DTDE 328

ECU 1000

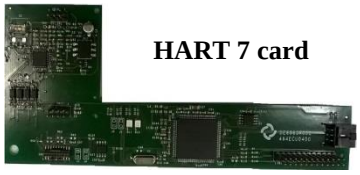
Input Characterization,Recorder, Graph, Logger,PST, HPU control, On-off control, Optional local lamps, PWM driver, RS485 Modbus RTU

Display card

Base and logic cards

ECU1000 with PWM driver card

Modbus RTU card



HART 7 card

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Warning: 	• **It is assumed that the installation, the setting, the commissioning, the maintenance and repair works are carried out by qualified personnel and checked by responsible Specialists.** • **The door of cabinet must be kept "closed" by the key (or equivalent tool). Operating the unit or working on the Electronics with the cabinet door "open" could cause personal injury and damage the equipment**

Warning: 	**The ECU1000 controls the actuator, it could control the HPU, it could drive generic electric, mechanic, pneumatic and hydraulic devices. To avoid unwanted movement of mechanic parts or leakage of pressurized fluids and risk injury of people and damage of equipment and ambient, any mechanic, electric, hydraulic and pneumatic device controlled by the ECU1000 device should be placed in safe condition before executing any installation, commissioning or maintenance operation (see relevant instruction manuals of actuator, HPU, etc.)**

Warning: 	**If the device is located in hazardous area a ''hot permit'' must be obtained before opening the explosion proof enclosures. Moreover the area must be cleaned from explosive mixture since time keeper battery and residual capacitor charge could generate electrical spark and cause explosion. The installation must be carried out in accordance to the applicable Ex-d Standards regarding the electrical installations in hazardous areas and any other applicable national standard and rule.**

Warning: 	**Refer to DTDE326 for the installation and maintenance instruction manual of the ECU1000 cabinet.**

REV.	DATE	PREPARED	APPROVED	NOTES
0	**04/12/2012**	**M. Giuliani**	**A. Affaticati**	**Issue**
1	**14/03/2013**	**M. Giuliani**	**A. Affaticati**	**Changed HPUctrl**
2	**08/05/2013**	**M. Giuliani**	**A. Affaticati**	**Changed ON-OFF**
3	**28/08/2013**	**M. Giuliani**	**A. Affaticati**	**Introd. and Pushbut.**
4	**20/12/2013**	**M.Giuliani**	**A. Affaticati**	**PWM and Modbus**
5	**04/04/2014**	**M.Giuliani**	**A. Battaglia**	
6	**22/06/2017**	**M.Giuliani**	**A. Battaglia**	**FW 3.01.00&2.01.00**
7	**20/10/2017**	**M.Giuliani**	**A. Battaglia**	**HPU-Pump tables**

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1 Introduction

The documents **DTDE326**, **DTDE327** and **DTDE328** are the **I**nstallation, **O**peration and **M**aintenance manuals of the **ECU1000**, **Electronic Control Unit** for electro-hydraulic actuators.
The **DTDE326** "Installation and Maintenance" provides the instructions for the installation and maintenance of cabinet with ECU1000. The **DTDE327** "Control functions and Local Operator Interface" provides the instructions to use the Local Operator Interface, the Positioner and the additional functions to control and monitor the actuator. The manual **DTDE328** "Functions description" provides the instructions relevant to the following ECU1000 functions:

- ***Input Characterization***
- ***Recorder, Graph and Logger***
- ***PST Partial Stroke Test***
- ***HPU (Hydraulic Power Unit) control***
- ***On-Off actuator control***
- ***Optional local lamps***
- ***PWM module***
- ***RS485 Modbus RTU interface (from FW versions 2.000.000 and 3.000.000 or further)***
- ***HART 7 interface (available from HW R00F/Red PCB of the Logic Card and FW 3.001.000 or further)***

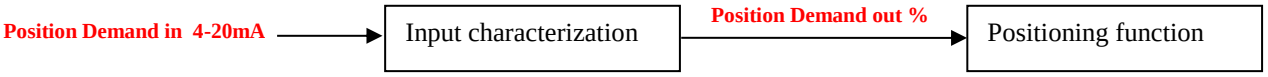
The manuals DTDE 326, DTE327 and DTDE328 provide the instructions relevant to complete set of ECU1000 functions. Only functions requested by the application and needed to allow the correct actuator control and operation will be activated in the factory setting.

Warning: 	**It is assumed that the installation, the setting, the commissioning, the maintenance and repair works are carried out by qualified personnel and checked by responsible Specialists. Operating the unit or working on the Electronics with the cabinet door open could cause personal injury.**

2 Input characterization

The **Input Characterization** function allows modifying the profile of the 4-20mA input signal "Position Demand" in a custom defined curve. The function is active only if the parameter "**In. Characteriz., on-off**" in the menu "**Restricted, Function Selector**" is set to **ON.**
If the above parameter is **OFF** the input 4mA = corresponds to Position Demand 0% and 20mA = corresponds to Position Demand 100%.
If the above parameter is **ON**, 4 options are available: off, linear 100-0, custom increase and custom decrease.

- **off**: the input signal 4mA corresponds to Position Demand 0% and 20mA corresponds to 100%.
- **Linear 100-0**: the input signal 4mA corresponds to Position Demand out 100% and 20mA corresponds to 0%. No additional parameters are required.
- **Custom increase**: the user sets the relationship between the 4-20mA Position Demand input signal and the Position Demand out %. The user should enter from 2 to 21 X-Y points according to the configurable parameter "**Custom point number**" in the menu "**Actuator setup, Input Characterization**". The entered data should be X>X-1, Y>=Y-1. If number of data is not according to "Custom point number" or their value is not according to the above constraints, the ECU1000 issues the ALARM "**Characterization**" and works in "**off**" mode.
- **Custom decrease**: the user sets the relationship between the 4-20mA Position Demand input signal and the Position Demand out %. The user should enter from 2 to 21 X-Y points according to the configurable parameter "**Custom point number**" in the menu "**Actuator setup, Input Characterization**". The entered data should be X>X-1, Y<=Y-1. If number of data is not according to "Custom point number" or their value is not according to the above constraints, the ECU1000 issues the ALARM "**Characterization**" and works in "**off**" mode.



If the Input Characterization function is on, the display of the Local Operator Interface shows the letter **<c>**before the value of the Position Demand %. The **<c>** indicates that the value shown on the display is the **Position Demand out %.**

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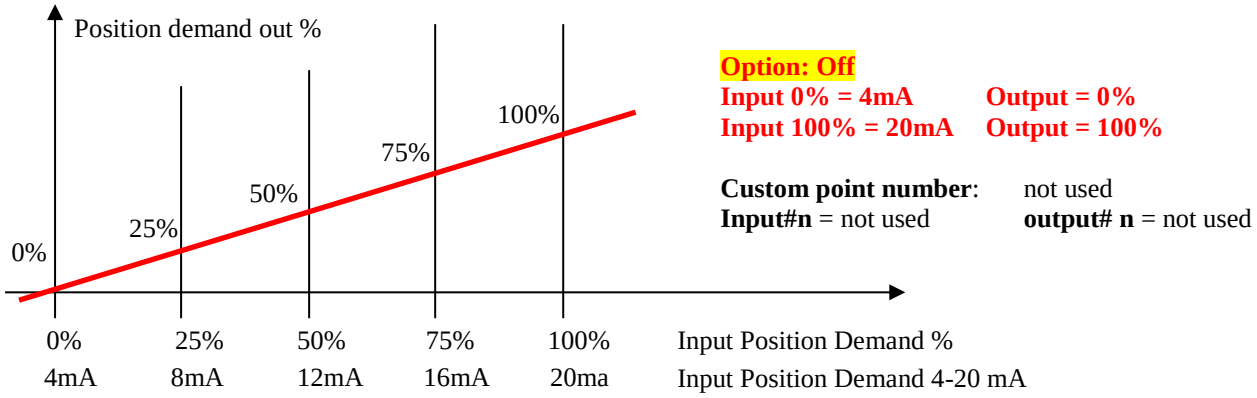
The following parameters are available:

- **Input characteristic (off, linear 100-0, custom increase, custom decrease)**
- **Custom point number (from 2 to 21), default 21**
- **Input #0 (X)**
- **Output #0 (Y)**
- **-----**
- **-----**
- **Input #20**
- **Output #20**

The local display of ECU1000 does not show the X,Y points that exceed the "Custom point number". The BIFFI-Assistant shows all 21 points even if "Custom point number" is less than 21.
The figures below shows the relationship between the Position Demand 4-20mA input and Position Demand out %

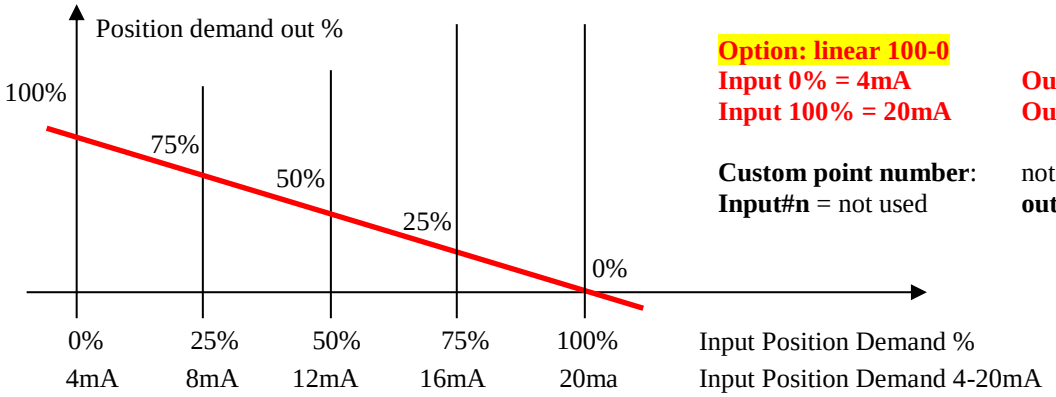
2.1 Option: Off



Option: Off
Input 0% = 4mA **Output = 0%**
Input 100% = 20mA **Output = 100%**

Custom point number: not used
Input#n = not used **output# n** = not used

2.2 Option: Linear 100-0



Option: linear 100-0
Input 0% = 4mA **Output = 100%**
Input 100% = 20mA **Output = 0%**

Custom point number: not used
Input#n = not used **output#n** = not used

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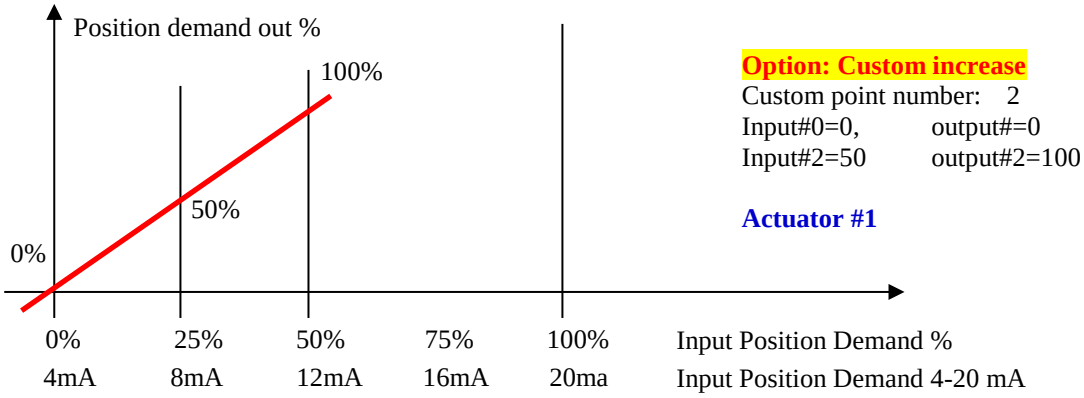
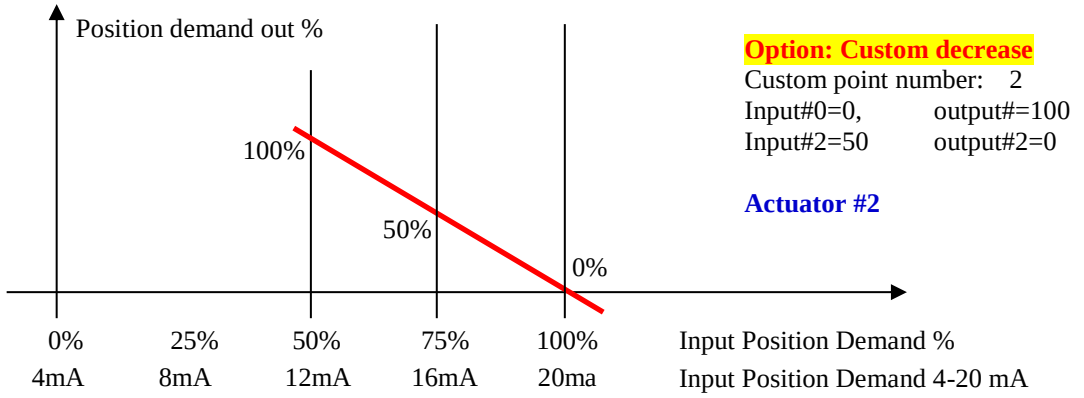
2.3 Configuration of 2 valves in Split range



Option: Custom increase
Custom point number: 2
Input#0=0, output#=0
Input#2=50 output#2=100

Actuator #1

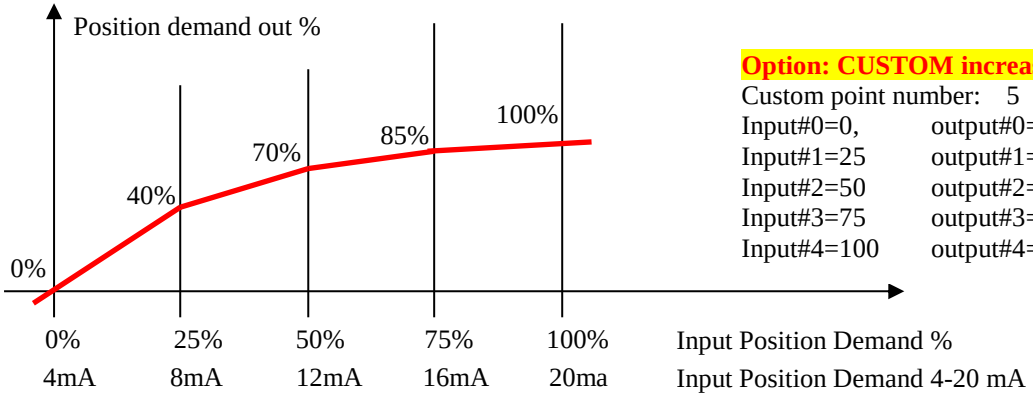


Option: Custom decrease
Custom point number: 2
Input#0=0, output#=100
Input#2=50 output#2=0

Actuator #2

The ECU1000 controls one only actuator. Two valves in split range can be controlled by 2 ECU1000 and one only 4-20mA input demand signal (see paragraph 2.6, Control of more valves by one only 4-20mA signal).

2.4 Option: Custom increase



Option: CUSTOM increase
Custom point number: 5
Input#0=0, output#0=0
Input#1=25 output#1=40
Input#2=50 output#2=70
Input#3=75 output#3=85
Input#4=100 output#4=100

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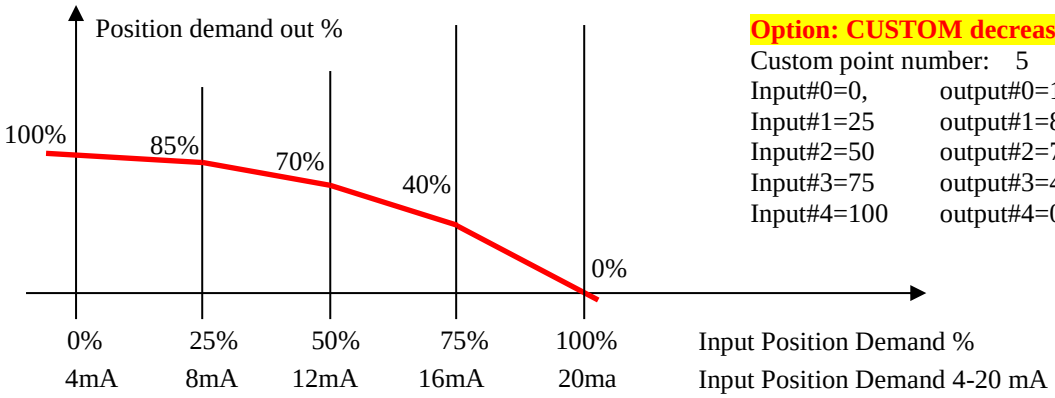
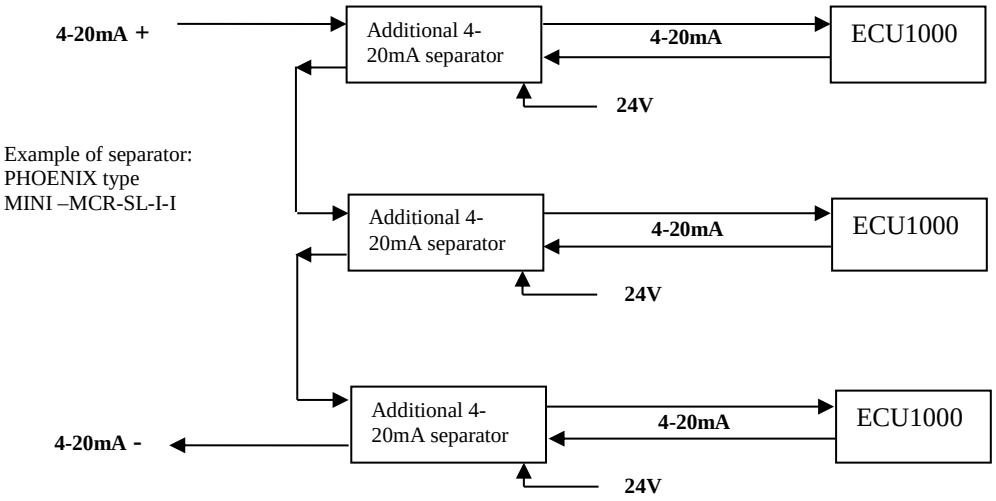
2.5 Option: Custom decrease



Option: CUSTOM decrease
Custom point number: 5
Input#0=0, output#0=100
Input#1=25 output#1=85
Input#2=50 output#2=70
Input#3=75 output#3=40
Input#4=100 output#4=0

2.6 Control of 3 valves by 1 only 4-20mA signal

Even if the 4-20mA analogue inputs are optocoupled, each input has a maximum voltage drop of 9V at 20mA, so one 4-20mA input signal can drive one only ECU1000. Control of more valves by one only 4-20mA input signal (Position Demand) can be done by an additional 4-20mA analogue separator/repeater with low voltage drop characteristic, according to the following diagram.



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2.7 Input characterization parameters

The following table shows the parameters of the Input Characterization function, the Function TAB, the Function BLOCK to which the parameters belong and the password level required. The option "View param." allows viewing their value, the option "Setup param." allows changing their value.

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	ESD		
	Input characterization		
		Input characteristic (off, linear 100-0, custom increase, custom decrease)	2
		Custom points (from 2 to 21)	2
		Input #0	2
		Output #0	2
		Input #1	2
		Output #1	2
		Input #2	2
		Output #2	2
		Input #3	2
		Output #3	2
		Input #4	2
		Output #4	2
		Input #5	2
		Output #5	2
		Input #6	2
		Output #6	2
		Input #7	2
		Output #7	2
		Input #8	2
		Output #8	2
		Input #9	2
		Output #9	2
		Input #10	2
		Output #10	2
		Input #11	2
		Output #11	2
		Input #12	2
		Output #12	2
		Input #13	2
		Output #13	2
		Input #14	2
		Output #14	2
		Input #15	2
		Output #15	2
		Input #16	2
		Output #16	2
		Input #17	2
		Output #17	2
		Input #18	2
		Output #18	2
		Input #19	2
		Output #19	2
		Input #20	2
		Output #20	2
Restricted			
	General		
	Function selector		
		In characteriz (on/off)	2

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2.8 Status and variables table

The following table shows the data visible from the **HOME VIEW** of local display by pressing DOWN and relevant to Input Characterization function. No PSW is requested.
Note: it needs to press one time one of the **Local Operator Interface** pushbuttons to wake up the display before initiating the menu operations.

Description of data	Content
Actuator status:	
Actuator variables:	- Position demand % **(Position Demand out % to positioning function)** Position error % In-pos demand % **(Position Demand input %)** - - Next PST Next pump switch
Failure:	
Alarm:	See list of alarms **(Characterization, in case of wrong data)**

2.9 ESD and Failsafe

Input Characterization function works only on the 4-20mA Position Demand input. ESD function and Failsafe functions are not affected by the Input Characterization.

2.10 Configuration by Local Operator Interface

Note: it needs to press one time UP or DOWN or ENTER to wake up the display before initiating the menu operations (due to display function "auto or save").
Use UP and DOWN to select the line of display or to change the value of parameter. Use ENTER to confirm the value of parameter and to move to next menu. Select the line "**..**" and press ENTER to return to previous menu. The access to "**Actuator setup**, **Input Characterization**" menu and to "**Restricted**, **Function selector**, **In characteriz**" parameter requires at least password **level 2** and username "**Operator**". The procedure to set the parameter of the function is the following:

- Press ENTER
- By UP and DOWN select the username, then press ENTER
- By UP and DOWN select View or Setup, then press ENTER.

Enter the password. By UP and DOWN select each character and then press ENTER to confirm.

If the function **Input Characterization** is disabled it need to enable it by the instruction below. If the function is already enabled the next step is not required.

- By UP and DOWN select "Restricted", then press ENTER
- By UP and DOWN select "Function selector", then press ENTER. By UP, DOWN select the parameter "**In characteriz**" , and then press ENTER.
- By UP, DOWN set it to "ON" and then press ENTER.
- By UP, DOWN select "**..**" and then press ENTER, to return to previous menu.
- Repeat the procedure until the menu is ".., **Actuator setup**, …. , **Restricted**" appears.

