PRELIMINARY DESCRIPTION

All of the data shared by a device communicating by Modbus TCP/IP protocol are mapped in tables, at each data is associated a proper address.
Each data can be of two types:
- "REGISTER", data of 2 bytes size (word of 16 bits) that can be associated to analogue input or output, variables, set-point, etc...
- "COIL", data of 1 single bit that can be associated to digital input or output or to a logic state.
A register could contain the image (mirror) of more coils; in example the 16 digital inputs of a device could be read or written as bit (singularly) addressing the coil related to each input or can be read or written as a single word addressing the associated register wherein each bit corresponds to a coil.
In the Modbus protocol, registers and coils are divided as per the following groups of addresses:
0xxxx and 1xxxx = Coils (bit)
3xxxx and 4xxxx = Registers (word)
When reading functions are performed, use the tables indicated below to address the registers .
It is possible to access to the internal registers of the device by direct command Modbus TCP/IP or by the integrated web server.

REGISTERS TABLE

Register Position (*)	Description	Access
40002	Firmware [0]	RO
40003	Firmware [1]	RO
40004	Name [0]	R/W
40005	Name [1]	R/W
40007	Node ID	R/W
40011	System Flags	R/W
40013	Watchdog timer	R/W
40031	Output type (1-0)	R/W
40032	Output type (3-2)	R/W
40041	Analog Output (0)	R/W
40042	Analog Output (1)	R/W
40043	Analog Output (2)	R/W
40044	Analog Output (3)	R/W
40049	Power-Up (0)	R/W
40050	Power-Up (1)	R/W
40051	Power-Up (2)	R/W
40052	Power-Up (3)	R/W
40057	Safe (0)	R/W
40058	Safe (1)	R/W
40059	Safe (2)	R/W
40060	Safe (3)	R/W

COILS TABLE

(*)Coil (Hex)	(*)Coil (Dec)	Description	Access
0x0092	00146	Watch-dog Enable	R/W
0x0093	00147	Watch-dog Event	R/W
0x0094	00148	Power-Up Event	R/W

SUPPORTED MODBUS FUNCTION CODES

Function	Description
01	Read Coil Status (0xxxx)
02	Read Inputs Status (1xxxx)
03	Read Holding Registers (4xxxx)
04	Read Inputs Registers (3xxxx)
05	Force Single Coil
06	Preset Single Register
15 (0F)	Force Multiple Coil
16 (10)	Preset Multiple Registers

NOTES:
(*) If the software DEV9K is in use subtract 1 to the address position number of the register and/or coil.
Registers and coils marked as RO in the column 'Access' are Read Only registers.
Registers and coils marked as R/W in the column 'Access' are Read and Write registers.
For the devices of DAT8000 series, the group of data 0xxxx is the mirror of the group 1xxxx, the group of data 3xxxx is the mirror of the group 4xxxx, therefore the first register could be addressed either as 30002 (with function 04) or 40002 (with function 03).

The maximum number of coils that can be read through Modbus functions 01 and 02 (see "Supported modbus functions codes") are: **128**
The maximum number of registers that can be read through Modbus functions 03 and 04 (see "Supported modbus functions codes") are: **64**
The maximum number of registers that can be written by Modbus function 16 (see "Supported modbus functions codes") are: **64**
The maximum number of coils that can be written by Modbus function 15 (see "Supported modbus functions codes") are: **64**

DESCRIPTION MODBUS REGISTERS

40002 / 40003 : FIRMWARE
Field of 2 read only registers ; contains the firmware identifier provided by the manufactured.
- Default value: 8B00 (hex)

40004 / 40005 : NAME
Field of 2 read/write registers (4 bytes or 4 ASCII characters) available for the user, it can contain the name of the device or an abbreviation that identifies its function inside the plant. Each one of the 4 bytes could be written by values from 0 to 255, ASCII characters included.
The default value of this field contains the identifier of the device expressed in ASCII characters.
- Default value: "8024" (ASCII).

40007 : NODE ID
Contains the MODBUS address of the device; the values allowed are from 1 to 245 decimal.
This data is necessary for the correct addressing of the device into the Modbus net and must follow the IP address.
- Default value: Dec: 1, Hex: 01 INIT: Dec 245, Hex : F5.

