MICROPROCESSOR-BASED CONTROLLERS

S503 Series

TECHNICAL MANUAL

CE

STEIEL Elettronica S.r.l. – Viale Europa, 24 – 35020 Ponte San Nicolò – PADOVA ITALY
Tel. +39 049.8961488 – Fax +39 049.8960184 – www.steiel.it – info@steiel.it

Certified Company, according to UNI EN ISO 9001 standards

WARNINGS

This manual is dedicated to the technical personnel responsible of the installation, management and maintenance of the plants. The manufacturer assumes no responsibility for damages or malfunctions occurring after intervention by non-authorized personnel, or not compliant with the prescribed instructions.

Before performing any maintenance or repair action, ensure that the system is electrically and hydraulically insulated.

Dispose of waste material and consumables accordingly with local regulations.

The manufacturer can modify the instrument or the technical manual without advanced notice.

WARRANTY

All our products are warranted for a period of 12 months from the delivery date.

Warranty is not valid if all instructions of installation, maintenance and use, are not strictly followed by the user.

Local regulations and applicable standards have also to be followed.

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PACKING LIST

1. Instrument
2. Technical manual
3. Mounting brackets (2 pcs.) for panel installation
4. Ferrites (2 pcs. – part no. 5062.0020)

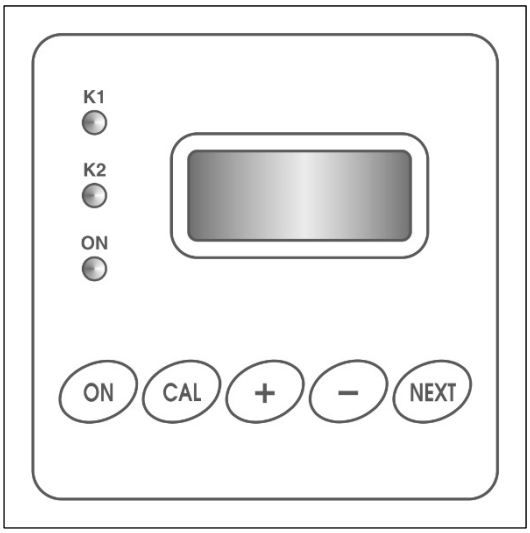
INTRODUCTION AND PRINCIPLE OF OPERATION

The S503 instruments are microprocessor-based digital devices, designed for panel installation.
All models feature 2 relay outputs (settable as set-points or alarm thresholds), one current output completely configurable and galvanically insulated. All outputs may be temporary deactivated (e.g. during maintenance) through the ON button. Alarms and errors are shown directly on the display, and calibration and configuration data are saved into the non-volatile memory for at least 10 years.

The S503 series includes several models, for measuring the following parameters:
- ✓ pH / ORP
- ✓ Conductivity
- ✓ Indicator (model with standardized input)

All models feature a temperature input for Pt100 sensor, for temperature measurement and compensation of the pH and conductivity readings.

DESCRIPTION OF THE FRONT PANEL



ON key	Enable / disable output relays
CAL key	Allow to enter configuration and calibration modes
[+] key	While in normal mode, show the "GAIN" value (amplification factor); in calibration mode increase the displayed value
[-] key	While in normal mode, show the "OFFSET" value (deviation from zero); in calibration mode decrease the displayed value
NEXT key	While in normal mode, toggle between main measure and temperature readings; in calibration mode exit without saving the new calibration data
LED K1	LED ON = K1 relay ON = contact closed
LED K2	LED ON = K2 relay ON = contact closed
LED ON	Light ON (fix) means instrument ON and no anomalies; blinking light indicates malfunction or outputs disabled through the ON button
Display	While in normal operation mode, displays measurement and temperature value. If no temperature probe is connected, shows the value set in parameter P04, within brackets.

TECHNICAL DATA

Common characteristics for all models

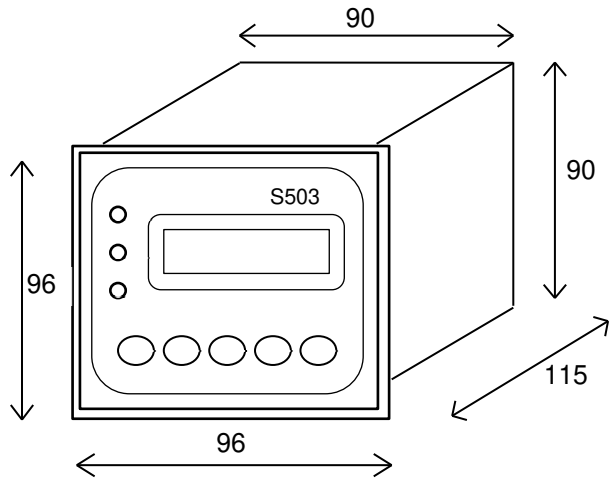
Power supply	100-240 V~ 50/60 Hz (24V~, 24V- upon request)	
Power Consumption	5 VA max	
Protection	5x20 fuse that can be accessed from the rear panel, 24 V~ ⇒ F 250 mA; 100-240 V~ ⇒ F 100 mA	
Display	2-row, alphanumeric LCD (8 digits per row), with backlight	
Analogue Input	precision better than 0.3% FS / repeatability better than 0.2% FS (electronics only)	
Temperature Input	removable, 2-pole terminal block, for connection of Pt100 sensor	
Relay Output	2 independent outputs on removable, 5-pole terminal block; contact max load: 250 V~, 3 A resistive	
Current Output	0/4-20 mA (selectable through software), 600 Ω max load, 0.5% FS max error; galvanic insulation from inputs	
Environment	storage temperature	-20 to +60 °C
	operating temperature	-10 to +50 °C
	RH	max 90% noncondensing
Casing	for panel installation with mounting brackets	
Materials	NORYL body, polyester front panel	
Protection rate	IP42 without protection; IP54 with optional protection	
Dimensions	instrument: DIN 96 x 96 x 115 mm; drilling template: 90 x 90 mm	
Weight	approx. 400 g	