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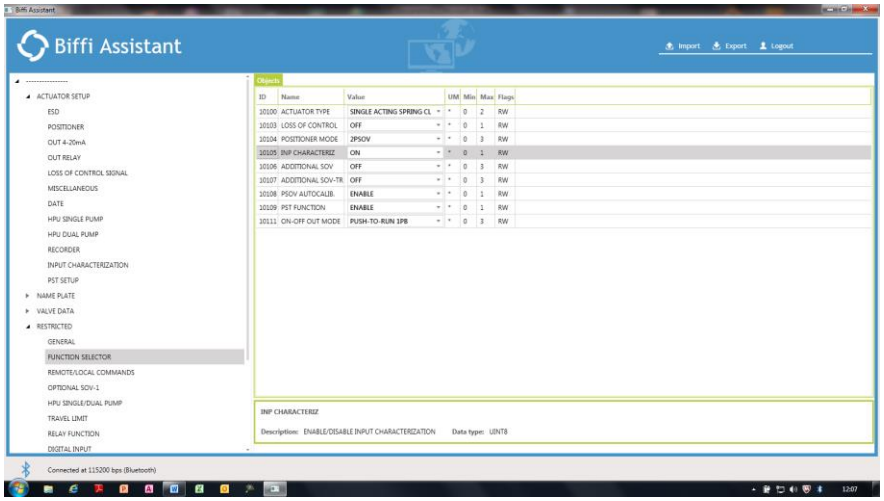
Setting of the "**Input characterization**" function:

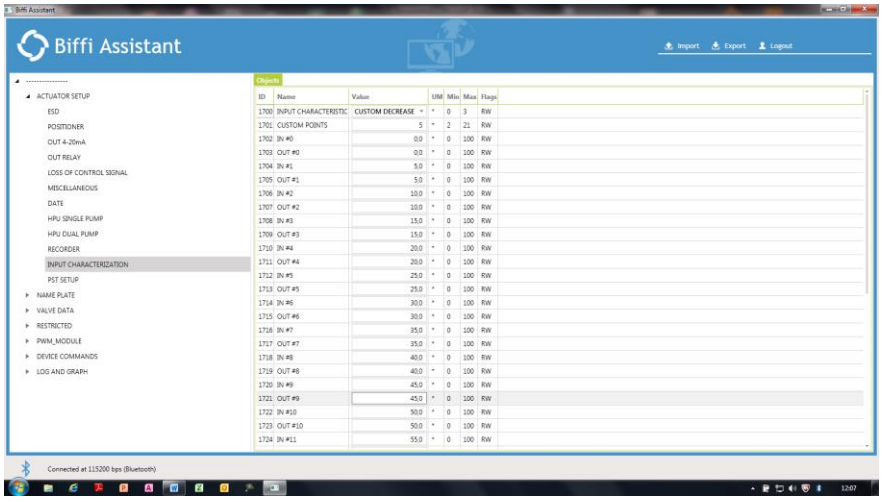
- By UP and DOWN select "Actuator Setup" and then press ENTER. By UP and DOWN select "**Input Characterization**" and then press ENTER.
- By UP and DOWN select "**Input characteristic**", then press ENTER. By UP and DOWN select the desired characteristic, then press ENTER.
- By UP and DOWN select "**Custom points**", then press ENTER. By UP and DOWN select the desired number of X-Y points, then press ENTER.
- By UP and DOWN select "**IN#0** (X0)", then press ENTER. By UP and DOWN set the IN#0 (X0) , then press ENTER.
- By UP and DOWN select "**OUT#0** (Y0)", then press ENTER. By UP and DOWN set the OUT#0 (Y0) , then press ENTER.
- Repeat the above steps and enter the number of points **IN#n** (Xn) and **OUT#n** (Yn) set by the parameter "Custom points"
- By UP and DOWN select "**..**", then press ENTER.
- Repeat the above step until the **HOME VIEW** appears.

2.11 Configuration by BIFFI-Assistant

The "Input Characterization" function can be configured by BIFFI-Assistant. The Instruction Manual of BIFFI-Assistant gives all the instructions to operate with it.



The figure shows the parameter Inp Characteriz to activate the Input Characterization function.



The figure shows the parameters of Input Characterization function

3 Recorder

The **Recorder** function allows sampling the variables selected by "**Y-axis**" in function of the time "**t**" and saving them in the permanent memory of the ECU1000. The data can be recovered, viewed and exported as **Y/t** graphs by the BIFFI-Assistant SW tool. The data cannot be viewed by the Local Operator Interface of ECU1000. Up to 5 curves of each "**Recorder mode**" option can be saved in the memory. When the memory is full and a new curve is saved, the oldest one is deleted. Each curve can have up to 4 Y-axis variables. One of the curves can be saved in a separate memory and used as "**Signature**". It can be compared with the last saved curves to obtain data relevant to the behavior of the actuator and process valve.
Sampling of data starts **5 sec.** after the selection of **Recorder mode**. When it is on, the HOME VIEW of the local display shows **<R>**. If **Recorder mode** is changed while "sampling" of data is on, the collected data will be lost.
Collected data are saved in the permanent memory of ECU1000 only if one of the "**STOP condition**" described below occurs.
The below tables show the parameters to set the Recorder function.

3.1 Recorder mode

Mode	Description
Off	Off (Recorder not active)
Record	to save the last **200** sample of "**Y-axis**" variables before than selected "**Stop condition**" occurs
PST:	to save the "**Y-axis**" variables sampled in the time "**Recording Duration**", in the PST cycle
OP-stroke:	• to save the "**Y-axis**" variables in the time "**Recording Duration**", in the full opening stroke • to save the "**Y-axis**" variables in the time "**Recording Duration**", during the actuator travel
CL-stroke:	• to save the "**Y-axis**" variables in the time "**Recording Duration**", in the full closing stroke • to save the "**Y-axis**" variables in the time "**Recording Duration**", during the actuator travel
Multi-Stroke	It corresponds to set at the same time PST, OP-stroke and CL-stroke From FW versions 2.001.000 and 3.001.000 or further.

3.2 Start condition

Mode	Description
Record	Data sampling starts 5 sec. after than the "Record" option is entered.
PST	Data sampling starts when command to perform PST (partial stroke test) is detected
OP-Stroke	• Recorder enabled 5 sec. after than the "OP-mode" option is entered • Modulating actuator: data sampling starts if position demand is **>1%** • On-Off actuator: data sampling starts when ECU1000 receives a command to open
CL-Stroke	• Recorder enabled 5 sec. after than the "CL-stroke" option is entered • Modulating actuator: data sampling starts if position demand is **<99%** • On-Off actuator: data sampling starts when ECU1000 receives a command to close

3.3 Stop condition

Mode	Description
Record	One of the following condition occurs: • **FAILURE** • **ALARM** • **POSITION < 5%** • **POSITION > 95%** • **Recording time > Max recording time**
Op- stroke	The selected "**Recording Duration**" has passed (measured from time of "Start condition")
Cl-stroke	The selected "**Recording Duration**" has passed (measured from time of "Start condition")
PST mode	The selected "**Recording Duration**" has passed (measured from time of "Start condition")

Only one **Recorder mode** at a time is active. In Record / Op-stroke / Cl-stroke modes the recorder switches off when the stop condition occurs. It can restart by a new setting of the "Recorder mode". In "PST mode" the recorder switches off when the stop condition occurs, but it restarts automatically when a new PST initiates.
In Multi-Stroke the recorder is always active and it does not automatically switch off.

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3.4 Recording duration

Recording Duration	Sampling Time
2 s	10 ms
4 s	20 ms
10 s	50 ms
20 s	100 ms
50 s	250 ms
100 s	500 ms
200 s	1.0 s
500 s	2.5 s
1000 s	5.0 s

The table shows the relationship between the selected "**Recording Duration**" and the "**Sampling Time**" of Recorder.

3.5 Max recording time

Recording duration	Max recording time, 4 variables hh:mm:ss	Max recording time, 3 variables hh:mm:ss	Max recording time, 2 variables hh:mm:ss	Max recording time, 1 variable hh:mm:ss
2 s	1m 42.4s	2m 33.6s	3m 24.8s	6m 49.6s
4 s	3m 24.8s	5m 7.2s	6m 49.6s	13m 39.2s
10 s	8m 32s	12m 48s	17m 04s	34m 08s
20 s	17m 04s	25m 36s	34m 08s	1h 08m 16s
50 s	42m 40s	1h 04s	1h 25m 20s	2h 50m 40s
100 s	1h 25m 20s	2h 08s	2h 50m 40s	5h 41m 20s
200 s	2h 50m 40s	4h 16s	5h 41m 20s	11h 21m 40s
500 s	7h 6m 40s	10h 40m	14h 13m 20s	28h 26m 40s
1000 s	14h 13m 20s	21h 20m	28h 26m 40s	56h 53m 20s

The table shows the relationship between the selected "**Recording Duration**" and the "**Max Recording Time**" in "**Record**" mode

3.6 Y-axis:

Y-Axis variable	Descritption
Position demand	Position Demand %
Actuator Position	Actuator Position %
HPU oil pressure	Available only if the HPU control is active
Position error	Position Error %
AO1 %	Analogue Output of positioner %
Interlock	Interlock variable
Pressure cylinder1	Available only if the transmitter is present
Pressure cylinder2	Available only if the transmitter is present
PST trigger	Start and stop marker of PST

The parameter "**Y-axis**" allows selecting the variables of Y-Axis to sample. Up to **4 variables** can be selected. Each saved curve is made of **200** samples of each variable

3.7 OP-stroke curve

Mode	Start condition	Stop condition	Y-axis	Recording duration
OP-stroke	**Modulating actuator:** Position demand >1%	Recording duration passed	Position demand%, Position%, max 4 variables	>Estimated full opening time
OP-stroke	**On-Off actuator:** Command to open	Recording duration passed	Position%, Pressure, max 4 variables	>Estimated full opening time

The above option can be used to record the full opening stroke of actuator. If the Position Demand is 0% and 5 sec. after "**OP-stroke"** mode selection, the recorder enters in the "**wait for trigger**" status. When Position Demand signal becomes >1% the sampling of data starts and ends when the "Recording duration" time has passed.
This option can be used also to record a partial actuator travel in both directions for the "Recording duration" time.

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3.7.1 OP-stroke signature

By the ECU commands, LOG and GRAPH, RECORDER COMMANDS in the Local Operator Interface or by BIFFI-Assistant, one OP-stroke curve of the ECU1000 memory, can be saved in a separated memory area and used as "**OP-stroke signature**" for comparison with the new curves to see changes in the actuator operation.

3.8 CL-stroke curve

Mode	Start condition	Stop condition	Y-axis	Recording duration
CL-stroke	**Modulating actuator:** Position demand <99%	Recording duration passed	Position demand%, Position%, max 4 variables	>Estimated full closing time
CL-stroke	**On-Off actuator:** Command to close	Recording duration passed	Position%, Pressure, max 4 variables	>Estimated full closing time

The above options can be used to record the full closing stroke of actuator.
If the Position Demand is100% and 5 sec. after "**CL-stroke"** mode selection, the recorder enters in the "**wait for trigger**" status. When Position Demand signal becomes <99% the sampling of data starts and ends when the "Recording duration" time has passed.
This option can be used also to record a partial actuator travel in both directions for the "Recording duration" time.

3.8.1 CL-stroke signature

By the ECU commands, LOG and GRAPH, RECORDER COMMANDS in the Local Operator Interface or by BIFFI-Assistant, one CL-stroke curve of the ECU1000 memory, can be saved in a separated memory area and used as "**CL-stroke signature**" for comparison with the new curves to see changes in the actuator operation

3.9 PST curve

The paragraph "PST Partial Stroke test" describes the PST Partial Stroke test and provides the detailed information relevant to PST function. Here are reported only the information to set the Recorder in the PST function

Mode	Start condition	Stop condition	Y-axis	Recording duration
PST	Rem-Auto, modulating Rem-Man, on-off	Recording duration passed	Position%, Pressure 1, Pressure2, max 4 variables	>Estimated max PST time

3.9.1 PST signature

By the ECU commands, LOG and GRAPH, RECORDER COMMANDS, in the Local Operator Interface or by BIFFI-Assistant, one PST curve of the ECU1000 memory, can be selected and saved in a separated memory area and used as "**PST signature**" for comparison with the new curves to see changes in the actuator operation. An **Alarm** is generated if PST cycle aborts or if the comparison with the signature fails.

3.10 Record curve

Mode	Start condition	Stop condition	Y-axis	Recording duration
Record	When Record mode is selected	Failure, Alarm, position <5%, position >95%	Position demand%, Position%, max 4 variables	>Estimated full closing time

This option can be used to sample the selected variables and save the last 200 samples in the ECU1000 memory when the condition to stop occurs. The record operation ends if the stop condition does not occur in "Max recording time".

3.10.1 Record signature

By the ECU commands, LOG and GRAPH, RECORDER COMMANDS, in the Local Operator Interface or by BIFFI-Assistant one Record curve of the ECU1000 memory, can be saved in a separated memory area and used as "**Record signature**" for comparison with the new curves to see changes in the actuator operation.

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3.11 Parameters and ECU cmd of Recorder

The following table shows the parameters of the Recorder function, the Function TAB, the Function BLOCK to which the parameters belong and the password level required. The option "View param." allows viewing their value, the option "Setup param." allows changing their value.

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	ESD		
	Recorder		
		Recording duration (from 2 to 1000 sec)	1
		Stop condition (in Record mode, Failure, Alarm, Position<5%, Position >95%)	1
		Y-axis (Position%, Position Demand%, AO1, etc)	1
		Recorder mode (off, OP-stroke, CL-stroke, PST, Record, Multi-Stoke)……..(#)	1

(#): Multi-Stroke available from FW versions 2.01.00 and 3.00.01 or further.

The following table shows the ECU cmd necessary to set the "**Signature**" in the Recorder function.

Function block	Function TAB	Parameter	Psw level
Log and graph			
	Logger		
	Curves		
		Select OP-stroke signature	1
		Select CL-stroke signature	1
		Select PST signature	1
		Select Record signature	1

3.12 Configuration of Recorder

Warning: the correct configuration of Recorder can be done only in accordance to the below conditions:

- Change of the recorder settings is allowed only if the parameter "**Recorder mode**" is **OFF**
- If the parameter "**Recorder mode** is **ON**, no change of recorder settings is accepted by the ECU1000
- To change the parameter "**Recorder mode**" it needs to set it to **OFF** and then enter the new mode

3.13 Configuration by Local Operator Interface

Before initiating menu operations, it needs to press one time UP or DOWN or ENTER to wake up the display.
Use UP and DOWN to select the line of display or to change the value of parameter. Use ENTER to confirm the value of parameter and to move to the next menu. Select the line "**..**" and press ENTER to return to previous menu. The manual **DTDE327** "Actuator control and Local Operator Interface" provides detailed instructions to use the Local Operator Interface. Here are reported only the information to set the Recorder by the Local Operator Interface.

3.13.1 Recorder function

- Select the username, enter the password. Select **View** or **Setup** mode
- By UP and DOWN select "Actuator Setup" and then press ENTER. By UP and DOWN select "**Recorder**" and then press ENTER.
- By UP and DOWN select the parameter "**Recorder mode**" and then press ENTER. By UP and DOWN select the option "**OFF**", then press ENTER.
- By UP and DOWN select the parameter "**Recording time**" and then press ENTER. By UP and DOWN select the desired time and then press ENTER.

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- By UP and DOWN select "**Stop condition**" and then press ENTER. By UP and DOWN select the desired stop condition and then press ENTER. Configure this parameter only if the Recorder mode will be "**Record**".
- By UP and DOWN select "**Y-Axis**, then press ENTER. By UP and DOWN set the variable to sample and then press ENTER.
- By UP and DOWN select the parameter "**Recorder mode**" and then press ENTER. By UP and DOWN select the desired option ("**OP-stroke**, **CL-stroke**, **PST**, **Record**") and then press ENTER.
- By UP and DOWN select the line "**..**" and then press ENTER. Repeat the procedure to return to HOME VIEW.

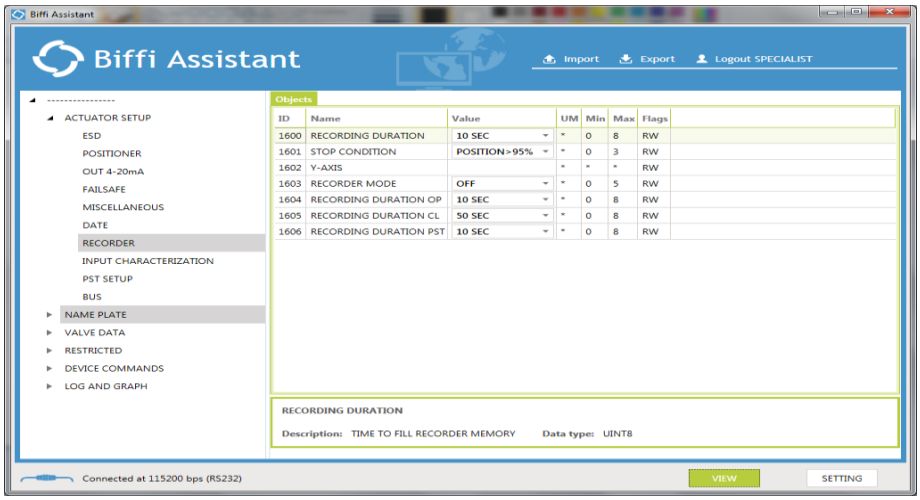
Now the Recorder is active. The sampling of data starts when the trigger condition occurs. To modify the setting it needs to set again the Recorder mode in OFF.

3.13.2 Curve signature

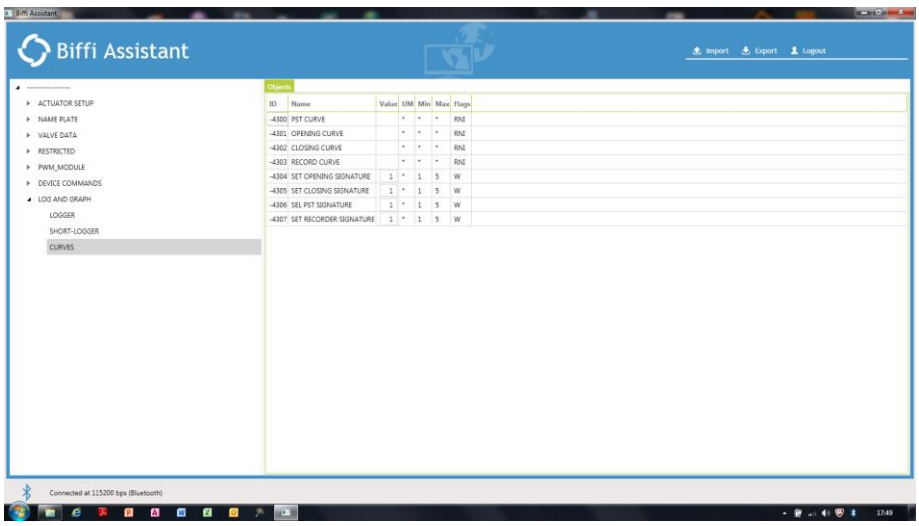
- Select the username, enter the password. Select **ECU cmd** mode
- By UP and DOWN select "**Log and Graph**" and then press ENTER.
- By UP and DOWN select "**Curves**" and then press ENTER.
- By UP and DOWN select the type of signature and then press ENTER.
- By UP and DOWN select the number of the curve to save as **signature** and then press ENTER.
- By UP and DOWN select the line "**..**" and then press ENTER. Repeat the procedure to return to HOME VIEW

3.14 Configuration by BIFFI-Assistant

The "Recorder" function can be configured by BIFFI-Assistant. The Instruction Manual of BIFFI-Assistant gives all the instruction to operate with it.



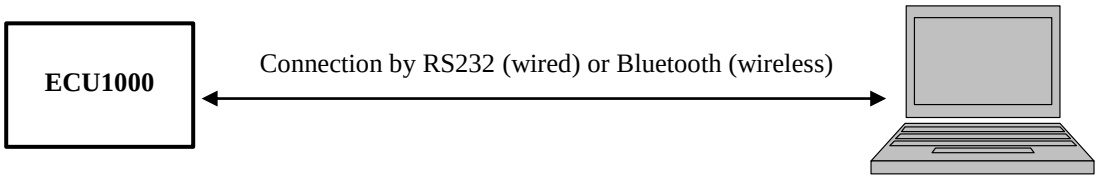
The figure shows the **parameters** of Recorder function

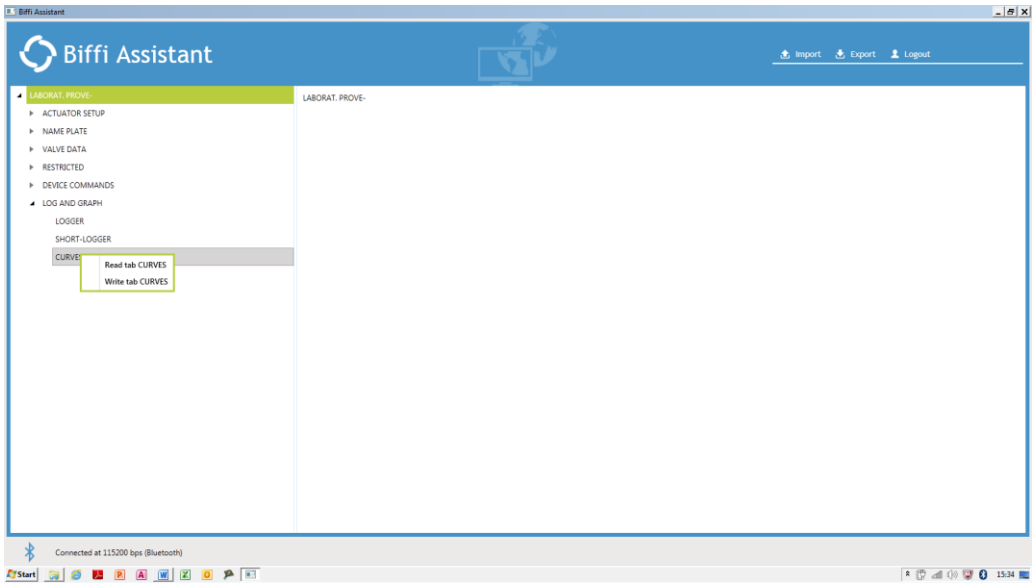


The figure shows the ECU cmd of **signature** selection

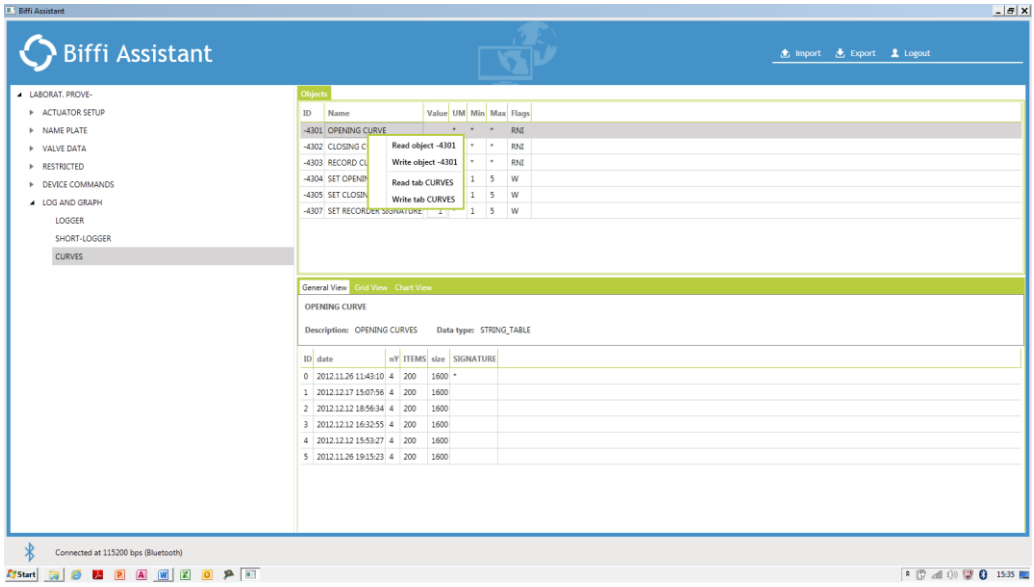
4 Graph

The function is available only by **BIFFI-Assistant**. The Recorder function saves the **curves** and the **signatures** in the ECU1000 permanent memory according to instructions of previous paragraphs. The saved data can be viewed as graph or table and exported only by BIFFI-Assistant SW tool. The Graphs are not visible on the local Operator Interface due to small visible area of the display. This paragraph reports only the instructions of BIFFI-Assistant relevant to the Graph. Detailed instructions about the installation and operation of the BIFFI-Assistant are reported in the "BIFFI-Assistant Instruction Manual". Use the left key of mouse to select the line, use right key of mouse to read / write the selected BLOCK, TAB, data. Each graph can be individually or with other data exported and saved in the PC memory.



