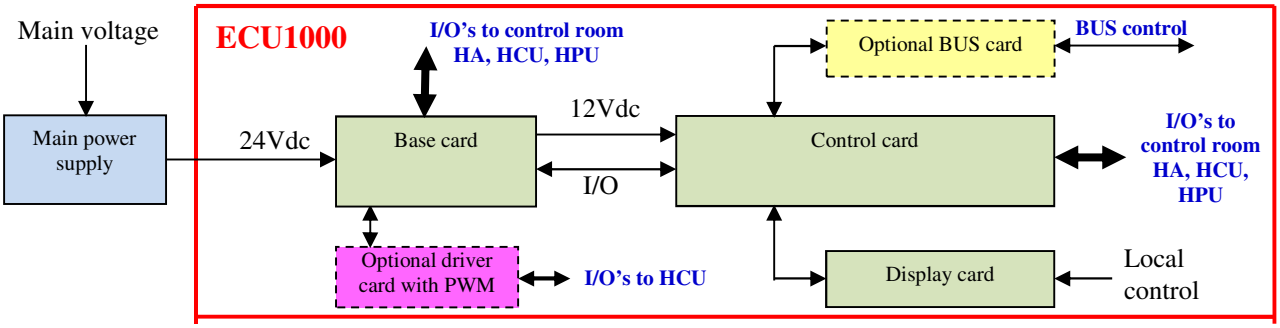


The figure below shows the control mode of smart hydraulic actuator with ECU1000



2 Features of ECU1000

2.1 Block diagram



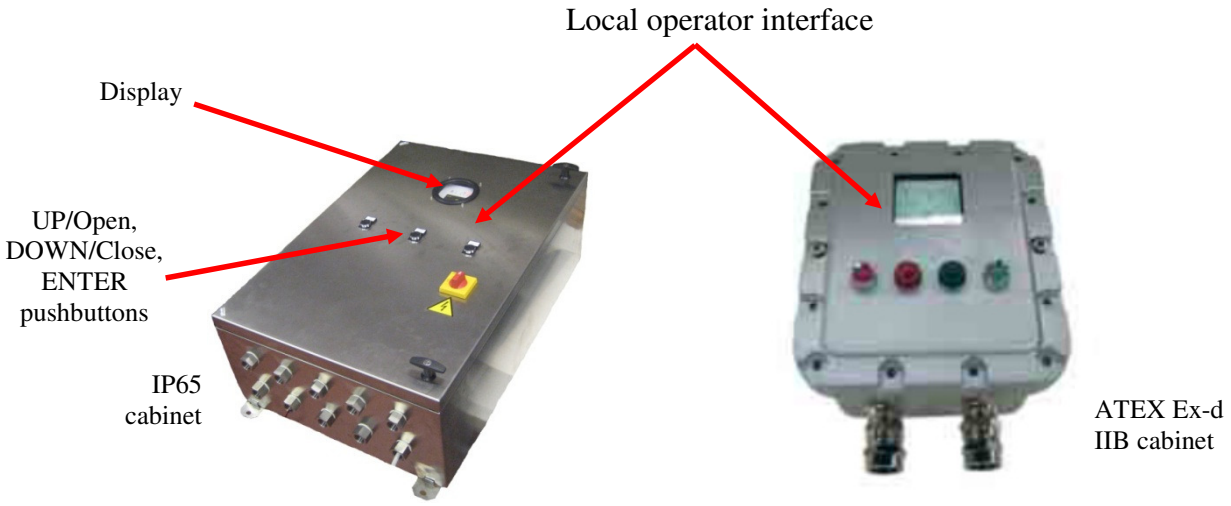
The ECU1000 is supplied at 24VDC. A power supply module should be provided in the cabinet to generate the requested 24 VDC. The optional driver card is requested to drive proportional valves by PWM signals.

2.2 General

- Control of any BIFFI hydraulic actuator (OLGA-H, OLGAS-H, HLA, HLA-S, single acting spring return or double acting, modulating and on-off service)
- Standard functions:
  1. *Positioning of modulating actuator (heavy duty, low drain-heavy duty, stepping)*
  2. *Control of integral HPU with single or dual pump. Automatic switch of electrical pumps*
  3. *Control of on-off actuator*
  4. *Partial Stroke Test*
  5. *Input characterization*
  6. *Failsafe function*
  7. *ESD function*
  8. *Stay in position by optional SOV*
  9. *Outputs to control Servovalves, Proportional Valves, on-off **S**olenoid **O**perated **V**alves (SOV's), contactors of Electrical Motor of hydraulic pumps*
  10. *Inputs to read 4-20mA transmitters and switches*
  11. *Optional module to drive proportional valves by PWM signals*
- Functions on demand :
  - *Process PID, Interlock controls, Process valve watching*
- Hardwired and BUS remote control
- Local control
- Local Operator Interface with graphic OLED display and pushbuttons, visible from -40°C
- User friendly navigation in the menu. English language menu.
- Diagnostic function
- Full local parameterization.
- Access to parameter protected by four levels of password
- Configuration data saved in 3 separated permanent memories
- 2 Watch-dog timer working in parallel
- Real Time Clock and battery to maintain date and time
- CRC function to validate communication messages and memory content
- Bluetooth wireless communication
- Temperature, humidity and acceleration sensors of electronic cards
- Electronic NAME PLATE of electronic cards
- Failure, Alarm, Event, Connection loggers, graph and recorder
- BIFFI-Assistant, SW tool for PC for connection to actuator via Bluetooth or RS232
- Operating temperature from -40 °C to +75 °C
- Electronics suitable to "On-field" operation inside an IPxx or Ex-d cabinet

