Marathon controllers designed to control sucker rod pumps (SRP unit) for significantly reduce costs and increase oil production.

Marathon controls and diagnoses SRP unit 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.

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

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

Marathon allows integration with various auxiliary equipment, such as barometers, thermometers, sonars, etc. using provided data for simulation and/or transfers it to host computer. Logical and mathematical transformation of acquired data is also available.

Fig. 1 Marathon Controller

## Features:

•Flexible control of SRP 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 customers request
- in manual mode.

•User-friendly multilingual GUI
•AI malfunction detection
•Precisely measured (not simulated) values of load and position
•SRP unit equipment diagnosis in real time, measuring load on components
•Reduced SRP unit equipment wear
•SRP unit equipment protection:
- maximum/minimum load setpoints
- minimum liquid load
- short circuit and other electrical malfunctions protection

•Remote firmware update
•Firmware update failsafe
•Well equipment integration
•Emergency situations alert
•Repair crew notification
•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,<br>2xRS435,<br>2xEthernet,<br>2xCAN,<br>2xUSB,<br>16 digital inputs,<br>16 digital outputs,<br>8 analog inputs,<br>2 analog outputs |
| Protocols | Modbus TCP/IP,<br>Modbus RTU,<br>Modbus ASCII |
| Communications | WiFi, Ethernet, GPS,<br>GPRS/UMTS, RF |
| Ethernet | 10/100 Mbit/s |
| Compatibility | XSPOC and other SCADA |
| GUI | Web-based,<br>windows/linux/macos<br>compatible, LabView<br>compatible |

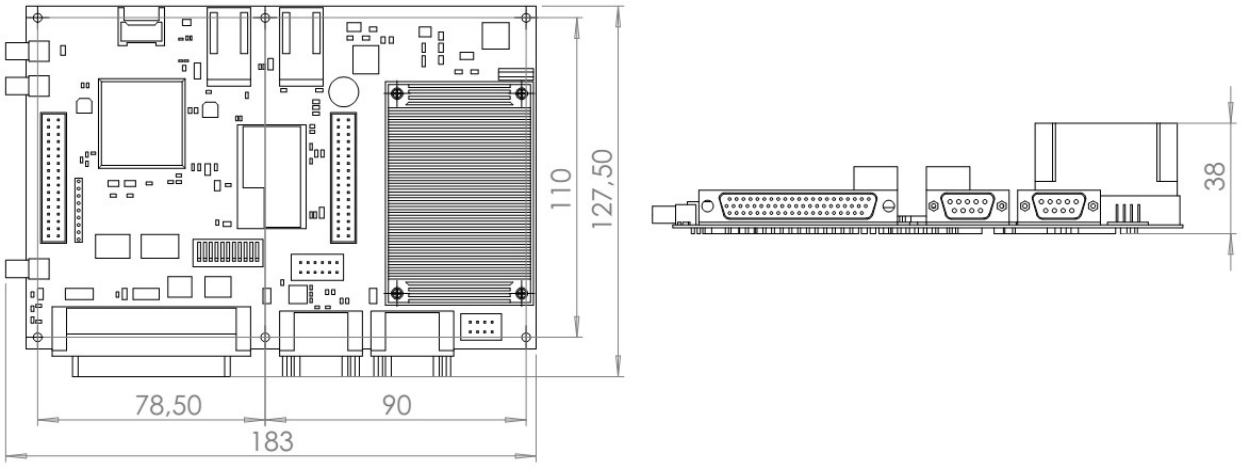



Fig. 2 Marathon board dimensions in mm.

## SRP unit management modes:

- Automatic control of SRP unit by pump fillage (Sim-Fillage)
  Marathon by using real-time model of the well determines percentage of pump fillage. In Sim-Fillage mode Marathon disables SRP unit for certain time when pump fillage percentage reaches control setpoint. Simultaneously with control by pump fillage, Marathon controls SRP unit by emergency setpoints.
- Automatic control of SRP unit by pump intake pressure (Sim-PIP)
  Marathon by using real-time model of the well determines value of pump intake pressure. In Sim-PIP mode Marathon disables SRP unit for certain time when pump intake pressure reaches control setpoint. When pump intake pressure are low, pump fillage will diminish in the process causing SRP unit to operate inefficiently. Simultaneously with control by pump intake pressure, Marathon controls SRP unit by emergency setpoints.
- Automatic control of SRP unit by timer (On/Off Timer)
  When operating in timer mode, Marathon starts and stops SRP unit motor with a strictly defined intervals. In this mode SRP unit operate and idle in time intervals determinated by user. Simultaneously with control by timer, Marathon 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, Marathon 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 Marathon to interfere with the SRP unit functioning. In this mode Marathon 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, Marathon 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.
- LC-less mode
  Marathon allows to use information received from a motor control device or an electricity meter for calculations, allowing to work without a load cell with an acceptable decrease in calculation accuracy.