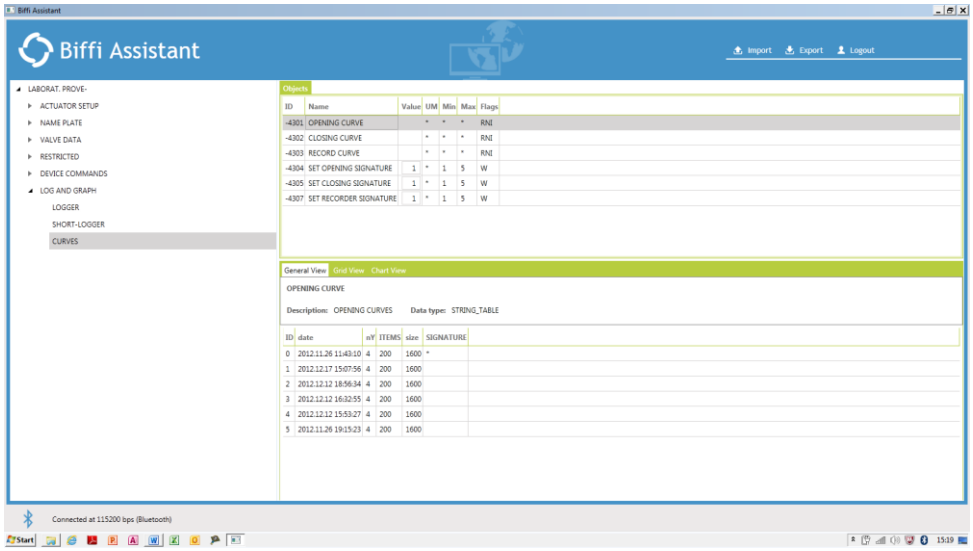


Select the line by the left key of mouse. Use the right key of mouse to read the complete function BLOCK or function TAB

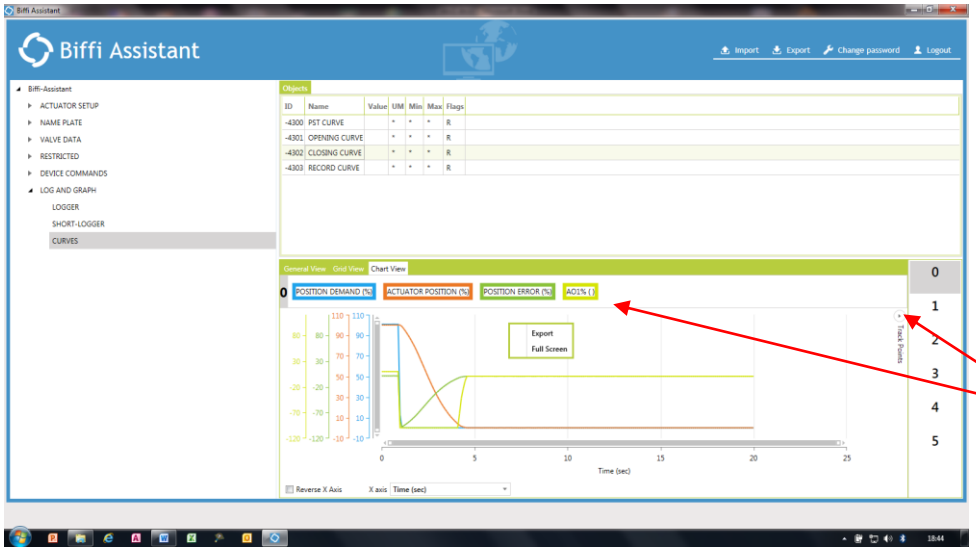


Select the line by the left key of mouse. Use the right key of mouse to read the data of the selected function

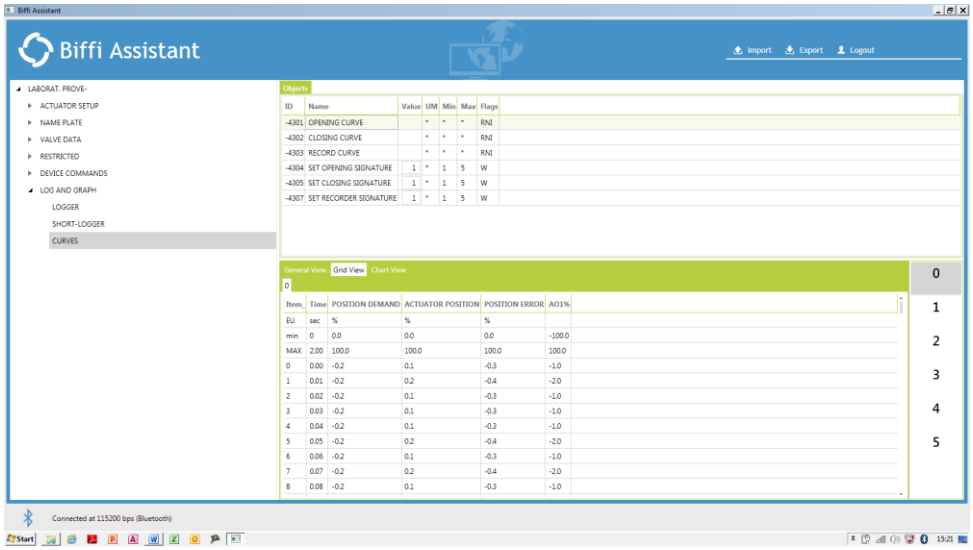
4.1 Curves



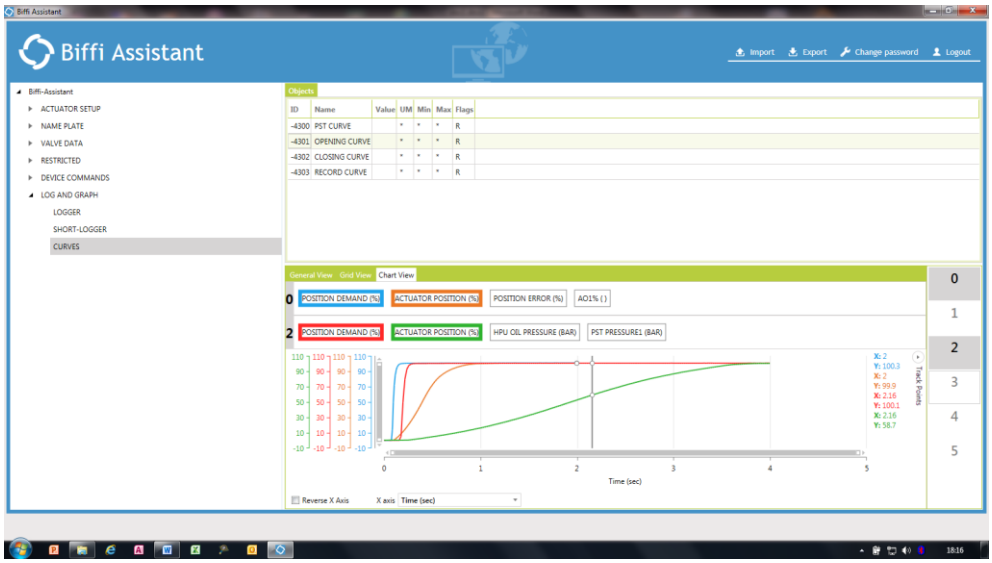
The figure shows the list of "Opening curves" (OP-stroke) available in the ECU1000 memory. The **signature** is identified by the number **0** and the "*" in the column "signature". The curve number 5 is the oldest one.



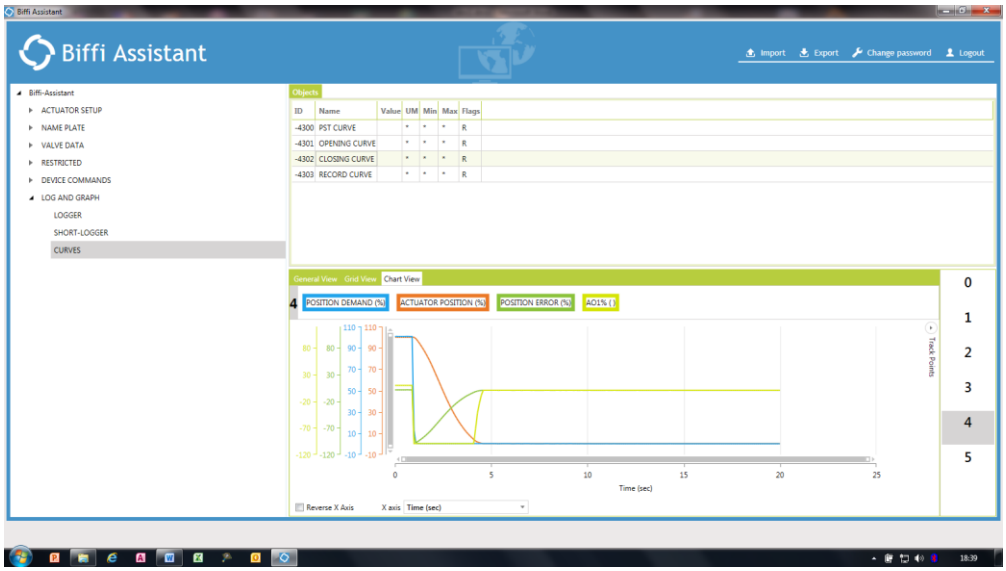
The figure shows the Y-t "Closing " **curve 0** (signature) available in the ECU1000 memory (CL-stroke).
The curve is viewed by selecting the option "Chart view". Use the left key of mouse to select the variable and to activate the "**Track points**". By the option "X axis" change to Y-X graph



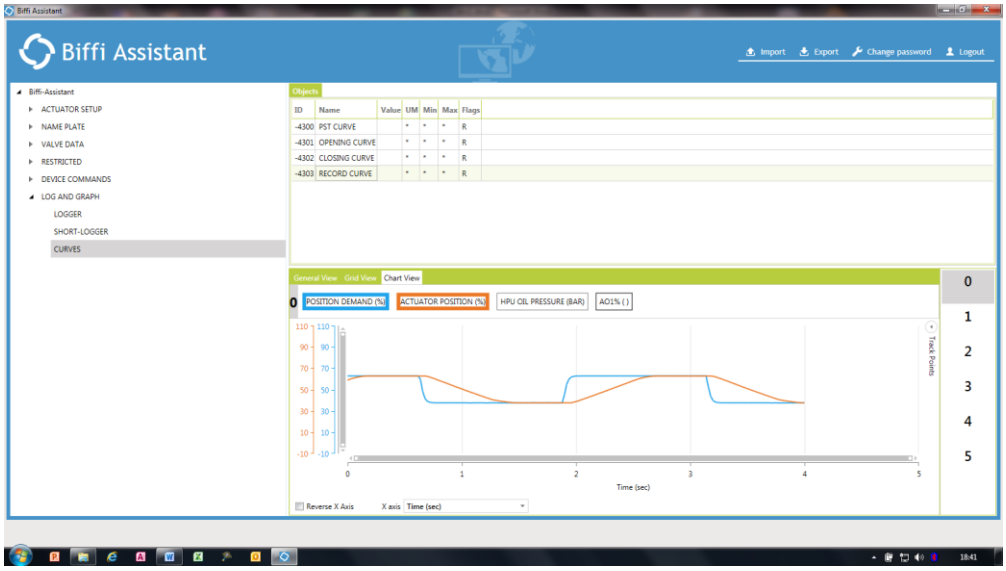
The figure shows the "Opening " **curve 0** (signature) available in the ECU1000 memory (OP-stroke). The point of the curve can be viewed by selecting the option "Grid view".



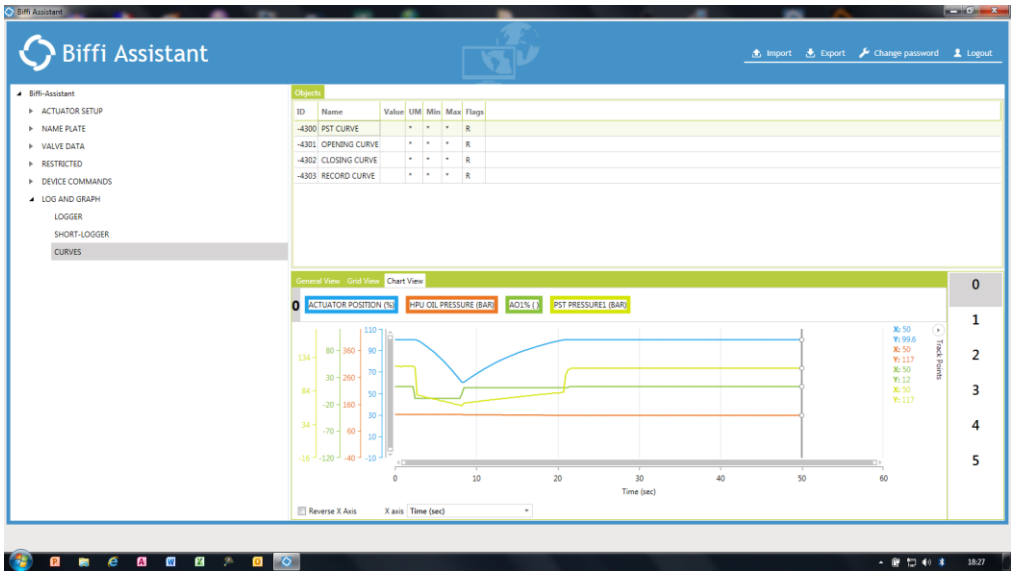
Only 2 curves at a time can be viewed. Each curve can have maximum 4 variables.
The figure shows the "Opening " **curve 0** (signature) and **curve 2,** 2 variables for each curve



The figure shows the "Closing"**curve 4,** 4 variables



The figure shows the "Record " **curve 0** (signature), 2 variables



The figure shows the "PST " **curve 0.** 4 variables are shown: actuator position, HPU pressure, AO1% and Pressure P1 of cylinder

Full screen view of PST curve in Y-X, X mode "reversed". Y= Pressure inside the cylinder in bar, X= actuator position %

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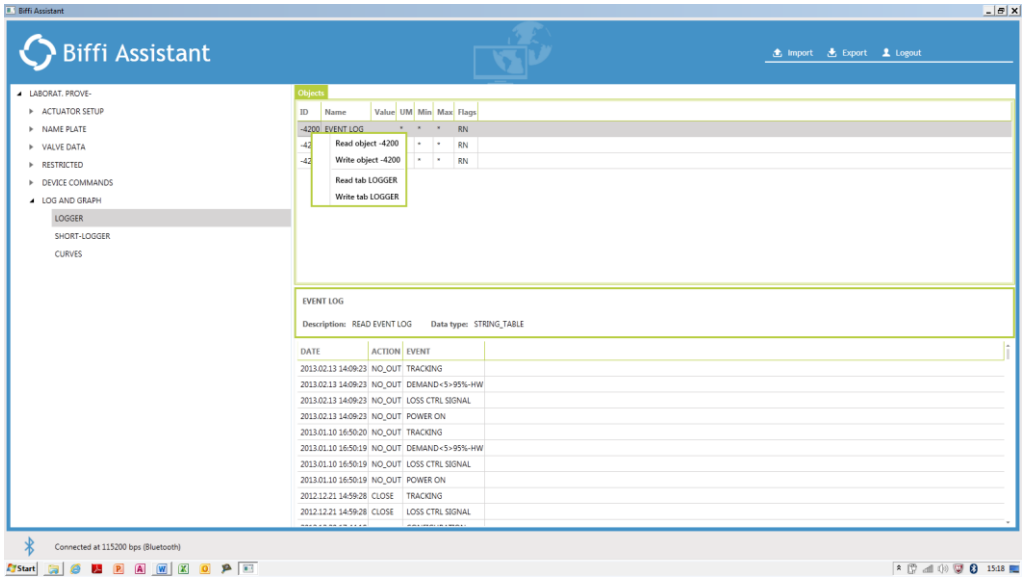
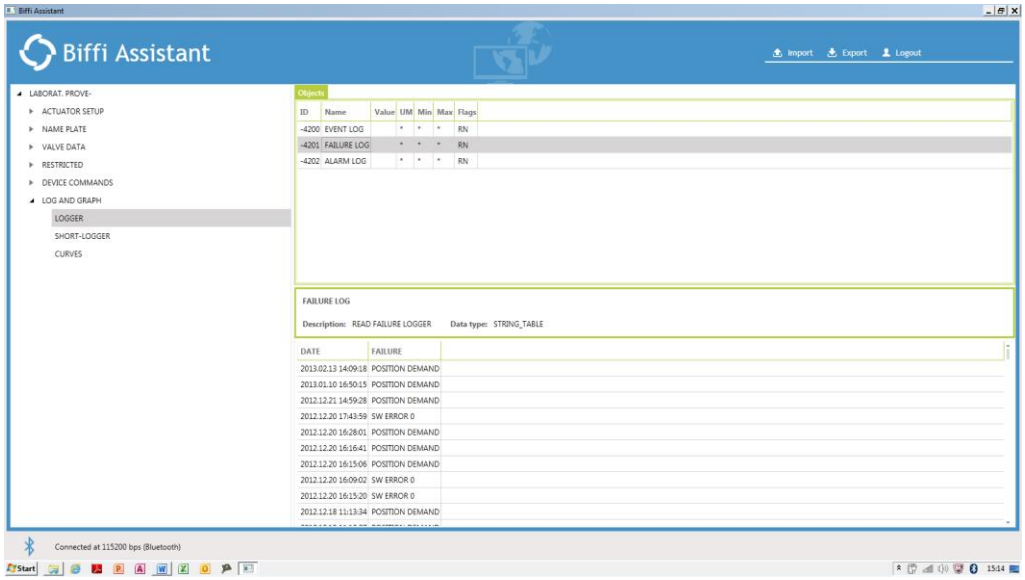
5 Logger

The function is available only by BIFFI-Assistant. The ECU1000 saves the **Event logger,** the **Failure logger** and the **Alarm logger** in the ECU1000 permanent memory. The saved data can be viewed as tables and exported only by BIFFI-Assistant SW tool. The loggers are not visible on the local Operator Interface due to small visible area of the display. This paragraph reports only the instruction of BIFFI-Assistant relevant to the Logger. Detailed instructions about the installation and operation of the BIFFI-Assistant are reported in the "BIFFI-Assistant Instruction Manual". Use the left key of mouse to select the line, use the right key of mouse to read / write the selected BLOCK, TAB, data. Each logger can be individually or with other data exported and saved in the PC memory. The list of Events, Failure and Alarms is reported in the manual DTDE327 "Actuator control and Local Operator Interface". The figures in the previous paragraph show how to use the BIFFI-Assistant SW tool.

5.1 Event, Failure and Alarm logger



The figure shows the **Event logger** saved in the ECU1000 memory. It may contain up to 256 events. When the memory is full and a new event occurs the oldest one is deleted. The table shows the name of event, the date of event and the action done by ECU1000 due to event.



The figure shows the **Failure logger** saved in the ECU1000 memory. It may contain up to 256 failures. When the memory is full and a new failure occurs the oldest one is deleted.