40011 : SYSTEM FLAGS
Contains the enable bits and system events of the device. The following parameters are configurable:

Watchdog Event Enable: this bit allows to enable the Watchdog Event (0 = Watchdog disabled, 1 = Watchdog enabled). If this bit is active and the device doesn't receive commands for the time specified in the register 40013 "Watchdog timer", the PWR green led blinks.
If this function is required must be implemented at the power-on of the device; the bit must be reset manually when the Watchdog event is occurred.
Watchdog Event: if this bit is set as 1 indicates that the Watchdog condition has happened (0 = Normal condition; 1 = alarm condition)
PowerUp Event: this bit is forced to 1 at each power on and indicates that the device has been switched off or reset. With the setting of this bit as 0 and checking its state, it is possible to know if a reset of the device has occurred (0 = reset not occurred; 1 = reset occurred).
This bit must be reset manually.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Coil	-	-	-	-	-	163	162	161	-	-	-	-	-	-	-	-
Descr.									Watchdog Event enabling / Watchdog Event / Power-up Event							

40013 : WATCHDOG TIMER
Contains the value of the WatchDog timer, expressed in step of 1 second. If the WatchDog is enabled and the device doesn't receive commands in a time lower or equal to the value of the one expressed in this register the WatchDog will be activated (see description register "System Flags").
- Default value: 10 (10 sec.)

40031: OUTPUT TYPE (1 - 0)
This register shows the type of the output configured (0 → mA , 1 → V) for the analog output 0 and the analog output 1. Each output channel can be configured in Voltage or in Current writing the related value in the high part (output 1) or low part (output 0) of the register.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Descr.			Output type #1								Output type #0					

The value for the output type configurable are the following:

00h → 20 mA
01h → 10 V

40031: OUTPUT TYPE (3 - 2)
This register shows the type of the output configured (0 → mA , 1 → V) for the analog output 3 and the analog output 2. Each output channel can be configured in Voltage or in Current writing the related value in the high part (output 3) or low part (output 2) of the register.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Descr.			Output type #3								Output type #2					

The value for the output type configurable are the following:

00h → 20 mA
01h → 10 V

40041 : ANALOG OUTPUT # 0 VALUE (ANALOG OUTPUT #0)
40042 : ANALOG OUTPUT # 1 VALUE (ANALOG OUTPUT #1)
40043 : ANALOG OUTPUT # 2 VALUE (ANALOG OUTPUT #2)
40044 : ANALOG OUTPUT # 3 VALUE (ANALOG OUTPUT #3)

The value written in these registers is converted into an analog signal on each corresponding output.
The values are expressed in mV for voltage outputs and uA for current outputs :

0 = 0 mA   0 = 0 V
20000 = 20 mA   10000 = 10 V

40049 : POWER-UP OUTPUT # 0 VALUE (POWER-UP #0)
40050 : POWER-UP OUTPUT # 1 VALUE (POWER-UP #1)
40051 : POWER-UP OUTPUT # 2 VALUE (POWER-UP #2)
40052 : POWER-UP OUTPUT # 3 VALUE (POWER-UP #3)

When power-on (PowerUp) the outputs are automatically set to the corresponding value in these registers . In the event of power-down, the values in these registers are not lost .
- Default manufacturer: 0 (0 V o 0mA)