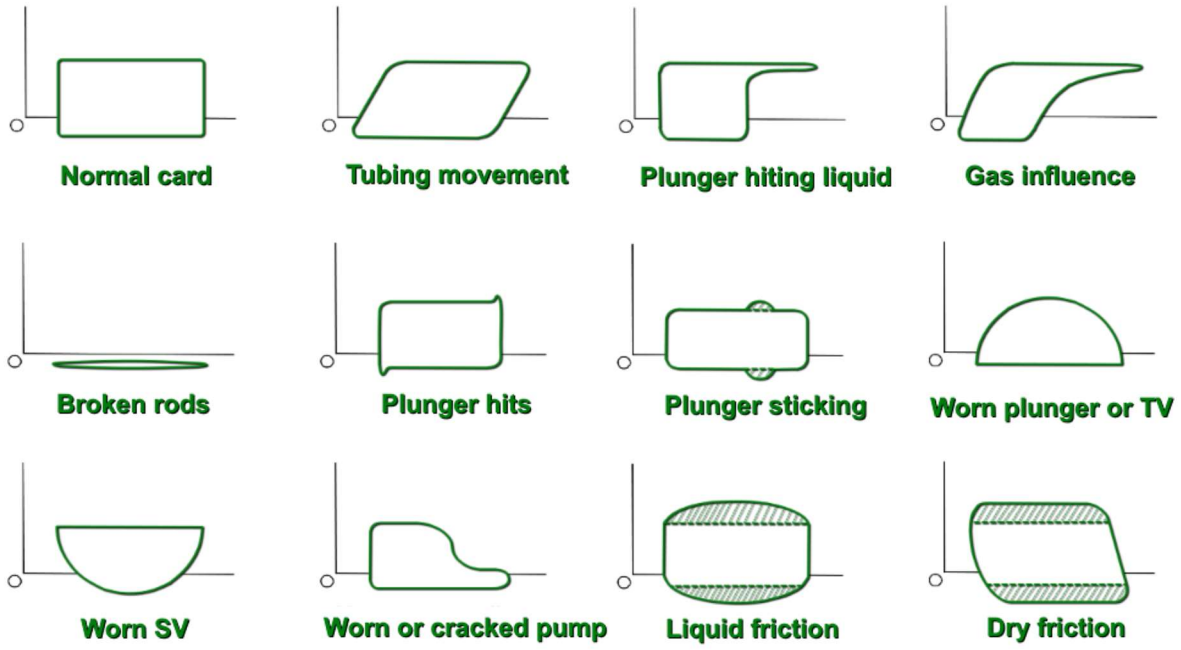
## Structure

Marathon controllers can be supplied:

- 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

Emsyst 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.

## Artificial intelligence malfunction detection




Marathon equipped with Artificial Intelligence system of pattern recognition which allows early detection of occurring undesirable states with 95% accuracy even if several malfunctions occurring at once.