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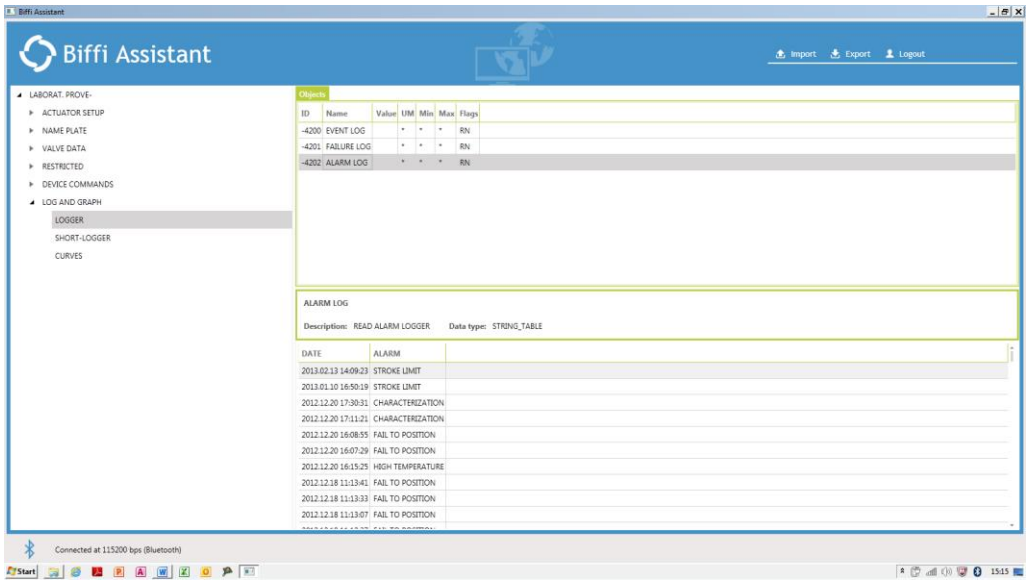
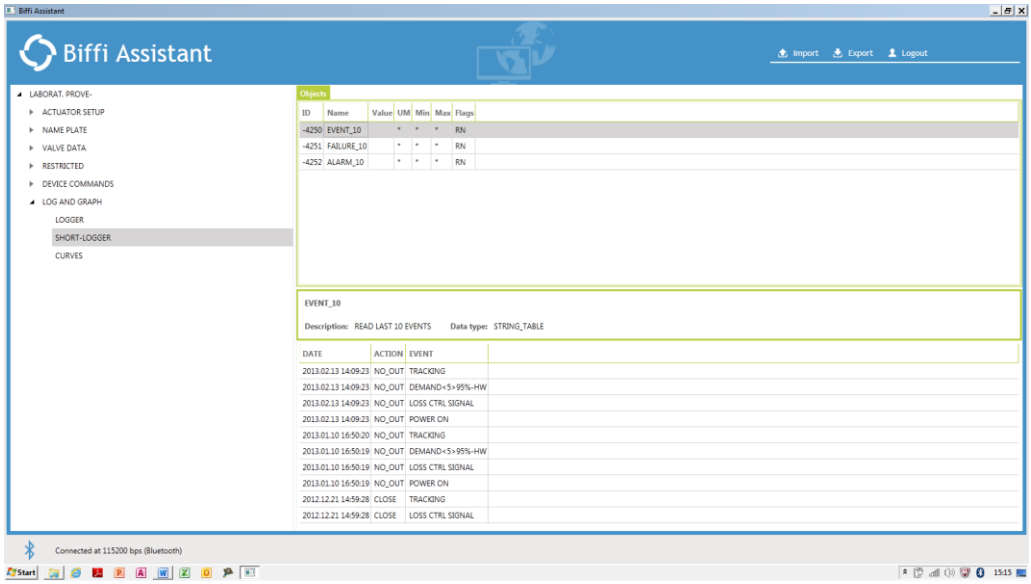


The figure shows the **Alarm logger** saved in the ECU1000 memory. It may contain up to 256 alarms. When the memory is full and a new alarm occurs the oldest one is deleted.

5.2 Short Event, Failure and Alarm logger



The figure shows the **short Event logger** saved in the ECU1000 memory. It contains the last 10 events. It is faster to read than the complete event logger.
The **short Failure logger** and the **short Alarm logger** have the same characteristics.

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6 PST Partial Stroke Test

6.1 General features

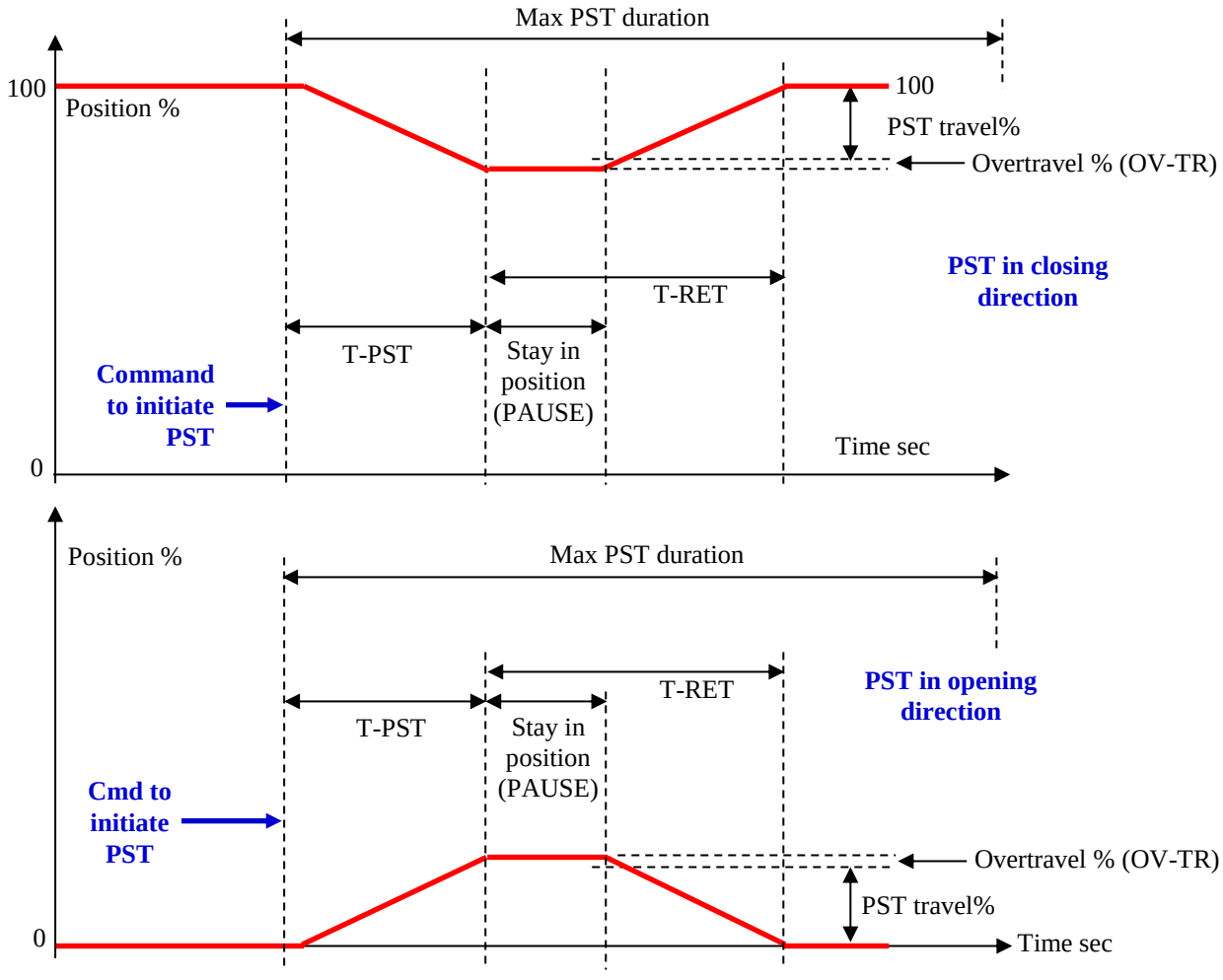
The function **P**artial **S**troke **T**est (**PST**) of ECU1000 is used to check the actuator and valve operation while they are in service in the pipeline. It is performed only if

- PST function was enabled (by manufacturer)
- the actuator is fully open or closed
- the actuator is not fully open or closed but the position is >98% or < 2%
- the actuator is not in local control mode (by Local Operator Interface)
- ESD command is off
- No FAILURE is present
- the actuator is
    - modulating under control of 4-20mA (AUTO-REM mode) and Position Demand is <2% or >100%
    - modulating and in manual mode (MAN-REM)
    - the actuator is on-off

The PST cycle (Partial Stroke Test) consists in the following steps:

- To drive the actuator to move the valve to the configured position (PST travel)
- To measure the time to reach the configured position (T-PST)
- To stop the actuator when the configured position is reached and measure the over-travel % (OV-TR)
- To stay in position for the configured PAUSE time
- To drive the actuator to move the valve to the initial position
- To measure the time to return to the initial position (T-RET)

The following figures show the actuator position% versus time in case of PST in closing and opening direction.



6.2 Parameters of Partial Stroke Test

The following parameters are available in the menu options "ACTUATOR SETUP, PST SETUP" of ECU1000 to set PST function:

a. PST START mode: OFF, MANUAL, AUTO, AUTO-MANUAL
   - OFF: the PST function is disabled
   - MANUAL: the PST cycle starts if one of the conditions 1 and 2 occurs
     1. ECU1000 receives a remote hardwired PST command (min duration 1 sec)
     2. ECU1000 receives the PST command from the Local Operator Interface in the menu option "ECU cmd, Device command"
   - AUTO: the PST cycle starts automatically if both the conditions 3 and 4 occur
     3. The time from the last PST cycle is equal to the parameter PST PERIOD
     4. The time of the day is equal to the parameter PST TIME (hh:mm:ss)
   - MAN-AUTO: the PST cycle starts if one of the condition 5 and 6 occurs
     5. Conditions 1. and 2. of MANUAL mode are satisfied
     6. Conditions 3. and 4. of AUTO mode are satisfied

b. PST PERIOD: time interval between PST's in days, configurable from 1 to 1000, in PST START="AUTO"

c. PST TIME: hour, minute and second to start the PST, in PST START="AUTO".

d. PST TRAVEL: position travel during PST cycle, in % of position, configurable from 1 to 40. If actuator is fully open it moves from 100% to "100-PST TRAVEL %", if actuator is fully closed it moves from 0% to "PST TRAVEL %"

e. MAX T-PST: max time to carry out the PST TRAVEL, measured in % of T-PST time of SIGNATURE, configurable from 0 to 1000%.

f. MAX PST T-RET: max time allowed to return to initial position, measured in % of T-RET time of SIGNATURE, configurable from 0 to 1000%

g. PAUSE: time of staying in position of actuator, in sec, configurable from 0 to 60 sec.

h. MAX PST OV-TR: max position over-travel during PST cycle, in percentage of position, configurable from 0 to 100.

i. MAX PST DURATION: max time to complete the PST cycle, configurable from 2 to 1000 sec.

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	PST setup		
		PST start (off, manual, auto, auto-manual)	2
		PST period (only in auto or auto-manual)	2
		PST time (only in auto or auto-manual)	2
		PST travel	2
		PST pause	2
		Max T-PST (% of signature)	2
		Max T-RET (% of signature)	2
		Max OV-TRAV (% of position)	2
		Max PST duration (sec)	2

6.3 Command to initiate the PST cycle

PST cycle initiates if the following conditions are satisfied:

- The conditions described in the par. 6.1 are satisfied
- The PST START mode is "MANUAL" and the ECU1000 receives the PST command
- The PST START mode is "AUTO" and the time to start automatically the cycle has arrived
- The PST START mode is "MAN-AUTO" and the ECU1000 receives the PST command or the time to start automatically the cycle has arrived

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6.4 Reset of PST cycle

PST cycle is aborted or not completed in the following conditions:

- FAILURE during the PST execution
- The time to complete the PST cycle is greater than the parameter "MAX PST DURATION"
- ESD command during the PST execution

6.5 PST reports

When the PST cycle is in progress the display of the Local Operator Interface shows the message "**PST**". The start of the PST cycle is saved in the Event logger as "**PST**"
When PST cycle ends, the ECU1000 compares the collected data with the configured setpoints "MAX T-PST, MAX PST T-RET, MAX PST, OV-TR. The following alarms are available:

Status	Description	Alarm	Note
Passed	Test OK		No message on the ECU1000 display
Reset	test aborted or not completed	PST	See reset conditions
T-PST	failed time T-PST	T-PST	See parameter MAX T-PST
T-RET	failed time T-RET	T-RET	See parameter MAX PST T-RET
OV-TR	PST over-travel	OV-TR	See parameter MAX PST OV-TR
Failed	at least two of T-PST, T-RET, OV-TR, Reset	Failed	

The Alarm can be viewed by the Local Operator Interface of ECU1000 or by a PC connected via Bluetooth interface.
The Alarms are also recorded in the Alarm log.

6.6 Remote signalling

The following conditions can be individually configured to switch the output relays.

- PST: PST cycle in progress
- PST failed: it summarizes T-PST, T-RET, OV-TR and Reset. The status of relay "PST failed" can be reset by a new PST command or by a manual reset of alarm via actuator Local Operator Interface (see manual DTDE327, paragraphs 19 and 20).

The manual DTDE327 in the paragraphs "Local Operator Interface" and "Output relay" provides the instructions to set the ECU1000 output relays.

Status relay table

Name	Description
Actuator status	
PST	PST function active
PST failed	PST result "failed/aborted"

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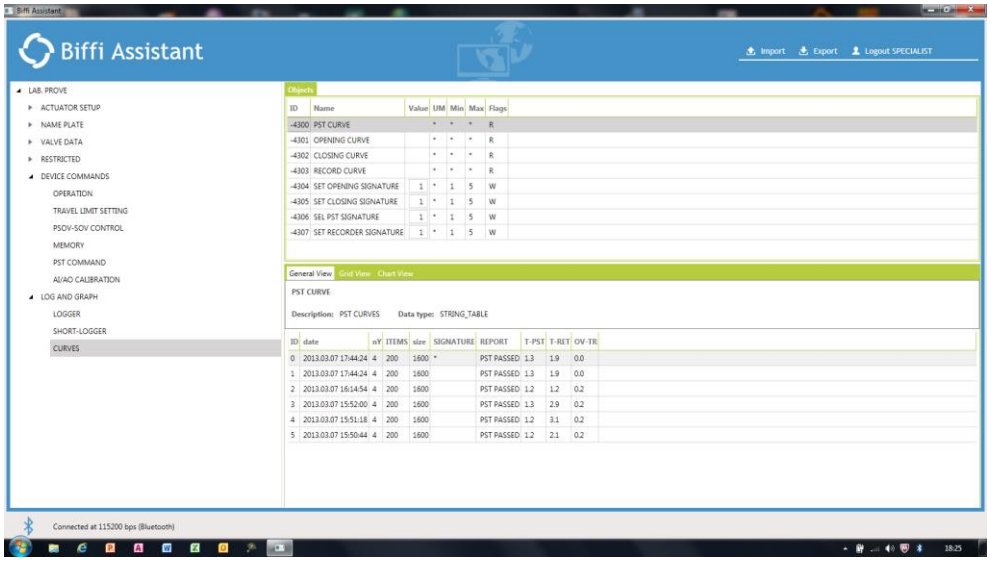
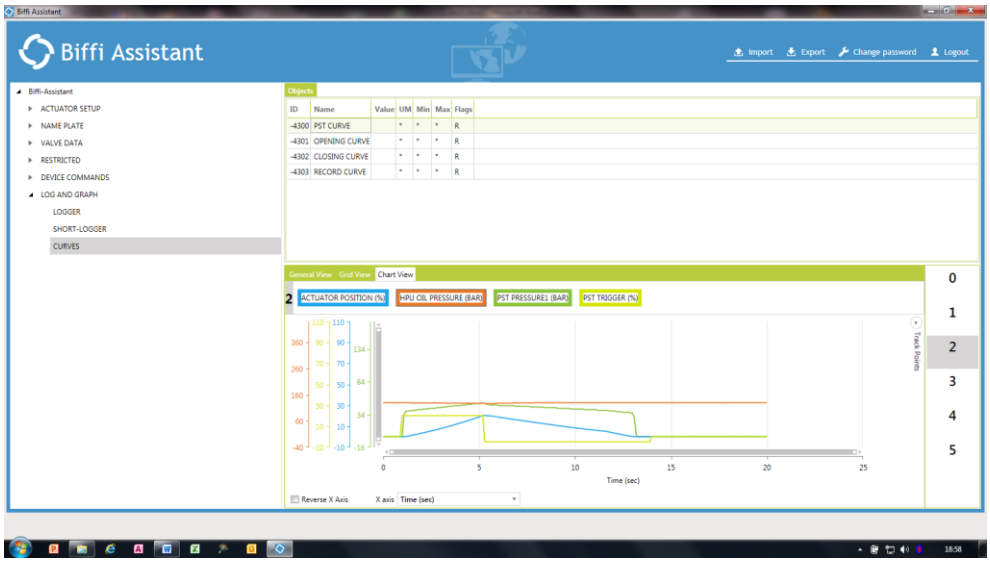
6.7 PST curves and PST signature

The Recorder function can save the profile of the PST cycle in the ECU1000 memory. It needs to configure Recorder mode "**PST**". The Recording duration should be greater than the estimated duration of PST cycle. The paragraph "**Recorder**", supplies the information to set the Recorder function.
During the PST cycle the ECU1000 samples and saves the Actuator Position%, the Time and the PST trigger. If the actuator is provided with transmitters of cylinder pressure (P1 and P2), the recorder saves also the profiles of the above pressures. The ECU1000 memory contains up to 5 PST profiles. When the memory is full and a new set of data is available the oldest profile is deleted and the new one is stored.
By the command "SELECT PST SIGNATURE", in the local operator interface, one "PST curve" can be copied in the "PST SIGNATURE" memory. The "PST SIGNATURE" cannot be modified; it can be updated only **by a new "SELECT PST SIGNATURE" command**.
By the comparison between the PST SIGNATURE and the PST curves, the ECU1000 can produce status and warning useful in maintenance operation.
By PC and BIFFI-Assistant software tool, the curves can be read from ECU1000 and then viewed and compared in a graph.



PST curve details



Example of PST in opening (**Y-t**)

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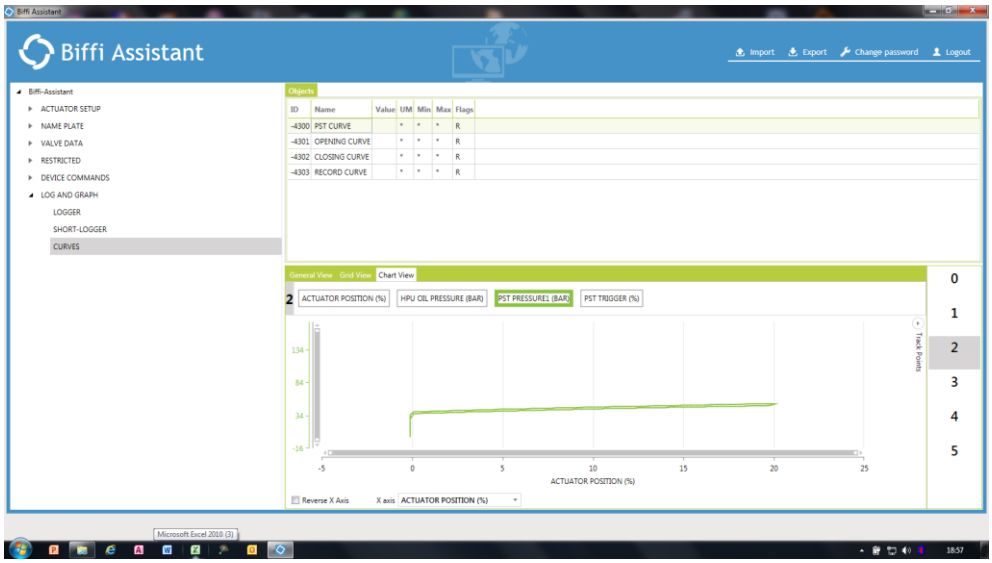

Example of PST in opening (**Y-X**), "Pressure in bar" versus "Actuator Position in %"

6.8 Procedure to initiate PST by local command

- Select the username, enter the password. Select **ECU cmd**
- By UP and DOWN select "**Device cmd**" and then press ENTER. By UP and DOWN select "**PST command**" and then press ENTER.
- By UP and DOWN select "**PST start**" and then press ENTER.
- By UP and DOWN move the cursor to "**PST start**" and then press ENTER.
- By UP and DOWN set "**ON**" and then press ENTER.
- By UP and DOWN select the line "**..**" and then press ENTER. Repeat the procedure to return to HOME VIEW.

Function block	Function TAB	Command	Psw level
Device cmd			
	PST command		
		PST start (off-on)	2

6.9 Procedure to select the PST SIGNATURE

- Select the username, enter the password. Select **ECU cmd**
- By UP and DOWN select "**Log and Graph**" and then press ENTER. By UP and DOWN select "**Curves**" and then press ENTER.
- By UP and DOWN select the parameter "**Select PST signature**" and then press ENTER. By UP and DOWN select the number of the curve to be saved as signature, then press ENTER.
- By UP and DOWN select the line "**..**" and then press ENTER. Repeat the procedure to return to HOME VIEW.

Function block	Function TAB	Command	Psw level
Device cmd			
Log and graph			
	Curves		
			1
			1
			1
		Select PST signature	1

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7 HPU control

7.1 General features

Input to control the HPU:

- 4-20mA HPU oil pressure input signal
- Digital inputs,to set optocoupled, max 30Vdc, available for optional HPU on-off sensors

Output to HPU Hydraulic Power Unit:

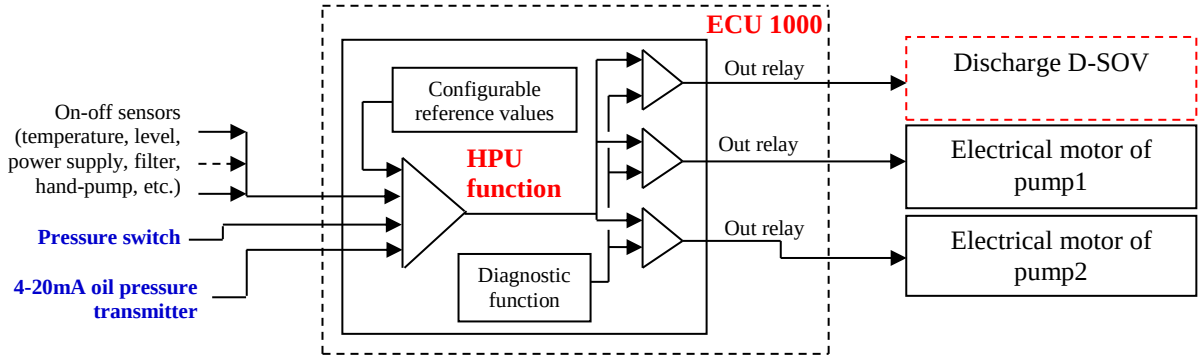
- Output by relay: SPST voltage free contacts, max 30Vdc/230Vac/1A (110Vdc/0.15A) to drive the contactor of pump1 motor
- Output by relay: SPST voltage free contacts, max 30Vdc/230Vac/1A (110Vdc/0.15A) to drive the contactor of pump2 motor (in case of dual pump)
- Output by relay: SPST voltage free contacts, max 30Vdc/230Vac/1A (110Vdc/0.15A) to drive the discharge SOV (in case of modulating actuator)

HPU type:

- HPU with 1 or 1 electrical pumps, Discharge SOV, 4-20mA pressure transmitter, optional pressure switch
- HPU with 1 or 2 electrical pumps and 4-20mA pressure transmitter, optional pressure switch
- HPU with 1 electrical pump and pressure switch
- HPU with 1 or 2 electrical pump, 4-20mA pressure transmitter, optional pressure switch, unloading relief valve

7.2 Function description

The HPU control function can be activated only by the manufacture. The type of control depends on the hydraulics of HPU. By the Local Operator Interface the end user can set the parameters to manage the HPU operations. The following figure shows the block diagram of HPU function.



