

Process Controller 1/4 DIN - 96 x 96 mm Dual-loop - QD line Controller - Programmer QP line

The Hardware **Package**

2 analog inputs, 1 remote set input, 3 logic inputs, 2 control outputs, 4 auxiliary relay outputs, 2 logical outputs, 1 retransmission and RS485 Modbus-Jbus communication.

Complete **Configurability**

From the keyboard and via serial connection, using a guided menu, you can choose the operation mode, the control algorithm, the input and output types, the Set points. You can also insert all parameters.

FUZZY Intelligence

In combination with the PID algorithm and an advanced tuner, this always guarantees a smooth and precise regulation, even for critical processes.

ASCON spa

High Security

Guaranteed: by the ISO9000 certificate for planning and construction quality; by the CE brand for security and immunity from disturbances; and by 3 levels of accessibility to parameters.

These 96x96 DIN controllerprogrammers are particularly suitable for the control of industrial processes.







Certified ISO 9001

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QD Series - Dual Controller configurable as: 1 loop, cascade, ratio or 2 independent loops QP Series - Controller-Programmer 16 programs 255 segments

All the performance for precise and safe control

The Hardware Package

- Up to 2 inputs for thermocouples, Pt 100, mA, Volt.
- 3 logical inputs for modifying the operating modes: Auto/Man, Local/Remote, keyboard lock, etc...
- Up to 2 control outputs with single or double action: relay or logic, mA or Volt and three point stepping.
- Up to 4 configurable auxiliary relay outputs and 2 logic outputs associated to the program.
- 1 isolated auxiliary output, in mA or Volt, for input, Set point, output or deviation retransmission.
- All types of Set points. The possibility of selecting between Local and Remote, Programmed (QP Series), and of choosing one among the 3 stored Set points.
- RS485 serial communication, with Modbus-Jbus protocol.

Complete Configurability.

The possible variants are all always available in the instrument. The operation mode is chosen based on the application. In field operation it is always possible, with the greatest simplicity, to reconfigure the instrument to adapt it to unexpected new requirements. The configuration is effected by keyboard or in serial line. Using a simple, menu-driven tree structure, you can choose, in sequence: control algorithm, input types, ranges, engineering units, output type with security values, Set points, etc...

Fuzzy Intelligence and an advanced "Tuning"

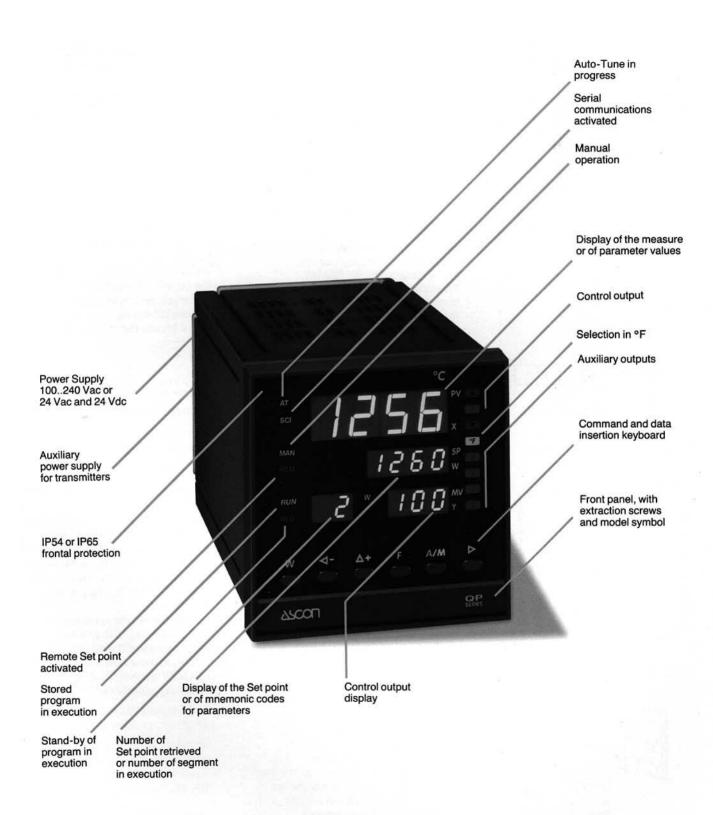
The power and flexibility offered by an advanced PID combined with FUZZY Logic guarantee a precise regulation of the most critical processes, whether in response to the dynamic solicitations or to any variations of the Set point. The tuning of the control parameters is highly facilitated by the use of an intelligent self-tuning algorithm.