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

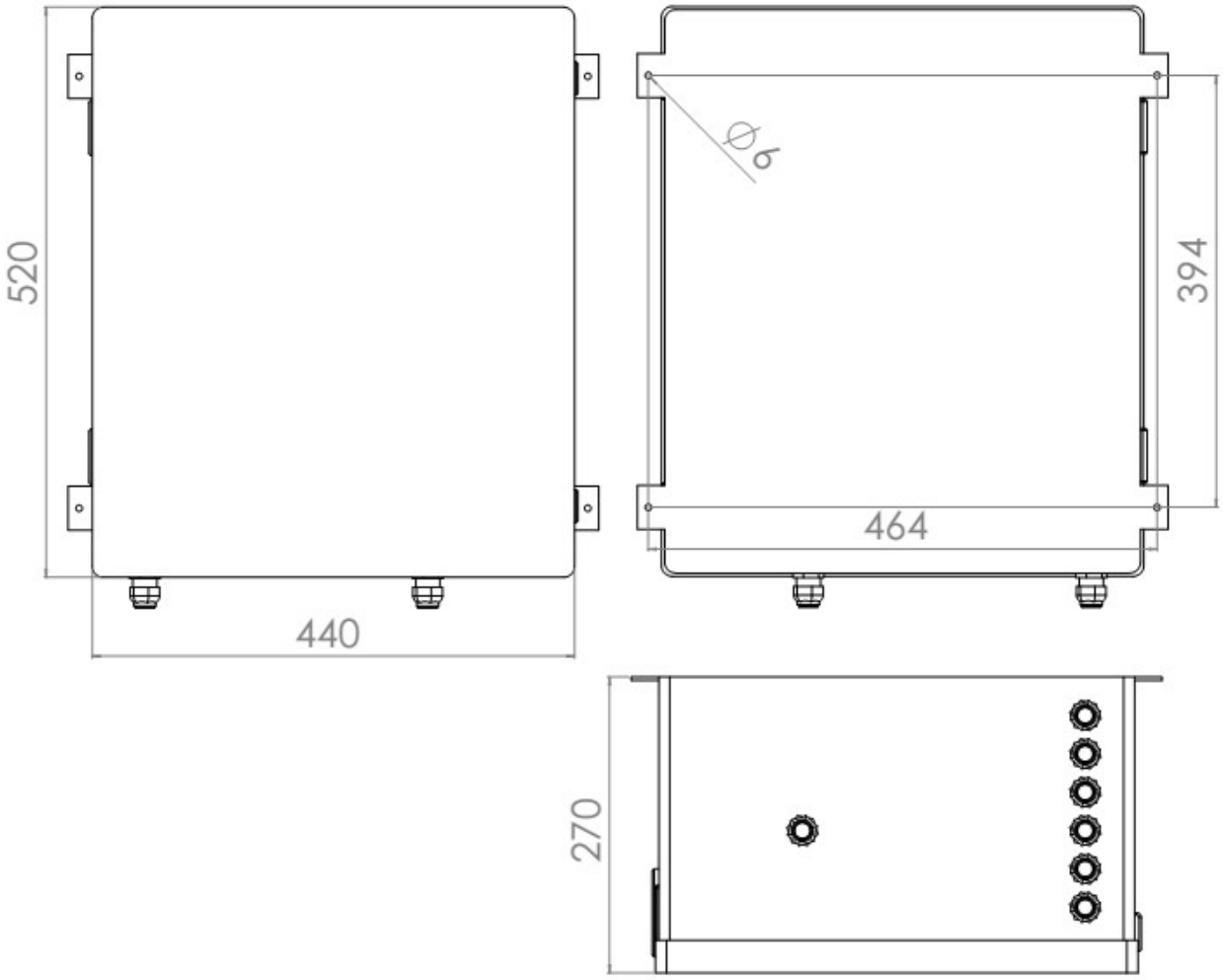



Fig. 3 Marathon Controller dimensions in mm

(board with peripherals in separate box for installation into existing control panel)
(Cabinet dimensions may vary based on equipment and accessories or upon agreement with the customer)

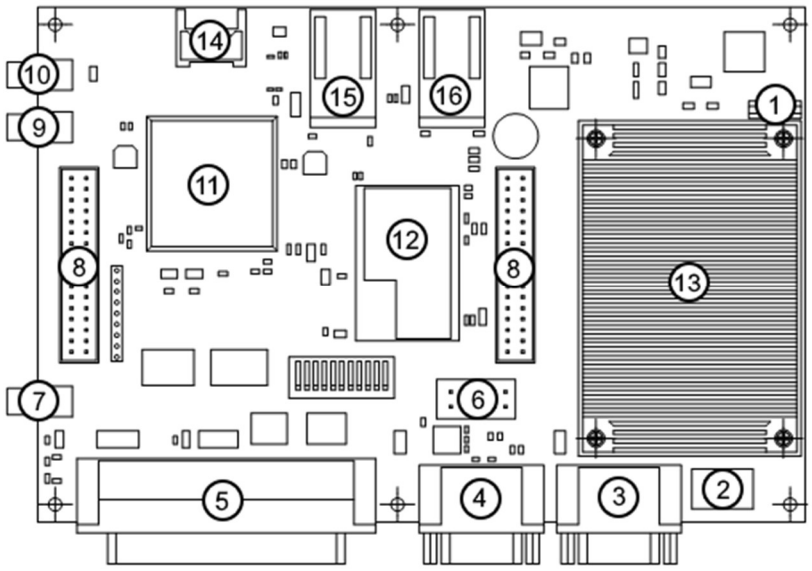
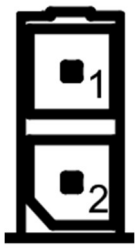



Fig. 4 Components of Marathon board

1 – Power connector, 2 – RS485 connector, 3 – CAN connector, 4 – RS232 connector, 5 – signal connector, 6 – COM connector, 7 – WiFi antenna connector, 8 – radio module connectors, 9 – GPS antenna connector, 10 – UMTS/GPRS antenna connector, 11 – UMTS module, 12 – WiFi module, 13 – CPU, 14 – SIM card connector, 15 – Ethernet-a/USB connector 1, 16 – Ethernet-a/USB connector 2