Analogic input, depending on model

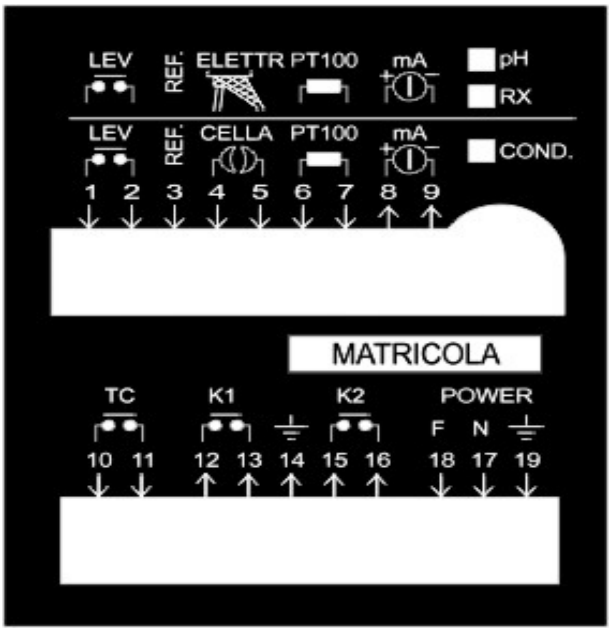
pH / ORP Input	removable, 4-pole terminal block (coaxial cable + reference); input impedance > 10^12 Ω
Conductivity Input	removable terminal block for cell with 2 electrodes + shield
Standardised Input	removable, 4-pole terminal block (specify input type, range and transducer power supply)

MECHANICAL DIMENSIONS

Note: all dimensions are in mm.



ELECTRICAL CONNECTIONS



For correct electrical connections always refer to the rear panel pad printing.

The difference among different models is the input signal terminal block (pins 3, 4 and 5), while the remaining connections are the same for all models.

- ✓ POWER: connect to these terminals (17, 18 19) the external power supply, accordingly with voltage technical specifications indicated on the instrument label; max tolerance ±10% ; in case of 24V-power supply, N=negative and F=positive
- ✓ K1: relay output: voltage-free contact, terminals 12 and 13
- ✓ K2: relay output: voltage-free contact, terminals 15 and 16
- ✓ LEV: digital input (terminals 1 and 2); accept voltage-free contact; when the contact is closed, after a proper delay, the outputs are disabled and the status is shown on the display
- ✓ mA: current output, terminals 8 (positive) and 9 (negative)
- ✓ ELETTR or CELLA: measure input, terminals 3, 4 and 5; for connections refer to the specific sections; the maximum cable length depends on the sensor type (20 m for pH or ORP, 5 m for low conductivity measurements, 10 m for medium-high conductivity, 60 m for standardised inputs using shielded cables); perform wiring while keeping signal and power cables separated; if using cables with additional shield, connect the shield to the REF terminal (never short-circuit the grounding with REF terminal!)
- ✓ PT100: temperature input (terminals 6 and 7), for connecting a Pt100 probe (if a sensor with cable longer than 5 meters is required, it is recommended to use a 2-wire cable + shield; connect the shield to terminal 3)

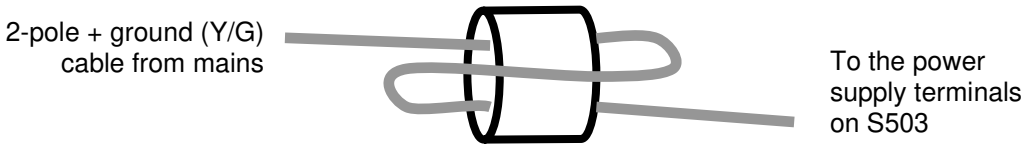
Warning! Before performing any connection, check that the meter is not powered!

Notes:

- *The maximum load for relay outputs is 3 A and 250 Vac resistive; with inductive load the maximum current is 1 A (with a 230 Vac power supply voltage it is possible to directly drive pumps or solenoid valves up to 200 VA).*
- *The output relay contacts are not protected: insert a fuse or other protection system appropriate for the load.*
- *In case of inductive load, the output should be protected with appropriate system for arc and interference suppression (RC nets or varistors in AC, diodes or varistors in DC).*

For a correct functioning of the device even in bad interference conditions, it is recommended to proceed as follows:

a) insert one of the supplied ferrites on the power supply cable as shown in the below picture
b) connect the shield of the signal cable to the grounding or to the REF terminal
c) insert the second supplied ferrite on the input signal cable as shown in the below picture
d) connect RC suppressors (or similar) in parallel with the load (properly dimensioned)
e) check the correct grounding connection of the electric cabin that contains the instrument
f) if the cable connected to the current output is longer than 20 meters, use shielded cable



Ferrite (part number 5062.0020)

Make one or two turns (depending on the cable section) around the ferrite.