Maximum Protection

All parameters are saved for an unlimited time in non-volatile memory. Their access is protected by password. They are divided into 4 homogeneous groups and are configurable with 3 different levels of operativity: visible and modifiable, visible but not modifiable, invisible. All this gives the instrument more security, but at the same time, more ease for the final operator, without limiting the great flexibility of use.

High Security

Like all ASCON instruments, these are designed in conformance with the most recent EN-IEC security regulations for industrial systems and apparatus, marked with the CE brand, and built in accordance with ISO9002/EN29002 Quality Assurance Management System, guaranteed by CSQ.



Operation

Fig. 1: Block diagram of Cascade control mode

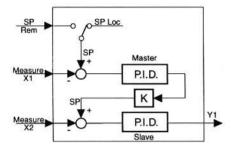


Fig. 2: Block diagram of Ratio control mode

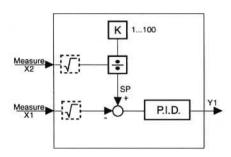


Fig. 3: Outline of Programs selection switch

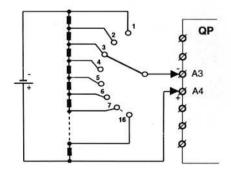
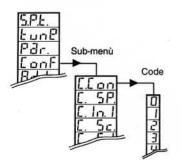


Fig. 4: Tree-structure of Function Menù



OPERATIONAL MODES

The QD Series process controller includes 2 distinct loops which can be coordinated with each other.

4 selectable operational modes are planned, in configuration as:

1 loop with single or double action, Cascade control loop with single or double action,

Ratio control loop with single or double action.

2 independent loops.

Cascade Control (See fig.1)

The primary controller output (Master) becomes the Set point for the secondary controller (Slave). This operational mode is particularly useful in critical processes, where there are long delays, dead times, non linearity, etc.

In fact, the secondary controller anticipates and practically cancels the perturbances acting on the primary process for a more efficient and stable control.

Ratio Control (see fig. 2).

A ratio between two variables in the process is maintained at a fixed value. Thanks to the capability of calculating the square root of the input values, it is suitable for combustion control (air/fuel ratio) or for the mixing of 2 fluids.

Set point Programmer

QP Series are single loop controllers, offering programmed Set point as an additional option. When operating as Controller-Programmer, a program is built using a simple guided procedure, formed out of the sequence of segments (see fig. 5).

For each of these segments, the end point is set along with the time, in addition to the associated logic output status and to the PID parameters chosen between two available sets. The number of loops (finite or infinite) is configurable, as is the execution mode: based on duration priority or on slope-priority of the segments. Up to 16 programs can be stored, with a max of 99 segments/program, for a max of up to 255 segments.

You can select, run and suspend the program from the keyboard, from logic inputs or through serial port.

A program can also be executed easily using and external voltage divider (see fig. 3).

Display of the progress status (segment being executed, time elapsed, time left, etc.) helps the operator.

MENU DRIVEN FUNCTIONS

The man-machine interface is made simple by menus.

The tree-structured main menu passes to the submenu and then to the insertion of parameters and configuration codes.

Figure 4 shows the menu structure.

CONTROL ALGORITHM

The QD and QP Series controllers use an innovative control technique based on **FUZZY** logic, combined with the traditional PID.

"FUZZY" logic uses some concepts from artificial intelligence.

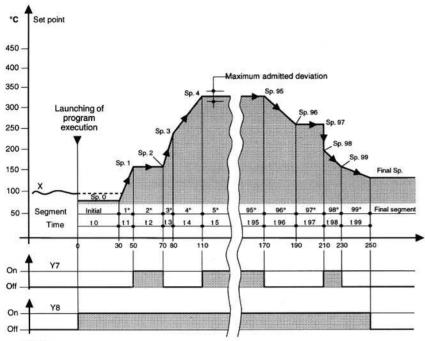
At the basis is a set of rules allowing it to act not on the basis of binary statuses (for example, black/white, open/closed, hot/cold), but rather on the evaluation of intermediary statuses (for example, very hot, hot, lukewarm, cold, very cold).