- Environment:
  - EMI test according to European directive 2004/108/EC
  - Low voltage test according to European directive 2006/95/EC
  - Vibration test according to IEC 60068-2-6 and 60068-2-57
  - Temperature test according to IEC 60068-2-1, 60068-2-2 and 60068-2-78

The following figures show examples of cabinets containing the ECU1000.



ECU1000 cabinets

The cabinet contains

- ECU1000 electronic cards
- Power supply module
- Line filter, fuse, surge arrester, breaker
- Terminals for connection with control room, HA, HPU, HCU
- Optional Heater

2.3 Bus interface

Upon request the ECU1000 is provided with Modbus RTU bus.

2.4 Inputs and Outputs

- **Analogue inputs**

5 x 4-20mA analogue inputs, insulating amplifiers and surge arresters

- **Analogue output**

1 x 4-20mA analogue output, insulating amplifier and surge arresters

- **Servovalve / proportional valve control**

1 x analogue output configurable by jumpers, insulating amplifier and surge arresters, dither
  - +-10V, +-10mA, +-15mA, +-50mA, +-100mA

1 x digital output, optocoupled, surge arrester
  - enable control to servovalve / proportional valve or general output

1 x digital input, optocoupled, surge arrester
  - fault status of servovalve / proportional valve or general input

- **Digital inputs**

10 x digital inputs, optocoupled, max voltage 30Vdc, surge arresters

- **Digital output**

1 x digital outputs, optocoupled, surge arresters

- **Output relays**

4 x single side stable, SPDT contact, voltage free, max 30Vdc/230Vac/1A
5 x single side stable, SPST NO contact, voltage free, max 30Vdc/230Vac/1A,
2 x single side stable, SPST NO contact, voltage free, max 30Vdc/230Vac/1A (on demand latching relay)

- **Extension connector**

It allows increasing the number of I/O's and connection to optional driver card
  - optional card with 2 PWM channel e 2 analog inputs to drive 2 BIFFI Proportional Solenoid Operated Valves "PSOV's" or generic proportional valve with PWM control input

Each input and output is configurable and can be associated either to signals to/from control room or HA, HCU, HPU.

2.5 Status signalling

According to NAMUR NE107 the ECU1000 provides the following outputs:

- FAILURE
- ALARM (OUT OF SPEC)
- REMOTE NOT AVAILABLE (FUNCTION CHECK)
- MAINTENANCE REQUIRED

The above statuses are available to the control room by means of output relays and locally by the ECU1000 Local Operator Interface. By the configuration options the conditions associated to output relays can be changed.

8 outputs are provided on the local operator interface to drive 8 optional LED's for local signalling. The status associated to the additional LED's is configurable.

2.6 Local Operator Interface

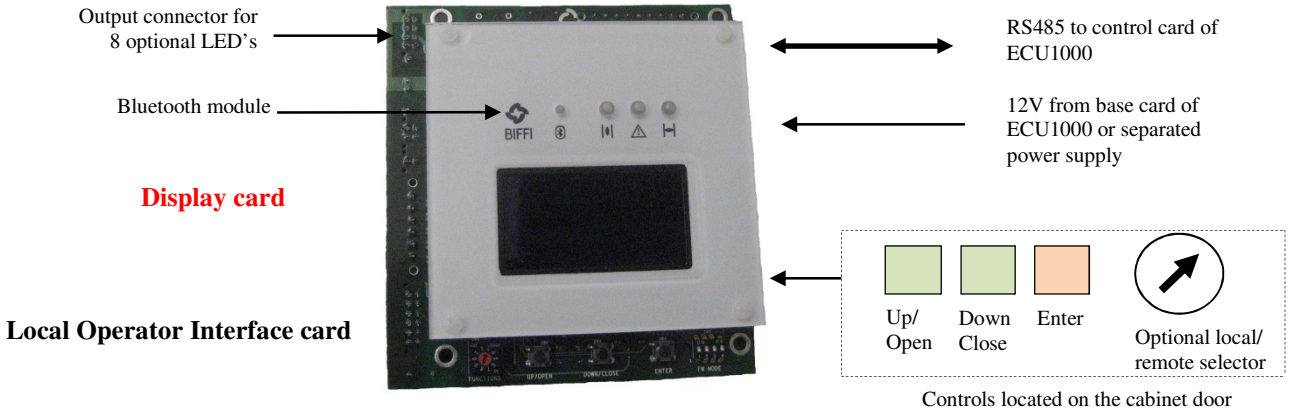
The actuator is provided with a powerful local operator interface for local control, configuration and diagnostic operation. It consists in 1 display, 3 pushbuttons, 3 bi-colour LED's, 1 blue LED, 1 Bluetooth module