Note: *The instrument is supplied with two ferrites, one for the power cable and one for the input signal cable. In the case of a second input (temperature) with separate cable from that of the main input, order a third ferrite.*

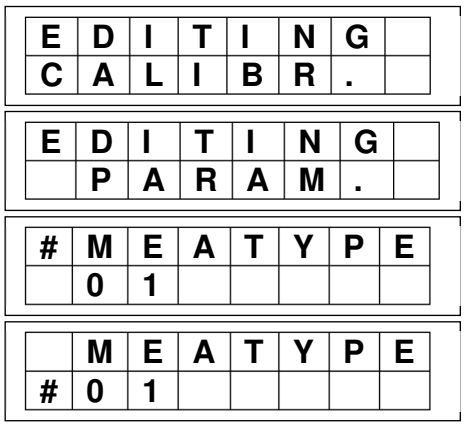
START-UP

At start-up S503 performs a quick test of the display switching on all the segments, then shows the instrument/software version code, checks the memory status, and displays error or advice codes (if present). For details, see "ERRORS" section.
After completing the start-up operations, the device enters the normal operating mode, displays main measurement and temperature, and updates accordingly the current and relay outputs.
If at start-up the [+] and [-] keys are pressed simultaneously, the device runs a simulation program: "0" is displayed and the LED ON blinks. This value simulates the measurement and can be adjusted with the [+] and [-] keys, for testing the functioning and configuration of the current and relay outputs. To exit the simulation mode, press NEXT.

CONFIGURATION

This section describes the operating procedure for configuring editable parameters from the keyboard.

1) Press and hold the CAL key for at least 2 seconds to enter configuration/calibration mode
2) Press NEXT to start the configuration
3) Release the and the display will show the first editable parameter
4) Use the [+] and [-] keys to go to the next/previous parameter, or press CAL to move the cursor on the parameter value; modify the value with the [+] and [-] keys
5) Press CAL to confirm the modification or next to proceed without saving
6) Now the display shows the next parameter
7) Proceed as explained at steps 4 and 5 for setting all the parameters
8) To exit the configuration mode, press NEXT
9) If no key is pressed, after a few seconds the instrument will automatically quit the configuration mode



LIST OF PARAMETERS

It is recommended to fill the last column with the values set for your application.

Model with pH / ORP or mA input

PAR.	Description	Min value	Max value	Default value	Set value
P01	Measure type	0	2	0	
P02	Reserved	0.00	0.00	0.00	
P03	Reserved	0	1	0	
P04	Working temperature	0	100	25 °C	
P05	Working mode for K1	0	2	1	
P06	Minimum threshold for K1 relay	-1000	2000	6.00 pH	
P07	Maximum threshold for K1 relay	-1000	2000	6.30 pH	
P08	Energizing delay for K1 relay	0	120	0 sec	
P09	De-energizing delay for K1 relay	0	120	0 sec	
P10	Working mode for K2	0	5	1	
P11	Minimum threshold for K2 relay	-1000	2000	6.50 pH	
P12	Maximum threshold for K2 relay	-1000	2000	6.80 pH	
P13	Energizing delay for K2 relay	0	120	0 sec	
P14	De-energizing relay for K2 relay	0	120	0 sec	
P15	Starting delay	0	60	0 min	
P16	mA output type	0	1	1	
P17	Starting value for mA output	-1000	2000	0.00 pH	
P18	Full scale value for mA output	-1000	2000	14.00 pH	
P19	Fault mA value	0.0	21.0	21.0 mA	
P20	Password	0	999	0	
P21	Auto-set	0	100	0	
(P22)	Starting value for meas.1 (mA model only)	-1000	2000	0	
(P23)	Full scale value for meas.1 (mA model only)	-1000	2000	2000	
(P24)	Decimal point position + measure unit (mA model only)	0	51	0	

Conductivity meter version

PAR.	Description	Min value	Max value	Default value	Set value
P01	Conductivity meter type (range)	0	25	23	
P02	Temp. compensation coefficient	0.00	4.00	2.00	
P03	Reference temperature	0	100	25 °C	
P04	Working temperature	0	100	25 °C	
P05	Working mode for K1	0	2	1	
P06	Minimum threshold for K1 relay	-1000	2000	70.0 µS	
P07	Maximum threshold for K1 relay	-1000	2000	80.0 µS	
P08	Energizing delay for K1 relay	0	120	0 sec	
P09	De-energizing delay for K1 relay	0	120	0 sec	
P10	Working mode for K2	0	5	1	
P11	Minimum threshold for K2 relay	-1000	2000	85.0 µS	
P12	Maximum threshold for K2 relay	-1000	2000	95.0 µS	
P13	Energizing delay for K2 relay	0	120	0 sec	
P14	De-energizing relay for K2 relay	0	120	0 sec	
P15	Starting delay	0	60	0 min	
P16	mA output type	0	1	1	
P17	Starting value for mA output	-1000	2000	0.00	
P18	Full scale value for mA output	-1000	2000	199.9 µS	
P19	Fault mA value	0.0	21.0	21.0 mA	
P20	Password	0	999	0	
P21	Auto-set	0	100	0	

MEANING OF PARAMETERS

PARAMETER 01 (**pH** / **ORP**) **MEASURE TYPE**

This model configured and calibrated for pH, ORP or temperature measurements, can be set as follows: 0 = pH-meter, 1 = ORP meter, 2 = thermometer.

PARAMETER 01 (**Conductivity**) **CONDUCTIVITY METER TYPE**

Set this parameter to choose the desired measurement range and cell constant:

Cell constant (K)	Range	P01	Range	P01	Range	P01	Range	P01
K = 10 cm	2 µS/cm	1	20 µS/cm	2	200 µS/cm	3	2000 µS/cm	4
K = 1 cm	20 µS/cm	6	200 µS/cm	7	2000 µS/cm	8	20 mS/cm	9
K = 0.1 cm	200 µS/cm	11	2000 µS/cm	12	20 mS/cm	13	200 mS/cm	14
K = 0.01 cm	2000 µS/cm	16	20 mS/cm	17	200 mS/cm	18	2000 mS/cm	19
K = 5 cm	2 µS/cm	21	20 µS/cm	22	200 µS/cm	23	2000 µS/cm	24

If the parameter is set with a value not included in the above table, the instrument will not function properly.