This operation mode is similar to human reasoning, with gradations leading to more real evaluations, and therefore, to more corrective actions. PID-FUZZY control, by ASCON, offers the following substantial advantages:

- reacts rapidly to load and Set point variations, avoiding overshooting;
- allows accurate control of critical processes, even when there are significant changes in the operational conditions (see fig. 6).

The controller calculates the "FUZZY" parameters automatically, deriving them from PID parameters optimized at the time of launching.

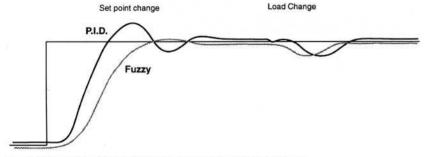
Fig. 5: Example of Programmed Set point with priority slope.



Notes:

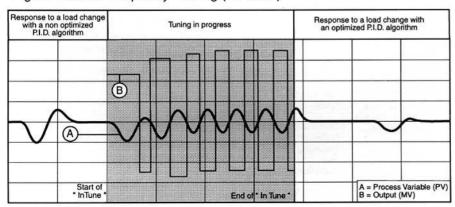
- 1 With duration of initial segment t 0 = 0, execution begins from segment 1 with W = X
- 2 With deviation greater than a maximum admitted value, time count stops in order to guarantee scheduled duration.

Fig. 6: Comparision of step response curves between P.I.D. algorithm and P.I.D.+Fuzzy algorithm in different operating conditions.



Note: P.I.D. parameters have been optimized before the change

Fig. 7: " Natural Frequency " tuning (In Tune)



Self-tuning "In-Tune"

This is a new method for calculating the PID parameters, called that of "natural frequency".

Tuning can occur at a Set point change or during process steady conditions. The method consists in the analysis of the response of the process of solicitations, even very small ones, imposed by the controller for calculating the natural frequency of the process.

The result is a great deal better than that obtainable using conventional methods, such as Ziegler and Nichols or similar ones (see fig. 7).

Technical data

Features at env. 25°C	Description							
Total Configurability	From the keyboard or serial line, with a guided menu, you can choose, in sequence: type of control, operational mode, inputs, outputs, Set points and insert all control parameters.							
	1 Loop with single/o							
Operational Modes	1 Loop as above an	Only for QP Series						
	2 independent loop		, out	only to: air conto				
	Cascade (1 master	Only for QD Series						
	Ratio (direct/revers			- Only for ab conce				
	Algorithm On-Off, P.I.D., PID + FUZZY and PID with "three point stepping" output							
	Supplementary P.I.D. parameters for main loop							
	Prop. Band (P) 0.5999.9%							
	Integral T. (I)	0.1100 min						
	Derivative T. (D)	0.0110 min						
	Fuzzy Intensity	0.0110 min Excludable with 0.0						
	Output Man.Reset	0100% For P and PD cont		ol.				
Control	Cycle T.	1200 sec.	"Duty Cycle" output					
		0.0110%		II.				
	Hysteresis Dead Band		For On-Off control					
	A AND COLUMN TO A STATE OF THE	0.05%	Heat/Cool output					
	Relative cool gain	0.13						
	Excursion T.	15600 sec	ana arar e vi					
	Min output resol.	0.110%	Three point steppin	g output				
	Potentiometer	100Ω10ΚΩ						
Input X1 (range, see tab. 1)	Common characteristics	A/D converter with 50.000 points Sampling time: 0.5 to 30 sec., configurable						
	Accuracy	0.2% ± 1 digit (T/C 0.1% ± 1 digit (mA		Between 100240Vac error is irrelevant				
	Resistance Thermometer	Pt100Ω at 0°C (IEC 751) With selection °C / °F /°K	Connection with 2 or 3 wires	Line: 20Ω max (3 wires Thermal drift: < 0.1°C/10°C env. T. < 0.5°C/10Ω line R.				
	Thermocouples	L,J,T,K,R,S,B,N, E,W (IEC 854) with selection °C /°F /°K	Cold joint compensation, internal or external in °C / °F / °K	Line: 150Ω max Thermal drift: $< 2\mu V/^{\circ}C$ env. T. $< 5\mu V/10\Omega$ line R.				
	Continuous	420mA,0-20mA	Engineering units,					
	current	Ri = 30Ω	floating point, with					
	Continuous Voltage	0-20mV, 0-50mV Ri = 10MΩ 0-1/1-5/0-5/0-10V	or without sq.rt. L.R9999999 H.R9999999	Input drift: < 0.1%/20°C env. T.				
Input	0,	Ri = 10kΩ	(min 100 digits)					
X2	Characteristics iden	itical to input X1 (only	for QD Series)					
Auxiliary inputs	3 logic	Permanent closure of external associated allow:	Auto/Man switching Set point selection, Set points, keyboard parameters set, Y1 Y1 = forcing value Run, hold, waitpro	recall of 3 stored d lock, 2nd PID = Remote Set point,				
			(only for QP Series)	- 6-900				
155	Single of dual, with	direct or reverse actio	n					
	(for combinations of possible outputs, see below)							
	Lower limit 090% (Heat)							
	Upper limit 10010% (Heat), -10010% (Cool)							
	Max slope 020% /sec. (Heat / Cool)							
	Safety value 0100%, -100100% (Heat / Cool)							
	Forcing value	n logic input						
Main			lay, 2 NO contacts, 5A/250Vac, 2x10 ⁵ transition					
output Y1	Discontinuous	Logic	0-22Vdc, 20mA (for solid state relay)	Galvanically isolated:				
	3-1	Current	0-20mA, 4-20mA 750Ω/10V max	500 Vac/1min, Protected from s.c.				
	Continuous	Voltage	1-5V, 0-5V, 0-10V 500Ω/20mA max	Res.: 12 bit (0.025%) Accuracy: 0.1%				
	"Three Point Stepp	ing"	Dual action relay, 2 NO contacts, 5A/250Vac, 2x10 ⁵ transitions					