Display: graphic, OLED, 128x64 dot. The display is visible through the window of the door of cabinet containing the Electronics. It is visible also at very low temperature (-40°C)

Local control: 3 pushbuttons UP/Open, DOWN/Close, ENTER. They allow to

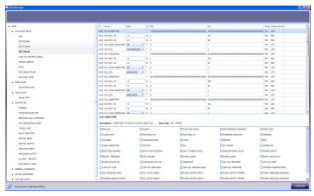
- *navigate in menu*
- *view internal variables and status*
- *view and change parameters*
- *view alarm and failure lists*
- *change control mode from REMOTE to LOCAL and CONFIGURATION*
- *move the actuator in open or close direction*

PASSWORD is requested to modify the working parameters (CONFIGURATION) and to select REMOTE/LOCAL control mode. In REMOTE, the actuator is controlled by DCS, PLC, etc. located in control room, while in LOCAL it is controlled by the local pushbuttons UP/Open and DOWN/Close. In CONFIGURATION mode, it stays in position and it is available for viewing and changing the internal parameters.



The ECU1000 can work without local operator interface. In the above case the configuration operation can only be done by the BIFFI-Assistant SW tool and PC.

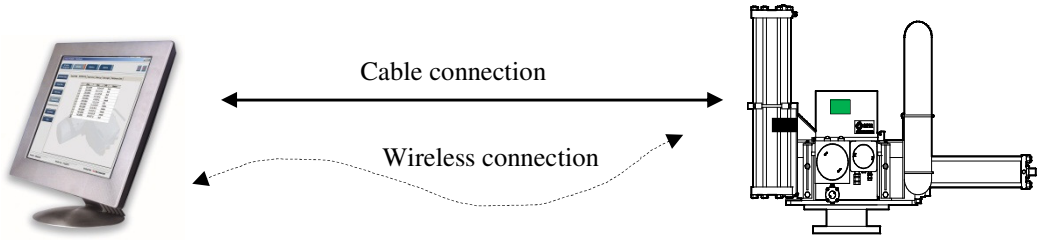
2.7 BIFFI-Assistant



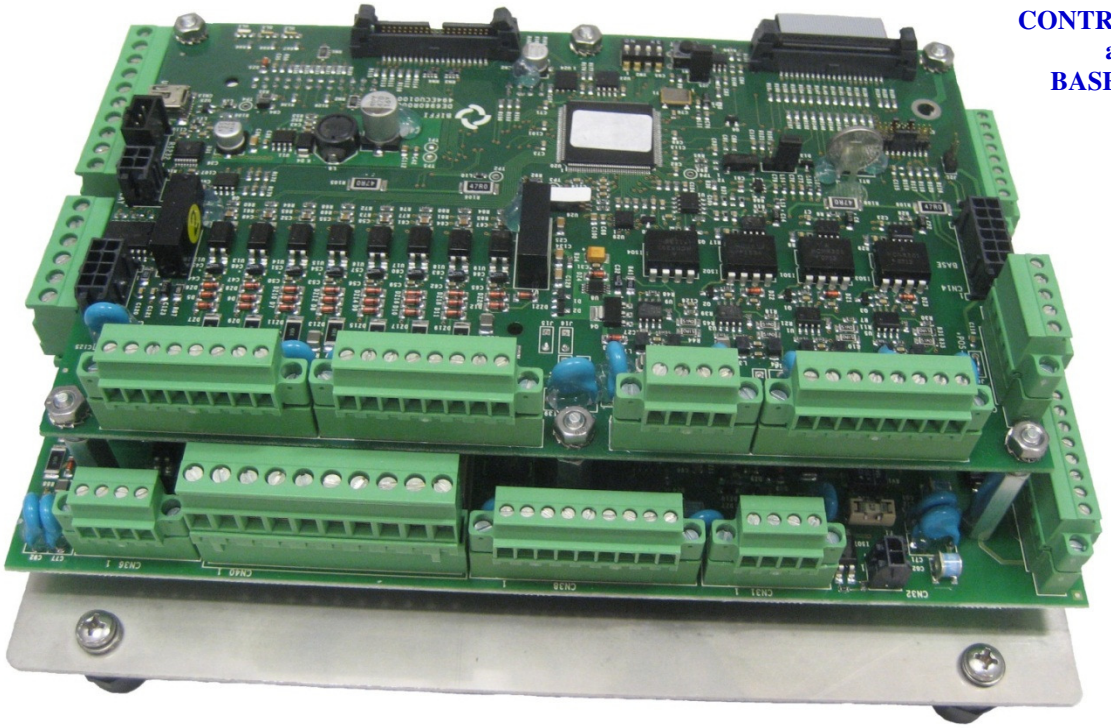
BIFFI-Assistant is a software tool for PC to allow

