EN Z203-1 Advanced Single-phase Network Analyser

General Description

Model Z203-1 is a complete single-phase network analyser suited for use with up to 500 Vac voltage range and 5 A (35 to 75 Hz) current.
The instrument provides all the following electrical measurable quantities: **Vrms**, **Irms**, **Watt**, **Var**, **Frequency, Energy, Cosϕ**.
Measurements are read through serial communication and both floating point and normalised format (except for energy). The DIP-switches (or Modbus registers) can be set for the analogue retransmission of any Vrms, Irms, Watt, Var, Frequency, and Cosϕ quantity. The module is also distinguished by:

- Facilitated power supply and serial bus wiring by means of the bus housed in the DIN rail.
- Communication configurability through DIP-switch or software.
- Rs485 serial communication with MODBUS-RTU protocol, maximum 32 nodes.
- Power input isolation: 3750 Vac respect to all the other circuits.
- Isolation between communication and power supply: 1500 Vac.
- Isolation between retransmitted output and power supply: 1500 Vac.
- Analogue output signal settable in voltage or current.
- Possibility for connection and management by an external CT (only if Z203-1 is configurated by a configuration software).
- Energy counter: pulse digital output, reading on Modbus register (the count is saved into retentive memory).
- Easy configuration with the software Easy, downloadable from www.seneca.it

Technical Specifications	
Power Supply:	10 – 40 ⎓ V o 19 – 28 V ∿ (50 – 60 Hz)
Consumption:	max 2.5 W
Communication Ports:	-RS485, 1200..115200 Baud. -RS232, 2400 Baud, Address: 01, Parity: NO, Data: 8 bits; Stop bits: 1.
Protocol:	MODBUS-RTU
Installation category:	II (Up to 300 V)

Input/Retransmitted output

Voltage Input :	up to 500 Vac; frequency: 35 to 75 Hz.
Current Input :	Current input rated range: 5 Arms, Max peak factor: 3, Max Current : 15 A, Frequency: 35 to 75 Hz.
Class/Base Precision :	Voltmeter : 0,5 %. Amperometer : 0,5 %. Wattmeter : 0,5 %. (active power)

Analog Output

Output Voltage :	0..10 Vdc, 0..5 Vdc, minimum load resistance: 2 kΩ.
Output Current :	0..20 mA, 4..20 mA, maximum load resistance: 500 Ω.
Transmission error :	0,1 % (max. range).

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Digital Output for pulses (energy counter)	
Type :	Passive (it must be powered), R > 480 Ω
Range :	50 mA
Insulation :	1500 Vpeak
Screw terminal :	1 and 6 (common with GND analogue output)
Insulation voltage :	3750 Vac between the measurement input and all the other circuits.1500 Vac between power supply and communication. 1500 Vac between power supply and outputs.
Protection :	IP20.
Environmental conditions :	Temperature -10..+65 °C. Humidity 30..90 % non-condensing. Altitude: up to 2000 m a.s.l.
Storage temperature :	-20..+85 °C
Signalling by LED :	Power supply, Fail, RS485 communication.
Connections :	-Removable 3-way screw terminals, 5.08 mm pitch. -Rear IDC10 connector for DIN rail. -3.5 mm stereophonic front jack for RS232 (COM) connection.
Box :	PA6, black
Dimensions and weight :	100 x 112 x 17,5 mm, 140 g.
Reference standards :	**EN61000-6-4** (electromagnetic emission, industrial environment) **EN61000-6-2** (electromagnetic immunity, industrial environment) **EN61010-1** (safety). All circuits must be insulated from the other circuits under dangerous voltage with double insulation. The power supply transformer must comply with EN60742: “Insulated transformers and safety transformers”. Notes: - Use with copper conductor. - Use in Pollution Degree 2 Environment. - Power Supply must be Class2. - When supplied by an Isolated Limited Voltage and/or Limited Current Power Supply, a fuse rated max 2,5 A shall be installed in the field.

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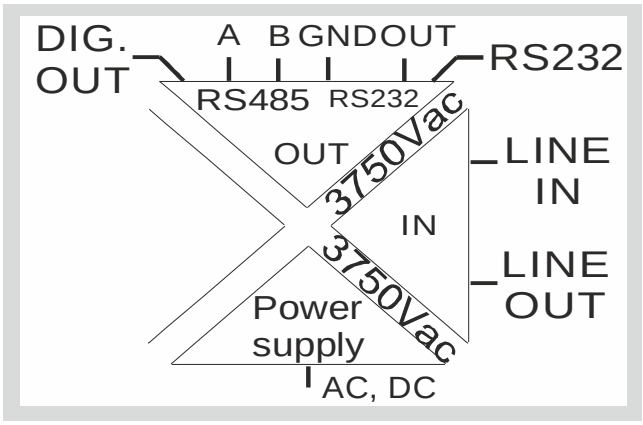
Operating logic

The module measures the electrical measurable quantities: Vrms, Irms, Watt, Var, Frequency, Energy, Cosϕ and provides the values in the corresponding MODBUS registers. Except for energy, these measurements are rendered in both floating point and normalized format between 0..+10000 (0 ..+10000 for absolute value of VAR and Cosϕ, 350..750 for frequency from 35.0 Hz to 75.0 Hz). The module output transmits one of the previous quantities selected (excluding energy) as either a current or voltage value. The range of the retransmitted output is proportional to the full scale value of the quantity measured: if the signal is a 4..20 mA current signal and the quantity to be transmitted is the Vrms voltage, for example, 4 mA will equal 0 V and 20 mA will equal 500 V because these are the top and bottom full scale values for rms voltage.

