We Measure, We Control, We Record

DigiRail-VA

USER GUIDE – V1.0x G

1. MAIN FEATURES

DigiRail-VA is a transmitter and signal conditioner related to alternating current (single-phase), capable of measuring the following quantities on the ***True-RMS***:

- Voltage
- Current
- Active, reactive, and apparent power
- Frequency
- Power Factor

The measured values can be read out via the RS485/Modbus RTU interface. In addition, they can be retransmitted simultaneously via the 4-20 mA and 0-10 V outputs.

These features make **DigiRail-VA** an excellent solution for measuring consumption profiles in machines and single-phase installations.

	**This equipment is not intended for commercial measurement of electrical energy!**

2. SPECIFICATIONS

Power Supply: 10 to 40 Vdc. Max consumption: approx. 40 mA @ 24 V; plus 20 mA when you used a 4-20 mA output. Peaks of up to 20 mA can also occur when the equipment is sending data through the RS485 interface.

Operation Temperature: 0 to 60 °C.

Dimensions: 99.5 x 114.0 x 17.5 mm.

Weight: 96 g.

Enclosure: PA66, with metallic attachment for 35 mm DIN track.

Internal protection against polarity inversion of the power supply voltage.

Wire gauge: AWG 28 to 12.

Recommended torque: 4 kgf·cm.

Voltage input range: 0 to 300 Vac (RMS).

Current input range: 0 to 5 Aac (RMS).

Frequency input range: between 45 to 65 Hz.

Analog outputs: 4-20 mA and 0-10 V.

Analog output rangeability: 10:1. A bigger zoom is allowed, but with accuracy loss.

RS485 Serial Interface: Modbus RTU Protocol – 3 wires.

The inputs are isolated from the outputs and communication interfaces. Isolation: 2500 Vac / 1 minute.

Accuracy:

- Reading by RS485:
  - RMS voltage, RMS current, active power (real), apparent power and reactive power: 0.25 % (True-RMS).
  - Power factor and frequency: 0.5 %.
- Reading by the 4-20 mA output:
  - RMS voltage, RMS current, active power (real), apparent power and reactive power: 0.5 % (True-RMS).
  - Power factor and frequency: 1.0 %.
- Reading by the 0-10 V output:
  - RMS voltage, RMS current, active power (real), apparent power and reactive power: 0.5 % (True-RMS).
  - Power factor and frequency: 1.0 %.

3. INSTALLATION AND OPERATION

3.1 MECHANICAL INSTALLATION

The **DigiRail-VA** housing was designed for installation on DIN rail 35 mm.

For installation on the rail, you should locate the clamp at the base and press it against the track.

3.1.1 DIMENSIONS

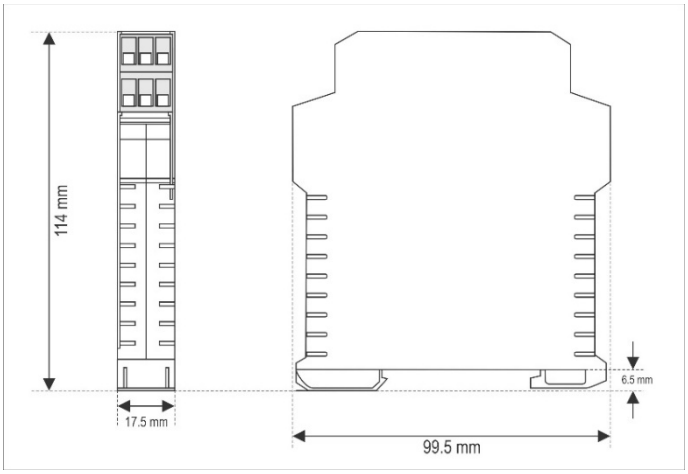


Figure 1 – Dimensions

3.2 ELECTRICAL INSTALLATIONS AND OPERATION

DigiRail-VA has connectors for the power supply, for the inputs for AC measurement, for the output for analog transmission and for the RS485 serial communication interface. Furthermore, it has a USB mini-B interface.

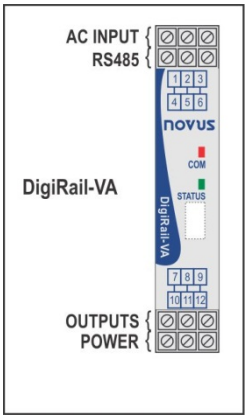


Figure 2 – Connection terminals

Figure 03 illustrates the electrical connection terminals. Terminals 4, 5 and 6 connect to the RS485/Modbus interface. Terminals 7, 8 and 9 are intended for the analog outputs of the device (4-20 mA and 0-10 V – they share the same "negative" terminal). Terminals 10, 11 and 12 are used to power the **DigiRail-VA** (terminals 10 and 11 are interconnected internally).