Table 1: Input X1

Input type, s	cale range			
Pt100Ω at 0°C	-200600 °C -3281112 °F			
Thermoresistance	-99.9300.0 °C			
J Thermocouple	0600 °C			
Fe-Cu 45% Ni	321112 °F			
L Thermocouple	0600 °C			
Fe-Cu/Ni	321112, °F			
T Thermocouple	-200400 °C			
Cu - CuNi	-328752 °F			
K Thermocouple	01200 °C			
Cromed Alumel	322192 °F			
S Thermocouple	01600 °C			
Pt10% Rh-Pt	322912 °F			
R Thermocouple	01600 °C			
Pt13% Rh-Pt	322912 °F			
B Thermocouple	4001800 °C			
Pt30% Rh-Pt6%Rh	7523272 °F			
N Thermocouple	01200 °C			
Nicrosil-Nisil	322192 °F			
Thermocouple	01100 °C			
Ni-NiMo18%	322012 °F			
W Thermocouple	02000 °C			
W3%Re-W25%Re	323632 °F			
420mA, 020mA				
050mV, 0200mV 01V, 15V, 05V 010V	Configurable eng. units *			

^{*} Linear or with square root extraction and decimal point selection

Dual action

For processes with "dual action" output Y1 (for example Heat-cool), two outputs are available with the following possible combinations:

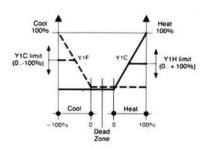
Y1 Heat	R	L	R	С	R	С	L	С
Y1 Cool	R	R	L	R	С	С	С	L

R =Relay; L =Logic; C =Continuous (mA or Volt);

When Y6 continuous output is used for Y1 cool, the retransmission output is not available.
4...20 mA or 0...10 Vdc.