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Relay scaling can also be selected from 100%, 50 % or 25 %. In the example above, with 50% retransmission scaling, a 4 mA signal will equal 0 V and a 20 mA signal will equal 250 V. The retransmission values saturate at approximately 11 V for voltage outputs and at around 21 mA for current outputs. When the module is switched on, the appropriate setting coefficients are measured (depending on the choice of 50 or 60 Hz frequency). All the settings made will be automatically loaded when the module is reset. The FeRAM allows to recovery the energy if a black-out occurs.
Note that the Vrms, Irms, Active Power and frequency values are obtained by direct measurement, whereas the energy, Reactive Power and cosϕ values are calculated. Active power can be only greater than 0. An example: if reactive power is -2500 VAR or +2500 VAR (physical value, electric line), corresponding numeric value is +10000 and analogue output (available at the screw terminals) is +10 V (if SW2-2,3=”00”).If reactive power is 0 VAR (physical value, electric line), corresponding numeric value is 0 and analogue output (available at the screw terminals) is 0 V (if SW2-2,3=”00”). Cosfi has the same behavior of reactive power. See the tables provided in APPENDIX A for the measurement and retransmission ranges in the cases of 50% and 25% scaling.

Isolations



Installation rules

The module is designed to be installed in vertical position on a DIN 46277 rail. In order to ensure optimum performance and the longest working life, the module(s) must be supplied adequate ventilation and no raceways or other objects that obstruct the ventilation slots. Never install modules above sources of heat; we recommend installation in the lower part of the control panel.

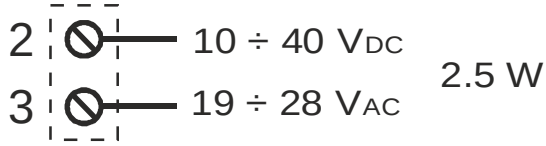
Electric connections

RS485 SERIAL PORT AND POWER SUPPLY

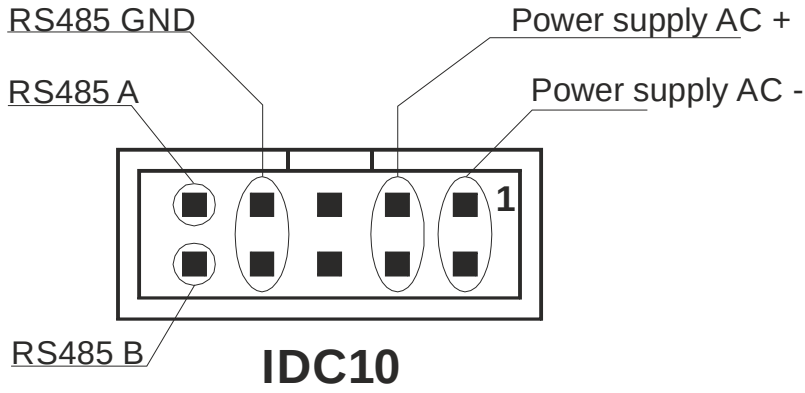
The electric connections for power supply can be made by using either the terminals or the bus for the Seneca DIN rail. The RS485 bus connections are available only by using the bus for the DIN rail.

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Power supply from terminals



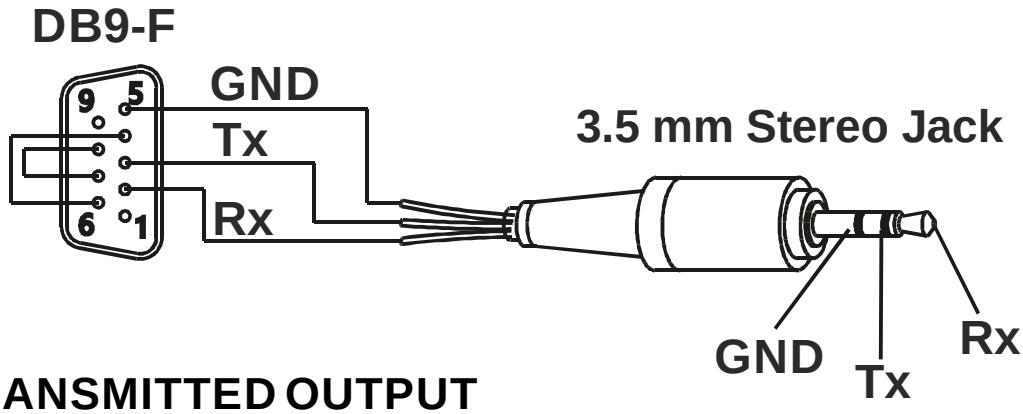
Bus connector for DIN rail connections



There is no isolation between RS485 and the retransmitted output.