Terminals 1, 2 and 3 are used for AC measurements and must be connected carefully. Refer to AC INPUTS section for connection details.

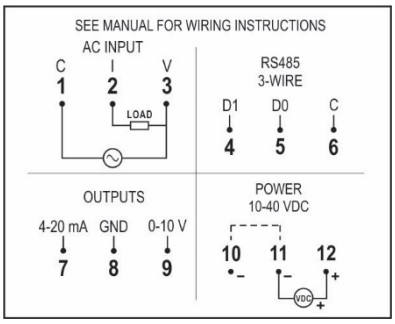


Figure 3 – Electrical connections

3.2.1 INSTALLATION RECOMMENDATIONS

	**We recommend using an appropriate fuse for the protection of the load to be measured.**

- Input conductors should travel the system plant separately from the output and supply conductors, in grounded electrical ducts.
- The power source of the instruments should come from a network that is appropriate for the instrumentation.
- The use of RC FILTERS (47 Ω and 100 nF, in series) parallel to the contactor coils and solenoids that are near or connected to the equipment is recommended.
- In control applications, it is essential to consider what can happen when any part of the system fails.
- Section of used wires: minimum gauge of 0,14 mm².

3.2.2 POWER SUPPLY

The terminals 11 and 12 (or 10 and 12) are intended for the power supply for **DigiRail-VA**. The polarity of the power supply must be carefully observed and the voltage level.

3.2.3 RS485

The RS485 interface of **DigiRail-VA** has terminals for 3-wire communication (including the common) and operates as a Modbus RTU slave. The commands and the table of available registers can be viewed in the MODBUS COMMANDS AND REGISTER TABLE.

This interface can be configured to operate in the following baud rate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200. In addition, it can be configured to operate with one or two stop bits, and parity even, odd or none.

D1	**D**	**D+**	**B**	Bidirectional data line.	**Terminal 4**
D0	**$\overline{D}$**	**D-**	**A**	Inverted bidirectional data line.	**Terminal 5**
C				Optional connection that improves the communication performance.	**Terminal 6**
GND					

Table 1 – RS485 connections

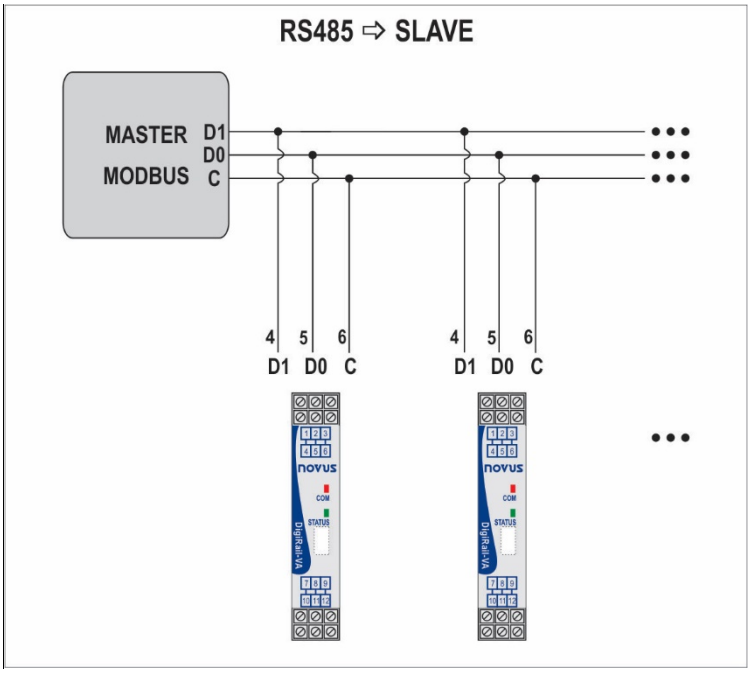


Figure 4 – RS485 connections

3.2.4 USB INTERFACE

DigiRail-VA has a USB device interface, used for configuration and monitoring. The Windows operating system will detect the device as a virtual serial port, allowing the use for supervisory software (SCADA).

To access this interface should be use the USB cable supplied with the equipment. When you first access, you need to install the USB drivers on the computer. To see how to do this, see USB DRIVER INSTALLATION section.

The communication of this interface is by the Modbus RTU protocol. The commands and the table of available registers of this interface can be viewed in the MODBUS COMMANDS AND REGISTERS TABLE.

Note: This equipment cannot be powered from its USB interface. An external power supply must be used for configuration.