PARAMETER 01 (**mA input**) **MEASURE TYPE**

P01=0 set the analogue input at 0-20 mA.
P01=1 set the analogue input at a 4-20 mA.

PARAMETER 02 (**pH** / **ORP, mA input**) **RESERVED**

Reserved parameter, for future use.

PARAMETER 02 (**Conductivity**) **TEMP. COMPENSATION COEFFICIENT αT**

S503 performs the temperature compensation accordingly with the following equation:

$$C(t) = C(tref) * \left(1 + \frac{\alpha T}{100} * (t - tref) \right)$$

where: t = measured (or set) temperature, °C
tref = reference temperature, °C (typically set at 25°C, parameter P03)
αT = temperature compensation coefficient, %/°C (parameter P02)

Typical αT values: 1.0 to 1.6 %/°C for acid solutions
1.8 to 2.2 %/°C for alkaline solution
2.2 to 3.0 %/°C for salt solution
approx. 2.0 %/°C for water

Anyway, the αT coefficient is not constant over all the standard temperature compensation range, but only for small temperature variations (e.g. 20 to 50°C).
Set αT = 0 means disabling the temperature compensation feature.

If the αT value is unknown, it may be determined as follows:

1) set αT (P02) = 0.00 (no temperature compensation)
2) read the conductivity value of the tested liquid at the reference temperature (e.g. 25°C)
3) bring the liquid at the working temperature
4) read the conductivity value at this temperature
5) calculate the αT (P02) value with the below equation:

$$\alpha T = \frac{C(t) - C(tref)}{t - tref} \times \frac{100}{C(tref)}$$

6) set the P02 parameter with the calculated value

PARAMETER 03 (**pH / ORP, mA input**) **RESERVED**

Reserved parameter, for future use.

PARAMETER 03 (**Conductivity**) **REFERENCE TEMPERATURE**

See description of parameter P02.

PARAMETER 04 WORKING TEMPERATURE

All the S503 models are designed for measuring temperature and use this value for temperature compensation (when required). If no temperature probe is connected, the working temperature value can be manually entered. In this case the set value is displayed within brackets.

PARAMETER 05 WORKING MODE OF RELAY K1

The K1 relay output cam work in 3 different modes:

0 = Relay output is disabled.

1 = Relay contact is closed when the set thresholds are exceeded; this mode is used for acidifying (pH-meter version), lowering the ORP value, lowering the conductivity value, etc.

2 = Contact is open when the set thresholds are exceeded; this mode is use for increasing the pH level, chlorinating (ORP-meter), adding substances for increasing the conductivity level, etc.

PARAMETER 06 MIN THRESHOLD FOR RELAY K1

Minimum threshold value for relay K1 action.

PARAMETER 07 MAX THRESHOLD FOR RELAY K1

Maximum threshold value for relay K1 action.

PARAMETER 08 ENERGIZING DELAY FOR RELAY K1

This parameter allows to enter a delay time (in seconds) for energizing relay K1, if it is configured with working type option 1 or 2. Entering zero will skip delay and the relay is activated immediately.

PARAMETER 09 DE-ENERGIZING DELAY FOR RELAY K1

This parameter allows to enter a delay time (in seconds) for de-energizing relay K1, if it is configured with working type option 1 or 2. Entering zero will skip delay and the relay is de-activated immediately.

PARAMETER 10 WORKING MODE OF RELAY K2

The K2 relay output can work in 6 different modes:

0 = Relay disabled.

1 = Contact is closed when the set thresholds are exceeded.

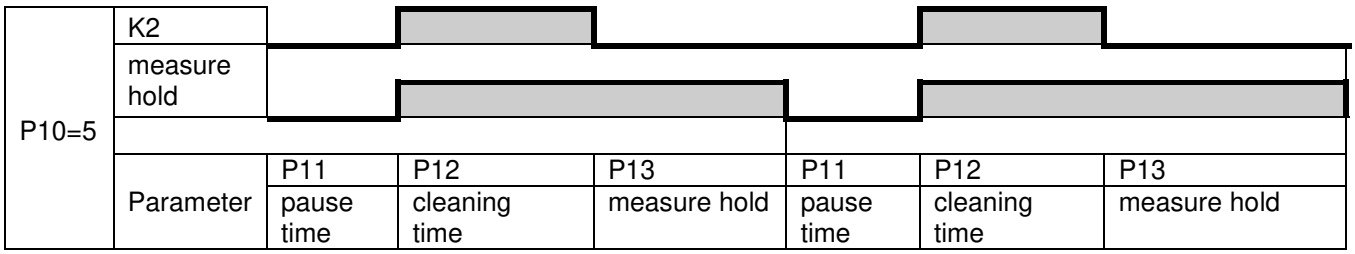
2 = Contact is open when the set thresholds are exceeded.

3 = NC (normally closed) alarm, i.e. K2 contact is closed when measurement is within the set thresholds (P11 e P12).

4 = NO (normally open) alarm, i.e. K2 contact is open when measurement is within the set thresholds (P11 e P12).

5 = Automatic cleaning cycle: at set time intervals, the instrument freezes measurement and the relay K2 closes. For example: Pause time = 1-2 hours = 60-120 minutes, Cleaning = 10 seconds; Measure hold = 60 seconds (time needed to discharge the dirty water and return to correct measurement).

The below diagram shows the functioning of the automatic cleaning mode.



PARAMETER 11 MIN THRESHOLD FOR RELAY K2

Minimum threshold value for relay K2 action. If P10=5 (cleaning cycle), this parameter is used to set the pause time (minutes) between two subsequent cleaning cycles.