- *configuration*
- *diagnostic*
- *local control*
- *saving and copying configuration data*
- *viewing loggers, graphs, and data collected by the ECU1000*

By the PC the data collected by the ECU1000 can be viewed, compared and modified
Connection to actuator is done by wireless Bluetooth interface or via RS 232.

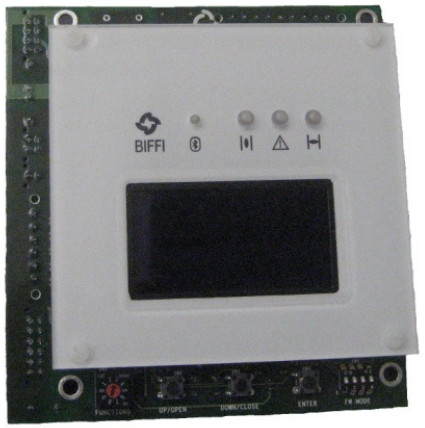


2.8 ECU 1000 electronic cards

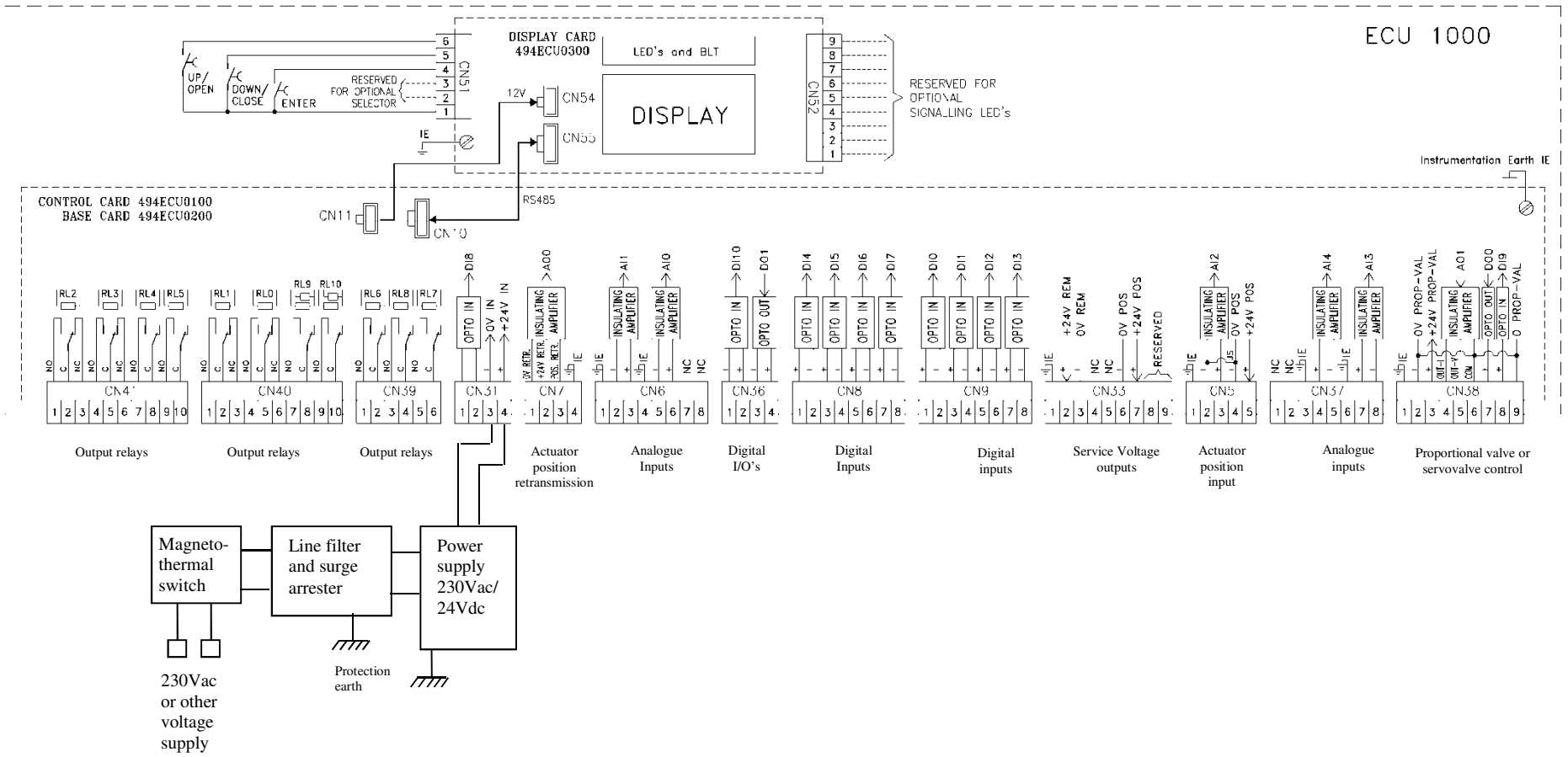


CONTROL CARD
and
BASE CARD

DISPLAY CARD



2.9 ECU1000 terminals

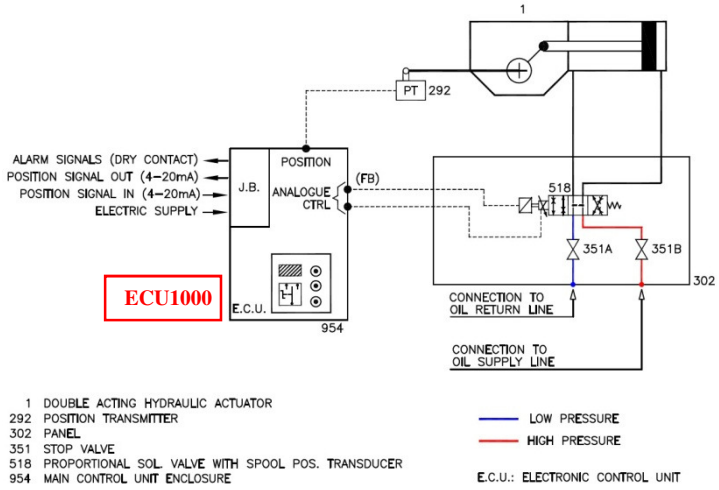


3 Actuator for heavy modulating service

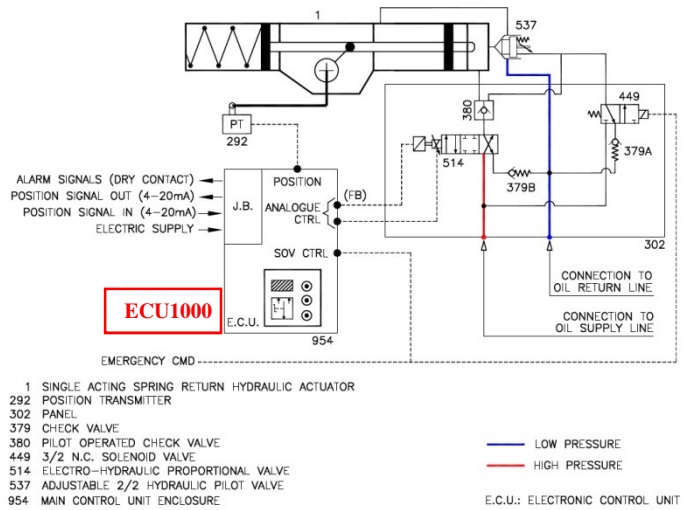