3.2.5 AC INPUTS

The measurement circuit is electrically isolated from the rest of the equipment (power circuits and interfaces). However, great care must be taken with electrical wiring connections. Take care to comply with the maximum voltage and current set (see SPECIFICATIONS chapter).

To measure higher voltages or current levels to be measured, you should use current or voltage transformers (see USING CURRENT TRANSFORMERS AND VOLTAGE TRANSFORMERS section).

TERMINAL	1	2	3
SIGN	COMMOM	I	V

Table 2 – Terminals

The current measurement is done by an internal shunt resistor, so that the **DigiRail-VA** is connected in series with the load to be measured. The following figure illustrates the device connected to the measuring circuit.

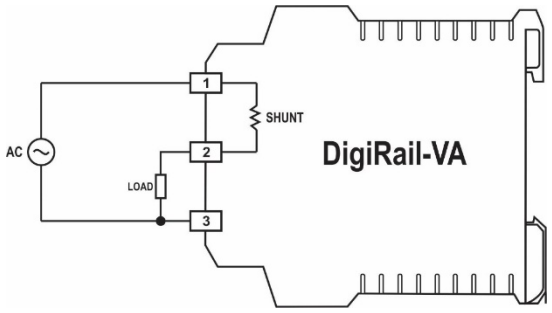


Figure 5 – Measurement of voltage and current

Despite being common simultaneous measurement of voltage and current, you can connect just the part on the voltage or current for measurement. In such cases, the measurement of the variable not connected will present value near zero as the calculated values of the side variables (power and power factor). The figures below illustrate the connections in these cases.

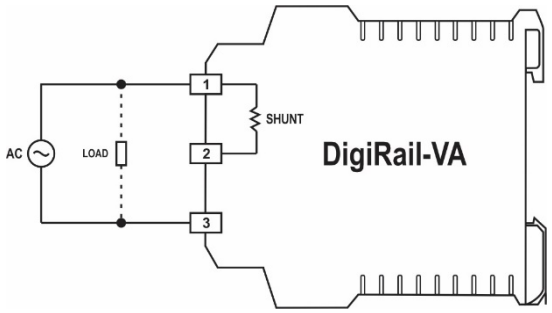


Figure 6 – Solely measurement of voltage

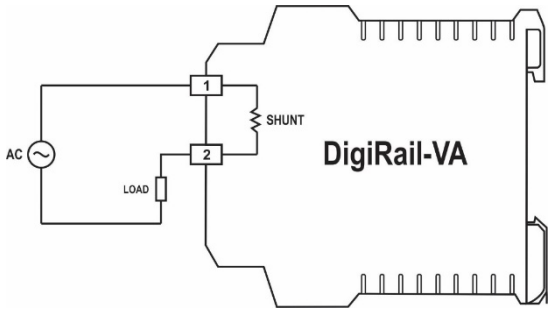


Figure 7 – Solely measurement of current

USING CURRENT TRANSFORMERS AND VOLTAGE TRANSFORMERS

To expand the capacity of measuring levels of current or voltage **DigiRail-VA**, you can use voltage and/or current transformers.

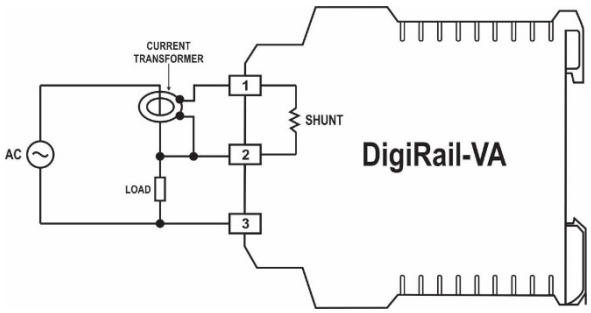


Figure 8 – Connecting with current transformer

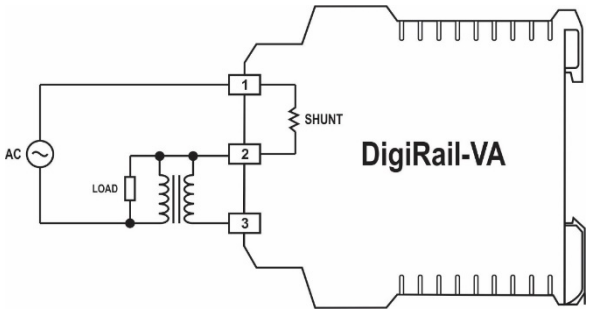


Figure 9 – Connection with voltage transformer

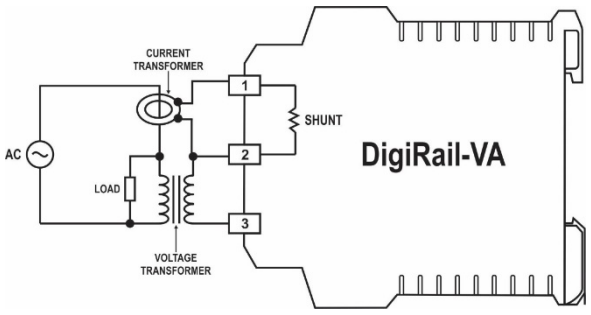


Figure 10 – Connection with current and voltage transformers.