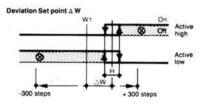
Features at env. 25°C				Des	cription				
at env. 25°C	Bolov with NC	cont	acte 5		ac, 2x10 ⁵ transitions - Hysteresis 0.0110.00%				
A	Helay Willi NC	COIR	acis, J	70250 Vac, 2X	Deviation Set poin				
Auxiliary		High A	ctive		Band Set point	0300 digit			
outputs Y2-Y3	Action .			Type of	Indep. Set point	from HR to LR			
(also available	Mode	Low A	ctive	action					
for loop 2 in	Whisters (•	Councilland	Set point to Y1	0100%			
QD Series)		Specia Functi		Sensor brea					
QD Ochos)			ons		d (only for QP Series)				
Auxiliary	Security status	S		Security ena	enabled or disabled with NO or NC contact				
outputs, Y4-Y5	Same charact	eristic	cs of Y2-Y3 (available only if continuous Y1)						
- 2	Galvanic, isola	Current:		Input retransmission X1					
	analog 500 Vac/1 min		0-20mA, 4-20mA 750Ω/10V max		Set point retransmission W1				
					Output retransmission Y1 (1st channel Δ)				
output Y6	12 bit (0.025%	b)	Voltag						
(option)	Accuracy: 0.1		1-5V, 0-5V, 0-10V 500Ω/20mA max		Output retransmission Y1 (2nd channel ∇) Error retransmission (0 to 25% of the range				
logic outputs	Open collecto)r	5004#20MA Max		30 mA max, 28 Vdc (OFF status)				
QP Series only)	500 Vac isolat		ac may	/1 min	Voltage drop: 1Vd				
ar conce emy			ao mas	0 1 1111111	Local	o max - oo ma			
	Up or down ra	CONTRACTOR OF THE PARTY OF THE			Local and 3 stored				
	can be set in digits/min, between 0.010% of the range				Remote only				
Set point	between 0.0	.10%	or the	ange	Local and remote				
7107	Limits: lower t	o unn	er can	be		romata)			
	sett separatel				Local and (local +				
D	- Soparator		2000	•	Programmable (or				
Remote			Curre		Bias in engineering	g units			
	Set point of available with Accuracy 0.1%		0-20mA, 4-20mA		-100% +200%				
			Ri =		(compatible with display)				
programmed			Volta		Ratio: -9.99 + 10.00				
Diodiammed			December 1	0-5V, 0-10V 300 kΩ	Local Set point +	Remote Set point			
			mi =	300 K11	100 to 100 to 200 to 20	riomote oet point			
Set point option)	16 programs r	may (0 000	manta Inragra	m may OFF sammer	to total			
					m max, 255 segmer	nts total.			
Set point option)	From 1 to 999	9 гере	titions	/ program or	infinite.	nts total.			
Set point option) Programmed	From 1 to 999 Time base cor	9 repe	etitions able in	/ program or seconds, mir	infinite.	nts total.			
Programmed Set point	From 1 to 999 Time base cor Priority of dura	9 repending	etitions able in or slope	/ program or seconds, mir e.	infinite. nutes, hours.				
Programmed Set point (option:	From 1 to 999 Time base con Priority of dura Up to 6 logic of	9 repending repe	etitions able in or slope s and 3	/ program or seconds, mir e. 3 logic inputs,	infinite. nutes, hours. programmable and	related to the program.			
Programmed Set point	From 1 to 999 Time base cor Priority of dura Up to 6 logic of Selection betw	9 repending repending to the second s	etitions able in or slope s and 3 he 2 a	/ program or seconds, mir e. B logic inputs, vailable sets o	infinite. nutes, hours. programmable and of PID parameters fo	related to the program.			
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Programmed Set point (option: QP Series only)	From 1 to 999 Time base con Priority of dura Up to 6 logic of Selection betw Auxiliary volta Run, hold, wa	9 repending repending to the second repending to the second repending to the second repending re	etitions able in or slope s and 3 he 2 a out for s , exec	/ program or seconds, mire. B logic inputs, vailable sets of selecting the utable from the	infinite. nutes, hours. programmable and of PID parameters fo program remotely. le keyboard, logic in	related to the program. r each segment. puts and via serial port.			
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Programmed Set point (option: QP Series only) Auto-tune	From 1 to 999 Time base con Priority of dura Up to 6 logic of Selection betwoen Auxiliary volta Run, hold, wa With "Natural during proces Incorporated, Switching from	of repending of the second of	etitions able in or slope s and 3 the 2 a out for , exec uency' dy cor Bumple board,	d / program or seconds, mire. B logic inputs, vailable sets of selecting the juitable from the method. Turn ditions, with less action logic inputs, of	infinite. nutes, hours. programmable and of PID parameters fo program remotely. le keyboard, logic in ling can occur at a S aunch enabling inde	related to the program. r each segment. puts and via serial port. tet point change or ex.			
Programmed Set point (option: QP Series only) Auto-tune Auto-Man st.	From 1 to 999 Time base con Priority of dura Up to 6 logic of Selection betwoen Auxiliary volta Run, hold, wa With "Natural during proces Incorporated, Switching from	of repending repending a second repending repe	etitions able in or slope s and 3 the 2 ar out for , exec uency' dy con Bumple board, ous pro	d / program or seconds, mire. B logic inputs, vailable sets of selecting the juitable from the method. Turn ditions, with less action logic inputs, of	infinite. nutes, hours. programmable and of PID parameters fo program remotely. le keyboard, logic in ling can occur at a S aunch enabling inde	related to the program. r each segment. puts and via serial port. tet point change or ex.			
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Programmed Set point (option: QP Series only) Auto-tune Auto-Man st. Serial Comms. (option) Auxiliary	From 1 to 999 Time base cor Priority of dura: Up to 6 logic of Selection betw Auxiliary volta Run, hold, wa With "Natural during proces Incorporated, Switching from RS 485, Mode (read only or re 24 Vdc ± 109 Up to 2 extern	eg rependiguration of putputs ween to age inputs, etc. Freques stead with Em keytous, Jt ead/w/6, 50 in putputs in putpu	etitions able in or slopes and 3 the 2 ar out for , exec uency' dy cor Bumple board, bus pro rite) mA mansmitte Out of is mor forced	r/program or seconds, mire. B logic inputs, vailable sets of selecting the utable from the method. Turnditions, with less action logic inputs, optocol, 1200, 200. Exers (2, 3, 4 wire range or harmitored and the to security variations of seconds.	infinite. nutes, hours. programmable and of PID parameters fo program remotely. ne keyboard, logic in ning can occur at a S aunch enabling inde or via serial port 2400, 4800, 9600 bit ne connections) dware failure (short of e outputs are alues	related to the program. r each segment. puts and via serial port. let point change or x. /sec., 2 wires,			
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Fig. 8: Output characteristic for dual action controllers. Example: Heat - Cool

