HCS
BUILDING AUTOMATION

Modbus TCP/IP server
16 Digital Inputs

User Guide – MODBUS TCP/IP protocol
Firmware Version : 8200

DAT 8148

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
40032	Digital Inputs	RO
40033	Digital Inputs Rise Latch	R/W
40034	Digital Inputs Fall Latch	R/W
40035	Freq. Digital Input 0	RO
40036	Freq. Digital Input 1	RO
40037	Freq. Digital Input 2	RO
40038	Freq. Digital Input 3	RO
40039	32 bit Counter Digital Input 0	R/W
40041	32 bit Counter Digital Input 1	R/W
40043	32 bit Counter Digital Input 2	R/W
40045	32 bit Counter Digital Input 3	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**

COILS TABLE

(*)Coil (Hex)	(*)Coil (Dec)	Description	Access
0x00A1	00161	Watch-dog Enable	R/W
0x00A2	00162	Watch-dog Event	R/W
0x00A3	00163	Power-Up Event	R/W
0x01F9	00505	Input #0	RO
0x01FA	00506	Input #1	RO
0x01FB	00507	Input #2	RO
0x01FC	00508	Input #3	RO
0x01FD	00509	Input #4	RO
0x01FE	00510	Input #5	RO
0x01FF	00511	Input #6	RO
0x0200	00512	Input #7	RO
0x01F1	00497	Input #8	RO
0x01F2	00498	Input #9	RO
0x01F3	00499	Input #10	RO
0x01F4	00500	Input #11	RO
0x01F5	00501	Input #12	RO
0x01F6	00502	Input #13	RO
0x01F7	00503	Input #14	RO
0x01F8	00504	Input #15	RO
0x0209	00521	Rise Latch Input #0	R/W
0x020A	00522	Rise Latch Input #1	R/W
0x020B	00523	Rise Latch Input #2	R/W
0x020C	00524	Rise Latch Input #3	R/W
0x020D	00525	Rise Latch Input #4	R/W
0x020E	00526	Rise Latch Input #5	R/W
0x020F	00527	Rise Latch Input #6	R/W
0x0210	00528	Rise Latch Input #7	R/W
0x0201	00513	Rise Latch Input #8	R/W
0x0202	00514	Rise Latch Input #9	R/W
0x0203	00515	Rise Latch Input #10	R/W
0x0204	00516	Rise Latch Input #11	R/W
0x0205	00517	Rise Latch Input #12	R/W
0x0206	00518	Rise Latch Input #13	R/W
0x0207	00519	Rise Latch Input #14	R/W
0x0208	00520	Rise Latch Input #15	R/W
0x0219	00537	Fall Latch Input #0	R/W
0x021A	00538	Fall Latch Input #1	R/W
0x021B	00539	Fall Latch Input #2	R/W
0x021C	00540	Fall Latch Input #3	R/W
0x021D	00541	Fall Latch Input #4	R/W
0x021E	00542	Fall Latch Input #5	R/W
0x021F	00543	Fall Latch Input #6	R/W
0x0220	00544	Fall Latch Input #7	R/W
0x0211	00529	Fall Latch Input #8	R/W
0x0212	00530	Fall Latch Input #9	R/W
0x0213	00531	Fall Latch Input #10	R/W
0x0214	00532	Fall Latch Input #11	R/W
0x0215	00533	Fall Latch Input #12	R/W
0x0216	00534	Fall Latch Input #13	R/W
0x0217	00535	Fall Latch Input #14	R/W
0x0218	00536	Fall Latch Input #15	R/W

DESCRIPTION MODBUS REGISTERS

40002 / 40003 : FIRMWARE
Field of 2 read only registers ; contains the firmware identifier provided by the manufactured.
- Default value: 8200 (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 byte 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: "8148" (ASCII).

40007 : NODE ID
Contains the MODBUS address of the device; the values allowed are from 1 to 255 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 40012 "Watchdog timer" the outputs of the device will be forced in function of the settings of the register 40011 section "Safe". The Watchdog condition is signalled by the blinking of the led PWR.
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).

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Output	-	-	-	-	-	163	162	161	-	-	-	-	-	-	-	-
Value								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.)