In any of the cases, the maximum limits of the equipment must be respected, that is, the use of a current transformer requires that it has a maximum output of 5 A and the use of a voltage transformer requires it to have an output maximum of 300 V.

Phase inversion can generate a considerable error on some measurements. To avoid that, some care must be taken when using current or voltage transformers so their polarity should keep the signal with its same original phase.

The transformer ratio should be informed in **DigiRail-VA** settings so you can make the correction of the measured value, adjusting to reality. Similarly, if the use of a transformer produces a phase shift between current and voltage in the secondary, can be corrected through the option "Allow the Correction of Phase" in the "Diagnostics" tab for DigiConfig.

Example 1: Using a voltage transformer with 1000 V input and 300 V output.

In this case, you must inform on DigiConfig that be used a voltage transformer, selecting the appropriate box. You must then inform the transformation ratio (in = 1000 V, out = 300 V).

Example 2: Using a current transformer with 50 A input and 4 A output.

In this case, you must inform on DigiConfig that be used a current transformer, selecting the appropriate box. You must then inform the transformation ratio. As the input range is 0 to 5 A, and in this example the current transformer to be used does not match the specification, adjust the parameter of the input current of the current transformer, so that the ratio transformation is maintained.

50 / 4 = 12.5

12.5 x 5 = 62.5 → Input = 62,5 A

MEASUREMENT OF FREQUENCY AND POWER FACTOR

The frequency measurement is performed by the voltage input. In case the voltage value is close to zero, the frequency calculation may be inaccurate and wrong values may happen. That is why **DigiRail-VA** inhibits the frequency measurement when voltage is near zero, typically below 0.5% of full scale. The inhibition of the frequency measurement, indicated as "0 Hz", also happens when it is not performing the voltage measurement, as in the case shown in **Figure 06**.

Measurement of power factor there need voltage and current being measured by **DigiRail-VA**, it is a calculated value based on the phase shift of these two quantities. If one of the values of the voltage or current is near zero, the calculated value of power factor may result in wrong values. That is why the **DigiRail-VA** inhibits power factor measurement when the voltage or current showing small values, typically 0.1 % of full scale. This

inhibition of measuring power factor, denoted as "0", also happens when it is not performing the measurement of voltage or current, as in the cases illustrated in **Figures 06** or **05**.

3.2.6 4-20 mA OUTPUT

The 4-20 mA output can be used to transmit any of the measures in the AC input:

- RMS Voltage
- RMS Current
- Active Power
- Apparent Power
- Reactive Power
- Power Factor
- Frequency

This output can be disabled if necessary.

Transmission is based on the full scale of the desired variable (e.g., 0 to 300 V for the rms voltage) or based on a reduced scale (e.g. transmit a value of rms voltage on the range from 80 to 140 V, where 80 V corresponds to 4 mA and 140 V to 20 mA).

Finally, you can select the behavior of the 4-20 mA output in case of error: current lower than 4 mA or higher than 20 mA.

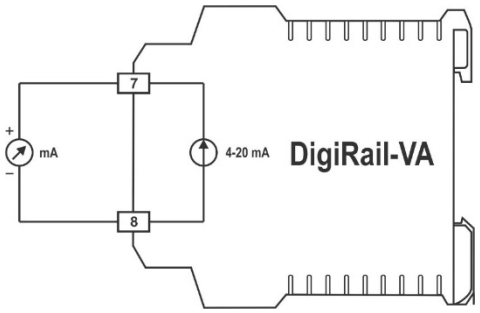


Figure 11 – Connecting the 4-20 mA loop output

⚠	The 4-20 mA output is **NOT** isolated from the 0-10 V output, as they are interconnected through the “negative” pole. In addition, this conductor is also connected to the negative of the power source! Therefore, you should be careful when using the 4-20 mA and 0-10 V outputs to send signals to other devices that are powered from the same source as **DigiRail-VA**. If the 4-20 mA and 0-10 V outputs are used at the same time, you can have problems if both are read by the same device and if the device does not have isolated inputs.

