

WellSim ARM Controller

WellSim controllers designed to control sucker rod pump units for significant reduce of costs and increase oil production.

WellSim controls and diagnoses pumping equipment and well condition, calculates flow rate without need to install additional flow meter, builds and analyzes dynagraphs, accounts electricity consumption, collects statistics, provides remote SRP unit control and data acquisition by SCADA system, prevents malfunctions, displays dynagraphs and other SRP unit operating parameters in a convenient graphical form on touch screen, retains 180-day history parameters with can be downloaded to SCADA system.

WellSim are easy to install and maintain. Modular structure of the system allows to find a solution for any customer's needs and operating conditions.

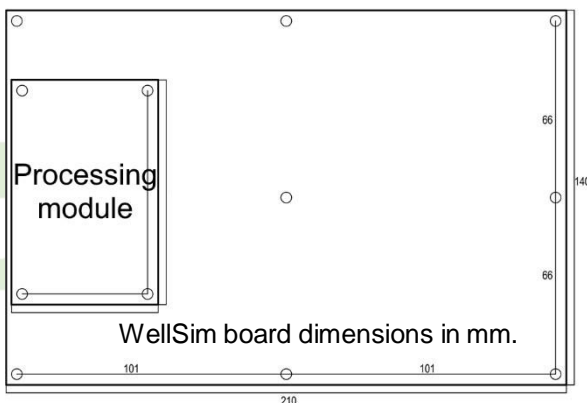
WellSim equipped with Artificial Intelligence system of pattern recognition which allows early detection of occurring undesirable states even if several malfunctions occurring at once.

WellSim allows integration with various auxiliary equipment, using provided data for simulation and/or transfers it to host computer. Logical and mathematical transformation of acquired data is also available.



Features:

- Flexible control of pump unit in real-time mode:
 - by pump fillage
 - by pump intake pressure
 - by liquid level
 - by schedule
 - by timer
 - by remote commands from SCADA
 - by special algorithm on customer's request
 - in manual mode.
- User-friendly multilingual GUI
- AI malfunction detection
- Precisely measured (not simulated) values of load and position
- Pumping unit equipment diagnosis in real time, measuring load on components
- Pumping unit equipment protection:
 - maximum/minimum load setpoints
 - minimum liquid load
 - short circuit and other electrical malfunctions protection
- Well equipment integration
- Emergency situations alert
- Detailed work history and event logs for a long period of time
- Dynamic calculation of leakage
- Wide operating temperature range



Basic specifications

Operating temperature	-40°C to +85°C
Humidity	10-90% non-condensating
Processor	1 GHz
RAM	2 Gb
Nonvolatile memory	8 Gb
Ports	2xRS232, RS485/422, Ethernet, CAN, USB, UART, 16 digital inputs, 12 digital outputs, 8 analog inputs, 2 analog outputs, SD-Card, SIM-Card
Protocols	Modbus TCP/IP, Modbus RTU, Modbus ASCII
Communications	WiFi, Ethernet, GPS, GPRS/UMTS, RF
Ethernet	10/100 Mbit/s
Compatibility	XSPOC and other SCADA
GUI	Web-based, windows/linux/macOS compatible



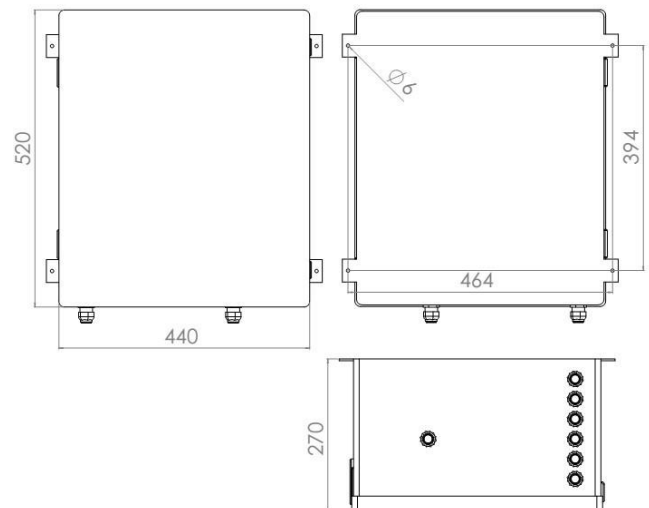
Structure

WellSim ARM controllers consist of two main parts - a computing module and a carrier board. The universal SODIMM module can be replaced with a more productive one with a larger memory capacity, etc., which allows the controller to adapt to customer requirements and be easily updated.

WellSim ARM can be supplied as:

- as a board for installation into existing control panel
- as a board with peripherals in separate box for installation into existing control panel
- as a control panel for separate installation

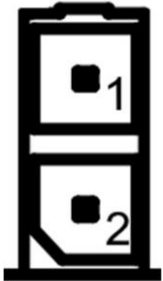
Naftamatika offers customer friendly approach, allowing to customize device according to wide-range of requirements, taking into account climatic conditions, power grid characteristics, desirable communication options etc.



