



FIO > Five In One

The SMART regulator

Indirect Flow Measurement
Outlet Pressure Control
Flow Limitation
Remote Monitoring
End-User Management

Integrated remote controlled regulator

FIO > Five In One

What is?

FIO (Five In One) system allows to remotely control the pressure reduction stations of a natural gas distribution network.

One device, five functions

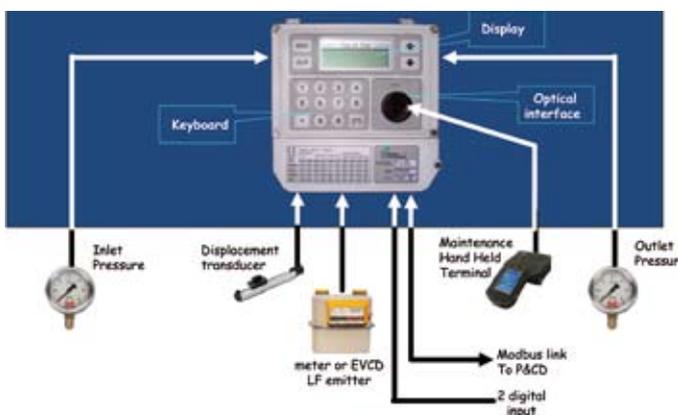
The specific feature of FIO is the integration of 5 functions in one single battery-operated device :

- [IFM]** > **Indirect Flow Measurement**, performed in an a non “intrusive mode”, instead of traditional measurement device, by means of the values correlations of the pressures and of the relevant displacement of the plug.
- [OPC]** > **Outlet Pressure Control** of the regulator, that is to say the control of the outlet pressure point, remotely or locally, in compliance with a daily/weekly program or compensated according to flow demand.
- [FL]** > **Flow rate Limitation**, by acting on the outlet pressure in order to keep the delivered flow rate below a configurable limit; it replaces the mechanical limiting devices without any intrusive component and any pressure loss under standard operating conditions.
- [RM]** > **Remote-Monitoring** of the meaningful parameters of the group functionality and safety (inlet and outlet pressure, safety valve, filters clogging, monitor take over, SSV trip, intrusion, gas leakages).
- [EUM]** > **End User Management**, that means an interruption of supply to the users in case of emergency or in case of arrearages.

FIO is designed to be applied to Fiorentini regulators.

In particular, FIO may be presently applied to all Fiorentini pilot-operated regulators; indirect flow measurement is limited only to REFLUX, REVAL.

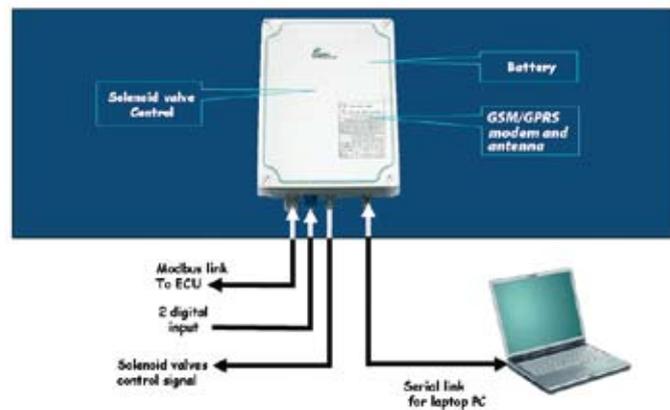
The FIO functions may be integrated into Fiorentini - Explorer FT volumes converter.



- > The electronic control unit (ECU) (that may be either a stand alone or the Explorer FT volume converter)
- > The linear transducer for detecting the plug shifting
- > The solenoid valves for controlling the forward pressure in the pilot's tank
- > The double diaphragm pilot of CS series with integrated buffer volume
- > The auxiliary pre reducer for generating the forward pressure starting from the upstream pressure
- > The battery pack, GSM feeding and communicating system to be installed in safe area.

FUNCTIONS
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Of the 5 functions of FIO 3 are independent (Indirect flow measurement, Outlet pressure modulation, Remote control) while the other 2 are dependent, that is they require the implementation of one or more independent functions.

P&CD - Power & Communication Device

[IFM] > Indirect Flow Measurement
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To know the gas flow rate through an intermediate reduction unit of a “meshed” network allows to perform more accurate balancing of the network itself.

Presently the metering of the flow rate of the existent units, performed by means of meters or quantometers, requires the modification of the units or the availability of important energy sources (ultrasonic, turbine, annubars) and, anyway, high costs that do not often justify the investment.