PARAMETER 12 MIN THRESHOLD FOR RELAY K2

Maximum threshold value for relay K2 action. If P10=5 (cleaning cycle), this parameter is used to set the cleaning time (seconds).

PARAMETER 13 ENERGIZING DELAY FOR RELAY K2

Energizing delay for relay K2 (seconds). If P10=5 (cleaning cycle), this parameter is used to set the time (seconds) with frozen measurement after the cleaning cycle has been completed, before returning to normal operations.

PARAMETER 14 DE-ENERGIZING DELAY FOR RELAY K2

De-energizing delay for relay K2 (seconds).

PARAMETER 15 STARTING DELAY

The sensor connected to the measure input may require a stabilization time before measuring reliable values, but anyway outputs are activated accordingly with readings. This parameter allows to enter a proper time delay (minutes), for waiting for sensor stabilization. Setting the parameter to zero means disabling this function.

PARAMETER 16 CURRENT OUTPUT TYPE

This parameter allows to choose the current output range:
0 = 0-20 mA; 1 = 4-20 mA.
Note: The precision for the current output refers to values greater than 0.3 mA (approx.). Note that the low values for the 0-20 mA output are quite approximate.

PARAMETER 17 STARTING VALUE FOR CURRENT OUTPUT

Measure value corresponding to the starting value of the current output (0 or4 mA).

PARAMETER 18 FULL SCALE VALUE FOR CURRENT OUTPUT

Measure value corresponding to the full scale of the current output (20 mA).

PARAMETER 19 FAULT CURRENT OUTPUT

This parameter is used to enter the output current value when an error occurs (e.g. reading out of range, measurement disabled, etc.).

PARAMETER 20 PASSWORD

The user can enter a protection password to avoid intervention by non-authorized personnel.
Warning! If the password is forgotten, the instrument has to be sent back to the factory for a complete re-configuration!

PARAMETER 21 AUTOSET

This parameter allows to restore the factory settings. Enter “12” and the display will show the “Autoset eseguito! (completed!)” message for 3 seconds, then the device returns to normal operating mode.

(PARAMETER 21) STARTING VALUE FOR MEASURE 1

This parameter is available only for model with mA input and represents the value corresponding to 0 or 4 mA, depending on the output type set. The parameter is factory set accordingly with customer indications and should not be modified!

(PARAMETER 23) FULL SCALE VALUE FOR MEASURE 1

This parameter is available only for model with mA input and represents the value corresponding to the full scale (20 mA). The parameter is factory set accordingly with customer indications and should not be modified!

(PARAMETER 24) DECIMAL POINT POSITION AND MEASURE UNIT FOR MEAS.1

This parameter is available for models with mA input and allows to set the decimal point position on display and the desired measure unit, accordingly with the following formula:

P24 = (Measure unit code x 8) + Decimal point position

Codified measure unit are listed in the table below:

0 =	1 = pH	2 = mV	3 = °C	4 = ppm	5 = uS	6 = mS	7 = %	8 = mA
9 = pulse	10 = sec	11 = min	12 = %/°C	13 = V	14=mbar	15 = bar	16 = cm	17 = m
18 = FTU	19 = NTU	20 = l/h	21 = m^3/h					

Example: 4-20 mA input from remote conductivity meter with measure range 0…50.0 mS/cm:
P1 = 1 ; P22 = 0 ; P23 = 500 ; P24 = (6x8)+1 = 49

Normally this parameter is factory set accordingly with customer indications. Do not attempt to modify this value!

Note: *In case of proportional control on the current output, choose starting and full scale values far enough to prevent calculation errors in the proportional control. The minimum difference between the two thresholds is 20 points (e.g. 0.20 pH for pH-meter). Also see the "Errors" section.*

TEMPERATURE COMPENSATION

The temperature compensation (for pH and conductivity measurements) is calculated using the temperature value measured through the dedicated input. If this input is not connected, the S503 controller will use the working temperature value set in the parameter P04.

ADDITIONAL VISUALIZATIONS

Pressing the [+] and [-] keys while in normal mode, the following values are displayed:

pH meter	key [+]	gain factor (0.667 to 1.428)
	key [-]	offset, pH units at 25°C (-1.50 to 1.50)
ORP meter	key [+]	gain factor (1.000 – fix)
	key [-]	offset (-150 to 150 mV)
Thermometer	key [+]	gain factor (0.900 to 1.100)
	key [-]	offset (-5.0 to +5.0°C)
Conductivity meter	key [+]	gain factor (0.750 to 1.500)
	key [-]	offset (-100 to 100 points)
Std. input	key [+]	gain factor (0.500 to 2.000)
	key [-]	offset (-200 to 200 points)

Note*: The first calibration settings are OFFSET = 0, GAIN = 1.000.*

Pressing the [+] and [-] keys simultaneously, the display shows the ON-OFF time for relay K1 set for proportional control.

CONTROL EXAMPLES

This section includes some configuration examples of control parameters:

1) Acidification control to have approximately pH 7.40

MEASURE TYPE = 0 (pH meter)	(P01 = 0)
WORKING MODE FOR K1 = 1 (closed when thresholds are exceeded)	(P05 = 1)

It is recommended to set a narrow threshold window, e.g.:

MIN THRESHOLD = 7.30 pH	(P06 = 7.30pH)
MAX THRESHOLD = 7.50 pH	(P07 = 7.50pH)

The relay K1 starts acidification when the pH level is greater than 7.50 and de-activates as soon as the pH level falls below the 7.30 threshold.
The relay K2 can be configured as alarm:

WORKING MODE FOR K2 = 3 (NC alarm)	(P10 = 3)
MIN THRESHOLD = 6.50 pH	(P11 = 6.50pH)
MAX THRESHOLD = 8.50 pH	(P12 = 8.50pH)

2) Control of the swimming pool chlorination using an ORP electrode, to have an approximate free chlorine level of 0.80 ppm. Using a photometer, analyze the water to obtain the ORP value of the water when the free chlorine concentration is 0.80 ppm; for example ORP=696 mV:

MEASURE TYPE = 1 (ORP-meter)	(P01 = 1)
WORKING MODE FOR K1 = 2 (open when thresholds are exceeded)	(P05 = 2)
MIN THRESHOLD = 675 mV	(P06 = 675 mV)
MAX THRESHOLD = 695 mV	(P07 = 695 mV)

In these conditions, the relay K1 activates when the ORP level falls below 675 mV, and deactivates for values greater than 695 mV.