WellSim Controller casing dimensions for modification as board with peripherals in separate box for installation into existing control panel in mm

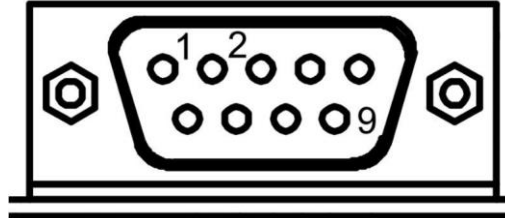
Connectors

Power connector



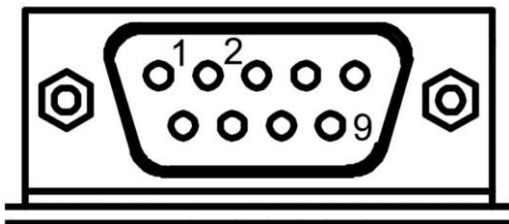
Pin	Net
1	+12 V DC
2	GND

RS485 connector



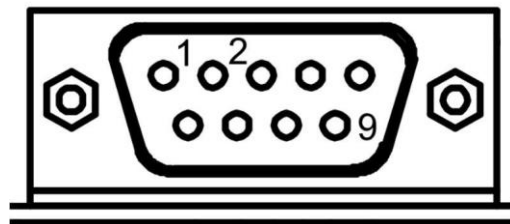
Pin	Net
1	B1
2	GND
3	A1
4	GND
5	A2
6	GND
7	B2
8	GND

CAN connector



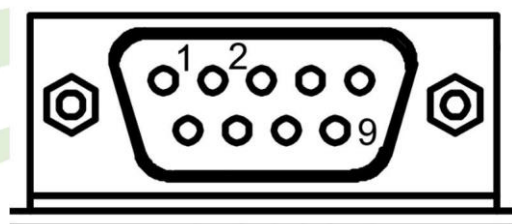
Pin	Net
1	
2	CAN L
3	
4	
5	VREF
6	
7	CAN H
8	
9	

RS232 connector



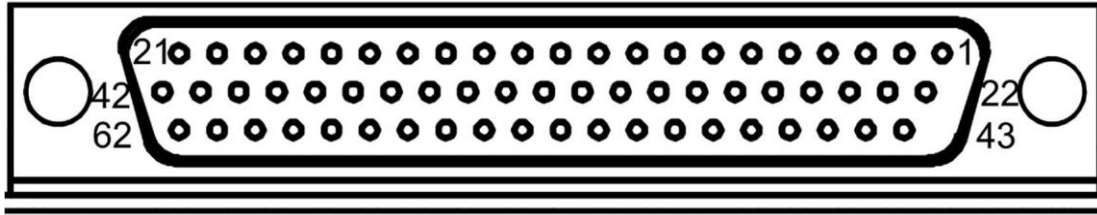
Pin	Net
1	COM2 DCD
2	COM2 RX
3	COM2 TX
4	COM2 DTR
5	GND
6	COM2 DSR
7	COM2 RTS
8	COM2 CTS
9	COM2 RI

UART connector



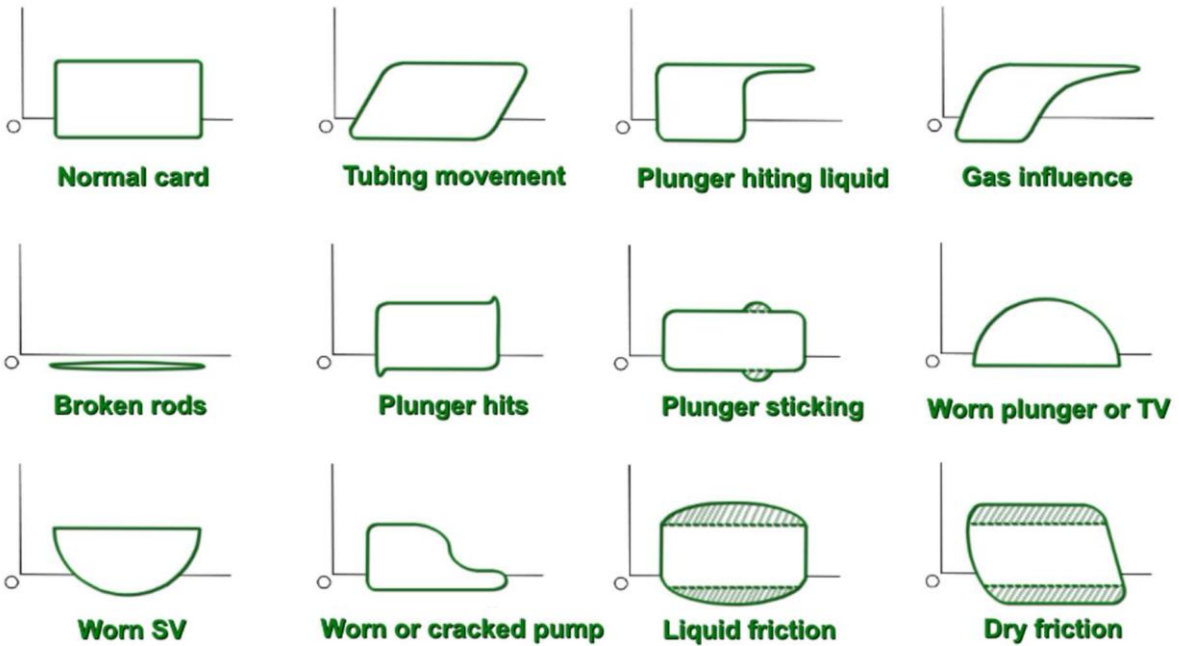
Pin	Net
1	UART-1 TTL TX
2	UART-1 TX
3	UART-1 TTL RX
4	UART-1 RX
5	UART-2 TTL TX
6	UART-2 TX
7	UART-2 TTL RX
8	UART-2 RX