Depending on the HPU hydraulics, the ECU1000 can control the HPU pressure

- By a **4-20mA analogue pressure transmitter** or
- By a **pressure switch** or
- By **4-20mA analogue pressure transmitter** and **pressure switch**
  - in case of failure of 4-20mA transmitter the ECU1000 works with the pressure switch

If redundancy of pumps is requested the ECU1000 can control **two electrical pumps** in two modes:

- **cyclic**: one pump at a time works, the ECU1000 switches from the running pump to the other one in case of malfunction or at the end of the configured cycle time
- **master-slave**: one pump at a time works, the ECU1000 switches from the master pump to the slave one in case of malfunction. A selector switch is needed to choose the master pump.

The **Discharge D-SOV** is present only in the HPU's in heavy working service with low drain proportional/PSOV valves and allows to by-pass the pump when the oil pressure reaches the **working pressure**. The SOV is released when the pressure is lower than the preset low limit to allow the pump charging the accumulator. The minimum on time of the pump is 2 sec. Optional **on-off sensors** can be added to monitor the HPU status and generate "**alarm (out of spec)**" conditions. The list of the optional on-off sensors is below

- Oil Level
- High oil temperature
- Oil filter
- Loss of main power supply
- High motor temperature
- General on-off sensors
- Hand-pump

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The max number of sensors, transmitters and commands is limited by the hardware characteristics of ECU1000, described in the document DTDE326 and DTDE 327 (11 digital inputs, 11 output relays, 5 analogue inputs, etc.). Configuration and diagnostic operations of HPU are available by the Local Operator Interface of ECU1000. Upon request, the ECU1000 cabinet can be provided with **8 additional LED's** to show HPU status. The complete list of the available conditions is in the paragraph "**Output relay**, **Status Relay table**" of manual DTDE327. The table below lists only the conditions related to HPU.

Status relay table

Name	Description
HPU status summary	
Pump1 alarm	It collects all alarms of HPU and pump1 (See table 15.3)
Pump 2 alarm	It collects all alarms of HPU and pump2 (See table 15.3)
HPU status	
Pump 1 motor on	Motor of pump1 on
Pump 2 motor on	Motor of pump2 on
Discharge SOV on (DSOV)	Discharge SOV on
HPU malfunction / Out of spec	
HPU pres. transm.	Pressure transmitter of HPU out of range
High oil pressure	Oil pressure > reference
Low oil pressure	Oil pressure < reference
Oil temperature (high)	High oil temperature
Oil level (low level)	Low oil level
HPU gener. sens.	General on-off sensor of HPU
Hand-pump	Hand-pump operation
HPU sign sw	HPU signalling on-off sensor (for instance " HPU oil filter")
Pump1 power sup.	Failure of electrical power supply of pump1 motor
Pump1 mot. TH (motor temperature)	High temperature of pump1 motor
Pump1 filter	Clogged filter of pump1
Gener. sens. pump1	General sensor of pump1
Max time pump1	Time to reach the working pressure > reference time "Max time to pressure"
Pump2 mot. Sup. (electrical power supply)	Failure of electrical power supply of pump2 motor
Pump2 mot. TH (motor temperature)	High temperature of pump2 motor
Pump2 filter	Clogged filter of pump2
Gener. sens. pump2	General sensor of pump2
Max time pump2	Time to reach the working pressure > reference time "Max time to pressure"

The next paragraphs describe the operation of the available HPU controls.

7.3 HPU in heavy service for modulating actuators

7.3.1 1 pump, intermittent service, 4-20mA pressure transmitter, discharge D-SOV

The following parameters are available in the menu "Actuator setup, Pump control"

Pump1 mode: it allows selecting the operating mode of Pump

- Off: the pump does not work
- Auto: the pump works

Pump stop delay: it is the time without any command or with actuator position error < 3%. After the above time the pump is stopped. It can be configured from 0 to 255 sec, but the value should be great enough to avoid frequent restarts of pump (for instance 30 sec).

Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.

Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.

Pump2 mode and **Pump cycle** are not used.

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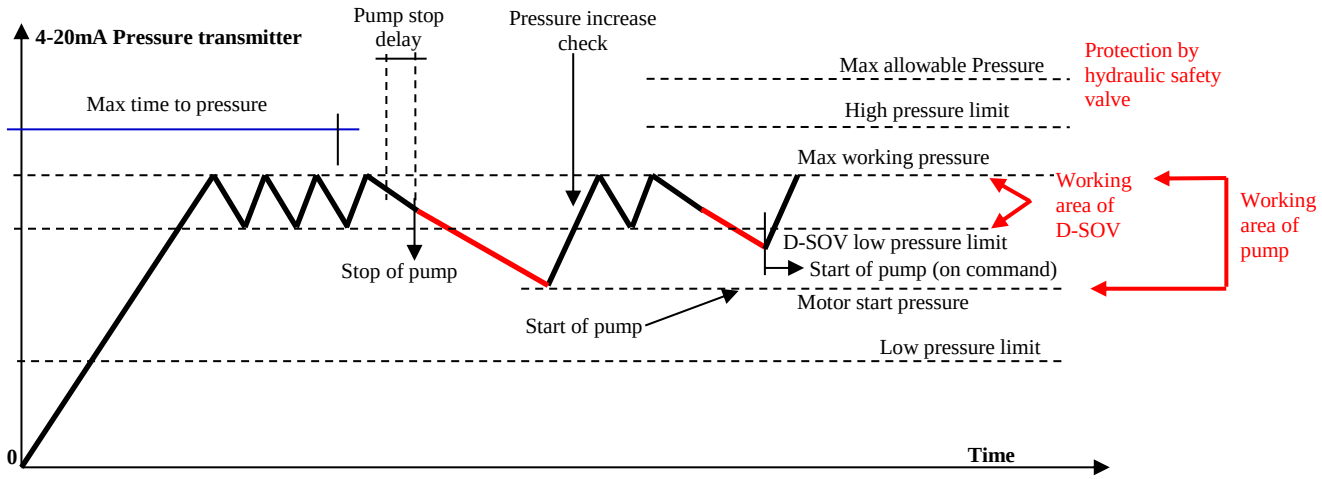
Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
		Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Other not used parameters	

The following figure shows the working cycle of the HPU pump, in AUTO mode. The motor pump starts by pressure and command. The max pressure of HPU should be limited by a hydraulic safety valve limiting the HPU pressure below the "Max allowable Pressure".



When HPU pressure is equal to "**Max working pressure**" the Discharge SOV is activated. The pump still runs, but the pressure stops increasing. The Discharge SOV is released when the HPU pressure becomes lower than "**D-SOV low pressure limit**" and pressure can increase again up to "Max working pressure". The pump stops if

- The Position error signal is less than 3% for the time "**Pump stop delay**"
- No command is sent to ECU100 (ESD, PST, etc.) for the time "**Pump stop delay**"

The pump restarts if

- The HPU pressure is lower than "**Motor start pressure**"
- The position error is>3% or a new command is sent to ECU1000 (ESD, PST, etc.) and the pressure is lower than "**Max working pressure**"

If the HPU pressure rises over the "High pressure limit" the ECU1000 stops the motor of pump and generates an Alarm
If the HPU pressure gets down the "Low pressure limit" the ECU1000 generates an Alarm.

The following tables show the HPU/Pump malfunctions detected by the ECU1000.
The "HPU/Pump malfunctions" are listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph "Actuator malfunction tables") and can exit only if the HPU control is on. The column "Signalling relay" shows the conditions that can be individually linked to the output relays of the ECU1000 by means of the menu options.

Malfunctions of HPU

Name of malfunction	Description	Pump control	Pump Alarm	Signalling relay
HPU pres. transm.	Pressure transmitter of HPU signal out of range	**Pump1 off**	x	x
High oil pressure	Oil pressure > high pressure limit	**Pump1 off**	x	x
Low oil pressure	Oil pressure < low pressure limit	Regular operation	x	x
Oil level (low)	Oil level sensor = on	**Pump1 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
Max start D-SOV	Starts of Discharge SOV (D-SOV) > reference	Regular operation	x	NO
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

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Malfunctions of pump

Name of malfunction	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off**	x	x
Pump1 filter	Oil filter sensor of pump1=on	Regular operation	x	x
Gener. sens. Pump1	General on-off sensor of pump1=on	**Pump1 off**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off** or **run** **(2)**	x	x
Max start pump1	Starts of motor of pump1 > reference	Regular operation	x	NO

(1) Max time pump1: it exits if one of the following conditions occurs:

- the oil pressure is lower than the "Max working pressure" after the time "Max time to pressure" (set by the user)
- the "pressure increase" (bar/min) is less than the parameter "Min pressure increase" (set by the manufacturer). The function "pressure increase" measures the pressure change only if the actuator is in stable position (position error within 3%), the pump is on and D-SOV off

(2) The pump control can be configured to **"the motor stops"** or **"the motor runs"** when the alarm occurs.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in DTDE327).
On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".
The malfunctions to set in "**HPU failure**" are: "HPU pres. transm.", "high oil pressure", "low oil pressure", "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1 power sup**, **pump1 mot. TH**, **Gener. Sens. Pump1**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".

7.3.2 2 pumps, intermittent service, 4-20mA pressure transmitter, Discharge D-SOV, cycle mode

One pump at a time works. The following parameters are available in the menu "Actuator setup, Pump control".
Pump1 mode: it allows selecting the operating mode of Pump1

- Off: the pump1 does not work
- Auto: the pump1 works

Pump stop delay: it is the interval of time without any command or with actuator position error < 3%. After the above time the pump is stopped. It can be configured from 0 to 255 sec, but the value should be great enough to avoid frequent restarts of pump (for instance 20 sec). The parameter works only if the Pump1 mode is "Auto".
Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.
Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1** and **Max time pump2**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.
Pump2 mode:

- Off: the pump2 does not work
- Auto: the pump2 works

Pump cycle: it sets the working time of each pump, from 1 to 10000 h. If both pumps are in AUTO, after the "Pump cycle" the running pump stops and after 4 sec the second pump starts.

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
		Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Pump2 mode (auto, off)	2
		Pump cycle (1-10000 h)	1

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The switch from one pump to the other one can be

- **Manual**: the working pump is selected by setting the parameter Pump1 mode and Pump2 mode (for instance Pump1 mode=off and Pump2 mode=Auto and viceversa)
- **Automatic**: in case of malfunction of one pump or at the end of the configured "**Pump cycle**"

Each pump works as described in the paragraph 7.3.1. The ECU1000 controls the D-SOV and two pumps instead of only one. The 4-20mA pressure transmitter, oil level sensor, oil temperature sensor are common in both pumps.
The following tables show the HPU/Pumps malfunctions detected by the ECU1000. They are also listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph Actuator malfunction tables). The column "Signalling relay" shows the conditions that can be individually linked to the output relays of the ECU1000 by means of the menu options.

Malfunctions of HPU

Name	Description	Pump control	Pump Alarm	Signalling relay
HPU pres. transm.	Oil pressure transmitter out of range	**Pump1 and 2 off**	x	x
High oil pressure	Oil pressure > high pressure limit	**Pump1 and 2 off**	x	x
Low oil pressure	Oil pressure < low pressure limit	Regular operation	x	x
Oil level (low)	Oil level switch = on	**Pump1 and 2 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 and 2 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 and 2 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
Max start D-SOV	Starts of Discharge SOV > reference	Regular operation	x	NO
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

Malfunctions of pumps

Name	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 filter	Oil filter sensor=on	**Pump1 off ,** switch to pump2 **(5)**	x	x
Gener. sens. pump1	General on-off sensor of pump1=on	**Pump1 off,** switch to pump2 **(2)**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off,** switch to pump2 **(3)**	x	x
Max start pump1	Starts of motor of pump1 > reference	**Pump1 off ,** switch to pump2 **(4)**	x	NO
Pump2 power sup. (electrical power)	Loss of power supply of pump2 motor	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 mot. TH	Motor thermostat of pump2=on	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 filter	Oil filter sensor=on	**Pump2 off ,** switch to pump1 **(5)**	x	x
Gener. sens. pump2	General on-off sensor of pump2=on	**Pump2 off,** switch to pump1 **(2)**	x	x
Max time pump2 **(1)**	Max time to reach the pressure (pump2)	**Pump2 off,** switch to pump1 **(3)**	x	x
Max start pump2	Starts of motor of pump2 > reference	**Pump2 off ,** switch to pump1 **(4)**	x	NO

(1) Max time pump1 and 2: they are due to one of the following conditions:

- the oil pressure is lower than the "Max working pressure" after the time "Max time to pressure" (set by the user)
- the "pressure increase" (bar/min) is less than the parameter "Min pressure increase" (set by the manufacturer). The function "pressure increase" measures the pressure change only if the actuator is in stable position (position error within 3%), the pump is on and D-SOV off.

(2) If both pumps are in Alarm both **Pumps are off.**
(3) If the alarm occurs the running pump switches to off and the second pump starts. If the alarm occurs also with the second pump, "**the motor stops**" or "**the motor runs**" according to the configuration of the ECU1000.
(4) If both pumps are in "**Max start alarm"** the running pump continues to work.
(5) If both pumps are in "**Pump filter" alarm** the running pump continues to work.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in the DTDE327. The above tables and notes describe the condition to switch the pumps due to alarm
On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".
The malfunctions to set in "**HPU failure**" are: "HPU pres. transm.", "high oil pressure", "low oil pressure", "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1/2 power sup**, **pump1/2 mot. TH**, **Gener. Sens. Pump1/2**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".

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7.3.3 2 pumps, intermittent service, 4-20mA pressure transmitter, Discharge D-SOV, master-slave mode

One pump at a time works. A 3-position "**PUMP1/OFF/PUMP2**" selector is requested to set the pump master.
In "**OFF"** both pumps are off.
In "**PUMP1"** the pump1 works. The pump2 starts in case of alarm of pump1. A further switch to pump1 is not allowed.
In "**PUMP2"** the pump2 works. The pump1 starts in case of alarm of pump2. A further switch to pump2 is not allowed.
The following parameters are available in the menu "Actuator setup, Pump control" of ECU1000.
Pump1 mode: it allows selecting the operating mode of Pump1

- Off: the pump1 does not work
- Auto: the pump1 works

Pump stop delay: it is the interval of time without any command or with actuator position error < 3%. After the above time the pump is stopped. It can be configured from 0 to 255 sec, but the value should be great enough to avoid frequent restarts of pump (for instance 20 sec). The parameter works only if the Pump1 mode is "Auto".
Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.
Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1**and **Max time pump2**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.
Pump2 mode:

- Off: the pump2 does not work
- Auto: the pump2 works

Pump cycle: not used

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
		Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Pump2 mode (auto, off)	2

The switch of pumps is

- Manual: by the selector "**PUMP1/OFF/PUMP2**"
- Automatic: in case of malfunction of one pump

Each pump works as described in the paragraph 7.3.1. The ECU1000 controls the D-SOV and two pumps instead of only one. The 4-20mA pressure transmitter, oil level sensor, oil temperature sensor are common in both pumps.
The following tables show the HPU/Pumps malfunctions detected by the ECU1000. They are also listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph Actuator malfunction tables). The column "Signalling relay" shows the conditions that can be individually linked to the output relays of the ECU1000 by means of the menu options.

Malfunctions of HPU

Name	Description	Pump control	Pump Alarm	Signalling relay
HPU pres. transm.	Oil pressure transmitter out of range	**Pump1 and 2 off**	x	x
High oil pressure	Oil pressure > high pressure limit	**Pump1 and 2 off**	x	x
Low oil pressure	Oil pressure < low pressure limit	Regular operation	x	x
Oil level (low)	Oil level switch = on	**Pump1 and 2 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 and 2 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 and 2 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
Max start D-SOV	Starts of Discharge SOV > reference	Regular operation	x	NO
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

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Malfunctions of pumps with selector in PUMP1 (pump1 master)

Name	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 filter	Oil filter sensor=on	**Pump1 off ,** switch to pump2 **(5)**	x	x
Gener. sens. pump1	General on-off sensor of pump1=on	**Pump1 off,** switch to pump2 **(2)**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off,** switch to pump2 **(3)**	x	x
Max start pump1	Starts of motor of pump1 > reference	**Pump1 off ,** switch to pump2 **(4)**	x	NO
Pump2 power sup. (electrical power)	Loss of power supply of pump2 motor	**Pump2 off (2)**	x	x
Pump2 mot. TH	Motor thermostat of pump2=on	**Pump2 off (2)**	x	x
Pump2 filter	Oil filter sensor=on	Regular operation	x	x
Gener. sens. pump2	General on-off sensor of pump2=on	**Pump2 off (2)**	x	x
Max time pump2 **(1)**	Max time to reach the pressure (pump2)	**Pump2 off (3)**	x	x
Max start pump2	Starts of motor of pump2 > reference	**Pump2 off (4)**	x	NO

Malfunctions of pumps with selector in PUMP2 (pump2 master)

Name	Description	Pump control	Pump Alarm	Signalling relay
Pump2 power sup (electrical power)	Loss of power supply of pump2 motor	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 mot. TH	Motor thermostat of pump2=on	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 filter	Oil filter sensor=on	**Pump2 off ,** switch to pump1 **(5)**	x	x
Gener. sens. Pump2	General on-off sensor of pump2=on	**Pump2 off,** switch to pump1 **(2)**	x	x
Max time pump2 **(1)**	Max time to reach the pressure (pump2)	**Pump2 off,** switch to pump1 **(3)**	x	x
Max start pump2	Starts of motor of pump2 > reference	**Pump2 off ,** switch to pump1 **(4)**	x	NO
Pump1 power sup. (electrical power)	Loss of power supply of pump1 motor	**Pump1 off (2)**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off (2)**	x	x
Pump1 filter	Oil filter sensor=on	Regular operation	x	x
Gener. sens. Pump1	General on-off sensor of pump1=on	**Pump1 off (2)**	x	x
Max time pump1	Max time to reach the pressure (pump1)	**Pump1 off (3)**	x	x
Max start pump1 **(1)**	Starts of motor of pump1 > reference	**Pump1 off (4)**	x	NO

(1) Max time pump1 and 2: they are due to one of the following conditions:

- the oil pressure is lower than the "Max working pressure" after the time "Max time to pressure" (set by the user)
- the "pressure increase" (bar/min) is less than the parameter "Min pressure increase" (set by the manufacturer). The function "pressure increase" measures the pressure change only if the actuator is in stable position (position error within 3%), the pump is on and D-SOV off.

(2) If both pumps are in Alarm both **Pumps are off.**
(3) If the alarm occurs the running pump switches to off and the second pump starts. If the alarm occurs also with the second pump, "**the motor stops**" or "**the motor runs**" according to the configuration of the ECU1000.
(4) If both pumps are in "**Max start alarm"** the running pump continues to work.
(5) If both pumps are in "**Pump filter" alarm** the running pump continues to work.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in the DTDE327. The above tables and notes describe the condition to switch the pumps due to alarm.
On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".
The malfunctions to set in "**HPU failure**" are: "HPU pres. transm.", "high oil pressure", "low oil pressure", "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1/2 power sup**, **pump1/2 mot. TH**, **Gener. Sens. Pump1/2**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".

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7.3.4 1 pump, continuous service, 4-20mA pressure transmitter, discharge D-SOV

The following parameters are available in the menu "Actuator setup, Pump control"

Pump1 mode: it allows selecting the operating mode of Pump

- Off: the pump does not work
- Auto: the pump works

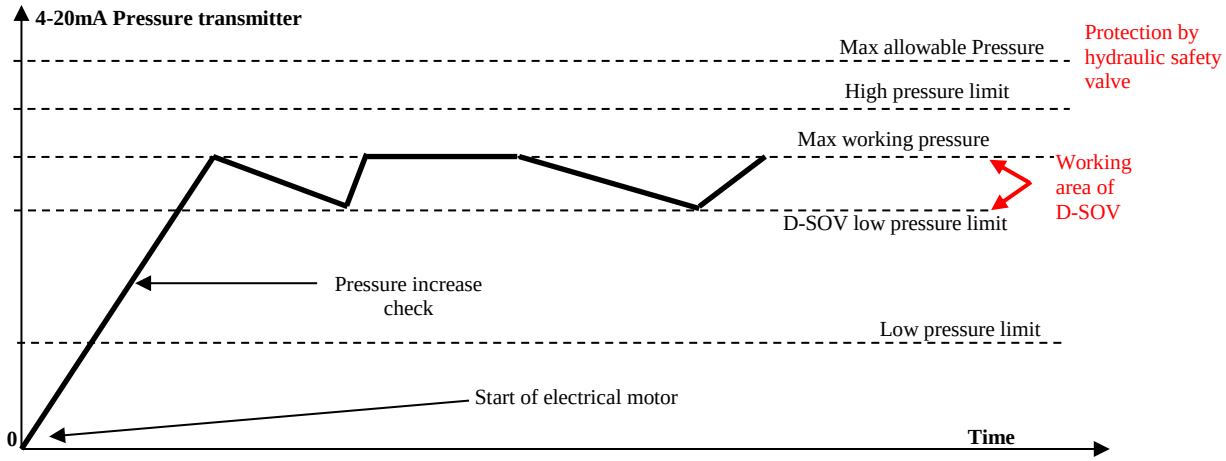
Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.

Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.

Pump2 mode, Pump stop delay and **Pump cycle** are not used.

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
	Not used	Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Other not used parameters	

The following figure shows the working cycle of the HPU pump, in AUTO mode. The motor pump starts as it is powered. The max pressure of HPU should be limited by a hydraulic safety valve limiting the HPU pressure below the "Max allowable Pressure".



When the HPU pressure is equal to "**Max working pressure**" the Discharge D-SOV is activated. The pump still runs, but the pressure stops increasing. The Discharge D-SOV is released when the HPU pressure becomes lower than "**D-SOV low pressure limit**". The pump does not stop.

If the HPU pressure rises over the "High pressure limit" the ECU1000 stops the motor of pump and generates an Alarm

If the HPU pressure gets down the "Low pressure limit" the ECU1000 generates an Alarm.

The following tables show the HPU/Pump malfunctions detected by the ECU1000.

The "HPU/Pump malfunctions" are listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph "Actuator malfunction tables") and can exit only if the HPU control is on. The column "Signalling relay" shows the conditions that can be individually linked to the output relays of the ECU1000 by means of the menu options.