40032 : DIGITAL INPUTS
This register shows the condition of the digital inputs (0 = OFF; 1 = ON).
The same inputs can also be read using the specific functions of reading coils (01-02) referring to the section in the coils table of which this register is a mirror; it is possible to read at the same time all of the bits of this register without implementing the coils' specific functions.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Input	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0

40033 : DIGITAL INPUTS RISE LATCH
The bits of this register are used to indicate the happened condition of the raise edge (event of change of level from the state 0 to the state 1) of each digital input. The latch event shows the single change of state and is not updated by the system; in the case of it is necessary to monitor this parameter continuously, the single bit or the group of bits must be wrote to 0 after the rising edge happened.
It is also possible to read and drive the bits using the specific functions of reading and force coils (01-02-05-15) referring to the section in the coils table of which this register is a mirror; it is possible to read and write at the same time all of the bits of this register without implementing the coils' specific functions.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Latch	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0

40034 : DIGITAL INPUTS FALL LATCH
The bits of this register are used to indicate the happened condition of the fall edge (event of change of level from the state 1 to the state 0) of each digital input. The latch event shows the single change of state and is not updated by the system; in the case of it is necessary to monitor this parameter continuously, the single bit or the group of bits must be wrote to 0 after the falling edge happened.
It is also possible to read and drive the bits using the specific functions of reading and force coils (01-02-05-15) referring to the section in the coils table of which this register is a mirror; it is possible to read and write at the same time all of the bits of this register without implementing the coils' specific functions.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Latch	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0

40035 : FREQUENCY DIGITAL INPUT 0
This register shows the measure of frequency related to the digital input channel 0. The value, expressed in hundredths of Hertz is an Integer 16 bit format. The maximum value of frequency measurable is 300.00 Hz.

40036 : FREQUENCY DIGITAL INPUT 1
This register shows the measure of frequency related to the digital input channel 1. The value, expressed in hundredths of Hertz is an Integer 16 bit format. The maximum value of frequency measurable is 300.00 Hz.

40037 : FREQUENCY DIGITAL INPUT 2

This register shows the measure of frequency related to the digital input channel 2. The value, expressed in hundredths of Hertz is an Integer 16 bit format. The maximum value of frequency measurable is 300.00 Hz.

40038 : FREQUENCY DIGITAL INPUT 3

This register shows the measure of frequency related to the digital input channel 3. The value, expressed in hundredths of Hertz is an Integer 16 bit format. The maximum value of frequency measurable is 300.00 Hz.

40039-40 (LO-HI) : 32 BIT COUNTER DIGITAL INPUT 0

This couple of registers shows the measure of the digital counter related to the input channel 0. The value is incremented at each change of level from 0 to 1 of the input channel; The type of register is a Unsigned Integer 32 bit and uses 2 registers .
It is possible to reset the value by direct writing. At each power-on of the device the value is set to 0.

40041-42 (LO-HI) : 32 BIT COUNTER DIGITAL INPUT 1

This couple of registers shows the measure of the digital counter related to the input channel 1. The value is incremented at each change of level from 0 to 1 of the input channel; The type of register is a Unsigned Integer 32 bit and uses 2 registers .
It is possible to reset the value by direct writing. At each power-on of the device the value is set to 0.