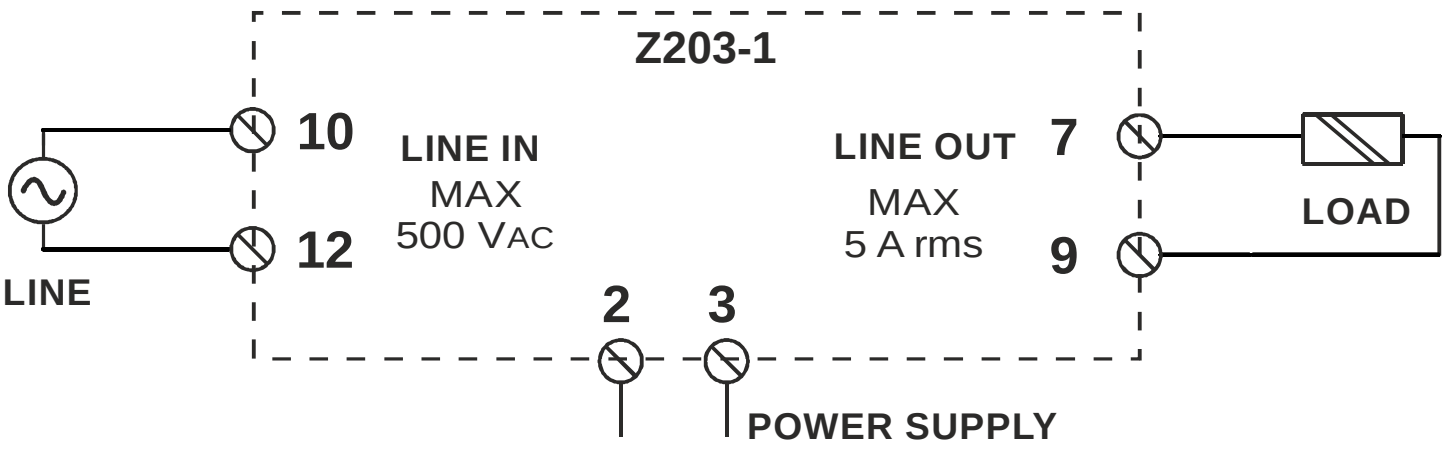
RS232 SERIAL PORT

Connection cable DB9 with a 3.5 mm stereo Jack, can be assembled as indicated in the following figure, or can be bought as an accessory.



INPUT/RETRANSMITTED OUTPUT

The module accepts an input voltage of up to a maximum 500 Vac. The input voltage is connected to Terminals 10 and 12, whereas the load to be analysed is connected to Terminals 7 and 9.

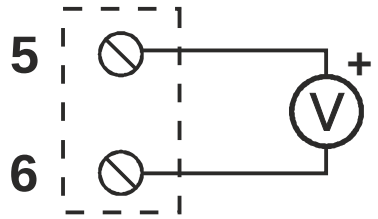


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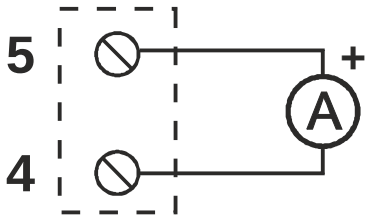
ANALOGUE OUTPUT

The module provides an analog output in voltage (0..10 Vdc, 0..5 Vdc) or current (0..20 mA, 4..20 mA). We recommend using shielded cables for the electric connections above.

Voltage Output



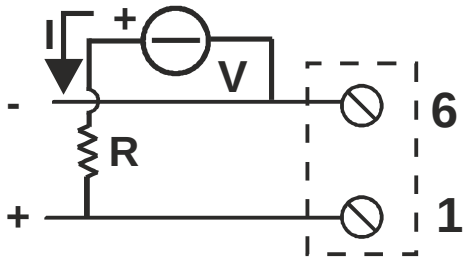
Current Output



There is no isolation between RS485 and the analog output.