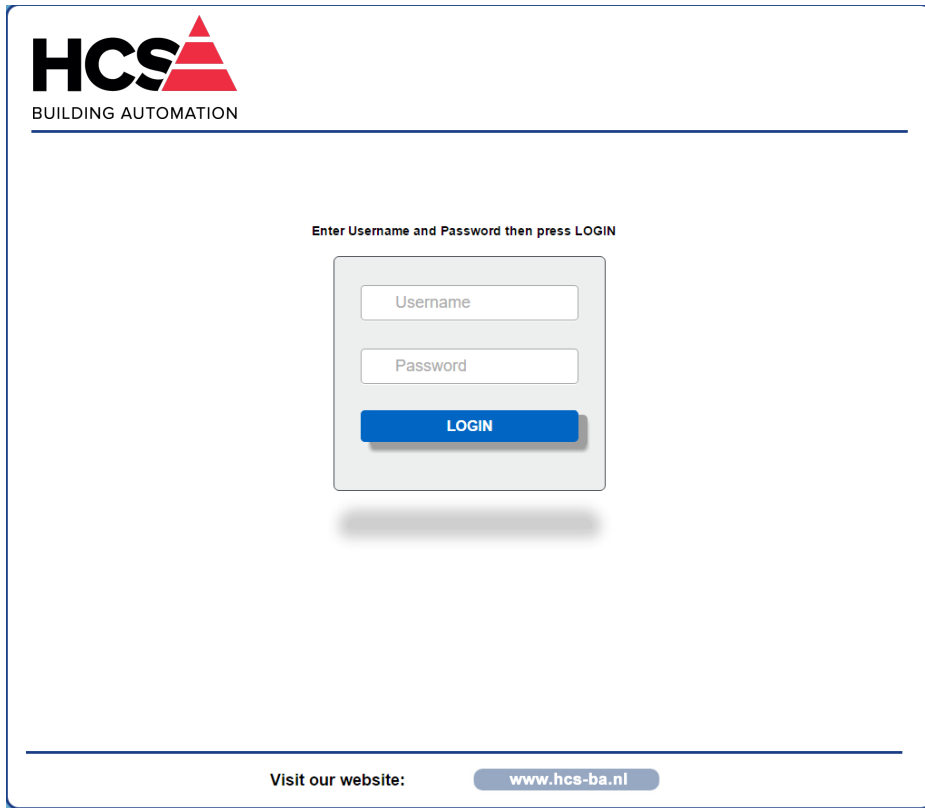The values are expressed in mV for voltage outputs and uA for current outputs :

0 = 0 mA   0 = 0 V
20000 = 20 mA   10000 = 10 V

40057 : SAFE VALUE OUTPUT # 0 (SAFE #0)
40058 : SAFE VALUE OUTPUT # 1 (SAFE #1)
40059 : SAFE VALUE OUTPUT # 2 (SAFE #2)
40060 : SAFE VALUE OUTPUT # 3 (SAFE #3)

In case of a watchdog alarm the outputs are automatically set to the corresponding value in these registers . In the event of power-down, the values in these registers are not lost .
- Default manufacturer: 0 (0 V o 0mA)

The values are expressed in mV for voltage outputs and uA for current outputs :

0 = 0 mA   0 = 0 V
20000 = 20 mA   10000 = 10 V

WEB SERVER STRUCTURE

To access the server, run the Web browser and edit in the Address Bar the IP address of the device.
It will appear the following window. Depending on the Web browser used some icons and/or writings may have little variation of shape and colour.
If necessary, it is possible to connect to the Datexel web site to download the data-sheet and the user guide of the device in use clicking on the button "www.datexel.it" in the bottom part of the window.

Write Username and Password. If the default settings are in use the parameters to access are:
Username: *Fact_user*; Password: *Fact_pwd*
Click on the button *Login* to access to the Home page of the device; it will appear as follows.
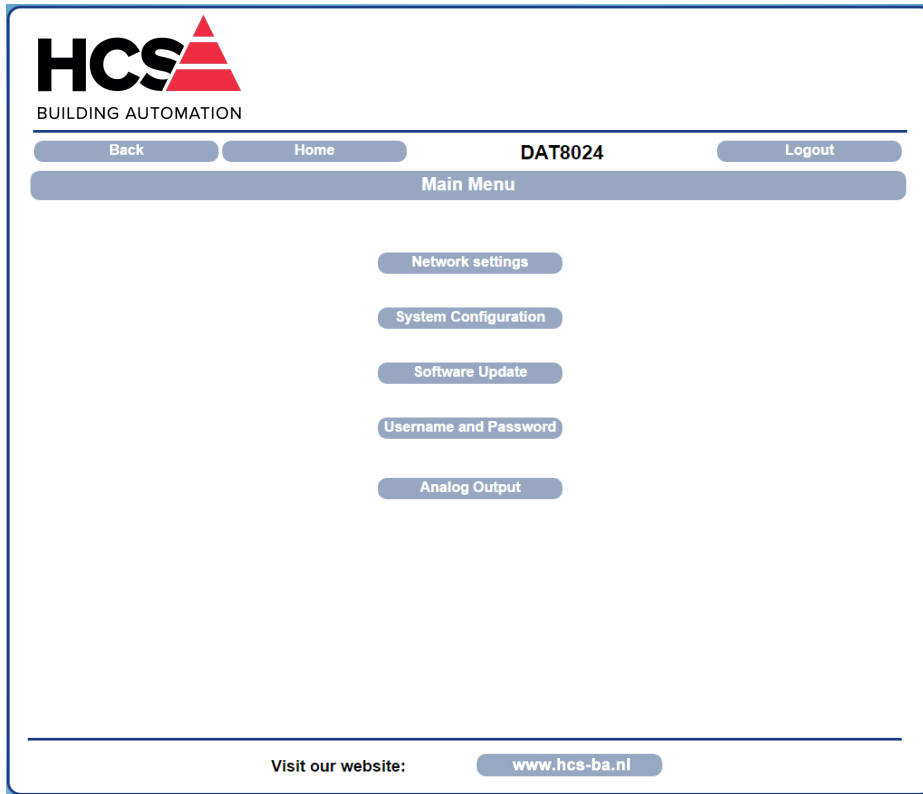
By this page it is possible to access the internal parameters of configuration of the device. If the mouse pointer is moved on the button related to a specific menu, it will appear a green tool tip that will help the user with the selection of menus that are the following:

Network Settings: allows to set the Ethernet communication parameters.
System Configuration: allows to set the system configuration parameters.
Software Update: allows to execute, if necessary a software update.
Username and Password: allows to set the access data used in the Login page.
Analog Input: allows to visualize the value of the analog inputs and if necessary to disable one or more .

In the next sections there is the description of the menus.

Network Settings
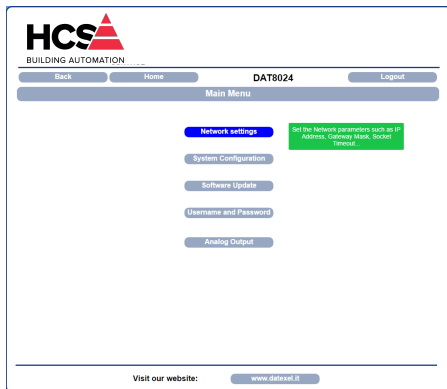
IP Address: allows to visualize and set the unique IP address of the device in the network in use.
**Subnet Mask**: allows to set the parameter of the Subnet Mask in order to determine the local network of the device.
Gateway Mask: allows to set the parameter of Gateway Mask for the correct addressing of the device.
Socket Timeout: allows to set the time expressed as minutes; that when it expires without to receive commands, the device will close the socket of communication.

To save the modified parameters, click the button "*Save*". Wait for the reset of the device and access to it via the new parameters set.

System Settings
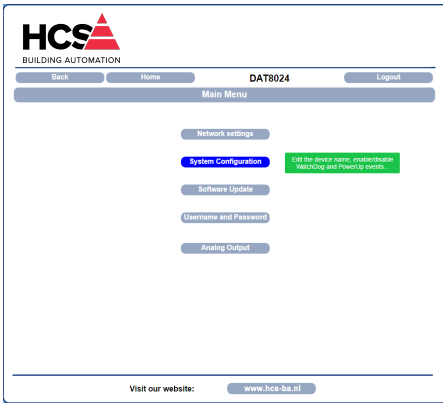
Name: allows to visualize and set the parameter NetBios Name of the device; this parameter, composed by max 15 alphanumeric characters, is visualized beside the IP address in the software Dev9k; it can also be used in the software that implement the use of this data.

Modbus Address: allows to visualize the modbus address of the device; this parameter is forced to 245 in INIT condition.

Watchdog Enable (ref. Reg "System Flags"): this flag allows to enable the Watchdog event (0 = WatchDog disabled, 1 = WatchDog enabled).

Timeout (ref. Reg "WatchDog timer"): allows to set the value, expressed as step of 1 second, of the WatchDog timer .

Watchdog Event (ref. Reg "System Flags"):this flag is used to signal that the Watchdog condition is happened (0 = Normal condition;1 = Alarm condition).

Power-up Event (ref. Reg "System Flags"):this flag is forced to 1 at each power-on and indicates that the device has been switched-off or a reset has occurred. (0 = reset not happened ; 1 =reset happened).

To save the modified parameters, click the button "*Save*". To read the parameters from the device click the button "*Refresh*".