3) Conductivity control of water exiting from a demineralization plant, and alarm signal (or triggering of a resin regeneration cycle) if measurement is greater than 12.00 µS/cm

CONDUCTIVITY METER TYPE = 22 (19.99 µS/cm, K=5cm)	(P01 = 22)
WORKING MODE FOR K1 = 1 (closed when thresholds are exceeded)	(P05 = 1)
MIN THRESHOLD = 12.00 µS/cm	(P06 = 12.00µS/cm)
MAX THRESHOLD = 12.00 µS/cm	(P07 = 12.00µS/cm)
ENERGIZING DELAY = 60 sec	(P08 = 60 sec)
DE-ENERGIZING DELAY = 0 sec	(P09 = 0 sec)

The relay K1 is activated (and alarm is generated or the regeneration cycle is triggered) when measured conductivity is greater than 12.00 µS/cm, and the value is kept for at least one minute (60 sec). This delay avoids erroneous actions due to instantaneous peaks or signal noise.

ERRORS

When an error is detected, the LED ON starts blinking, the mA output provides the fault current value set in P19, and the display shows the corresponding error message, as listed here below:

WARNING 1 - RELAY K1 DISABLED

No working mode has been configured for K1 output, but the instrument works normally.

WARNING 2 - RELAY K2 DISABLED

No working mode has been configured for K2 output, but the instrument works normally.

ERR. 2 CURRENT OUTPUT

The maximum and minimum threshold values for the mA output (P17 and P18) are too close. The current output will not work correctly. Enter new values for parameters P17 and P18.

CALIBRATION ERROR!

The requested calibration cannot be performed. Check probe and connection cable; repeat the procedure.

UR/OR

Under Range / Over Range: the input signal is greater than the full scale value, or lower than the minimum value of the measurement range. Check sensor and cable. When this error occurs, the instrument outputs are disabled.

Auto Clean

This is not an error message, but an indication that the automatic cleaning is in progress; while this message is displayed, measurement is frozen at the value read before the cycle start.

pH INPUT SPECIFICATIONS

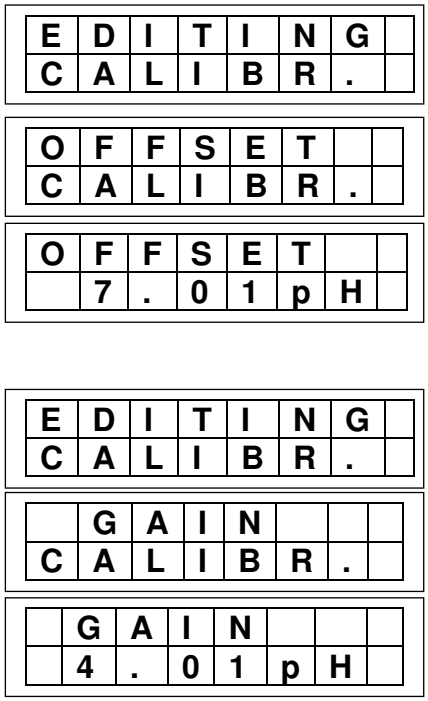
ELECTRICAL CONNECTIONS FOR pH-METER

The signal comes from the electrode through a coaxial cable, with maximum recommended length of 20 meters (for longer cables, please contact the manufacturer).
The electrode input is on removable terminal block: connect the coaxial cable core to terminal 4, and the shield to terminal 5 (**Note**: remove any black conductive plastic between the core and shield of the cable).
If two separate electrode are used for measure and reference, connect the reference electrode to terminal 3 (REF).
The Pt100 temperature sensor should be connected to terminals 6 and 7. If no sensor is connected, the instrument uses a constant temperature of 25.0°C. If a Pt100 probe is used, immerse it into the liquid to be tested, close to the electrode or anyway at the same temperature. If a 3-wire Pt100 sensor is used, connect the 2 wires of the same colour at the same terminal (the wires are internally short circuited).
It is recommended to keep signal cables away from power cables.

ELECTROCHEMICAL CALIBRATION OF pH-METER

Before starting this procedure, ensure to have fresh buffer solutions (not expired). If temperature compensation is used, immerse the Pt100 probe into the buffer solutions together with the measure electrode.