Main features:

- Failsafe by spring or accumulator
- Quarter turn or linear
- Integral HPU with single or dual motor pump or separated HPU
- Proportional valve or servovalves control
- Heavy modulating service
- Standard hardwired or BUS remote control
- Optional ESD function by dedicated SOV
- Optional "stay in position" function and "fast operation" by dedicated SOV's

The figures below show the operating principle.



Double acting actuator for heavy modulating service



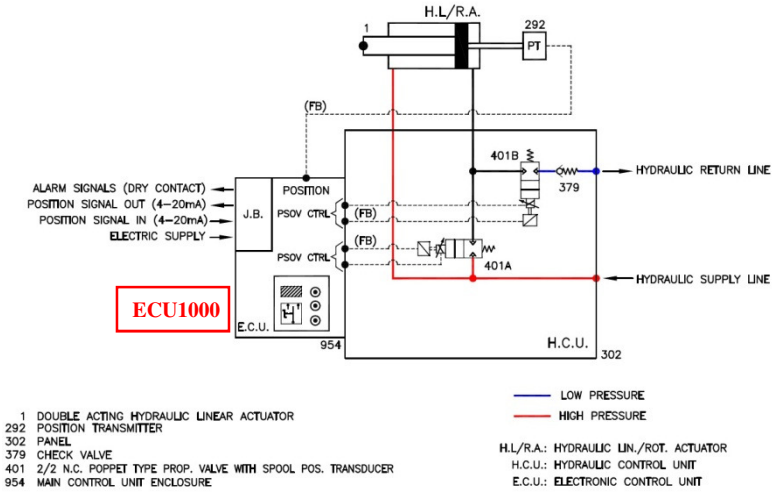
Single acting spring return actuator for heavy modulating service and additional SOV for emergency command