The functioning principle of the indirect metering is based on the assumption that, for each type of regulator, there is a functional relation among the instantaneous flow rate under basic conditions, the regulator plug position and the inlet and outlet pressures:

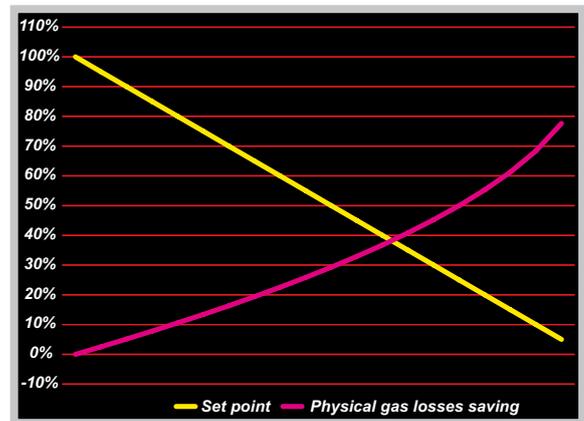
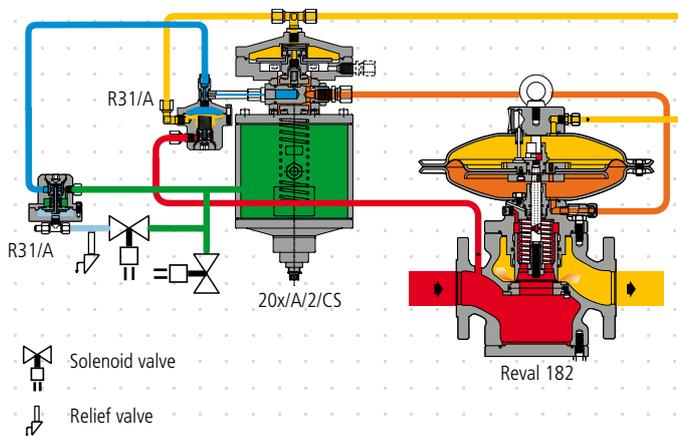
By considering the errors due to the actual compliance of the regulator with the correlation formula, the total accuracy of the metering, in all operating conditions, is better than the 8% of the regulator full scale value.

FIO performs the instantaneous flow rate measurement every 30 seconds.

In order to increase or decrease the outlet pressure in the pilot regulators, it is sufficient to decrease or increase the spring force of the pilot. Such increase or decrease of spring force may be obtained by increasing or decreasing the air or gas pressure (“forward pressure”) injected into the spring chamber. The pilot operated regulator spring shall be set in order to obtain the required minimum pressure in case of a lack of forward pressure.

To modify the outlet pressure set point of a regulator without an operator’s intervention, is useful in those cases in which the outlet pressure is highly variable during daytime due to different drawing conditions by the users downstream from the regulator, or in order to limit the flow rate.

The objective to reduce the gas physical losses is achieved keeping the operating pressure at minimum allowable valve.



To increase the system safety the use of a double diaphragm regulator of the CS series is needed, replacing the previous pilot pneumatic operated regulator. The double chamber and the double diaphragm guarantee a full separation between the main hydraulic regulation circuit and the motorization circuit for the modulation.

The system is able to pilot also two or more lines (up to 4) by keeping the intervention delta the between lines, constant.

The pressure profiling function is an automatic control to change the outlet pressure at specific values according to the time of the day. The operator can set 7 setting pressure for each day of the week. The ECU stores 1 weekly program active plus 1 weekly program as stand by.

If flow input (indirect or direct) is available, the pressure compensation function which is an alternative to pressure profiling can be activated. This function allow to automatically correlate the operating pressure to the gas demand.

The setting accuracy is 1% better than the nominal Pd full scale.

Contributing to the sustainable development

■ Physical losses are as well a carbon foot print. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent. Every tonn of natural gas is approx. 25 tonns of equivalent CO2 emission. Pressure management strategies allow to reduce gas losses and the consequential carbon emissions. ■



[FL] > Flow Limitation**Fio > Five in One**

The flow limitation of the industrial customers allows to comply with the contractual obligations, the technical specifications of gas drawing according to which the regulation and metering unit was sized as well as to grant a safety operation in the network.

The flow limitation can be used to perform network balancing.

The flow limitation function may be performed only if the outlet pressure modulation function and flow measurement (direct/indirect) is available.

When the flow rate value at reference conditions, calculated with the indirect flow rate metering function or detected from an external metering system (meter, converter), reaches or exceeds the set and configurable limit flow (Qlim), FIO modulates Pd in order to keep the flow at the standard condition with respect to Qlim up to the achieving of the configurable pressure limits.

The overall accuracy, according to the procedures with which the flow rate is calculated, may vary from 0,5% to 10% of the regulator nominal flow rate at the Pu and Pd operating conditions.

[RM] > Remote Monitoring**Fio > Five in One**

To remotely control the functionality of the units is very important for the network safety and this allow as well to achieve high quality of the distribution service and to reduce the operational costs because it can reduce the frequency of the inspections.