40043-44 (LO-HI) : 32 BIT COUNTER DIGITAL INPUT 2
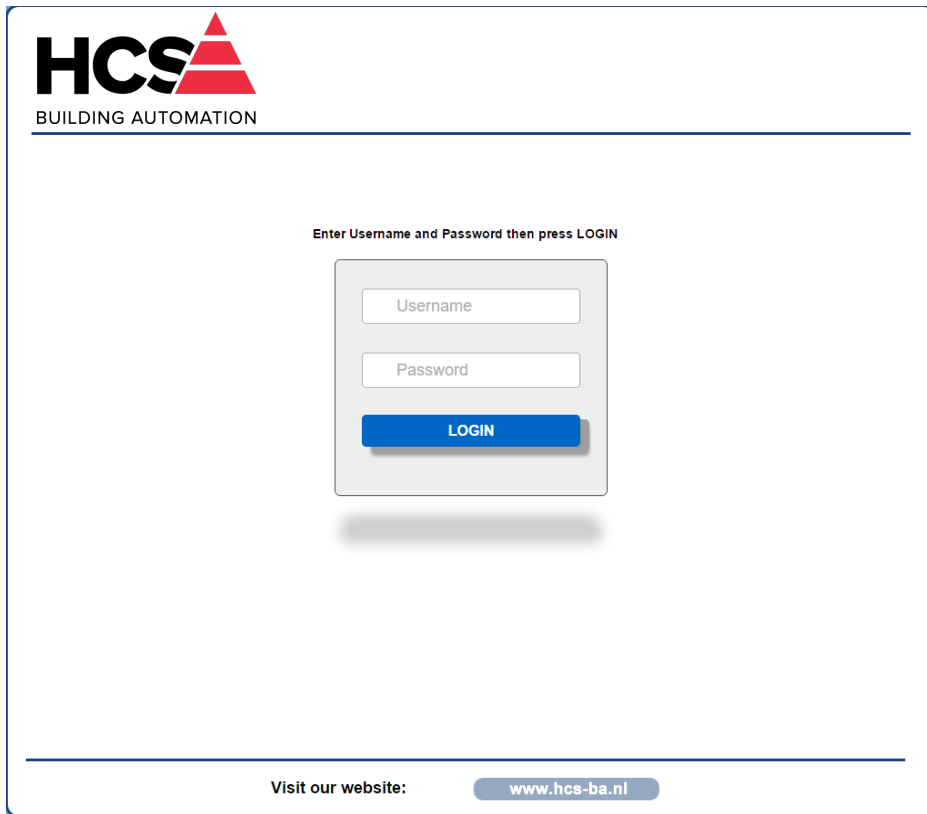
This couple of registers shows the measure of the digital counter related to the input channel 2. The value is incremented at each change of level from 0 to 1 of the input channel; The type of register is a Unsigned Integer 32 bit and uses 2 registers .
It is possible to reset the value by direct writing. At each power-on of the device the value is set to 0.

40045-46 (LO-HI) : 32 BIT COUNTER DIGITAL INPUT 3

This couple of registers shows the measure of the digital counter related to the input channel 3. The value is incremented at each change of level from 0 to 1 of the input channel; The type of register is a Unsigned Integer 32 bit and uses 2 registers .
It is possible to reset the value by direct writing. At each power-on of the device the value is set to 0.

WEB SERVER STRUCTURE

To access the server, run the Web browser and edit in the Address Bar Th 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.
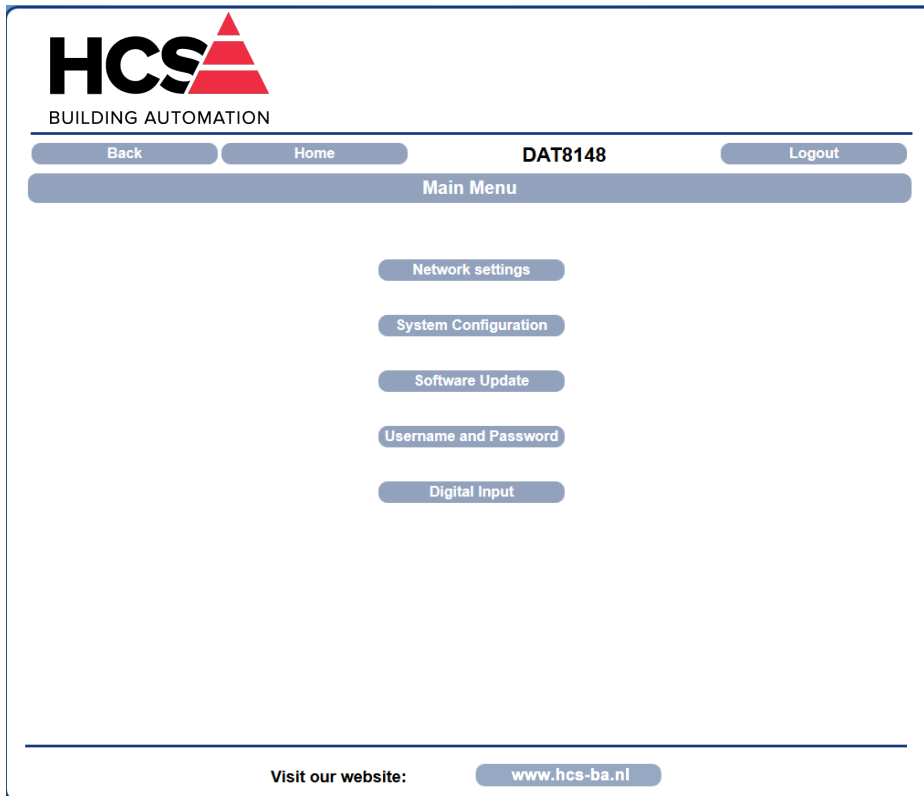
Write Username and Password. If the default settings are in use the parameters to access are:
Username: Fact_user; Password: Fact_pwd
Click on the button Login to access to the Home page of the device; it will appear as follows.