1) Rinse the electrode with distilled water
2) Immerse the electrode in pH 7.01 buffer solution
3) Press and hold CAL for at least 2 seconds to enter the calibration mode
4) Press [-] and the OFFSET message is displayed; release the button and the display will show the buffer pH value, automatically recognized
5) If necessary, adjust the value using the [+] or [-] key
6) Confirm calibration by pressing CAL, or press NEXT to exit without saving (the previous calibration data are kept)
7) Rinse the electrode with distilled water
8) Immerse the electrode in pH 4.01 (or pH 9.01) buffer solution
9) Press and hold CAL for at least 2 seconds to enter the calibration mode
10) Press [+] and the GAIN message is displayed; release the button and the display will show the buffer pH value, automatically recognized
11) If necessary, adjust the value using the [+] or [-] key
12) Confirm calibration by pressing CAL, or press NEXT to exit without saving (the previous calibration data are kept)



The instrument does not automatically recognizes the buffer pH values whenever:

a) The buffer solution is contaminated dirty or expired
b) The electrode is not working properly or it is exhausted
c) The electrode connection cable is damaged

Note: *If you attempt to calibrate the offset at a pH value too different from pH 7, or to calibrate the gain with a buffer solution too close to pH neutrality, the instrument shows the "CALIBRATION ERROR!" message and does not save the calibration data.*

ORP INPUT SPECIFICATIONS

ELECTRICAL CONNECTIONS OF ORP-METER

The signal comes from the electrode through a coaxial cable, with maximum recommended length of 20 meters (for longer cables, please contact the manufacturer).
The electrode input is on removable terminal block: connect the coaxial cable core to terminal 4, and the shield to terminal 5 (**Note**: remove any black conductive plastic between the core and shield of the cable).
If two separate electrode are used for measure and reference, connect the reference electrode to terminal 3 (REF).
If temperature measurement is also required, connect a Pt100 temperature sensor to terminals 6 and 7. If a 3-wire Pt100 sensor is used, connect the 2 wires of the same colour at the same terminal (the wires are internally short circuited).
It is recommended to keep signal cables away from power cables.

ELECTROCHEMICAL CALIBRATION

Before starting the procedure, check to have a fresh calibration solution (not expired).

1) Rinse the electrode with distilled water
2) Immerse the electrode into the calibration solution (e.g. 230 mV)
3) Press and hold CAL for at least 2 seconds, to enter the calibration mode
4) Press [-] and the OFFSET message is displayed; release the button and the display will show the current measure
5) If necessary, adjust the value using the [+] or [-] key
6) Confirm calibration by pressing CAL, or press NEXT to exit without saving (the previous calibration data are kept)

E	**D**	**I**	**T**	**I**	**N**	**G**	
C	**A**	**L**	**I**	**B**	**R**	**.**	

O	**F**	**F**	**S**	**E**	**T**		
C	**A**	**L**	**I**	**B**	**R**	**.**	

O	**F**	**F**	**S**	**E**	**T**		
	2	**4**	**3**	**m**	**V**		

After performing the calibration, the meter does not display the standard solution value whenever:

a) The calibration solution is contaminated dirty or expired
b) The electrode is not working properly or it is exhausted
c) The electrode connection cable is damaged

Note: *If you attempt to calibrate the offset at a value too different from the internal one, the instrument shows the "CALIBRATION ERROR!" message and does not save the calibration data.*

ORP calibration is a single point procedure (offset)!

CONDUCTIVITY INPUT SPECIFICATIONS

The electronic precision of the conductivity measurements is better than 0.3%, and the repeatability is better than 0.2% FS, without temperature compensation (resistive calibration). The temperature compensation introduces an additional error of 0.3% FS, and is performed through the PT100 input. The temperature sensor may be a probe separated from the conductivity cell (e.g. PT100S), or a built-in sensor (e.g. CCK5TC). For further details, refer to the technical documentation supplied with the cell.

ELECTRICAL CONNECTIONS OF CONDUCTIVITY METER

The signal comes from the 2-electrode cell, to be connected to terminals 4 and 5; if a shielded cable is used, connect the shield to terminal 3 (GND). In case of low conductivity measurement, it is recommended to use a shielded cable.
The Pt100 sensor input is at terminals 6 and 7. If no temperature probe is connected, the instrument uses a constant working temperature of 25.0°C. If a Pt100 probe is used, immerse it in the liquid to be tested, close to the cell or anyway at the same temperature.
To avoid interferences and measure errors due to parasitic capacity of the cable, it is recommended to use a cell connection cable as short as possible. Do not extend the supplied cable; if a longer cable is needed, please contact the manufacturer.
It is recommended to keep signal cables away from power cables.

ELECTRICAL CALIBRATION

To test the proper functioning of the instrument, connect to the cell input a resistive simulator. Set an infinite resistor value and the meter should display "0". To calculate the resistor value to be entered for simulating a given conductivity value, use the following formula:

$$Rcell = \frac{1}{(Cond * K)} \quad \left(M\Omega = \frac{1}{(\mu S/cm * cm)} \right)$$

Rcell = simulation resistor
Cond = conductivity value to be simulated
K = cell constant

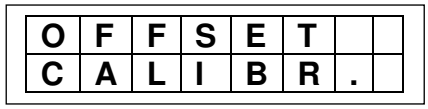
Notes:

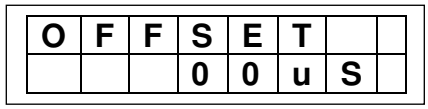
- *To verify the correct visualization, also consider the set "gain" factor. To view the gain value, press the [+] key.*
- *The temperature should be approx. 25°C; if not, leave terminals 6 and 7 not connected.*

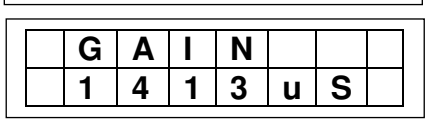
ELECTROCHEMICAL CALIBRATION

The electrochemical calibration allows to compensate errors due to the cell-instrument connection cable and to the mechanical error of the cell constant. If the temperature compensation feature is used, immerse the Pt100 sensor into the solution close to the cell, or anyway at the same temperature.