4 Actuator for heavy modulating service and low oil drain

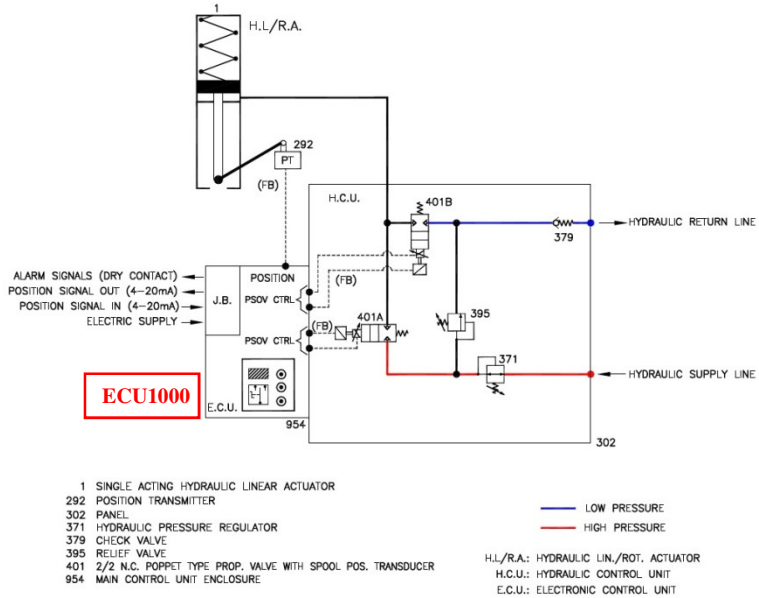
Main features:

- Failsafe by spring or accumulator
- Quarter turn or linear
- Integral HPU with single or dual motor pump, or separated HPU
- Proportional PSOV "Biffi design".
- Very low oil drain in off state
- PWM driver card to control the Biffi PSOV's
- ESD function and Fast operation by optional dedicated SOV's
- Standard hardwired or BUS remote control

The figures below show the operating principle.



Double acting actuator for heavy modulating service, stay in position in case of loss of electrical power



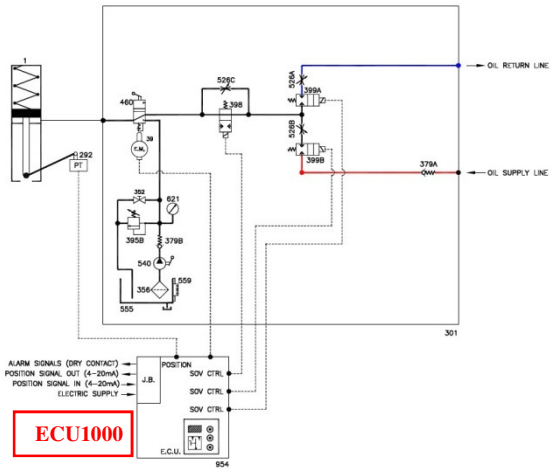
Single acting spring return actuator for heavy modulating service, stay in position in case of loss of electrical power

5 Actuator for stepping modulating service

Main features:

- Failsafe by spring or accumulator
- Quarter turn or linear
- Integral HPU with single/dual motor pump, or separated HPU
- On-off Solenoid Operated Valves (SOV's) control
- Stepping modulating service with optional "fast/slow speed" SOV
- Hardwired or BUS remote control
- Optional PST function

The figures below show the operating principle



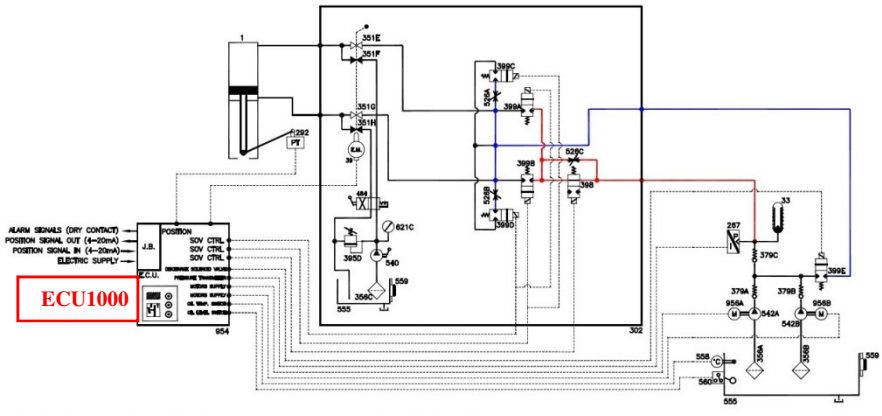
1 SINGLE ACTING SPRING RETURN HYDRAULIC ACTUATOR
39 SIGNALLING MICROSWITCH
292 ELECTRIC POSITION TRANSMITTER
302 PANEL
352 NEEDLE VALVE
356 HYDRAULIC FILTER
379 CHECK VALVE
398 2/2 N.O. POPPET TYPE SOLENOID VALVE
399 2/2 N.C. POPPET TYPE SOLENOID VALVE
526 BIDIRECTIONAL FLOW REGULATOR (ADJUSTABLE SETTING)
540 HANDPUMP
555 OIL TANK
559 LEVEL GAUGE
621 PRESSURE GAUGE
954 MAIN CONTROL UNIT ENCLOSURE

LOW PRESSURE
HIGH PRESSURE

E.C.U.: ELECTRONIC CONTROL UNIT

Single acting spring return actuator for modulating service, two SOV's to open/close the actuator, one fast/slow speed SOV, manual pump with selector.