Software Update
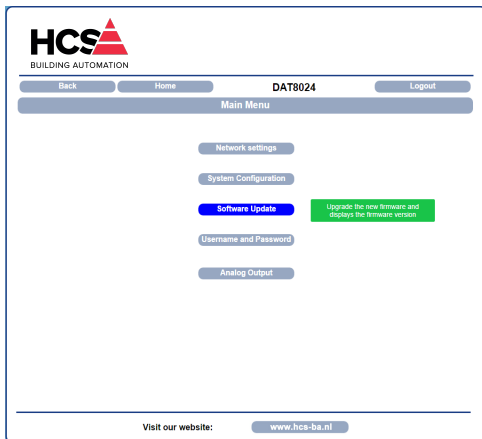
This section allows to update the versions of the firmware or web server and is used in case of necessity. To execute the update click on the button "*Upgrade*"; the system will open a pop-up window where to insert the credentials to proceed with the update. Contact the Technical Assistance service for information about the procedure to follow. The parameter "*Actual Firmware*" shows the firmware version loaded on the device.
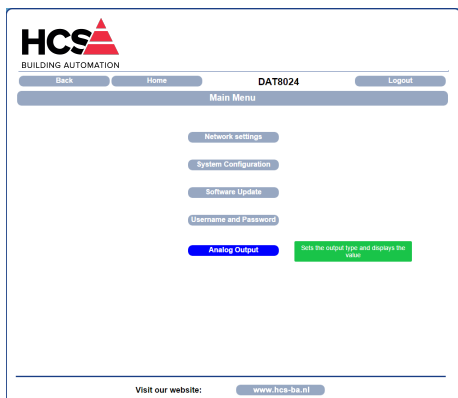
Username and Password

This section allows to set user name and password to access to the Webserver of the device.
Username: allows to set and visualize the user name of the device. Default "*Fact_user*".
Password: allows to set and visualize the password of the device. Default "*Fact_pwd*".
To save the modified parameters, click the button "*Save*".

Analog Output

This section allows to view and write the values of the analog outputs expressed in the unit of measure defined by "*Output Type*".
Each output can be configured independently in Voltage or Current because the device has 4 isolated analog outputs.

Output Type (ref. Reg "Output Type") : allows to view and configure the desired type of analog output .
Value (ref. Reg " Analog Output") : allows to write Voltage or Current value to be generated on the related analog output .

Safe (ref. Reg "Safe"): allows to set the value to whitch the related analog output will be set in case of the Watchdog event occurs (if properly configured from the page "*System Settings*"
PowerUp (ref. Reg "Power-Up"): allows to set the value to whitch the related analog output will be set at power-on the device.
Write Ch0, Write Ch1, Write Ch2 e Write Ch3: allow to modify the parameters of each single output without modify the other channels

To update all fields on the page ("Output Type", "Value", "Safe" and "PowerUp") press "***Read All***"
To save the changes of the entire page ("Output Type", "Value", "Safe" and "PowerUp"), press "***Save All***".

PROCEDURES

USE OF THE FUNCTION "INIT" (*)
All of the devices of DAT8000 series are equipped with the INIT modality. This is a procedure to access the device by the default parameters and to proceed with its configuration:

IP Address: XXX.XXX.XXX.XXX (assigned by DHCP if enabled)
192.168.1.174 (DHCP disabled, verify that the IP is not in use)
Modbus address: 245
By these parameters it is possible to access the device in INIT modality to set and check how it is configured.
To work in INIT follow the procedure:
- Switch-off the device;
- Connect the terminal INIT to terminal -V as shown in the technical datasheet of the device.
- Power-on the device;
- Connect to the device by use of the default above parameters.
When the user finish to work in INIT:
- Switch-off the device;
- Disconnect INIT;
- Power-on the device and connect to it by the known parameters or by those set in INIT modality.
(*): If the software Dev9k is in use, with the goal to allow the correct identification of the device the parameter Netbios name must be set as "DAT8024". If different after the to have searched for the device (Pict 1 in next page), access by the menu Settings->Controller as shown in the picture below.
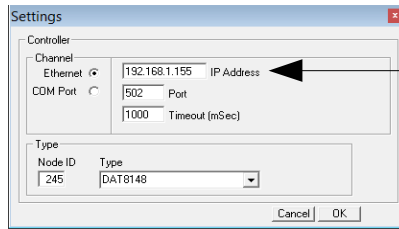
IP address assigned by DHCP visualised in the menu Search.