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Malfunctions of HPU

Name of malfunction	Description	Pump control	Pump Alarm	Signalling relay
HPU pres. transm.	Pressure transmitter of HPU signal out of range	**Pump1 off**	x	x
High oil pressure	Oil pressure > high pressure limit	**Pump1 off**	x	x
Low oil pressure	Oil pressure < low pressure limit	Regular operation	x	x
Oil level (low)	Oil level sensor = on	**Pump1 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
Max start D-SOV	Starts of Discharge SOV (D-SOV) > reference	Regular operation	x	NO
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

Malfunctions of pump

Name of malfunction	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off**	x	x
Pump1 filter	Oil filter sensor of pump1=on	Regular operation	x	x
Gener. sens. Pump1	General on-off sensor of pump1=on	**Pump1 off**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off** or **run** **(2)**	x	x
Max start pump1	Starts of motor of pump1 > reference	Regular operation	x	NO

(1) Max time pump1: it exits if one of the following conditions occurs:

- the oil pressure is lower than the "Max working pressure" after the time "Max time to pressure" (set by the user)
- the "pressure increase" (bar/min) is less than the parameter "Min pressure increase" (set by the manufacturer). The function "pressure increase" measures the pressure change only if the actuator is in stable position (position error within 3%), the pump is on and D-SOV is off.

(2) The pump control can be configured to **"the motor stops"** or **"the motor runs"** when the alarm occurs.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in DTDE327).
On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".
The malfunctions to set in "**HPU failure**" are: "HPU pres. transm.", "high oil pressure", "low oil pressure", "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1 power sup**, **pump1 mot. TH**, **Gener. Sens. Pump1**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".

7.3.5 2 pumps, continuous service, 4-20mA pressure transmitter, Discharge D-SOV, cycle mode

One pump at a time works. The following parameters are available in the menu "Actuator setup, Pump control".
Pump1 mode: it allows selecting the operating mode of Pump1

- Off: the pump1 does not work
- Auto: the pump1 works

Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.
Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1**and **2**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.
Pump2 mode:

- Off: the pump2 does not work
- Auto: the pump2 works

Pump cycle: it sets the working time of each pump, from 1 to 10000 h. If both pumps are in AUTO, after the "Pump cycle" the running pump stops and after 4 sec the second pump starts.
Pump stop delay: not used

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Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
		Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Pump2 mode (auto, off)	2
		Pump cycle (1-10000 h)	1

The switch from one pump to the other one can be

- **Manual**: the working pump is selected by setting the parameter Pump1 mode and Pump2 mode (for instance Pump1 mode=off and Pump2 mode=Auto and viceversa)
- **Automatic**: in case of malfunction of one pump or at the end of the configured "**Pump cycle**"

Each pump works as described in the paragraph 7.3.4. The ECU1000 controls the D-SOV and two pumps instead of only one. The 4-20mA pressure transmitter, oil level sensor, oil temperature sensor are common in both pumps.
The following tables show the HPU/Pumps malfunctions detected by the ECU1000. They are also listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph Actuator malfunction tables). The column "Signalling relay" shows the conditions that can be individually linked to the output relays of the ECU1000 by means of the menu options.

Malfunctions of HPU

Name	Description	Pump control	Pump Alarm	Signalling relay
HPU pres. transm.	Oil pressure transmitter out of range	**Pump1 and 2 off**	x	x
High oil pressure	Oil pressure > high pressure limit	**Pump1 and 2 off**	x	x
Low oil pressure	Oil pressure < low pressure limit	Regular operation	x	x
Oil level (low)	Oil level switch = on	**Pump1 and 2 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 and 2 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 and 2 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
Max start D-SOV	Starts of Discharge SOV > reference	Regular operation	x	NO
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

Malfunctions of pumps

Name	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 filter	Oil filter sensor=on	**Pump1 off ,** switch to pump2 **(5)**	x	x
Gener. sens. pump1	General on-off sensor of pump1=on	**Pump1 off,** switch to pump2 **(2)**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off,** switch to pump2 **(3)**	x	x
Max start pump1	Starts of motor of pump1 > reference	**Pump1 off ,** switch to pump2 **(4)**	x	NO
Pump2 power sup. (electrical power)	Loss of power supply of pump2 motor	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 mot. TH	Motor thermostat of pump2=on	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 filter	Oil filter sensor=on	**Pump2 off ,** switch to pump1 **(5)**	x	x
Gener. sens. pump2	General on-off sensor of pump2=on	**Pump2 off,** switch to pump1 **(2)**	x	x
Max time pump2 **(1)**	Max time to reach the pressure (pump2)	**Pump2 off,** switch to pump1 **(3)**	x	x
Max start pump2	Starts of motor of pump2 > reference	**Pump2 off ,** switch to pump1 **(4)**	x	NO

(1) Max time pump1 and 2: they are due to one of the following conditions:

- the oil pressure is lower than the "Max working pressure" after the time "Max time to pressure" (set by the user)
- the "pressure increase" (bar/min) is less than the parameter "Min pressure increase" (set by the manufacturer). The function "pressure increase" measures the pressure change only if the actuator is in stable position (position error within 3%), the pump is on and D-SOV off.

(2) If both pumps are in Alarm both **Pumps are off.**
(3) If the alarm occurs the running pump switches to off and the second pump starts. If the alarm occurs also with the second pump, "**the motor stops**" or "**the motor runs**" according to the configuration of the ECU1000.
(4) If both pumps are in "**Max start alarm"** the running pump continues to work.
(5) If both pumps are in "**Pump filter" alarm** the running pump continues to work.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in the DTDE327. The above tables and notes describe the condition to switch the pumps due to alarm

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On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".
The malfunctions to set in "**HPU failure**" are: "HPU pres. transm.", "high oil pressure", "low oil pressure", "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1/2 power sup**, **pump1/2 mot. TH**, **Gener. Sens. Pump1/2**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".

7.3.6 2 pumps, continuous service, 4-20mA pressure transmitter, Discharge D-SOV, master-slave mode

One pump at a time works. A 3-position "**PUMP1/OFF/PUMP2**" selector is requested to set the pump master.
In "**OFF"** both pumps are off.
In "**PUMP1"** the pump1 works. The pump2 starts in case of alarm of pump1. A further switch to pump1 is not allowed.
In "**PUMP2"** the pump2 works. The pump1 starts in case of alarm of pump2. A further switch to pump2 is not allowed.
The following parameters are available in the menu "Actuator setup, Pump control" of ECU1000.
Pump1 mode: it allows selecting the operating mode of Pump1

- Off: the pump1 does not work
- Auto: the pump1 works

Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.
Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1** and **Max time pump2**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.
Pump2 mode:

- Off: the pump2 does not work
- Auto: the pump2 works

Pump cycle and **Pump stop delay:** not used

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
		Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Pump2 mode (auto, off)	2

The switch of pumps is

- Manual: by the selector "**PUMP1/OFF/PUMP2**"
- Automatic: in case of malfunction of one pump

Each pump works as described in the paragraph 7.3.4. The ECU1000 controls the D-SOV and two pumps instead of only one. The 4-20mA pressure transmitter, oil level sensor, oil temperature sensor are common in both pumps.
The following tables show the HPU/Pumps malfunctions detected by the ECU1000. They are also listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph Actuator malfunction tables). The column "Signalling relay" shows the conditions that can be individually linked to the output relays of the ECU1000 by means of the menu options.

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Malfunctions of HPU

Name	Description	Pump control	Pump Alarm	Signalling relay
HPU pres. transm.	Oil pressure transmitter out of range	**Pump1 and 2 off**	x	x
High oil pressure	Oil pressure > high pressure limit	**Pump1 and 2 off**	x	x
Low oil pressure	Oil pressure < low pressure limit	Regular operation	x	x
Oil level (low)	Oil level switch = on	**Pump1 and 2 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 and 2 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 and 2 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
Max start D-SOV	Starts of Discharge SOV > reference	Regular operation	x	NO
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

Malfunctions of pumps with selector in PUMP1 (pump1 master)

Name	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 filter	Oil filter sensor=on	**Pump1 off ,** switch to pump2 **(5)**	x	x
Gener. sens. pump1	General on-off sensor of pump1=on	**Pump1 off,** switch to pump2 **(2)**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off,** switch to pump2 **(3)**	x	x
Max start pump1	Starts of motor of pump1 > reference	**Pump1 off ,** switch to pump2 **(4)**	x	NO
Pump2 power sup. (electrical power)	Loss of power supply of pump2 motor	**Pump2 off (2)**	x	x
Pump2 mot. TH	Motor thermostat of pump2=on	**Pump2 off (2)**	x	x
Pump2 filter	Oil filter sensor=on	Regular operation	x	x
Gener. sens. pump2	General on-off sensor of pump2=on	**Pump2 off (2)**	x	x
Max time pump2 **(1)**	Max time to reach the pressure (pump2)	**Pump2 off (3)**	x	x
Max start pump2	Starts of motor of pump2 > reference	**Pump2 off (4)**	x	NO

Malfunctions of pumps with selector in PUMP2 (pump2 master)

Name	Description	Pump control	Pump Alarm	Signalling relay
Pump2 power sup (electrical power)	Loss of power supply of pump2 motor	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 mot. TH	Motor thermostat of pump2=on	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 filter	Oil filter sensor=on	**Pump2 off ,** switch to pump1 **(5)**	x	x
Gener. sens. Pump2	General on-off sensor of pump2=on	**Pump2 off,** switch to pump1 **(2)**	x	x
Max time pump2 **(1)**	Max time to reach the pressure (pump2)	**Pump2 off,** switch to pump1 **(3)**	x	x
Max start pump2	Starts of motor of pump2 > reference	**Pump2 off ,** switch to pump1 **(4)**	x	NO
Pump1 power sup. (electrical power)	Loss of power supply of pump1 motor	**Pump1 off (2)**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off (2)**	x	x
Pump1 filter	Oil filter sensor=on	Regular operation	x	x
Gener. sens. Pump1	General on-off sensor of pump1=on	**Pump1 off (2)**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off (3)**	x	x
Max start pump1	Starts of motor of pump1 > reference	**Pump1 off (4)**	x	NO

(1) Max time pump1 and 2: they are due to one of the following conditions:

- the oil pressure is lower than the "Max working pressure" after the time "Max time to pressure" (set by the user)
- the "pressure increase" (bar/min) is less than the parameter "Min pressure increase" (set by the manufacturer). The function "pressure increase" measures the pressure change only if the actuator is in stable position (position error within 3%), the pump is on and D-SOV off.

(2) If both pumps are in Alarm both **Pumps are off.**
(3) If the alarm occurs the running pump switches to off and the second pump starts. If the alarm occurs also with the second pump, "**the motor stops**" or "**the motor runs**" according to the configuration of the ECU1000.
(4) If both pumps are in "**Max start alarm"** the running pump continues to work.
(5) If both pumps are in "**Pump filter" alarm** the running pump continues to work.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in the DTDE327. The above tables and notes describe the condition to switch the pumps due to alarm.
On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".

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The malfunctions to set in "**HPU failure**" are: "HPU pres. transm.", "high oil pressure", "low oil pressure", "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1/2 power sup**, **pump1/2 mot. TH**, **Gener. Sens. Pump1/2**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".

7.4 HPU for modulating and ON-OFF actuators

7.4.1 1 pump, intermittent service, 4-20mA pressure transmitter

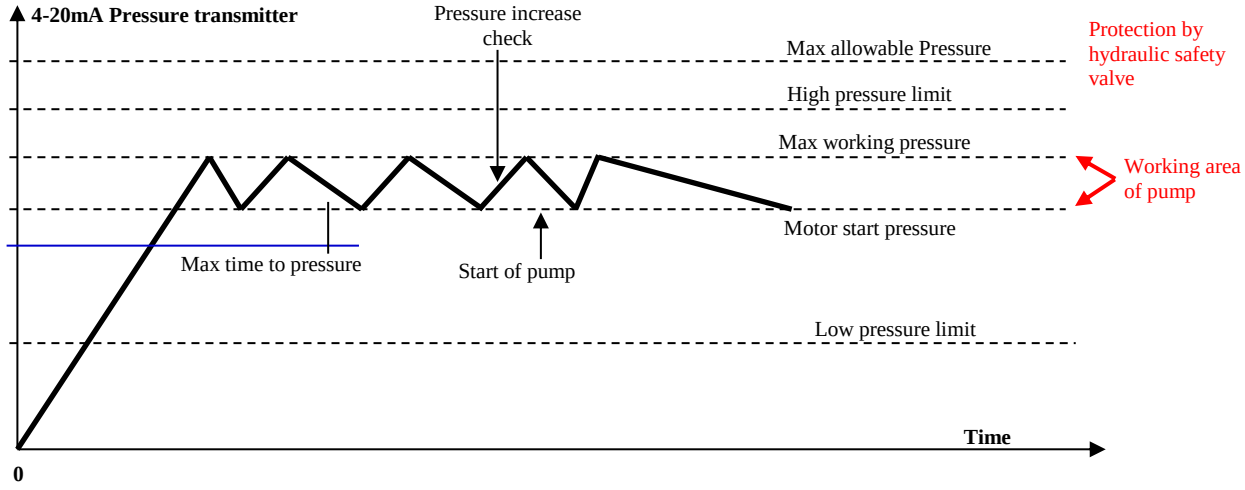
The following parameters are available in the menu "Actuator setup, Pump control"
Pump1 mode: it allows selecting the operating mode of Pump

- Off: the pump does not work
- Auto: the pump works

Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.
Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.
Pump2 mode, Pump stop delay and **Pump cycle** are not used.

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
		Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Other not used parameters	

The following figure shows the working cycle of the HPU pump, in AUTO mode. The motor pump starts when it is powered. The max pressure of HPU should be limited by a hydraulic safety valve limiting the HPU pressure below the "Max allowable Pressure".
When the HPU pressure is equal to "**Max working pressure**" the pump stops and the pressure stops increasing. The pump restarts when the HPU pressure is lower than "**Motor start pressure**".
If the HPU pressure rises over the "High pressure limit" the ECU1000 stops the motor of pump and generates an Alarm
If the HPU pressure gets down the "Low pressure limit" the ECU1000 generates an Alarm.



The following tables show the HPU/Pump malfunctions detected by the ECU1000.
The "HPU/Pump malfunctions" are listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph "Actuator malfunction tables") and can exit only if the HPU control is on. The column "Signalling relay" shows the condition that can be individually linked to the output relays of the ECU1000 by means of the menu options.

Malfunctions of HPU

Name of malfunction	Description	Pump control	Pump Alarm	Signalling relay
HPU pres. transm.	Pressure transmitter of HPU signal out of range	**Pump1 off**	x	x
High oil pressure	Oil pressure > high pressure limit	**Pump1 off**	x	x
Low oil pressure	Oil pressure < low pressure limit	Regular operation	x	x
Oil level (low)	Oil level sensor = on	**Pump1 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

Malfunctions of pump

Name of malfunction	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off**	x	x
Pump1 filter	Oil filter sensor of pump1=on	Regular operation	x	x
Gener. sens. Pump1	General on-off sensor of pump1=on	**Pump1 off**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off** or **run** **(2)**	x	x
Max start pump1	Starts of motor of pump1 > reference	Regular operation	x	NO

(1) Max time pump1: it exits if one of the following conditions occurs:

- the oil pressure is lower than the "Max working pressure" after the time "Max time to pressure" (set by the user)
- the "pressure increase" (bar/min) is less than the parameter "Min pressure increase" (set by the manufacturer). The function "pressure increase" measures the pressure change only if the actuator is in stable position (position error within 3%) and the pump is on.

(2) The pump control can be configured to **"the motor stops"** or **"the motor runs"** when the alarm occurs.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in DTDE327).
On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".
The malfunctions to set in "**HPU failure**" are: "HPU pres. transm.", "high oil pressure", "low oil pressure", "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1 power sup**, **pump1 mot. TH**, **Gener. Sens. Pump1**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".

7.4.2 2 pumps, intermittent mode, 4-20mA pressure transmitter, cycle mode

One pump at a time works. The following parameters are available in the menu "Actuator setup, Pump control".
Pump1 mode: it allows selecting the operating mode of Pump1

- Off: the pump1 does not work
- Auto: the pump1 works

Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.
Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1**and **2**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.
Pump2 mode:

- Off: the pump2 does not work
- Auto: the pump2 works

Pump cycle: it sets the working time of each pump, from 1 to 10000 h. If both pumps are in AUTO, after the "Pump cycle" the running pump stops and after 4 sec the second pump starts.
Pump stop delay: not used

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Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
		Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Pump2 mode (auto, off)	2
		Pump cycle (1-10000 h)	1

The switch from one pump to the other one can be

- **Manual**: the working pump is selected by setting the parameter Pump1 mode and Pump2 mode (for instance Pump1 mode=off and Pump2 mode=Auto and viceversa)
- **Automatic**: in case of malfunction of one pump or at the end of the configured "**Pump cycle**"

Each pump works as described in the paragraph 7.4.1. The ECU1000 controls two pumps instead of only one. The 4-20mA pressure transmitter, oil level sensor, oil temperature sensor are common in both pumps.
The following tables show the HPU/Pumps malfunctions detected by the ECU1000. They are also listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph Actuator malfunction tables). The column "Signalling relay" shows the conditions that can be individually linked to the output relays of the ECU1000 by means of the menu options.

Malfunctions of HPU

Name	Description	Pump control	Pump Alarm	Signalling relay
HPU pres. transm.	Oil pressure transmitter out of range	**Pump1 and 2 off**	x	x
High oil pressure	Oil pressure > high pressure limit	**Pump1 and 2 off**	x	x
Low oil pressure	Oil pressure < low pressure limit	Regular operation	x	x
Oil level (low)	Oil level switch = on	**Pump1 and 2 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 and 2 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 and 2 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

Malfunctions of pumps

Name	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 filter	Oil filter sensor=on	**Pump1 off ,** switch to pump2 **(5)**	x	x
Gener. sens. pump1	General on-off sensor of pump1=on	**Pump1 off,** switch to pump2 **(2)**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off,** switch to pump2 **(3)**	x	x
Max start pump1	Starts of motor of pump1 > reference	**Pump1 off ,** switch to pump2 **(4)**	x	NO
Pump2 power sup. (electrical power)	Loss of power supply of pump2 motor	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 mot. TH	Motor thermostat of pump2=on	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 filter	Oil filter sensor=on	**Pump2 off ,** switch to pump1 **(5)**	x	x
Gener. sens. pump2	General on-off sensor of pump2=on	**Pump2 off,** switch to pump1 **(2)**	x	x
Max time pump2	Max time to reach the pressure (pump2)	**Pump2 off,** switch to pump1 **(3)**	x	x
Max start pump2 **(1)**	Starts of motor of pump2 > reference	**Pump2 off ,** switch to pump1 **(4)**	x	NO

(1) Max time pump1 and 2: they are due to one of the following conditions:

- the oil pressure is lower than the "Max working pressure" after the time "Max time to pressure" (set by the user)
- the "pressure increase" (bar/min) is less than the parameter "Min pressure increase" (set by the manufacturer). The function "pressure increase" measures the pressure change only if the actuator is in stable position (position error within 3%) and the pump is on

(2) If both pumps are in Alarm both **Pumps are off.**
(3) If the alarm occurs the running pump switches to off and the second pump starts. If the alarm occurs also with the second pump, "**the motor stops**" or "**the motor runs**" according to the configuration of the ECU1000.
(4) If both pumps are in "**Max start alarm"** the running pump continues to work.
(5) If both pumps are in "**Pump filter" alarm** the running pump continues to work.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in the DTDE327. The above tables and notes describe the condition to switch the pumps due to alarm

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On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".
The malfunctions to set in "**HPU failure**" are: "HPU pres. transm.", "high oil pressure", "low oil pressure", "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1/2 power sup**, **pump1/2 mot. TH**, **Gener. Sens. Pump1/2**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".

7.4.3 2 pumps, intermittent mode, 4-20mA pressure transmitter, master-slave mode

One pump at a time works. A 3-position "**PUMP1/OFF/PUMP2**" selector is requested to set the pump master.
In "**OFF"** both pumps are off.
In "**PUMP1"** the pump1 works. The pump2 starts in case of alarm of pump1. A further switch to pump1 is not allowed.
In "**PUMP2"** the pump2 works. The pump1 starts in case of alarm of pump2. A further switch to pump2 is not allowed.
The following parameters are available in the menu "Actuator setup, Pump control" of ECU1000.
Pump1 mode: it allows selecting the operating mode of Pump1

- Off: the pump1 does not work
- Auto: the pump1 works

Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.
Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1**and **2**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.
Pump2 mode:

- Off: the pump2 does not work
- Auto: the pump2 works

Pump cycle and **Pump stop delay:** not used

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
		Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Pump2 mode (auto, off)	2

The switch of pumps is

- Manual: by the selector "**PUMP1/OFF/PUMP2**"
- Automatic: in case of malfunction of one pump

Each pump works as described in the paragraph 7.4.1. The ECU1000 controls two pumps instead of only one. The 4-20mA pressure transmitter, oil level sensor, oil temperature sensor are common in both pumps.
The following tables show the HPU/Pumps malfunctions detected by the ECU1000. They are also listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph Actuator malfunction tables). The column "Signalling relay" shows the conditions that can be individually linked to the output relays of the ECU1000 by means of the menu options.