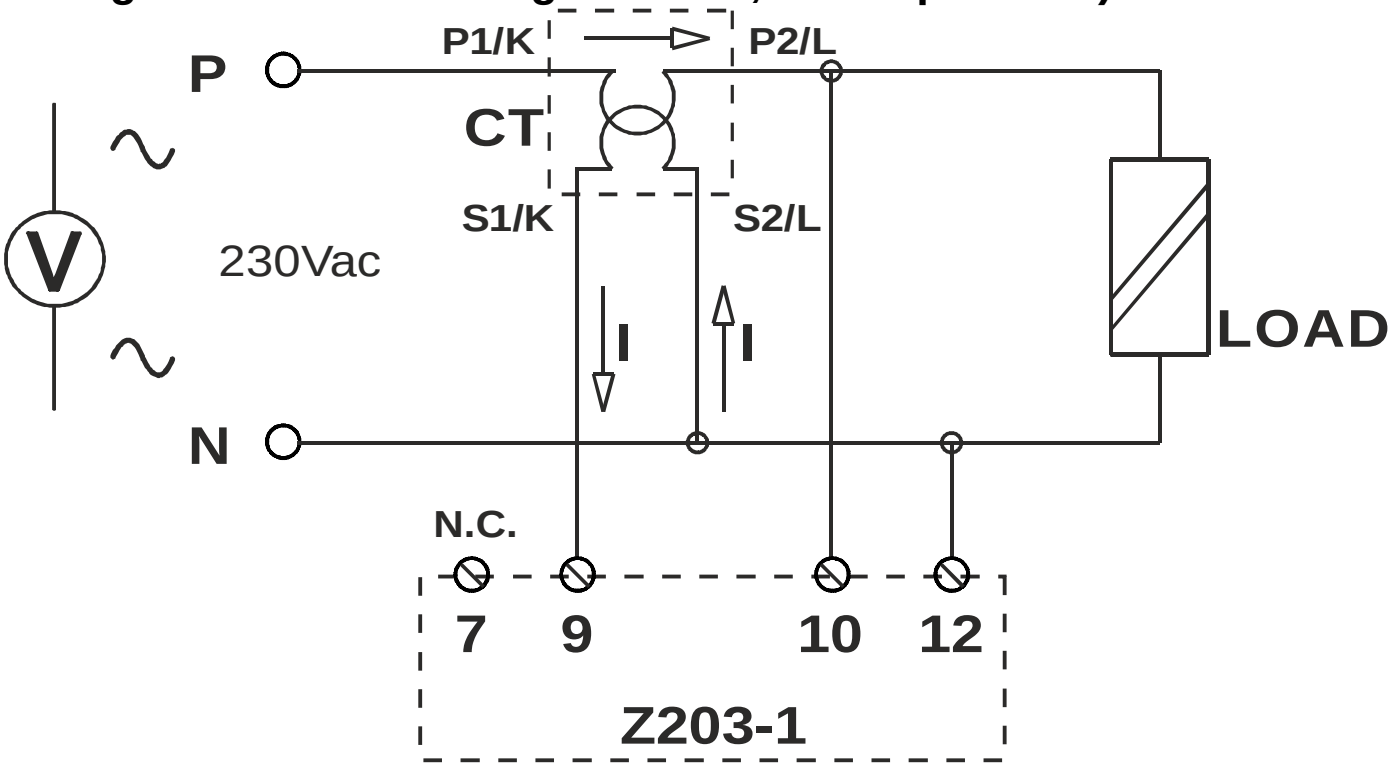
DIGITAL OUTPUT

The module has a digital output: each pulse (200 ms) corresponds to a given number of increments of the energy counted (see the register Digital Output Ratio). Imax=V/R=50mA



Digital output

EXAMPLE OF CONNECTION WITH AN EXTERNAL CT (in this case, configure the Z203-1 using software, NOT dip-switch)



Indications by LED on the frontal panel

PWR LED (GREEN)	Meaning
Steady ON	Power supply is present.

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ERR LED (YELLOW)	Meaning
Steady ON	Communication error between internal peripherals.
Flashing	Voltage measured at less than 40 Vac and at less than 20 mA.

RX LED (RED)	Meaning
Steady ON	Data are being received through the RS485 communication port

TX LED (RED)	Meaning
Steady ON	Data are being transmitted through the RS485 communication port

Serial interface

For detailed information on RS485 serial interface, consult the documentation provided by the website www.seneca.it, in the section **Prodotti/Serie Z-PC/MODBUS TUTORIAL**.

DIP-SWITCH SETTING

Default configuration

The instrument leaves the factory with all DIP-switches configured in position 0. The settings of the DIP-switches defines the module's communication parameters: address and speed.

In all the following tables, the indication ● corresponds to a DIP-switch set in 1 (ON); no indication is provided when the DIP-switch is set in 0 (OFF).

BAUD RATE			
SW1	1	2	
			9600 Baud
		●	19200 Baud
	●		38400 Baud
	●	●	57600 Baud

ADDRESS							
SW1	3	4	5	6	7	8	
							Communication Parameters from EEPROM (*)
						●	Fixed Address: 01
					●		Fixed Address: 02
					●	●	Fixed Address: 03
				●			Fixed Address: 04
	X	X	X	X	X	X	Fixed Address, as from binary representation.
	●	●	●	●	●	●	Fixed Address: 63

NOMINAL FREQUENCY (50 or 60 Hz)		
SW2	1	
		Network Frequency: 50 Hz
	●	Network Frequency: 60 Hz

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OUTPUT TYPE			
SW2	2	3	
			0..10 V
		●	0..5 V
	●		0..20 mA
	●	●	4..20 mA

RETRANSMISSION SCALING (OUT. RANGE)			
SW2	4	5	
			100%
		●	50 %
	●		25 %
	●	●	Not allowed

(*) The default configuration is the following: Address 1, 38400, no parity, 1 stop bit.