WATCHDOG
The devices of the DAT8000 series are equipped with the Watchdog timer; if enabled it actives an alarm each time that there is not communication between the device and the master for a time greater than that specified .
In alarm condition, the output values are automatically set to the values specified in the relevant "Safe" registers , to prevent damage to the system in case of danger. In the event of power loss to the device , the values in these registers are not lost .
During this alarm condition the green led PWR on the front of the device blinks and the coil "*Watchdog Event*" is forced to 1. To exit from the alarm condition, send any command to the device and reset the coil "*Watchdog Event*".

FUNCTION BUTTON "P"

In the case it is necessary to restore the default parameters of the device , with device powered and not in INIT condition, push the button "P" located on the front for at least 5 seconds.
The green led PWR will switch-off, the yellow led STS will become orange and the reset of the device will occur.
When the reset procedure is finish, both the leds will set back to the default condition and will be loaded the following parameters:

Ethernet:
- IP Address : 192.168.1.100
- Subnet Mask : 255.255.255.0
- Gateway Mask: 192.168.1.1

Username: Fact_user
Password: Fact_pwd

Modbus:
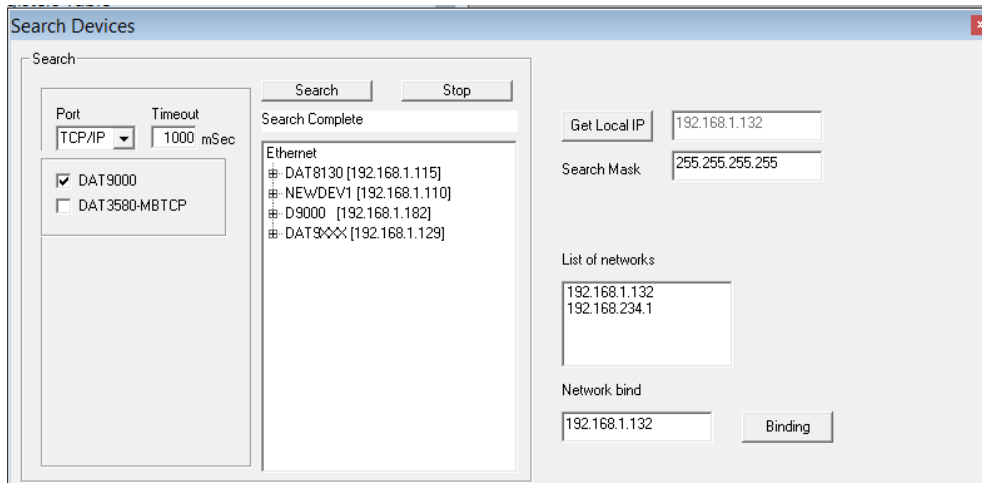Address : 1.

SEARCH A DEVICE OVER THE NETWORK

The devices of DAT8000 series are provided with default IP address: 192.168.1.100, modbus address 1.
The PC could work with multiple subnets.
In order to connect with the device, the PC and the device of DAT8000 series must be in the same network.
It is possible to visualize the PC's IP address running the software Dev9K clicking the button "Get Local IP" under the menu Tools / Search (Pict 1)

Pict. 1

Make sure the IP identified is used in the Network which the device is connected to.
Click the button "Search"; in the field "List of networks" the available networks for the PC in use will be shown. The IP addresses visualized are those assigned to the PC from each network.
Click, if present, the interested network (192.168.1.xxx) to select the network to use.
Click the button "Binding" to set the network over to search the device. Note: the assignment is executed only for the Dev9k that is running. If the PC is in a subnet different from the one of default of the device , the user has to change the IP of the PC to make possible the change of the device's IP.
To do this, open the " Network and Sharing center " of the operating system, go to the Properties of Internet Protocol version 4 of PC (Pict 2) and configure the network parameters in according to the default IP of device : (refer to the section "examples to check Windows configurations")

IP Address : 192.168.1.XXX; modbus address (xx)
Subnet Mask: 255.255.255.0
Default Gateway: 192.168.1.1