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Malfunctions of HPU

Name	Description	Pump control	Pump Alarm	Signalling relay
HPU pres. transm.	Oil pressure transmitter out of range	**Pump1 and 2 off**	x	x
High oil pressure	Oil pressure > high pressure limit	**Pump1 and 2 off**	x	x
Low oil pressure	Oil pressure < low pressure limit	Regular operation	x	x
Oil level (low)	Oil level switch = on	**Pump1 and 2 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 and 2 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 and 2 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

Malfunctions of pumps with selector in PUMP1 (pump1 master)

Name	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off ,** switch to pump2 **(2)**	x	x
Pump1 filter	Oil filter sensor=on	**Pump1 off ,** switch to pump2 **(5)**	x	x
Gener. sens. pump1	General on-off sensor of pump1=on	**Pump1 off,** switch to pump2 **(2)**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off,** switch to pump2 **(3)**	x	x
Max start pump1	Starts of motor of pump1 > reference	**Pump1 off ,** switch to pump2 **(4)**	x	NO
Pump2 power sup. (electrical power)	Loss of power supply of pump2 motor	**Pump2 off (2)**	x	x
Pump2 mot. TH	Motor thermostat of pump2=on	**Pump2 off (2)**	x	x
Pump2 filter	Oil filter sensor=on	Regular operation	x	x
Gener. sens. pump2	General on-off sensor of pump2=on	**Pump2 off (2)**	x	x
Max time pump2 **(1)**	Max time to reach the pressure (pump2)	**Pump2 off (3)**	x	x
Max start pump2	Starts of motor of pump2 > reference	**Pump2 off (4)**	x	NO

Malfunctions of pumps with selector in PUMP2 (pump2 master)

Name	Description	Pump control	Pump Alarm	Signalling relay
Pump2 power sup (electrical power)	Loss of power supply of pump2 motor	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 mot. TH	Motor thermostat of pump2=on	**Pump2 off ,** switch to pump1 **(2)**	x	x
Pump2 filter	Oil filter sensor=on	**Pump2 off ,** switch to pump1 **(5)**	x	x
Gener. sens. Pump2	General on-off sensor of pump2=on	**Pump2 off,** switch to pump1 **(2)**	x	x
Max time pump2 **(1)**	Max time to reach the pressure (pump2)	**Pump2 off,** switch to pump1 **(3)**	x	x
Max start pump2	Starts of motor of pump2 > reference	**Pump2 off ,** switch to pump1 **(4)**	x	NO
Pump1 power sup. (electrical power)	Loss of power supply of pump1 motor	**Pump1 off (2)**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off (2)**	x	x
Pump1 filter	Oil filter sensor=on	Regular operation	x	x
Gener. sens. Pump1	General on-off sensor of pump1=on	**Pump1 off (2)**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off (3)**	x	x
Max start pump1	Starts of motor of pump1 > reference	**Pump1 off (4)**	x	NO

(1) Max time pump1 and 2: they are due to one of the following conditions:

- the oil pressure is lower than the "Max working pressure" after the time "Max time to pressure" (set by the user)
- the "pressure increase" (bar/min) is less than the parameter "Min pressure increase" (set by the manufacturer). The function "pressure increase" measures the pressure change only if the actuator is in stable position (position error within 3%) and the pump is on.

(2) If both pumps are in Alarm both **Pumps are off.**
(3) If the alarm occurs the running pump switches to off and the second pump starts. If the alarm occurs also with the second pump, "**the motor stops**" or "**the motor runs**" according to the configuration of the ECU1000.
(4) If both pumps are in "**Max start alarm"** the running pump continues to work.
(5) If both pumps are in "**Pump filter" alarm** the running pump continues to work.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in the DTDE327. The above tables and notes describe the condition to switch the pumps due to alarm.
On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".
The malfunctions to set in "**HPU failure**" are: "HPU pres. transm.", "high oil pressure", "low oil pressure", "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1/2 power sup**, **pump1/2 mot. TH**, **Gener. Sens. Pump1/2**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".

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7.5 Simple HPU, 1 pump, intermittent service, pressure switch

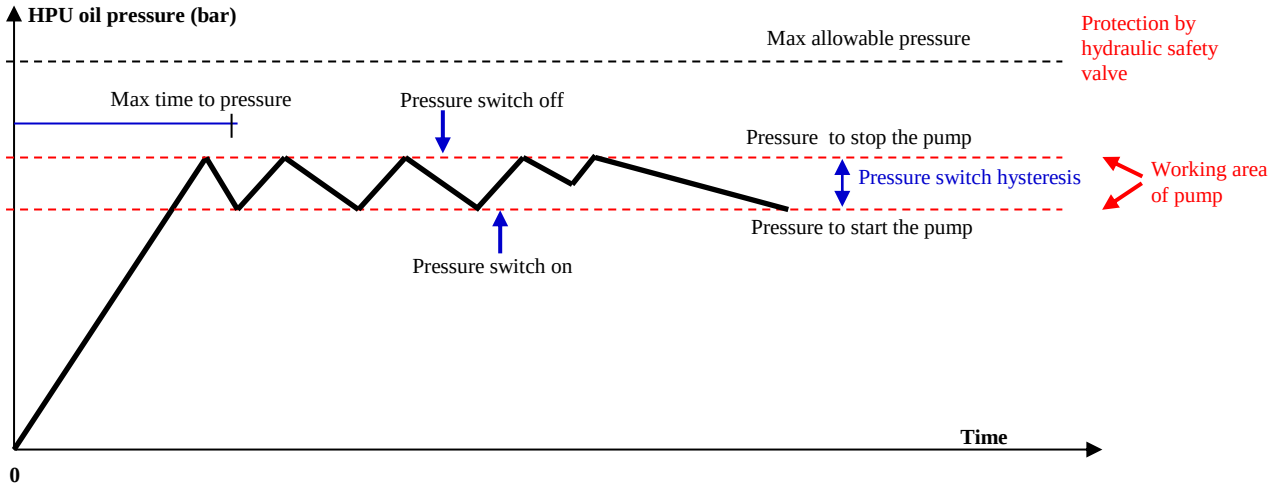
The control of HPU pressure is based on a pressure switch. Start and stop of motor pump depend on the pressure switch hysteresis.
The following parameters are available in the menu "Actuator setup, Pump control"
Pump1 mode: it allows selecting the operating mode of Pump

- Off: the pump does not work
- Auto: the pump works

Actuator control delay: delay to initiate the actuator control after the ECU1000 power on. It can be set from 0 to 255 sec.
Max time to pressure: it is the maximum allowed time to reach the working pressure. The parameter can be set from 0 to 255 min. If the working pressure is not reached in the above time the ECU1000 generates the alarm "**Max time pump1**". The alarm is cleared when the pressure is correct or by the ECU commands "Clear Failure / Alarm". If the parameter is **set to 0** the alarm is not generated.
Pump2 mode, Pump stop delay and **Pump cycle** are not used.

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Pump control		
		Pump1 mode (auto, off)	2
		Pump stop delay (0-255 sec)	1
		Actuator ctrl delay (0-255 sec)	2
		Max time to pressure (0-255 min)	2
		Other not used parameters	

The following figure shows the working cycle of the HPU pump, in AUTO mode. The max pressure of HPU should be limited by a hydraulic safety valve limiting the HPU pressure below the "Max allowable Pressure".
When the **pressure switch** is **off (open contact)** the pump stops and the pressure stops increasing. The pump restarts when the **pressure switch** is **on (contact closed)**. The two limits "**pressure to stop the pump**" and "**pressure to start the pump**" are set by the hysteresis of the pressure switch.



The logic of pressure switch can be reversed on request: **pressure switch off (closed contact)=** the pump stops and **pressure switch on (open contact)=** the pump starts.
The following tables show the HPU/Pump malfunctions detected by the ECU1000.
The "HPU/Pump malfunctions" are listed in the "Additional Alarm table" of the instruction manual DTDE327 (paragraph "Actuator malfunction tables") and can exit only if the HPU control is on. The column "Signalling relay" shows the condition that can be individually linked to the output relays of the ECU1000 by means of the menu options.

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Malfunctions of HPU

Name of malfunction	Description	Pump control	Pump Alarm	Signalling relay
Oil level (low)	Oil level sensor = on	**Pump1 off**	x	x
Oil temper. (high temperature)	Oil thermostat = on	**Pump1 off**	x	x
HPU gener. sens.	General on-off sensor of HPU = on	**Pump1 off**	x	x
Hand-pump	Hand-pump engaged	Regular operation	x	x
HPU sign sw	HPU signalling on-off sensor	Regular operation	x	x

Malfunctions of pump

Name of malfunction	Description	Pump control	Pump Alarm	Signalling relay
Pump1 power sup (electrical power)	Loss of power supply of pump1 motor	**Pump1 off**	x	x
Pump1 mot. TH	Motor thermostat of pump1=on	**Pump1 off**	x	x
Pump1 filter	Oil filter sensor of pump1=on	Regular operation	x	x
Gener. sens. Pump1	General on-off sensor of pump1=on	**Pump1 off**	x	x
Max time pump1 **(1)**	Max time to reach the pressure (pump1)	**Pump1 off** or **run** **(2)**	x	x
Max start pump1	Starts of motor of pump1 > reference	Regular operation	x	NO

(1) Max time pump1: it exits if the HPU pressure is lower than the "Pressure to stop the pump" after the time "Max time to pressure" (set by the user)
(2) The pump control can be configured to **"the motor stops"** or **"the motor runs"** when the alarm occurs.

In case of "**HPU/Pump alarm**" the actuator **works regularly** (see the paragraph "Actuator malfunction tables, Additional alarm table" in DTDE327).
On request, the ECU1000 can be set (by the manufacturer) to signal "**Failure**" due to "**HPU failure**". In case of "**HPU failure**" the ECU1000 can be configured either to "**regular actuator operation**" or "**failsafe**" or "**optional SOV1**" actions. The manual DTDE327 describes the functions "Failsafe" and "optional SOV1".
The malfunctions to set in "**HPU failure**" are: "oil level", "oil temperature", "HPU general sensor", "hand-pump", "pump blocked".
"**Pump blocked**" summarizes the following alarms "**pump1 power sup**, **pump1 mot. TH**, **Gener. Sens. Pump1**". The alarm "**Max time pump1** is included in the "**Pump blocked**" if it is configured "**the motor stops**". On the contrary it is not included in the "**Pump blocked**" if it is configured "**the motor runs**".
The options with 2pumps, master-slave or cycle, are available and each pump works as described above. The conditions to switch from one pump to the other are described in the paragraphs 7.4.2 and 7.4.3.

7.6 HPU with 4-20mA pressure transmitter and hot-backup pressure switch

The option is available in the HPU configurations described in the previous paragraphs 7.3. and 7.4. It provides redundancy in the pressure measure. Normal control is done by the 4-20mA pressure transmitter. In case of failure of 4-20mA pressure transmitter, the ECU1000 switches to pressure switch mode, described in the paragraph 7.5. In the above mode the start/stop of pumps depends only on the pressure switch hysteresis. When 4-20mA restores, the pressure control returns to pressure transmitter. The switch from 4-20mA transmitter to pressure switch is done in **5 sec**, the restoration in > **30 sec.**

7.7 HPU with hydraulic unloading relief valve

If the ECU1000 controls an HPU provided with unloading relief valve all options described in the previous paragraphs are still available. The Discharge D-SOV is not necessary since the unloading relief valve performs in automatic the same function. In fact the unloading relief valve allows automatic pump by-pass as the pressure reaches the setting value. The valve closes when the pressure drops at 88% and pump can charge again the accumulator.

7.8 HPU with D-SOV to reduce the start current of motor pump

If it needs to reduce the start current of the electric motor it is possible to add a Discharge D-SOV in the HPU to allow pump by-pass. The D-SOV is activated at each start of motor and after 5 sec is released to let the pump to charge the accumulator. The D-SOV can be used with the options described in the previous paragraphs. In the HPU described in the paragraph 7.3 the D-SOV is activated at the start of the pump and as the pressure reaches the "Max working pressure".

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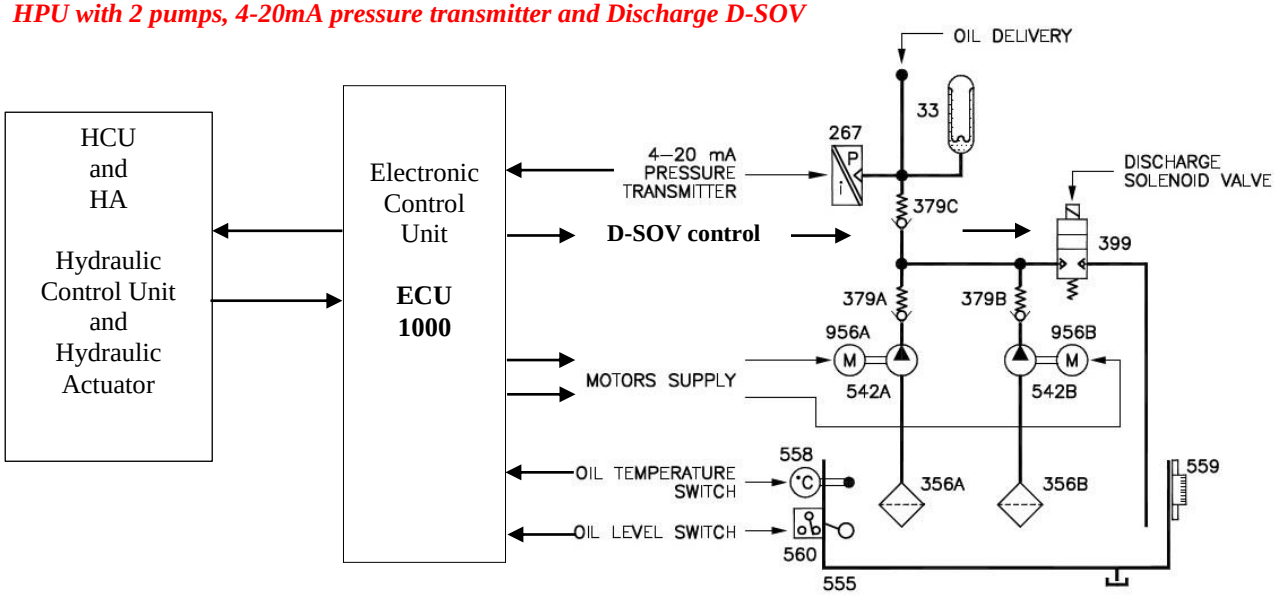
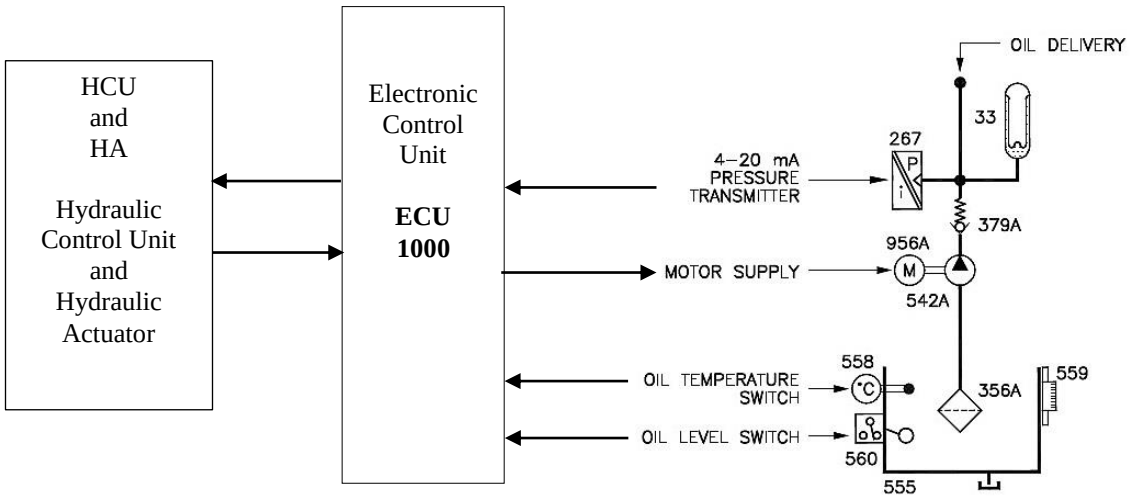
7.9 Examples of HPU

HPU with 2 pumps, 4-20mA pressure transmitter and Discharge D-SOV



HPU with 1 pump and 4-20mA pressure transmitter



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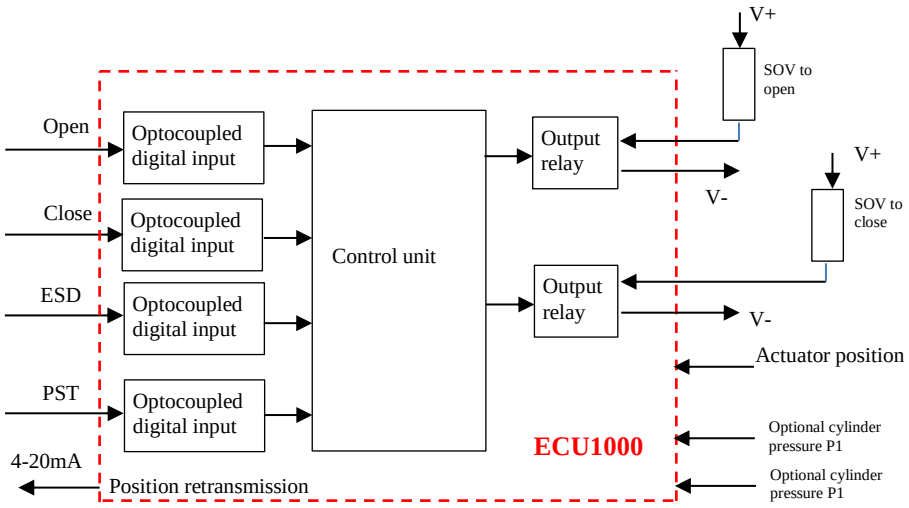
8 ON-OFF actuator control

The paragraph describes the ECU1000 functions to control an on-off Hydraulic Actuator with **S**olenoid **O**perated **V**alves (SOV) and optional Hydraulic Power Unit (HPU). The "Positioning" and "Input Characterization" functions are disabled or not working, while the remaining ECU1000 functions are still available. The "Position Demand" signal is not present and not visible on the local display. The "Actuator position" signal is present and it is visualized on the local display. The manuals DTDE326 and DTDE327 and the previous paragraphs of this document can be used as instruction manual for the functions used by the ECU1000 with on-off actuator.

8.1 Control options

The ECU1000 receives the commands on the digital inputs and drives the SOV's by the output relays. The following types of controls are available:

8.1.1 2 inputs/2outputs

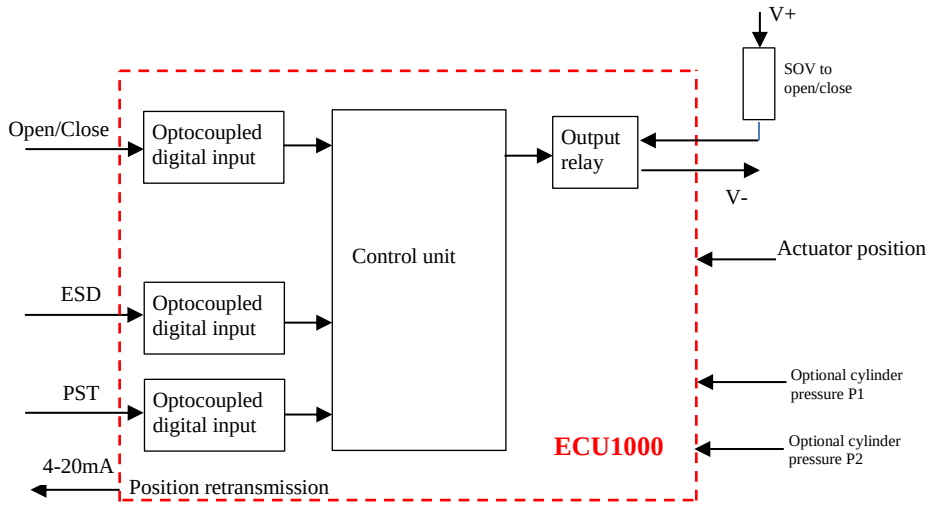


Control options:
- Open: push to run
- Close: push to run

Travel limit options:
- position
- Continuous

ESD options:
- Off
- Go to position 100%
- Go to position 0%
- Tracking

8.1.2 1 inputs/1outputs



Control option 1:
- Signal=on: opens
- Signal=off: closes

Control option 2:
- Signal=on: closes
- Signal=off: opens

Travel limit options:
- Continuous

ESD options:
- Off
- Go to position 100%
- Go to position 0%

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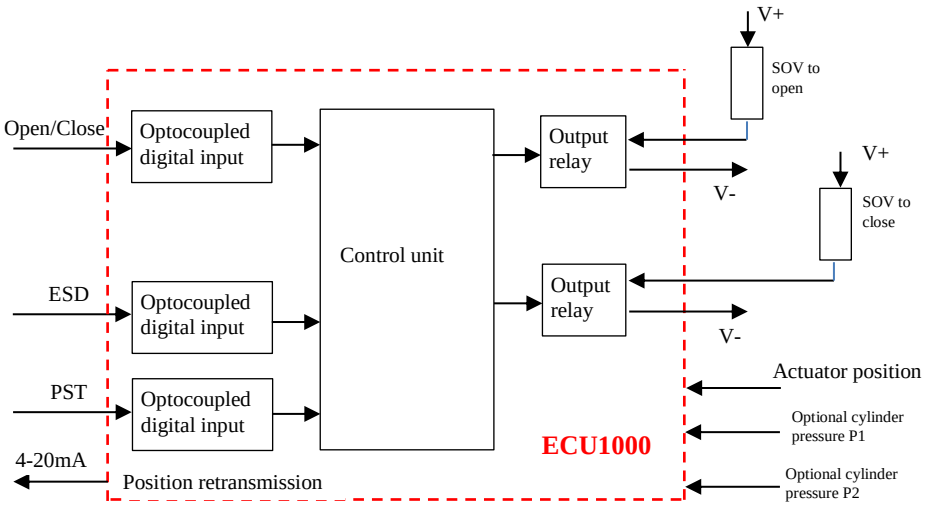
8.1.3 1 inputs/2outputs



Control option 1:
- Signal=on: opens
- Signal=off: closes

Control option 2:
- Signal=on: closes
- Signal=off: opens

Travel limit options:
- Continuous
- Position

ESD options:
- Off
- Go to position 100%
- Go to position 0%
- Tracking

8.2 ESD function

ESD function can be started by a command on the digital inputs and drives the SOV's by the output relays as shown in the previous figures. The DTDE327 "Actuator control and Local Operator Interface" provides the instruction of ESD function.

8.3 PST function

PST function can be initiated by a command on the digital inputs and drives the SOV's by the output relays as shown in the previous figures. The paragraph 6 provides the instruction of PST function

8.4 Alarms

- Max time to position
- Hyd. Valve leak

See Alarm table in the manual DTDE 327, paragraph "Actuator malfunction tables".