Double acting actuator for modulating service, four SOV's to open/close the actuator and one fast/slow speed SOV, integral HPU with dual motor pump, manual pump



1 DOUBLE ACTING HYDRAULIC LINEAR ACTUATOR
33 HYDRAULIC ACCUMULATOR (BLADDER TYPE)
39 SIGNALLING MICROSWITCH
267 PRESSURE TRANSMITTER
292 POSITION TRANSMITTER
302 PANEL
351 STOP VALVE
356 HYDRAULIC FILTER
379 CHECK VALVE
395 RELIEF VALVE
398 2/2 N.O. POPPET TYPE SOLENOID VALVE
399 2/2 N.C. POPPET TYPE SOLENOID VALVE

484 4/2 HAND ACTUATED VALVE
526 BIDIRECTIONAL FLOW REGULATOR (ADJUSTABLE SETTING)
540 HANDPUMP
542 HYDRAULIC ROTATING PUMP
555 OIL TANK
558 ELECTRIC TEMPERATURE SWITCH
559 LEVEL GAUGE
560 ELECTRIC LEVEL SWITCH
621 PRESSURE GAUGE
954 MAIN CONTROL UNIT ENCLOSURE
956 ELECTRIC MOTOR

LOW PRESSURE
HIGH PRESSURE

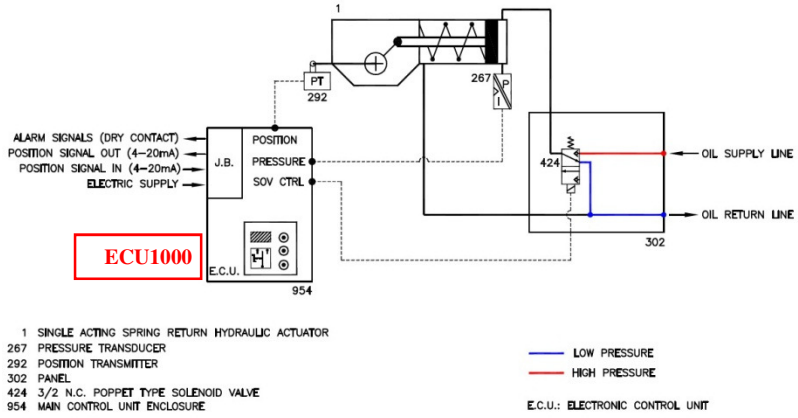
E.C.U.: ELECTRONIC CONTROL UNIT

6 Actuator for ON-OFF service

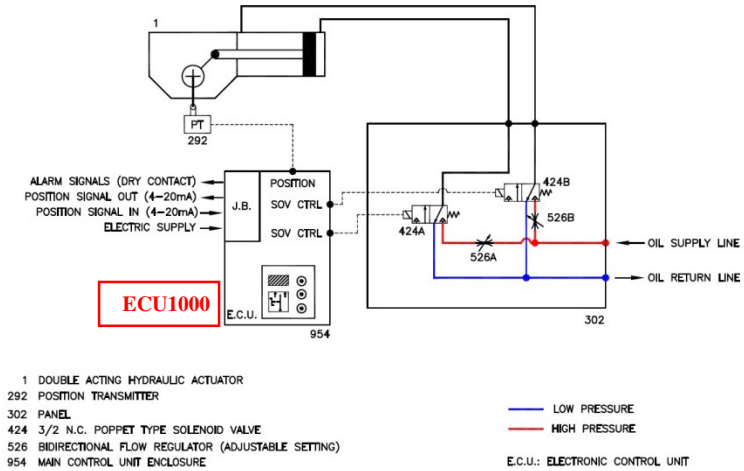
Main features:

- Failsafe by spring or accumulator
- Quarter turn or linear
- Integral HPU with single/dual motor pump, or separated HPU
- On-off Solenoid Operated Valves (SOV's) control
- On-off service
- Hardwired or BUS remote control
- ESD function by optional dedicated SOV
- Optional PST function

The figures below show the operating principle



Single acting spring return actuator for ON-OFF service, pressure transmitter for Partial Stroke Test, one SOV to open and close the actuator