SELECTION OF QUANTITY RETRANSMITTED (RETR. OUTPUT)				
SW2	6	7	8	
				Not allowed (**configuration by EEPROM if SW2-1..8 are all «0»**)
			●	Retransmission of Vrms
		●		Retransmission of Irms
		●	●	Retransmission of Watt
	●			Retransmission of cosϕ
	●		●	Retransmission of frequency
	●	●		Retransmission of VAR
	●	●	●	Not allowed

TERMINATOR RS485			
SW3	1	2	
		x	Terminator OFF, the SW3-2 is not used.
	●	x	Terminator ON, the SW3-2 is not used.

Programming

For the product's programming and/or configuration tools, consult the website www.seneca.it.

During initial programming, the EEPROM (SW3 ..8 in OFF position) default setting values originally programmed as follows can be used:

Address = 01, **SPEED =38400 Baud**, **PARITY= none**, **BIT NUMBER = 8**, **STOP BIT=1**.

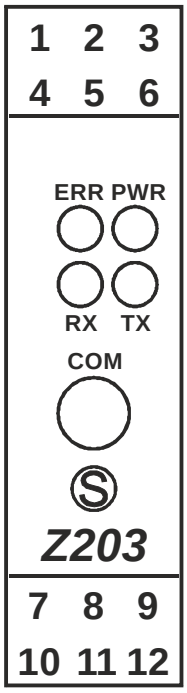
The module can also be programmed through the front connector (COM) while paying attention to set the following connection parameters:

Address = 01, Speed =2400 Baud, **PARITY =none**, **STOP BIT** = **1**.

The Com communication port behaves in the same way as the RS485 bus port except for the communication parameters described above. It also has priority over the RS485 serial port and closes after 15 seconds of inactivity.

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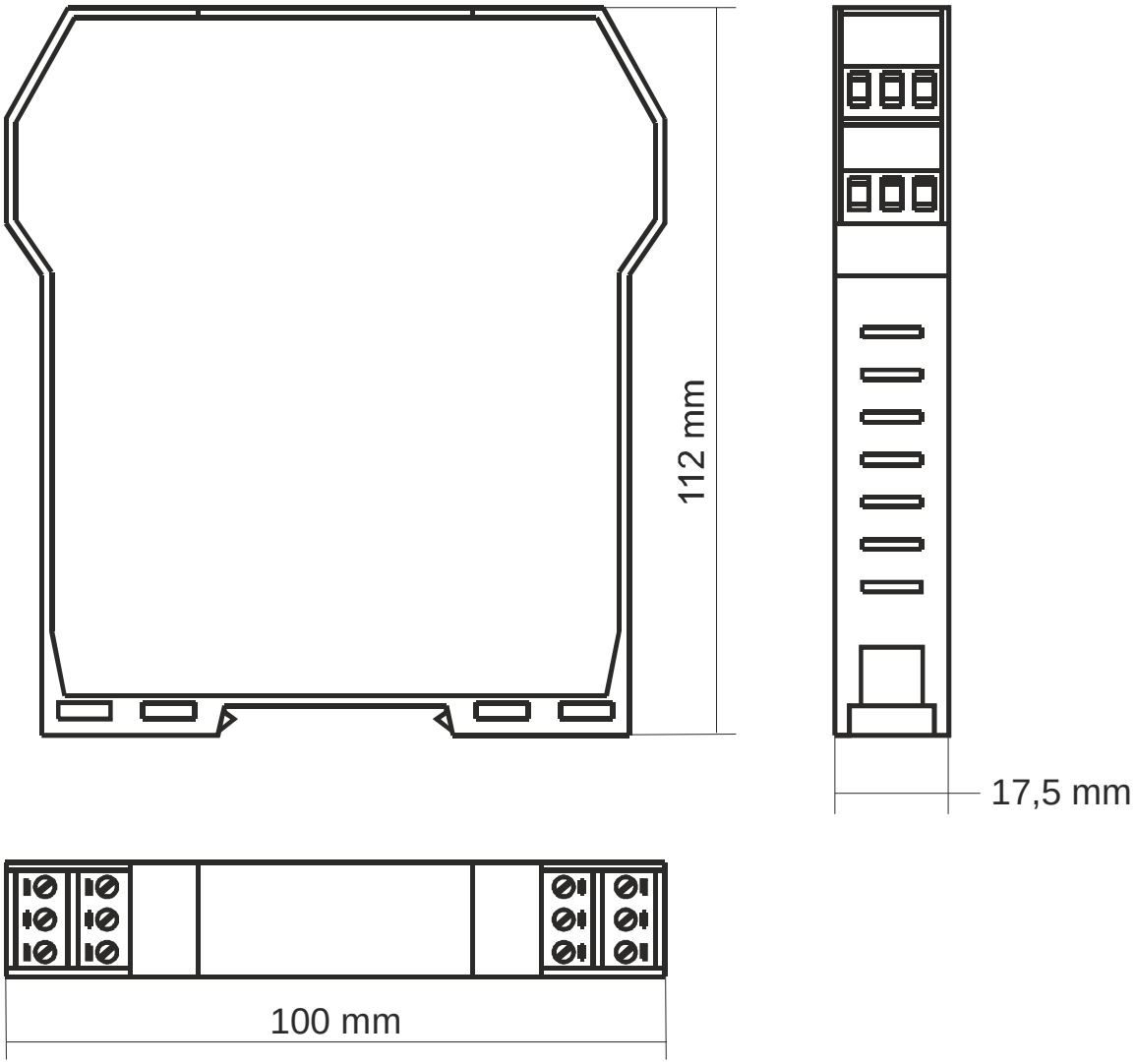
Frontal Panel and Led