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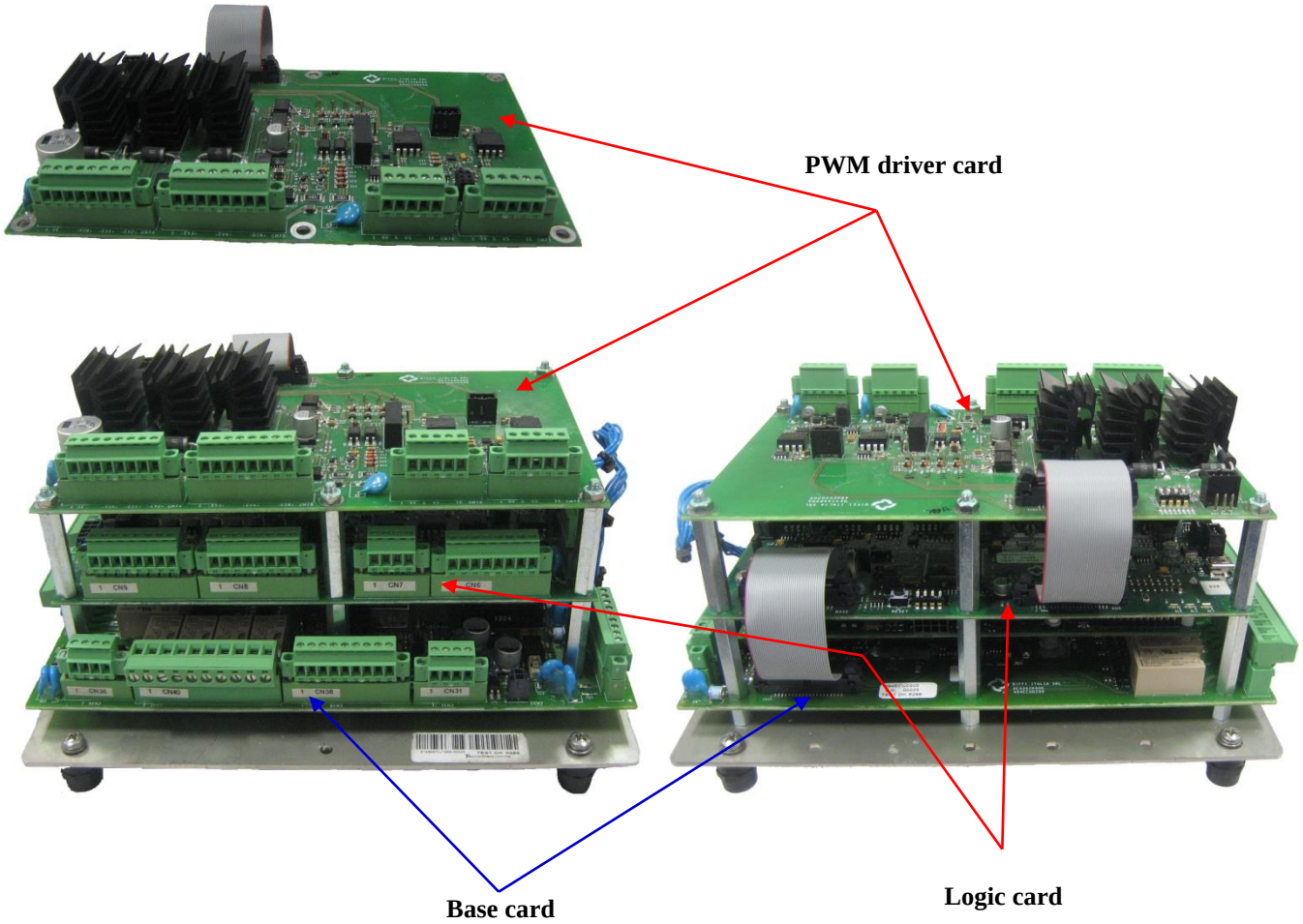
9 PWM driver

The optional card "**ECU1000 PWM driver**" is mounted above the control card of the ECU1000 assembly. It is supplied at 24 VDC and it is connected to ECU1000 control card by a flat cable. It can drive standard proportional valves without spool feedback with 1 or 2 solenoids or 2BIFFI **P**roportional **SO**lenoid **V**alves (**PSOV**'s) with spool feedback. It has the following inputs/outputs

- Two PWM output channels (24V, max 5A)
- One optocoupled digital input (max input 30Vdc)
- One digital output (24V, max 2A)
- One digital output (24V, max 0.5A)
- Two analogue input channels

The parameters of PWM module are stored in the ECU1000 memory and can be set only by the manufacturer. They can be modified with username "Service", "Specialist" and "Guest2".



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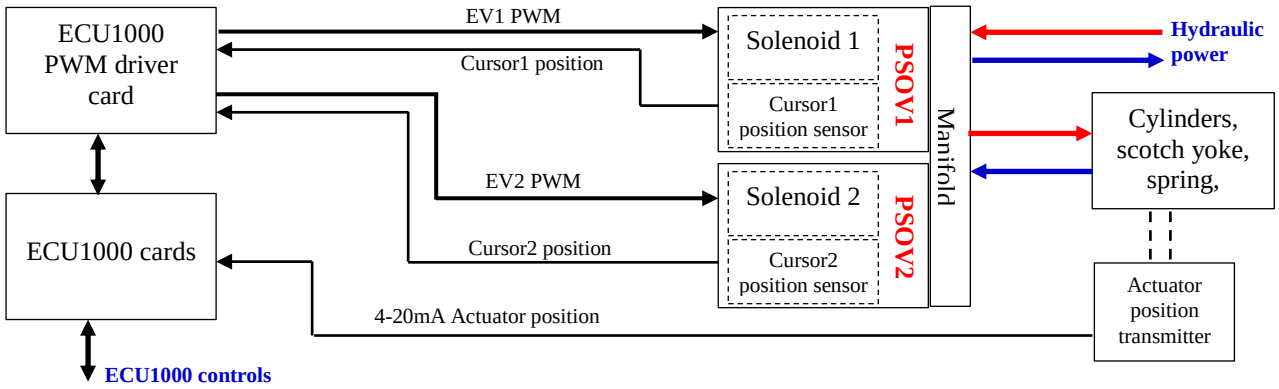
9.1 PWM driver for Biffi PSOV's

The Biffi **P**roportional **SO**lenoid **V**alves (**Biffi PSOV**) are used to control an hydraulic modulating actuator when a very low drain is requested. Each actuator is controlled by 2 PSOV's, one PSOV to open and the other one to close. Each PSOV is provided with contactless sensor of cursor position. The following diagram shows the operating principle.



PWM utilization function: it calculates the average in the configurable "**Max PWM time**" of PWM duty of each PSOV and allows to evaluate their utilization rate and to avoid overheating and damage of system. The value of the "**PWM utilization %**" is visible in the display of the Local Operator Interface in the menu "Status and variables", "**EV1-2 MONITOR**" and "E**V1-2 RATE**" (see DTDE 327, paragraph Local Operator Interface, Status and variables table).

Failures: the PWM driver generates the failure "**Proportional valve**" in the following conditions:

- Power supply voltage of card <18Vdc or > 30Vdc
- Cursor1 position or cursor2 position = 0V

Alarms: the PWM driver generates the alarm **"PWM utilization"** if the PWM utilization is higher than the configurable reference "**MAX PWM UTILIZATION**%". The ECU1000 restricts the maximum PWM duty to the "MAX PWM UTILIZATION" until the alarm disappears.

See the instruction manual DTDE327 par. "Actuator malfunction tables" to view the complete list of ECU1000 Failure and Alarm.

ECU1000 commands: the following table shows the list of commands available in the Local Operator Interface in the menu "**ECU command**"

Function block	Function TAB	Command	Psw level
Device cmd			
	PWM control		
		PSOV's autocalibration (off, on)	2
		Manual PWM (0-100 %)	2
		Drive Hyd-Valve	2

The command "**Manual PWM**" allows setting the level of PWM for a manual drive of the PSOV. The command "**Drive Hyd-Valve**" allows moving the actuator in opening or closing by the local Open and Close pushbuttons with the PWM level set in "Manual PWM". The command "**PSOV's autocalibration**" allows initiating the calibration cycle of PSOV's. By this command the ECU1000 reads and memorizes the minimum and maximum cursor position of each PSOV, to be used in the control operation. The above commands are available with username "OPERATOR".

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The following parameters are available in the Local Operator Interface with username “SERVICE” for the PSOV’s position loop tuning:

Function block	Function TAB	Parameter	Psw level
Restricted			
	PWM module		
		Kp EV1	3
		Ti EV1	3
		Td EV1	3
		Min PWM EV1	3
		Max PWM EV1	3
		AI5 bit at 2.5V	3
		AI5 bit at 4.5V	3
		AI5 signal filter	3
		Kp EV2	3
		Ti EV2	3
		Td EV2	3
		Min PWM EV2	3
		Max PWM EV2	3
		AI6 bit at 2.5V	3
		AI6 bit at 4.5V	3
		AI6 signal filter	3
		PWM Frequency (200,400, 1000Hz)	3
		Max PWM Utilization %	3
		Max PWM time	3

Test of the PSOV’s drain: On request the Local Operator Interface can be provided with an additional self-maintained pushbutton on the cabinet door **to test the drain of the PSOV’s**. The option is available only if the Local Selector (Local, Remote) is not requested (see DTDE327 par. Local Operator Interface, par. 19.2 and 19.3).
The procedure is the following:

- Switch ECU1000 to LOCAL control mode by the instruction in par. 19.2 and 19.3 of DTDE327
- Push the pushbutton “**PSOV test**” on the ECU1000 cabinet door
- Take note of the actuator position% and of HPU pressure
- Wait few hours
- Take note of the actuator position% change
- Release the “**PSOV test**”
- Switch to REMOTE control mode by the instruction in par. 19.2 and 19.3 of DTDE327

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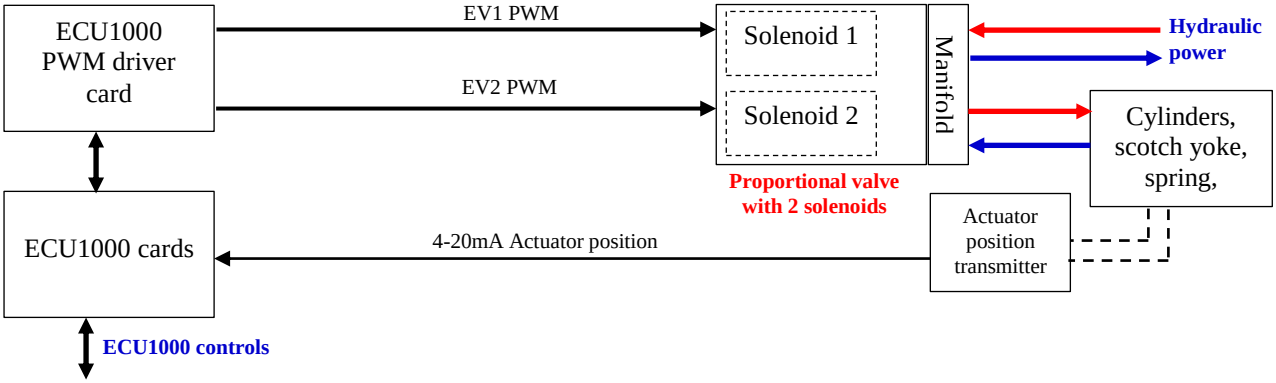
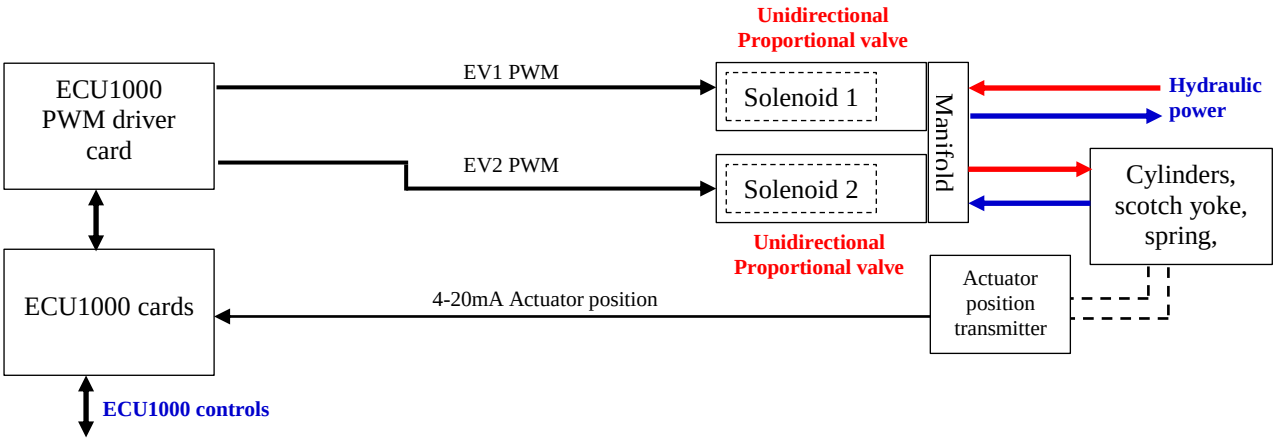
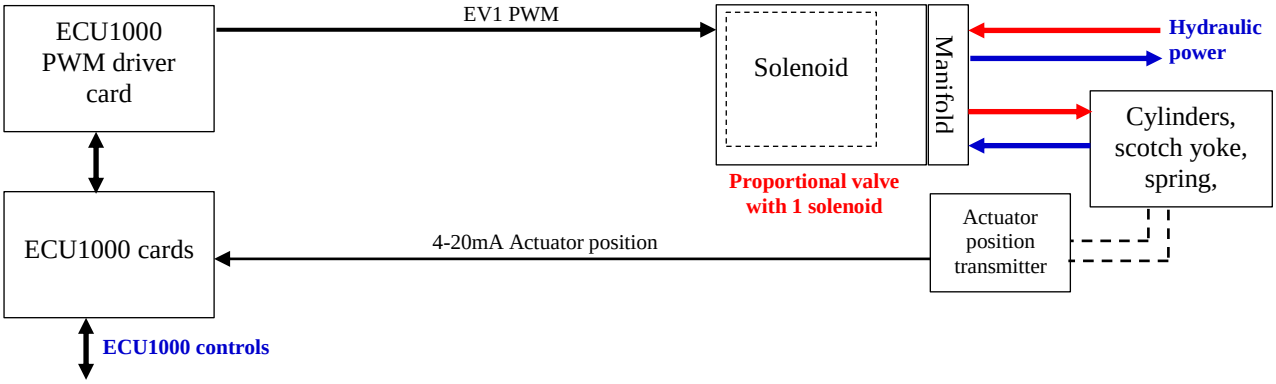
9.2 PWM driver for proportional valve without spool feedback

The following diagram shows the block diagram of ECU1000 e PWM driver card with

- 1 bidirectional proportional valve without spool feedback and with 2 solenoids
- 2 unidirectional proportional valves without spool feedback and with 1 solenoid for each valve
- 1 bidirectional proportional valve valves without spool feedback and with 1 solenoid







PWM utilization function: it calculates the average in the configurable "**Max PWM time**" of PWM duty of proportional valve and allows to evaluate their utilization rates and to avoid overheating and damage of system. The value of the "**PWM utilization %**" is visible in the display of the Local Operator Interface in the menu "Status and variables", "**EV1-2 MONITOR**" and "E**V1-2 RATE**" (see DTDE 327, paragraph Local Operator Interface, Status and variables table).

Failures: the PWM driver generates the failure "**Proportional valve**" in the following conditions:

- Power supply voltage of card <18Vdc or > 30Vdc

Alarms: the PWM driver generates the alarm **"PWM utilization"** if the PWM utilization is higher than the configurable reference "**MAX PWM UTILIZATION**%". The ECU1000 restricts the maximum PWM duty to the "MAX PWM UTILIZATION" until the alarm disappears.

ECU1000 commands: the following table shows the list of commands available in the Local Operator Interface in the menu "**ECU command**"

Function block	Function TAB	Command	Psw level
Device cmd			
	PWM control		
		Manual PWM (0-100 %)	2
		Drive Hyd-Valve	2

The command "**Manual PWM**" allows setting the level of PWM for a manual drive of the proportional valve. The command "**Drive Hyd-Valve**" allows moving the actuator in opening or closing by the local Open and Close pushbuttons with the PWM level set in "Manual PWM". The above commands are available with username "OPERATOR".
The following parameters are available in the Local Operator Interface with username "SERVICE" for the proportional valve tuning.
Case of bidirectional proportional valve with 2 solenoid or 2 unidirectional proportional valves with 1 solenoid

Function block	Function TAB	Parameter	Psw level
Restricted			
	PWM module		
		Min PWM EV1	3
		Max PWM EV1	3
		Min PWM EV2	3
		Max PWM EV2	3
		PWM Frequency (200,400, 1000Hz)	3
		Max PWM Utilization %	3
		Max PWM time	3

Case of bidirectional proportional valve with 1 solenoid

Function block	Function TAB	Parameter	Psw level
Restricted			
	PWM module		
		Min PWM EV1	3
		Max PWM EV1	3
		PWM Frequency (200,400, 1000Hz)	3
		PWM OFFSET (MO-PVAL-1C only)	3
		Reverse polarity (MO-PVAL-1C only)	3
		Max PWM Utilization %	3
		Max PWM time	3

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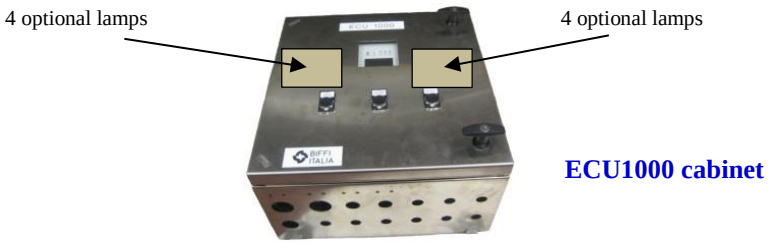
10 Optional local lamps

On request, the door of the ECU1000 cabinet can be provided with 8 additional LED lamps to signal the condition listed in the "Status relay table" of manual DTDE327 paragraph "Output relay". Setting of conditions to switch on each lamp can be done only by the manufacturer. Information of LED's can be latched and cleared by an additional local pushbutton



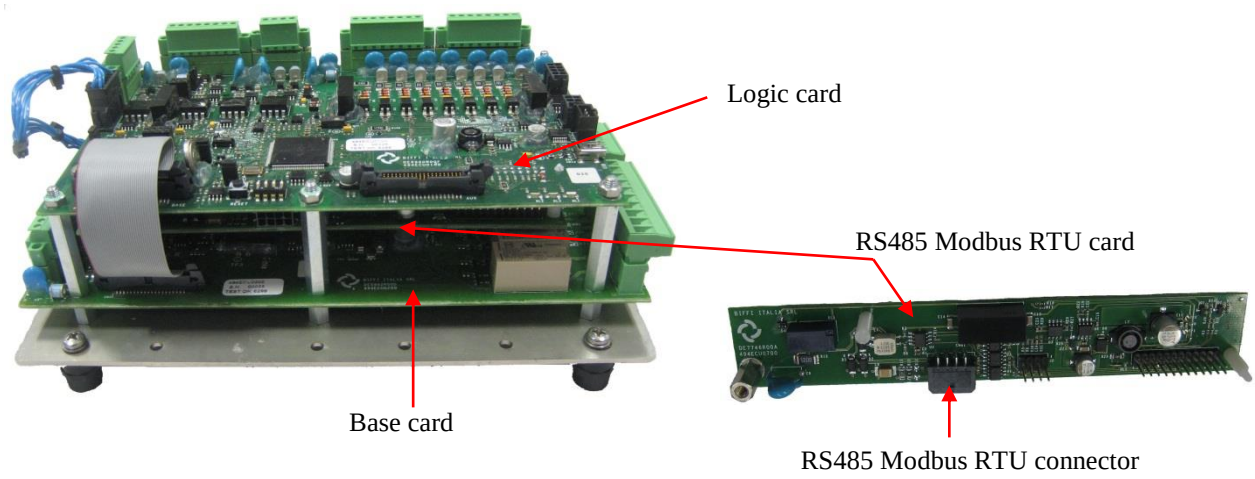
ECU1000 cabinet

The option "LED latched or momentary"is available only if the Local Selector (Local, Remote) is not requested (see DTDE327 par. Local Operator Interface, par. 19.2 and 19.3).

11 RS 485 MODBUS RTU Interface

On request the ECU1000 can be provided with RS485 MODBUS RTU interface. The above card is mounted on the control card of ECU1000 and allows controlling the ECU1000 by a multidrop RS485 Modbus RTU communication line. The manual **DTDE332** gives detailed instructions relevant to the communication messages.
The following parameters can be set with username "Operator".

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Bus		
		Node address (from 1 to 247)	2
		Baud rate (1200, 9600, 19200)	2
		Parity (Odd, Even, No parity)	2
		Line termination (On, Off)	2



MODBUS interface available from FW versions 2.000.000 and 3.000.000 or further.

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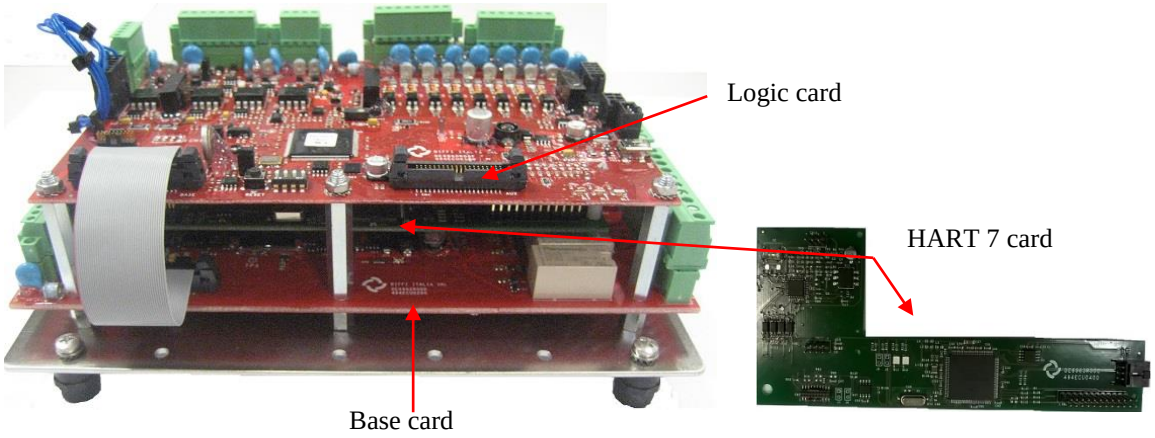
12 HART 7 Interface

On request the ECU1000 can be provided with HART interface. The HART card is mounted on the control card of ECU1000 and allows providing diagnostic and controlling (HART 7) on the same loop of the Analog Input 0. The manual **MDE248** gives detailed instructions relevant to the communication messages.
The following parameters can be set with username “Operator”.

Function block	Function TAB	Parameter	Psw level
Actuator Setup			
	Bus		
		Hart Device ID (1..16777215)	2
		Hart Polling Address (0..63)	2
		Hart Mode (Loop Enable, Loop Disable, Multidrop)	2
		SW Rev Level	2
		HW Rev Level	2



HART 7 interface available from HW R00F/Red PCB of the Logic Card and FW 3.001.000 or further

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