3.2.7 0-10 V OUTPUT

The 0-10 V output can be used to transmit any of the measures in the AC input:

- RMS Voltage
- RMS Current
- Active Power
- Apparent Power
- Reactive Power
- Power Factor
- Frequency

This output can be disabled if necessary.

The transmission is based on the full scale of the desired variable (e.g., 0-5 A for the rms current) or based on a reduced scale (e.g., transmit a current effective value of range of 0.5 to 3 A, where 0.5 A corresponds to 0 V and 3 A corresponds to 10 V).

Finally, you can select the behavior of the output 0-10 V on error: Voltage equal to 0 V or exceeding 10 V.

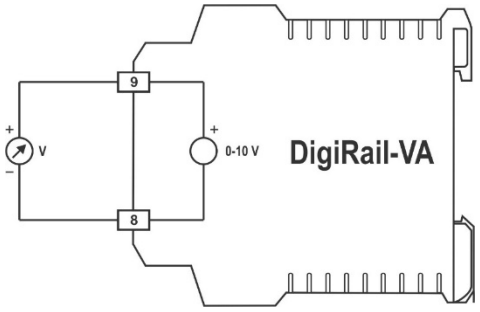


Figure 12 – Connecting the 0-10 V output

The 4-20 mA output is **NOT** isolated from the 0-10 V output, as they are interconnected through the “negative” pole. In addition, this conductor is also connected to the negative of the power source!

Therefore, you should be careful when using the 4-20 mA and 0-10 V outputs to send signals to other devices that are powered from the same source as **DigiRail-VA**.

If the 4-20 mA and 0-10 V outputs are used at the same time, you can have problems if both are read by the same device and if the device does not have isolated inputs.

4. INDICATOR LIGHTS (LEDS)

Status LED: STATUS

It indicates the operational status of the equipment, according to the table shown below:

LED STATUS	MEANING
ON	The input measurement is OK.
1 blink every 2 seconds	Voltage input value greater than the range operation.
2 blinks every 2 seconds	Voltage input value lower than the range operation.
3 blinks every 2 seconds	Current input value greater than the range operation.
4 blinks every 2 seconds	Current input value lower than the range operation.
5 blinks every 2 seconds	Input frequency out of operating range.
OFF	Possible hardware issues.

Table 3 – Status LED

Communication LED: COM

It indicates that an RS485/Modbus communication is in progress. Blinks whenever the **DigiRail-VA** is sending a Modbus frame via the RS485 interface (in response to a command).

5. USB DRIVER INSTALLATION

To use the **DigiRail-VA** USB interface to configure it, for example, for the first time, you need to install the USB driver, available on the product page on the **NOVUS** website. The installation steps may vary from computer to computer, between operating systems, and even between one version of the same operating system and another.

The steps for installing the driver are shown below.

5.1 WINDOWS 11

1. Plug the **DigiRail-VA** into a USB port on your computer. Windows will recognize it as a USB Serial Device (COM X), a generic device. You will need to manually install the device driver.
2. To install the device driver, open the “Device Manager”. In the Windows 11 search bar, simply search for “Device Manager”. Then go to the Ports section (COM and LPT) and locate the device, which will still have a generic name.

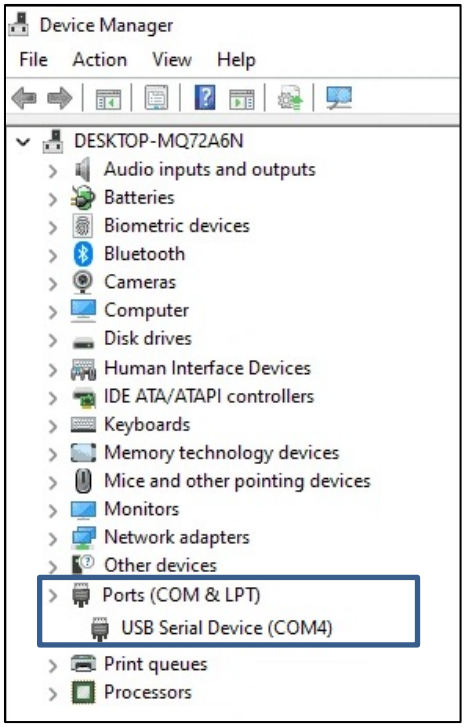


Figure 13 – Device manager

3. Right-click on the equipment. Then, select the “Properties” option. Go to the “Driver” tab and then select the “Update Drivers” option, as shown in the figure below:

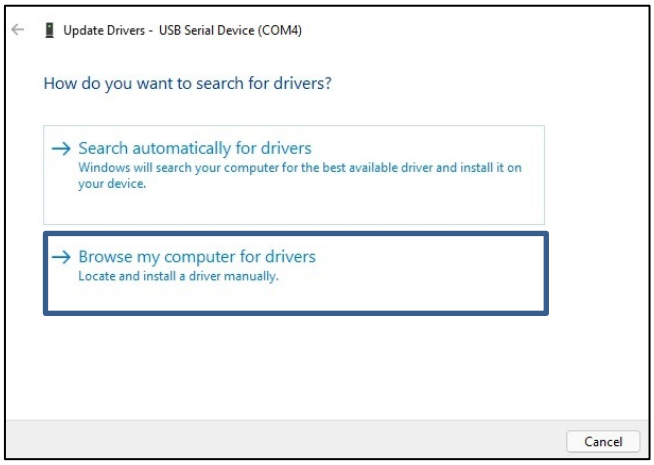


Figure 14 – Drivers update

4. Ask to “Browse my computer for drivers”, indicating the path to the folder where the equipment drivers are (files downloaded from **NOVUS'** website, available on the product page):

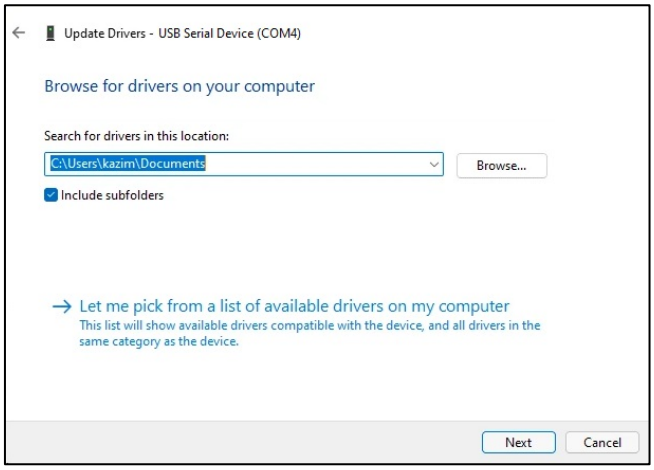


Figure 15 – Searching drivers

5. Wait for the installation to finish. After this, the device will be recognized by your computer, as you can see in the “Device Manager”:

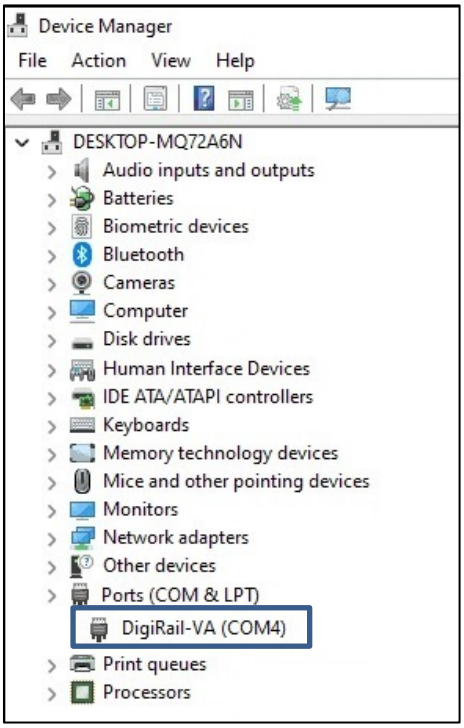


Figure 16 – Device successfully recognized

6. You can now configure the device with the DigiConfig software. Check the CONFIGURATION SOFTWARE chapter.

6. HOW TO SET AND SELECT A SERIAL PORT (COM) – WINDOWS

The **DigiRail-VA** serial port is determined by the operating system moments after you plug in the device. To identify or change the COM port associated with the **DigiRail-VA**, follow the path below:

Control Panel / System / Hardware / Device Manager / Ports (COM & LPT)

When you select the "USB Serial Device"' device corresponding to the **DigiRail-VA** and click on "Properties", you must select the "Port Settings" tab and click on the "Advanced" button. In the "Advanced Settings for COM X" list, you must select the serial port to be associated with the **DigiRail-VA**.

Some serial ports may be marked as *In Use*. Only select one of these ports if you are sure that it is not being used by another peripheral on your computer.

In certain situations, serial ports may be marked as in use even when the associated device is no longer installed on the computer. In this case, it is safe to associate this port with **DigiRail-VA**.

7. CONFIGURATION SOFTWARE

7.1 INITIAL CONFIGURATION AND SOFTWARE INSTALLATION

The **DigiConfig** software is a program for Windows used to set up the **DigiRail-VA**. For its installation, you must execute the "*DigiConfigSetup.exe*" file, available on our website. It is recommended to check sporadically for updates.