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.
User and Password: allows to set the access data used in the Login page.
Digital Input: allows to visualize the parameters related to the digital inputs.
In the next sections there is the description of the menus.

Network Settings
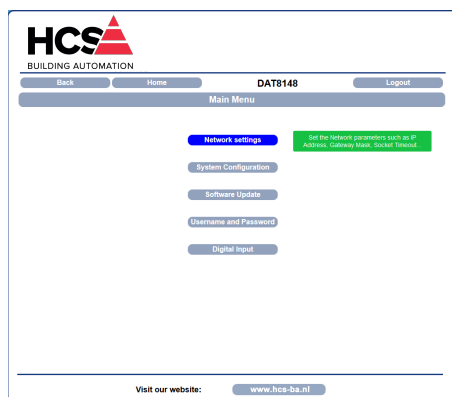
IP Address: allows to visualize and set the unique IP address of the device in the network in use.
Subnet Mask: allows to set the parameter of the Subnet Mask in order to determine the local network of the device.
Gateway Mask: allows to set the parameter of Gateway Mask for the correct addressing of 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 Configuration

Name: allows to visualize and set the parameter NetBios Name of the device; this parameter is a string and 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
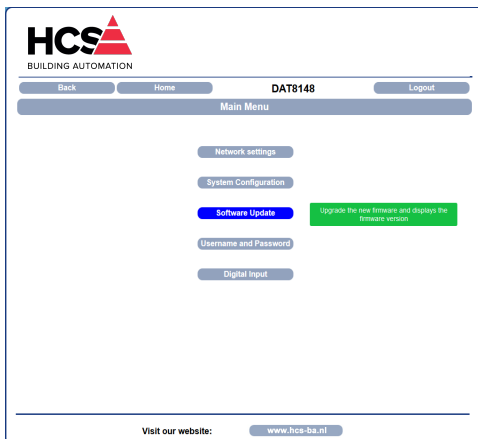