1) Leave the cell in air
2) Press and hold CAL for at least 2 seconds to enter the calibration mode
3) Press [-] and the "OFFSET" message is displayed, followed by the 0.0 µS/cm value
4) If necessary, adjust this value using the [+] and [-] keys; the zero value with cell in air is generally not adjusted
5) Press CAL to confirm calibration, or NEXT to exit without saving
6) Immerse the cell and the Pt100 probe (if used) into a solution at a known conductivity value; typically a KCl solution (see table here below)
7) Press and hold CAL for at least 2 seconds to enter the calibration mode
8) Press the [+] key and the "GAIN" message is displayed, followed by the previously measured value
9) If necessary, adjust this value with the [+] and [-] keys
10) Press CAL to confirm calibration, or NEXT to exit without saving







Note: *If you attempt to calibrate using an offset value too different from the range minimum value or a gain value with a too low input signal, the instrument shows the "CALIBRATION ERROR!" message and does not save the calibration data.*

Conductivity values of KCl (potassium chloride) solutions:

Temp. (°C)	KCl 1 N (µS/cm)	KCl 0.1 N (µS/cm)	KCl 0.01 N (µS/cm)
0	65410	7150	776
5	74140	8220	896
10	83190	9330	1020
15	92540	10480	1147
16	94430	10720	1173
17	96330	10950	1199
18	98240	11190	1225
19	100160	11430	1251
20	102090	11670	1278
21	104020	11910	1305
22	105940	12150	1332
23	107890	12390	1359
24	109840	12640	1386
25	111800	12880	1413
26	113770	13130	1441
27	115740	13370	1468
28		13620	1496
29		13870	1524
30		14120	1552

TEMPERATURE INPUT SPECIFICATIONS

ELECTRICAL CONNECTIONS OF THERMOMETER

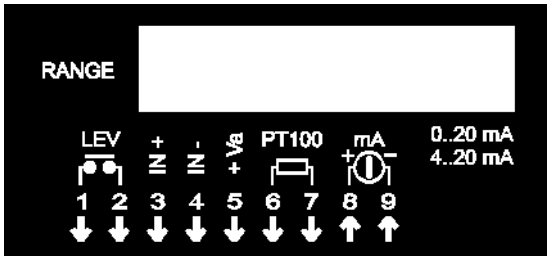
The signal comes from a Pt100 sensor through a 2 or 3-wire cable, that has to be shielded if longer than 15 meters. Connections are made on removable terminal block, at pins 6 and 7.
If a sensor with 3-wire cable is used, connect to the same terminal the two wires of the same colour (internally short-circuited). If a shielded cable is used, connect the shield to terminal 3 (REF).

THERMOMETER CALIBRATION

The electronic calibration of the instrument and the accuracy class of the Pt100 sensor ensure a maximum error of ±0.3°C at 0°C and ±0.8°C at 100°C (Pt100 class B, according to IEC 751 standard). Therefore, no user calibration is required.

Note*: Factory calibration is performed with a sensor with 2 m cable. Using a probe with a cable longer than 2 meters could introduce a greater reading error.*

STANDARDIZED INPUT SPECIFICATIONS



ELECTRICAL CONNECTIONS OF THE STANDARDIZED INPUT

The signal comes from the transmitter (or transducer) through a 2 or 3-pole cable, that has to be shielded if longer than 20 meters.
Connections are made on removable terminal block as follows:

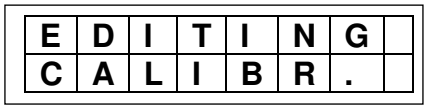
1. Active transmitter: terminal 3 = connect the positive (+) pole of the transmitter
   terminal 4 = connect the negative (-) pole of the transmitter
2. Two-wire passive transmitter:
   terminal 5 (power supply) = connect the positive (+) pole of the transmitter
   terminal 3 = connect the negative (-) pole of the transmitter

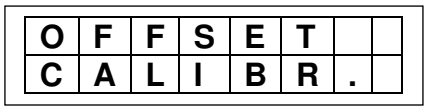
Note: If a shielded cable is used, connect the cable shield to terminal 4 (S503 side).

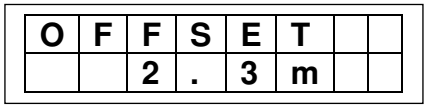
ELECTRICAL CALIBRATION

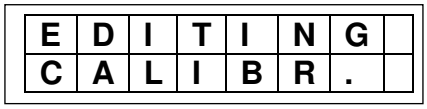
Errors due to instrument (S503) and transducer are typically very small and no calibration is required. However, in case of pressure transducer converted into piezometric levels, sometimes zero and gain calibrations are needed; proceed as explained here below.

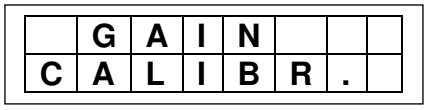
1) Set the transmitter to have the minimum range signal (e.g. 0 or 4 mA)
2) Press and hold CAL for at least 2 seconds to enter calibration mode
3) Press the [-] key and the "OFFSET" message is displayed, followed by the zero value
4) If necessary, adjust this value with the [+] and [-] keys
5) Press CAL to confirm calibration, or NEXT to exit without saving
6) Set the transmitter to have the full scale signal (or a signal greater than the 70% of the range)
7) Press and hold CAL for at least 2 seconds to enter calibration mode
8) Press the [+] key and the "GAIN" message is displayed, followed by the previously measured value
9) If necessary, adjust this value with the [+] and [-] keys
10) Press CAL to confirm calibration, or NEXT to exit without saving

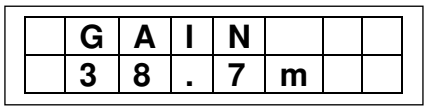












Note: *If you attempt to calibrate using an offset value too different from the range minimum value or a gain value with a too low input signal, the instrument shows the "CALIBRATION ERROR!" message and does not save the calibration data.*