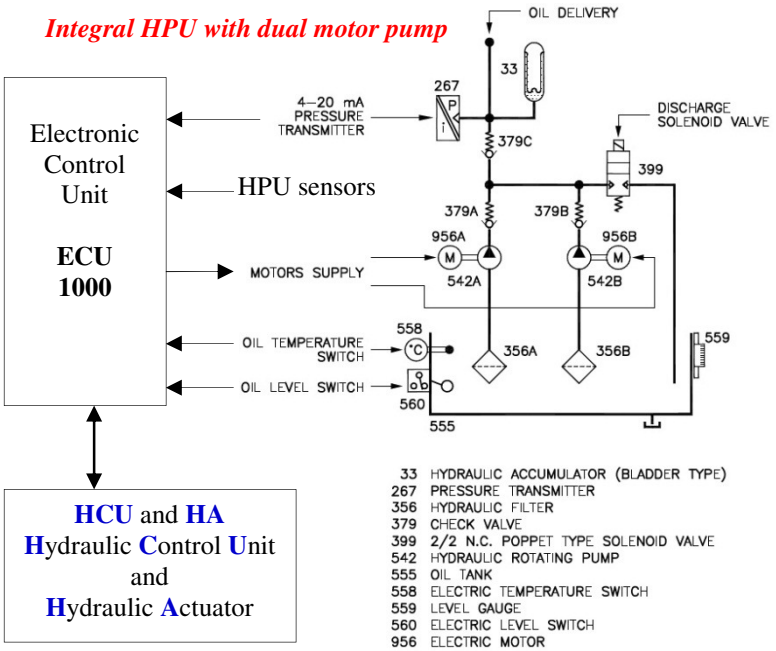


Double acting actuator for ON-OFF service, two SOV's to open and close the actuator. Additional on-off SOV's and pressure transmitter can be added for emergency operation or Partial Stroke Test.

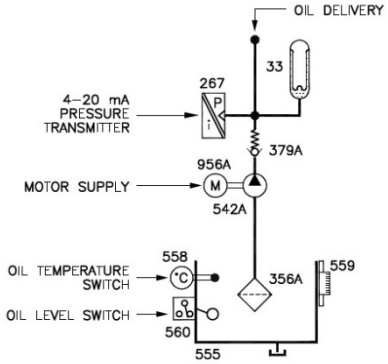
7 Hydraulic Power Unit HPU

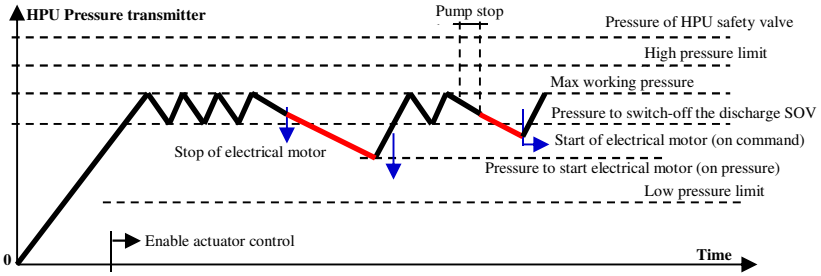
The **HPU** gives the hydraulic power requested to move the "actuator + valve" system. It consists in electrical motor, hydraulic pump, reservoir, sensors, manual pump, check valves, oil filter etc. Through its analogue and digital inputs and outputs, the **ECU1000** controls the oil pressure, monitors the HPU status, drives the electrical motors, generates alarm in case of malfunction, controls the cycle and switching conditions in case of dual redundant pump.
The figures below show the basic diagram of an HPU for modulating and on-off actuator.

Integral HPU with dual motor pump



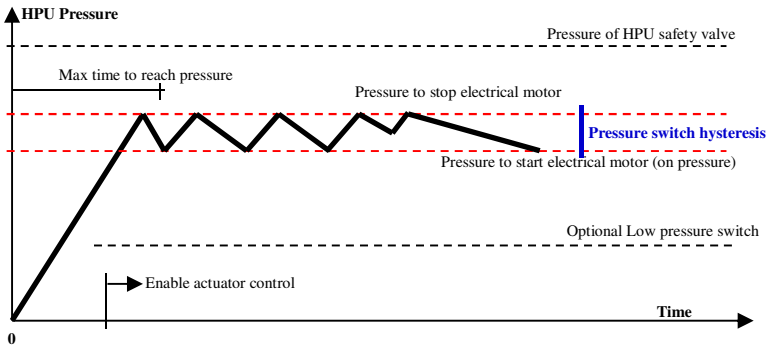
Integral HPU for on-off actuator





The figure shows the control of HPU pressure for actuator in modulating service. The HPU pressure is measured by a 4-20mA transmitter.

Additional sensors (oil level switch, oil temperature switch, motor thermostat, motor supply on, clogged filter, manual pump switch, etc.) can be added to monitor the HPU operation and signal to control room in case of malfunction.



The figure shows the control of HPU pressure for actuator in on-off service. The HPU pressure is measured by a pressure switch.

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