DigiRail-VA can be set either by its USB or RS485 interfaces. Do not forget to configure its Modbus address as desired.

Important: For initial configuration, connect the **DigiRail-VA** to the computer via USB cable and install the device drivers. After that, run **DigiConfig** and, on the main screen, go to "*Configurations*" → "*Communication*" and edit the settings according to the parameters below:

- Serial Port = DigiRail-VA (COM X)
- Baud rate = 115200
- Parity = None
- Stop Bits = 2
- Timeout (msec) = 300
- First Address (configure in the Search options) = 255

In addition to configuring the equipment, the software also allows you to check the readings from the input channels and provide status information.

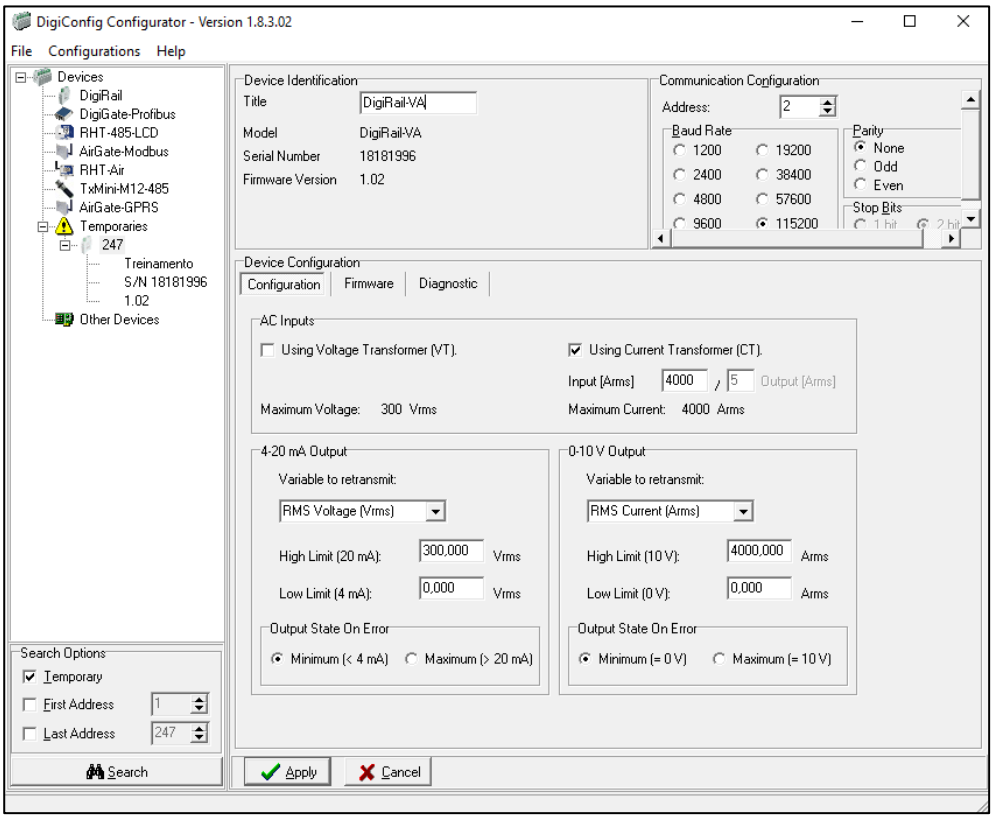
DigiConfig has a help file. To consult it, start the software and select the "*Help*" menu or press the "*F1*" key.

To configure the **DigiRail-VA**, connect the equipment to the computer (via USB or RS485) and select the "*Communication*" option in the "*Settings*" menu. In the next window, select the serial port and configure the other communication parameters. After applying the communication configuration, the system will be able to read the **DigiRail-VA** configuration, making the search in the button located in the lower left corner of the main window.

To accelerate the search, use the USB interface and use the option "*Temporary*". If you are using the RS485 interface and know the equipment Modbus address, select the "*Starting Address*" and enter the correct address in this field. Once the equipment is identified, it appears in the list on the left. Clicking on it will show the configuration on the right side.

The configuration of the device is divided by functionality into several tabs. The choice of some options may affect the limitation or absence of other configuration parameters. Last of all, you must apply the configuration to the equipment through the *Apply* button.

The use of **DigiRail-VA** with full functionality is detailed in the INSTALLATION AND OPERATION chapter.



7.2 EQUIPMENT FIRMWARE UPDATE

It is possible to update the firmware of your **DigiRail-VA**, which allows you to enjoy versions with new features or important improvements without having to send the equipment to technical assistance.