For instance the reduction of the inspections frequency from 1 every 2 days to 1 every 7 days for the implementation of the remote control produces a saving of 70%.

FIO supports all the remote control functions presently implemented in the devices of the EXPLORER family.

In particular the control unit at its maximum configuration is able to monitor:

- > The inlet and outlet pressure of the unit, with two integrated transducers with a stability and accuracy higher than 0,5% of the scale value
- > The gas temperature value by means of an external type PT100 sensor (the function is not available if the indirect flow measurement function is enabled)
- > The flow rate calculated by an external apparatus (meter or volumes converter) and transmitted through low frequency pulse emitter
- > Two inputs able to detect the operating status (ON-OFF) of some system functional conditions (clogged filters, slam-shut valve intervention, monitor intervention, intrusion, flooding, etc.

Fio can be powered by long life batteries, solar panel or power grid.

When FIO is battery powered and if the remote modulation function of the outlet pressure is not required, in order to increase the battery life , the control unit and the communication unit are usually kept in the sleeping mode. When an alarm is detected, the control unit goes out from the sleep status and it activates the communication unit to call the control center. However periodically the control unit verifies for SMS reception.

[EUM] > End User Management

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To remotely intervene for the disconnection of special users (Load Breaking) in precarious conditions that might compromise the network operation or in arrears conditions, allows reducing the operational costs, the intervention times and might result in an advantageous alternative for the improvement of the network when this is necessary only for coping with occasional overloading situations.

The interruption of the supply may be made by triggering the slam shut valve or by reducing the regulator outlet pressure to the minimum configurable value; the restoration of the supply is generally an activity to perform under safety conditions with the operator's intervention; the reset acknowledgement control may be generated by the FIO or it may require the manual triggering of the slam shut valve.

The reset may be enabled either through a specific control from the remote center or locally by entering a password.

FIO - SUPPORTING TOOLS

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- [A] > DMS@home
Scada system software
- [B] > FIO - TERM
Free software to configure and access totally to the unit
- [C] > WEB SERVICE package
for easy scada integration
- [D] > HTML product configurator
Never select the wrong P/N

GENERAL SPECIFICATION
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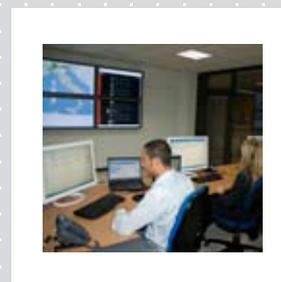
Operating temperature	-20°+60°C (On demand: extended range -25°C+65°C)
Ambient temperature	-20°+60°C (On demand: extended range -25°C+65°C)
Power supply	batteries: LYTHIUM (ECU), ALKALINE (P&CD) On demand: Solar panel power supply or power grid power supply
Protection:	ECU: IP65 with ABS pressure transducers, otherwise IP55 P&CD: IP65
ECU Input	Inlet pressure Outlet Pressure Displacement transmitter (IFM function) or PT100 (EVCD function) Counter (1 x LF) Alarm status (2 x DI)
P&CD Input	Link to ECU
ECU Output	Link to P&C:
P&CD Output	Solenoid valves command (2 x open collector)
Local Interfaces	ECU: keyboard + display / Irda -P&CD: serial link On demand: Keyboard + display on P&CD
Remote interfaces	GSM/GPRS/SMS modem
Communication Protocol	Modbus (ASCII and RTU)
Data Logging	Variables: any combination of P (1 and 2), T, Counter and Diagnostic Period : 30s up to 12h (sec resolution), daily, monthly Strategy : Average, Statistics (min, max, σ) Data Storage : > 50.000 records (Single Variable, Average Strategy) Memory management : circular vs filling
Alarms and Events	Analog Variables: "Value"thresholds: Measured values (3 Max + 3 Min) "Delta"threshold : allowed variation prior to alarm generation Digital inputs variations (2 on ECU + 2 on P&CD) Data Setup modifications Low Battery level Diagnostic events
Alarm In-bound calls	Up to three telephone numbers Programmable sequence Alarm Buffer for up to 1000 alarms and 1000 events
Safety Approval:	Certificate EEx -ia IIB T4 Reference: EN 50014, EN50020 Approval Number : Ineris 01.E.5003 X -Ineris 03ATEX0017X
EVCD "Electronic Volume Conversion Device"	Reference : CEN 12405-1, "Ijkgeregeling gasmeter"(NL) Approval : NMI T5928 Certificate : NMI TC3466



Reducing Stations



Metering



Data Management Service



**Pietro
Fiorentini**

Pietro Fiorentini S.p.A.
via E.Fermi 8/10
I-36057 Arcugnano (VI) Italy

Tel. +39 0444 968.511
Fax. +39 0444 960.468

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CT-s 530-E July 10

www.fiorentini.com