Pict. 2
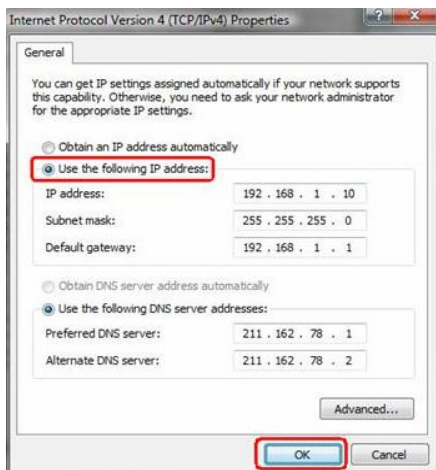
Now the device of DAT8000 series is searchable and the user can change its IP with the desired one. It must be different from the other ones in the network (right click → Set IP address).
Once the device's IP address has been modified, the device will not appear in the results of Dev9k. So the user has to modify the network parameters of PC again in order to display the device.
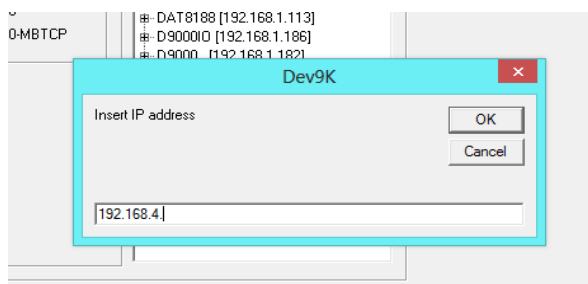
ADDITIONAL COMMANDS TO DETERMINE THE NETWORK IN USE