Signal connector



Pin	1	2	3	4	5	6	7	8	9
Net	AI 4	AI 5	AI 6	AI 7	AI 8	DI 1	DI 2	DI 3	DI 4
Pin	10	11	12	13	14	15	16	17	18
Net	DI 5	DI 6	DI 7	DI 8	DI 9	DI 10	DI 11	DI 12	DI 13
Pin	19	20	21	22	23	24	25	26	27
Net	DI 14	DI 15	DI 16	GND	GND	GND	GND	GND	GND
Pin	28	29	30	31	32	33	34	35	36
Net	GND	GND	GND	GND	GND	GND	GND	GND	GND
Pin	37	38	39	40	41	42	43	44	45
Net	+10 V	AI 1	AI 2	AI 3	AO 1	AO 2	II 1	II 2	DO +
Pin	46	47	48	49	50	51	52	53	54
Net	DO 1	DO 2	DO 3	DO 4	DO 5	DO 6	DO 7	DO 8	DO 9
Pin	55	56	57	58	59	60	61	62	
Net	DO 10	DO 11	DO 12	HO +	HO 1	HO 2	LC -	LC +	

Artificial intelligence malfunction detection



WellSim equipped with Artificial Intelligence system of pattern recognition which allows early detection of occurring undesirable states. The system is trained using real dynacard data and continuously updated.

AI also used for correction of calculations and as protection from unreasonable actions of the system operator.

SRP unit management modes:

- **Automatic control of SRP unit by pump fillage (Sim-Fillage)**

WellSim by using real-time model of the well determines percentage of pump fillage. In Sim-Fillage mode WellSim disables SRP unit for certain time when pump fillage percentage reaches control setpoint. Simultaneously with control by pump fillage, WellSim controls SRP unit by emergency setpoints.

- **Automatic control of SRP unit by pump intake pressure (Sim-PIP)**

WellSim by using real-time model of the well determines value of pump intake pressure. In Sim-PIP mode WellSim disables SRP unit for certain time when pump intake pressure reaches control setpoint. When pump intake pressure is low, pump fillage will diminish in the process causing SRP unit to operate inefficiently. Simultaneously with control by pump intake pressure, WellSim controls SRP unit by emergency setpoints.

- **Automatic control of SRP unit by timer (On/Off Timer)**

When operating in timer mode, WellSim starts and stops SRP unit motor with a strictly defined interval. In this mode SRP unit operate and idle in time intervals determined by user. Simultaneously with control by timer, WellSim controls SRP unit by emergency setpoints.

- **Automatic control of SRP unit according to schedule**

Schedule mode allows to customize the schedule of shutdowns and starts of SRP unit. Simultaneously with control by schedule, WellSim controls SRP unit by emergency setpoints.

- **“Host” mode**

Host mode allows to manage SRP unit remotely by SCADA. This mode can be set independently from the others, and allows user to control SRP unit remotely as well as on-site.

- **Manual mode**

Manual mode prohibits WellSim to interfere with the SRP unit functioning. In this mode WellSim continues to collect and store data about SRP unit operations, that data can be provided to user on-site or remotely by SCADA.

- **Emergency setpoints**

Emergency setpoints mode is part of all other modes except manual mode. When emergency setpoint reached, WellSim counts continuous violations and after predetermined number of violations is reached shuts down SRP unit, trying to restart it after predetermined delay, and if it still reaches emergency setpoints, control station shutting down motor and alerts dispatcher and repair crew about malfunction.