The latest update is available for download on **NOVUS'** website. The update process is done by using **DigiConfig**, through the related tab.

8. MODBUS COMMANDS AND REGISTERS TABLE

DigiRail-VA accepts some Modbus commands that are sent to its Modbus' own address, operating as a network slave. Commands forwarded to other slaves (routing) will be sent in a transparent way. The following listed Modbus RTU commands (functions) are implemented, and these are interpreted by **DigiRail-VA**.

For further information about each command and the Modbus protocol in general, access the website www.modbus.org.

8.1 SUPPORTED MODBUS COMMANDS

8.1.1 READ HOLDING REGISTERS – 03H

This command can be used to read a value of one or up to the maximum consecutive holding registers, as shown in **Holding Registers Table**.

8.1.2 WRITE SINGLE REGISTER – 06H

This command can be used to write on a holding register, as shown in **Holding Registers Table**.

8.1.3 WRITE MULTIPLE REGISTERS – 16H

This command can be used to write in multiple holding registers, as shown in **Holding Registers Table**.

8.2 HOLDING REGISTERS TABLE

The specified addresses correspond to the low-level physical addresses, where zero (0) corresponds to the address PLC 40001. The *Minimum and Maximum* columns have a range of valid values for each parameter. The R/W column indicates if the parameter is for reading and writing (R/W) or if it is only reading the *Mnemonic SuperView* status what the register mnemonic is for in the **SuperView** software.

ADDRESS	DESCRIPTION	MINIMUM	MAXIMUM	R/W	MNEMONIC SUPERVIEW
0	RMS Voltage (floating point – word high)	0.0	+3.4 e +38	R	
1	Voltage RMS (floating point – word low)				
2	Current RMS (floating point – word high)	0.0	+3.4 e+38	R	
3	Current RMS (floating point – word low)				
8	Active Power / real power (floating point – word high)	0.0	+3.4 e +38	R	
9	Active Power / real power (floating point – word low)				
10	Apparent power (floating point – word high)	0.0	+3.4 e +38	R	
11	Apparent power (floating point – word low)				
12	Reactive power (floating point – word high)	0.0	+3.4 e +38	R	
13	Reactive power (floating point – word low)				
14	Power factor (floating point – word high)	-1.0		R	
15	Power factor (floating point – word low)				
16	Frequency (floating point – word high)	0.0	+3.4 e +38	R	
17	Frequency (floating point – word low)				
20	Voltage RMS x 10 (integer 16 bits unsigned)	0	65535	R	VoltageRMS
21	Current RMS x 100 (integer 16 bits unsigned)	0	65535	R	CurrentRMS
22	Maximum peak voltage x 10 (integer 16 bits unsigned)	0	65535	R	MaxVoltagePeak
23	Maximum peak current x 100 (integer 16 bits unsigned)	0	65535	R	MaxCurrentPeak
24	Active Power (real power) x 10 (integer 16 bits unsigned)	0	65535	R	ActivePower
25	Apparent power x 10 (integer 16 bits unsigned)	0	65535	R	ApparentPower
26	Reactive power x 10 (integer 16 bits unsigned)	0	65535	R	ReactivePower
27	Power factor x 1000 (integer 16 bits signed)	-1000	1000	R	PowerFactor
28	Frequency x 10 (integer 16 bits unsigned)	0	650	R	Frequency
31	Sign of the Reactive power (0 = Inductive, 1 = Capacitive)	0	1	R	LeadLag
200	Serial number (word high)	0	65535	R	SerialNumber_H
201	Serial number (word low)	0	65535	R	SerialNumber_L
202	Firmware version	0	999	R	FirmwareVersion

Table 4 – Holding registers table

8.3 DETAILS ABOUT SOME REGISTERS

8.3.1 REGISTERS 20 TO 28 – MEASUREMENT VALUE IN INTEGER FORMAT

Reports the value of the respective variable input. The value will be multiplied by 10, 100 or 1000 depending on the variable. Example: a value of 217.8 reads as 2178.

8.3.2 REGISTERS 200 AND 201 – SERIAL NUMBER

They keep the serial number of the device. The two registers together form the serial number equipment, i.e., must be treated as a 32-bit number.

8.3.3 REGISTER 202 – FIRMWARE VERSION

States the version of firmware of the device, as shown below:

If the version is “1.00” it will read the value as “100”. If the version is "2,04" it will read it as "204".

8.4 FLOATING POINT FORMAT

DigiRail-VA uses floating point values of single precision (32 bits) according to the **IEEE-754** standard (ANSI / IEEE Standard for Binary Floating-Point Arithmetic).

9. WARRANTY

Warranty conditions are available on our website: www.novusautomation.com/warranty.