Power connector pinout

| Pin | Net |
|---|---|
| 1 | +12 V DC |
| 2 | GND |

Fig.5 Power connector

RS485 connector pinout

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

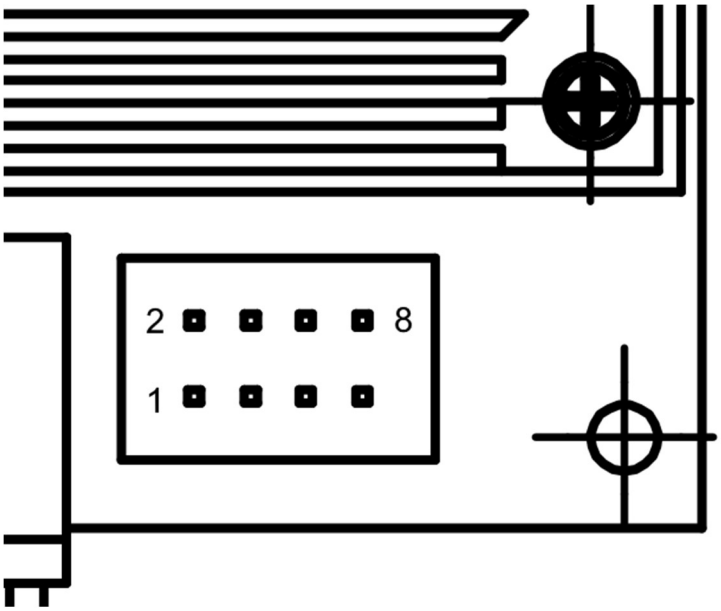



Fig.6 RS485 connector

CAN connector pinout

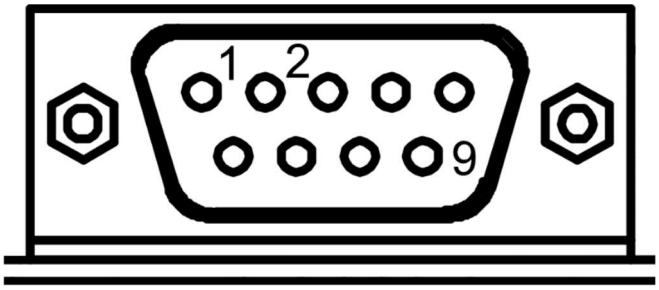



Fig. 7 CAN connector

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

RS232 connector pinout

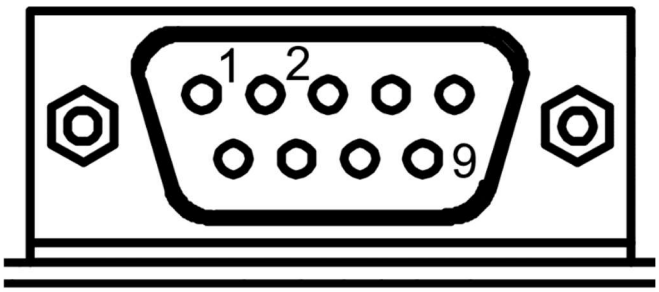



Fig. 8 RS232 connector

| 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 |

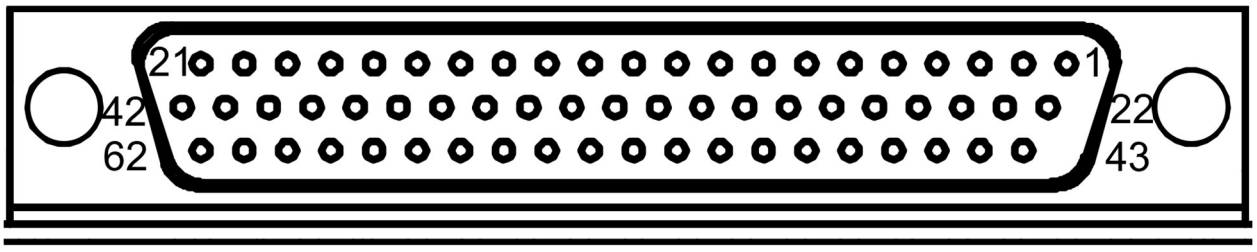



Fig. 9 Signal connector

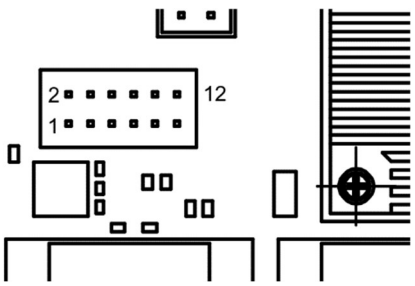



Fig. 10 COM connector

Signal connector pinout

| 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 + | |

COM connector pinout

| Pin | Net |
|---|---|
| 1 | RS232-1 TTL TX |
| 2 | RS232-1 TX |
| 3 | RS232-1 TTL RX |
| 4 | RS232-1 RX |
| 5 | GND |
| 6 | GND |
| 7 | GND |
| 8 | GND |
| 9 | RS232-2 TTL TX |
| 10 | RS232-2 TX |
| 11 | RS232-2 TTL RX |
| 12 | RS232-2 RX |