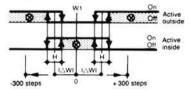


Y1C = Cool output (----) Y1H = Heat output (----) Indication for Y1: -100%... + 100%

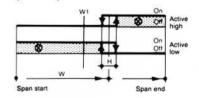
Fig. 9: Auxiliary control outputs Y2 and Y3



Band Set point I Δ W I

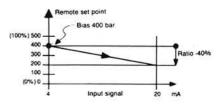


Independent Set point W



Note: W1: Main Set point H: Auxiliary outputs hysteresis

Fig. 10: Example of Bias and Ratio setting for a Controller with scale range 0...500 bar

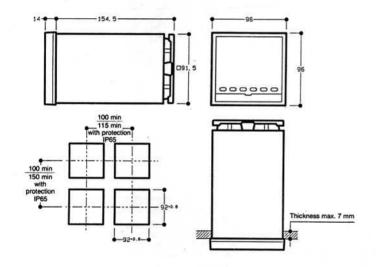


Connections and fitting dimensions

CONNECTIONS QD Series

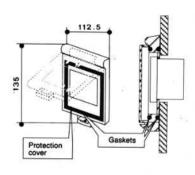
Notes:
1 To supply a 3 or 4 wire transmitter, use terminals B5 (+) and A6 (-) or B5 (+) and B7 (-)
2 Main control output Y1 can be selected within the 5 built-in possible functions: relay (terminals C1 and C2), logic or continuous 4...20 mA or 0...10 Volt (terminals D5 and D6) and three point stepping (terminals C1, C2 and C3).

OVERALL DIMENSIONS

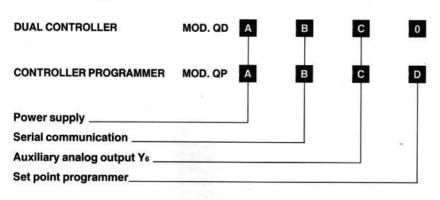


FRONT PROTECTION KIT IP65:

mod. F10-435-2A101



Ordering Codes



Power supply	Α
100240 Vac 50/60 Hz	3
1628 Vac 50/60 Hz and 2030 Vdc	5
Serial Communication (option)	В
None	0
RS485, Modbus, Jbus	3
Auxiliary analog output Y ₆ (option)	С
None	0
0/420mA, 0/15V, 010V)	1
Set point programmer (option QP only)	D
None	0
Up to 16 programs, 255 segments	1