Dip-switch and Modbus register

If all the dip-switch of SW2 are equal to zero, so “00000000”: the module acquires the configuration from EEPROM for: nominal frequency, output-type, output-electric value, retransmitted output, electric start scale, electric end scale (see the modbus registers).
If at least one dip-switch of SW2 is different from zero: the module acquires **only the configurations appliable** from dip-switch SW2. For example: if SW2 is equal to “1 | 00 | 00 | 001”, then the nominal frequency is configurated as “60 Hz” from dip-switch, the output type is configurated as “0..10 V” from dip-switch, the retransmission scaling is configurated as “100%” and the retransmitted output is VRMS. **In this case, the content of the registers 40110/40111, 40112/40113 (retransmitted output range), 40114/40115, 40116/40117 (analogue output range) are not acquired for the scaling.**

Overall Dimensions



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MODBUS REGISTERS

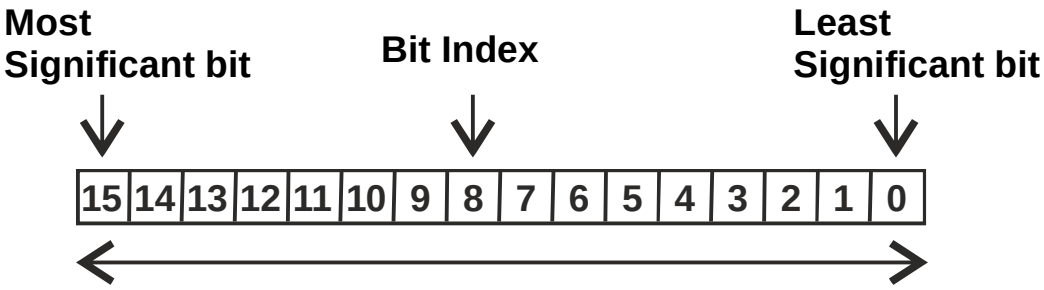
Z203-1 has MODBUS 16 bits (words) registers, accessible by RS485 or RS232 serial communication. In the next paragraphs, we shall describe the supported MODBUS commands, and the functions of the registers.

Supported MODBUS Commands

Code	Function	Description
03	Read Holding Registers	Reading of registers up to 16 words at a time **within the same group**.
06	Write Single Register	Writing of a word register

Holding Registers

The 16-bit Holding Registers have the following structure:



Word (16 bits): MODBUS Register

The Bit notation [x:y] shown in the table indicates all the bits from x to y. For example, Bit [2:1] indicates bit 2 and bit 1, and illustrates the meaning of the various linked combinations of the values of the two bits. Remember that the MODBUS 3 and 6 functions (respectively of multiple reading and single writing) can be executed on the following registers. Default values are marked with * symbol.

The following indication (only readable or also writable) is provided for every register:
R: Readable
W: Writeable

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GROUP 1

REGISTER	Description	ADD.	R/W
MACHINE ID	**Bit [15:8]: contain the module's ID** **Bit [7:0] contain the firmware's external revision.**	**40001**	**R**
ADDR	**Register for the setting of the module's address and parity control.**	**40002**	**R/W**
Bit [15:8]	Set the module's address. Permissible values from **0x00** to **OxFF** (decimal values in the interval of 0-255). Default address: 1.		
Bit [7:0]	Set the type of parity control: 00000000 : No parity (NONE)*(Default) 00000001 : Even parity (EVEN) 00000010 : Odd parity (ODD)		
BAUDR	**Register for the setting of the Baud rate and the response delay time in characters.**	**40003**	**R/W**
Bit [15:8]	Set the serial communication speed value (Baudrate): 00000000 (0x00) : 4800 Baud 00000001 (0x01) : 9600 Baud 00000010 (0x02) : 19200 Baud 00000011 (0x03) : 38400 Baud *(Default). 00000100 (0x04) : 57600 Baud 00000101 (0x05) : 115200 Baud 00000110 (0x06) : 1200 Baud 00000111 (0x07) : 2400 Baud		
Bit [7:0]	Set the response delay time in characters that represents the number of pauses of 6 characters each to be entered between the end of the Rx message and the start of the Tx message. Default value: 0 (hexadecimal: 0x00).		
CT_RATIO	**Register for the setting of the coefficient of the CT connected to the instrument.**	**40004**	**R/W**
Bit [15:0]	Set the coefficient for any CT connected to the module. The transformation ratio multiplied by 10 must be entered. This coefficient will influence the floating point value of IRMS, Active Power and Reactive Power, but will not influence the integer (0 - 10000) and retransmission values. Default: 10 (retransmission is not influenced by CT value, if configuration from Dip-switch)		
FW_CODE	**Register containing the firmware's internal code.**	**40005**	**R**