It is possible to use the following additional commands to determine to which network is connected the PC.
To use it run the command Prompt (cmd.exe) as Administrator in the Windows in use .
Command "Ipconfig"
It is possible to visualize the nets used by the PC writing this command and press enter.
The system will return a list of all the nets used by the PC. Before to try to estabish a communication with the device the user must be sure to be in the correct subnet (ref previous chapter).
Command "ping"
To determine if a device is connected on the net it is possible to use the "ping " command that is an utility for computer networks used to measure the time, in milliseconds, used by one or more packets to reach a network device and to return to the origin.
To use the command , type the command " ping " followed by the IP address of the device and press Enter .
Example:
ping 192.168.1.100
If the device is connected the system will return the answer from the device with the IP mentioned.
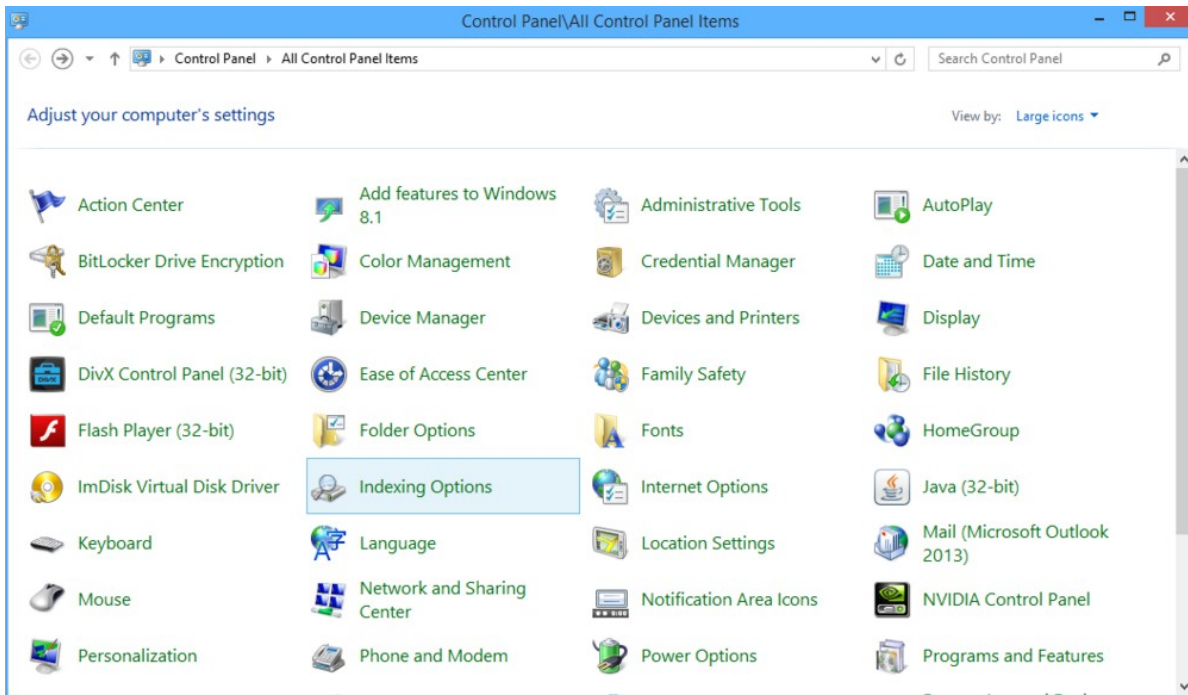If the systems returns the message Host Unreachable the device is not connected in the net in use.
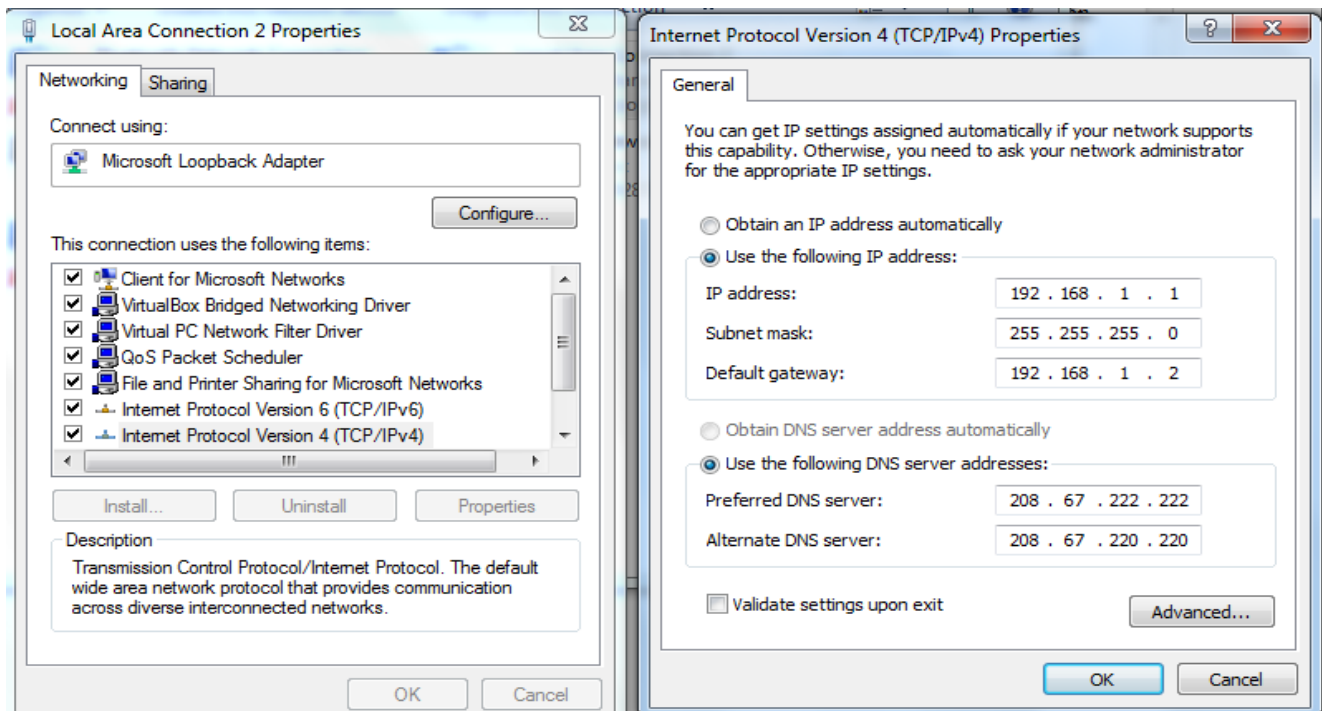In this case it is suggested to check the network assigment.

EXAMPLE TO CHECK WINDOWS ® CONFIGURATION

How to change the IP address of the PC (each version of the operative system could change in part from others)

- Access to Control Panel of PC

- Network and Sharing Center→ Change Adapter Settings → select the interested network → right click → Property → Internet Protocol version 4 → Property.

- Change parameters and click OK.

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