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FREQUENCY	Register to set the network frequency	40007	R/W
Bit [15:0]	If the dip switch Sw2 are configurated as «00000000»: 0=50 Hz; 1=60 Hz		

OUT TYPE	Register to set the range of the analogue output	40008	R/W
Bit [15:0]	If SW2 are equal to “00000000”, analogue output is: 0=voltage; 2=current. In this case, start scale output is reg.40114/40115, end scale output is reg.40116/40117		

ELECTRICAL MEASURE TO OUT	Register to set the retransmitted output	40009	R/W
Bit [15:0]	If SW2 are equal to “00000000”: 0=VRMS; 1=IRMS; 2=potentiometer; 3=cosfi; 4=frequency; 5=VAR; otherwise: see the Dip-switch table		

GROUP 2

ENERGY_M	Measure of energy in unsigned long (most significant word)	40079	R
Bit [15:0]	Measure of energy in W/h (MSW).		

ENERGY_L	Measure of energy in unsigned long (least significant word)	40080	R
Bit [15:0]	Measure of energy in W/h (LSW).		

VRMS_FLOAT_M	Vrms voltage measurement in floating point (most significant word)	40081	R
Bit [15:0]	Vrms voltage measurement in V (MSW).		

VRMS_FLOAT_L	Vrms voltage measurement in floating point (least significant word)	40082	R
Bit [15:0]	Vrms voltage measurement in V (LSW).		

IRMS_FLOAT_M	Irms current measurement in floating point (most significant word).	40083	R
Bit [15:0]	Irms current measurement in mA (MSW).		

IRMS_FLOAT_L	Irms current measurement in floating point (least significant word).	40084	R
Bit [15:0]	Irms current measurement in mA (LSW).		

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WATT_FLOAT_M	**Active power measurement in floating point (most significant word).**	**40085**	**R**
Bit [15:0]	Active power measurement in W (MSW).		
WATT_FLOAT_L	**Active power measurement in floating point (least significant word).**	**40086**	**R**
Bit [15:0]	Active power measurement in W (LSW).		
FREQ_FLOAT_M	**Frequency measurement in floating point (most significant word)**	**40087**	**R**
Bit [15:0]	Frequency measurement in Hz (MSW).		
FREQ_FLOAT_L	**Frequency measurement in floating point (least significant word)**	**40088**	**R**
Bit [15:0]	Frequency measurement in Hz (LSW).		
VARRMS_FLOAT_M	**Reactive power measurement (in VARrms) in floating point (most significant word).**	**40089**	**R**
Bit [15:0]	Reactive power measurement in VARrms (MSW).		
VARRMS_FLOAT_L	**Reactive power measurement (in VARrms) in floating point (least significant word).**	**40090**	**R**
Bit [15:0]	Reactive power measurement in VARrms (LSW).		
COSΦ_FLOAT_M	**Cosϕ measurement in floating point (most significant word)**	**40091**	**R**
Bit [15:0]	Cosϕ measurement (MSW).		
COSΦ_FLOAT_L	**Cosϕ measurement in floating point (least significant word)**	**40092**	**R**
Bit [15:0]	Cosϕ measurement (LSW).		

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GROUP 3

STATUS	Status Register	40093	R/W
Bit 7	*Zero cross error* 1: signals that the input voltage is less than 40 V.		
Bit [6:5]	*Reserved.*		
Bit 4	*Communication error with the sensor:* 1: signals an error of communication with the sensor.		
Bit [3:1]	*Reserved.*		
Bit 0	*1: Communication error with Feram*		

VRMS_INT	**Register containing the measurement of the Vrms voltage in 0.. 10000 scale.**	**40095**	**R**
Bit [15:0]	Measurement of the Vrms voltage with 0.. 10000 scale.		

IRMS_INT	**Register containing the measurement of the Irms current in 0.. 10000 scale.**	**40096**	**R**
Bit [15:0]	Measurement of the Irms current with 0.. 10000 scale.		

WATT_INT	**Register containing the measurement of the active power in 0.. 10000 scale.**	**40097**	**R**
Bit [15:0]	Measurement of the active power with 0.. 10000 scale.		

VAR_INT	**Register containing the measurement of the reactive power in 0 ..+ 10000 scale.**	**40098**	**R**
Bit [15:0]	Measurement of the reactive power with 0..+10000 scale (absolute value)		

COSϕ_INT	**Register containing the measurement of cosϕ in 0.. + 10000 scale.**	**40099**	**R**
Bit [15:0]	Measurement of cosϕ (absolute value)		

FREQUENCY	**Measure of frequency**	**40101**	**R**
Bit [15:0]	Measure frequency between 350 (35.0 Hz) and 750 (75.0 Hz)		

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COMMAND	**Register of command**	40102	R/W
Bit [15:0]	0xBACA: this command loads the value CommandAux in the register energy; 0x6500 forces the RESET of the module.		

COMMANDAUX_M	**Register of auxiliary command (most significant word)**	40103	R/W
Bit [15:0]	Value to load in the register energy		

COMMANDAUX_L	**Register of auxiliary command (least significant word)**	40104	R/W
Bit [15:0]	Value to load in the register energy		

START SCALE ELECTRIC_M	**Electrical start scale of retransmitted output in floating-point (most significant word)**	40110	R/W
Bit [15:0]	start scale value. To know which input is acquired, see reg.40009 (if SW2 are “00000000”)		
END SCALE ELECTRIC_L	**Electrical start scale of retransmitted output in floating-point (least significant word)**	40111	R/W
Bit [15:0]	As the previous (least significant word)		

STOP SCALE ELECTRIC_M	**Electrical end scale of retransmitted output in floating-point (most significant word)**	40112	R/W
Bit [15:0]	stop scale value. To know which input is acquired, see reg.40009 (if SW2 are “00000000”)		

STOP SCALE ELECTRIC_L	**Electrical end scale of retransmitted output in floating-point (least significant word)**	40113	R/W
Bit [15:0]	As the previous (least significant word)		

START SCALE OUTPUT_M	**Start scale of analogue output in floating-point (most significant word)**	40114	R/W
Bit [15:0]	Output start scale value. To know the analogue output, see reg.40008 (if SW2 are equal to “00000000”)		

START SCALE OUTPUT_L	**Start scale of analogue output in floating-point (least significant word)**	40115	R/W
Bit [15:0]	As the previous (least significant word)		

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STOP SCALE OUTPUT_M	**Stop scale of analogue output in floating-point (most significant word)**	40116	R/W
Bit [15:0]	Output stop scale value. To know the analogue output, see reg.40008 (if SW2 are equal to "00000000")		

STOP SCALE OUTPUT_L	**Stop scale of analogue output in floating-point (least significant word)**	40117	R/W
Bit [15:0]	As the previous (least significant word)		

DIG. OUT ENERGY RATIO_M	**Digital output energy ratio (unsigned long, most significant word)**	40118	R/W
Bit [15:0]	Partition coefficient with which a pulse is generated. If it is 1: the pulse is generated for each unit increment of energy, if it is 10: the pulse is generated every 10 increments of energy, etc...		

DIG. OUT ENERGY RATIO_L	**Digital output energy ratio (unsigned long, least significant word)**	40119	R/W
Bit [15:0]	As the previous (least significant word)		

ENERGY RATIO_M	**Energy ratio (most significant word)**	40120	R/W
Bit [15:0]	Multiplier coefficient with which the energy counter is incremented. If it is 1: the energy is counted as W/h, if it is 0,001: the energy is counted as kW/h, etc... Default: 0,001		

ENERGY RATIO_L	**Energy ratio (least significant word)**	40121	R/W
Bit [15:0]	As the previous (least significant word)		

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APPENDIX A : Retransmission scaling (from Dip-Switch)

100 % Scaling: Retransmission scaling

Electrical Quantities	Measurement range	Selectable analogue output
Vrms	0..500 Vrms	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Irms	0..5 A	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Active Power	0..2500 W	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Reactive Power (*)	0..2500VAR	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
cosϕ (*)	0..1	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Frequency	35..65 Hz	0..10 V, 0..5 V, 0..20 mA or 4..20 mA

50 % Scaling: Retransmission scaling

Electrical Quantities	Measurement range	Selectable analogue output
Vrms	0..250 Vrms	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Irms	0..2,5 A	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Active Power	0..1250 W	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Reactive Power (*)	0..1250VAR	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
cosϕ (*)	0..0,5	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Frequency	45..75 Hz	0..10 V, 0..5 V, 0..20 mA or 4..20 mA

25 % Scaling: Retransmission scaling

Electrical Quantities	Measurement range	Selectable analogue output
Vrms	0..125 Vrms	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Irms	0..1,25 A	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Active Power	0..625 W	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Reactive Power (*)	0..625VAR	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
cosϕ (*)	0..0,25	0..10 V, 0..5 V, 0..20 mA or 4..20 mA
Frequency	40..60 Hz	0..10 V, 0..5 V, 0..20 mA or 4..20 mA

(*) absolute values



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