This section allows to update the versions of the firmware or web server and is used in case of necessity. To execute the update click on the button "Upgrade"; the system will open a pop-up window where to insert the credentials to proceed with the update. Contact the Technical Assistance service for information about the procedure to follow. The parameter "Actual Firmware" shows the firmware version loaded on the device.
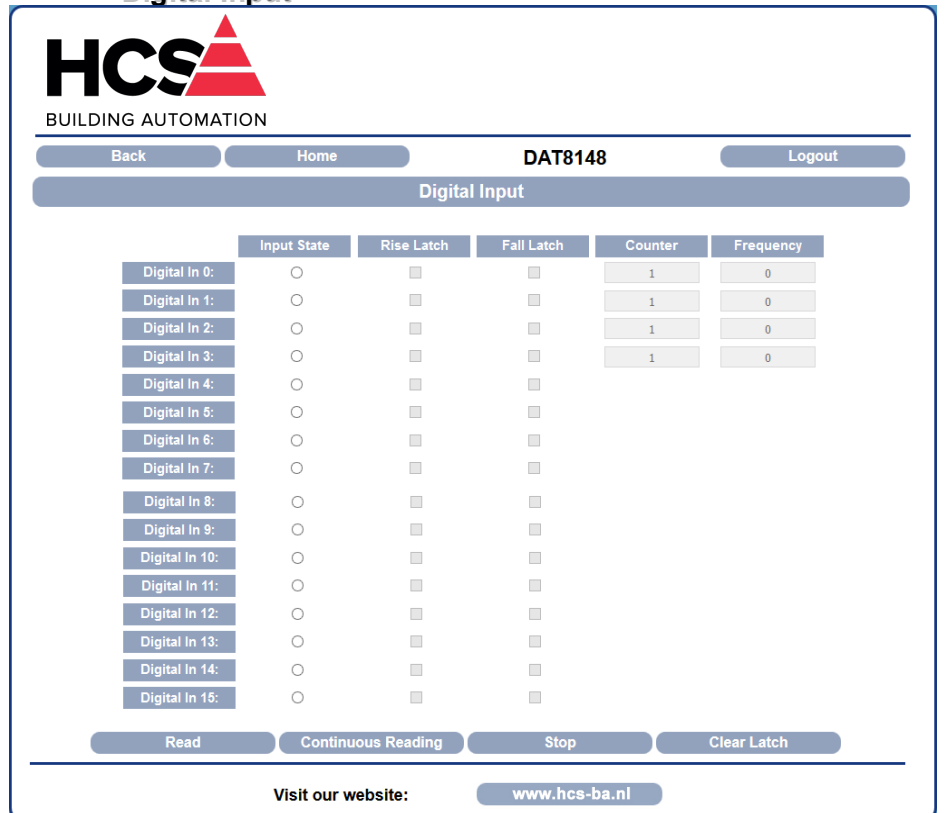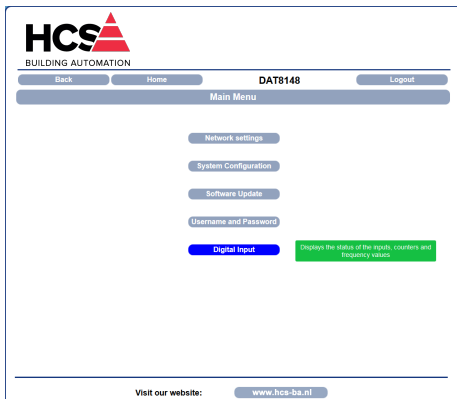
User and Password
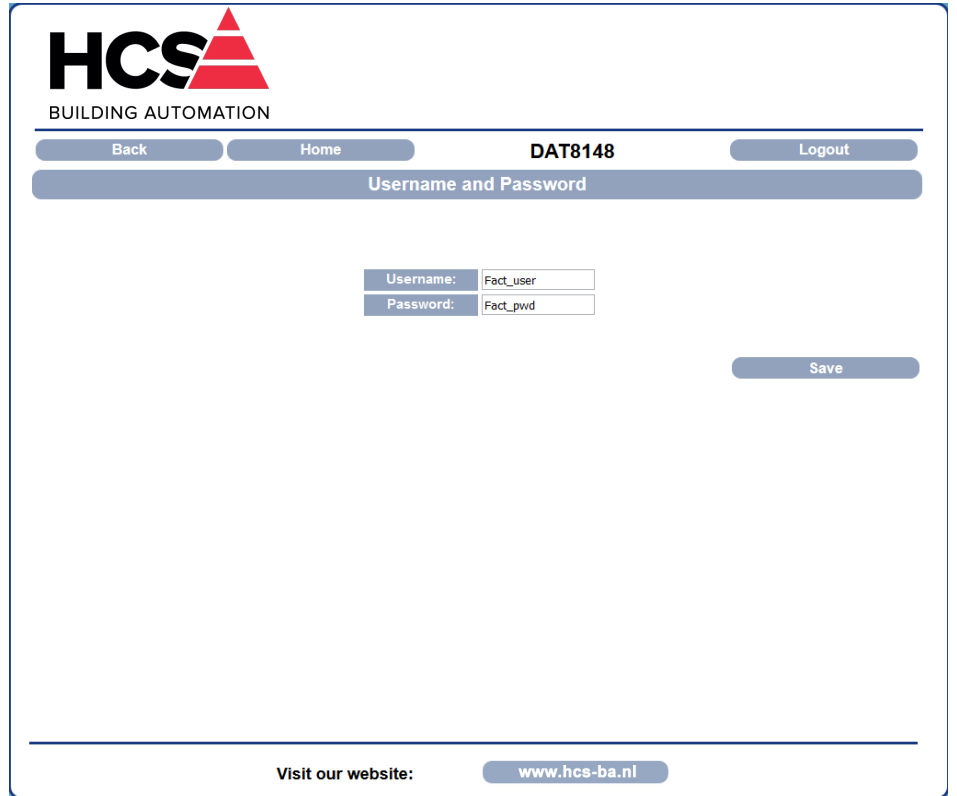
This section allows to set user name and password to access to the Webserver of the device.
Username: allows to set and visualize the user name of the device. Default "Fact_user".
Password: allows to set and visualize the password of the device. Default "Fact_pwd".
To save the modified parameters, click the button "Save".

Digital Input

This section allows to visualize the state of the digital inputs and the latchs. Each row is related to each input. To execute a single reading click the button "Read", To execute a continuous reading click the button "Continuos Reading". To stop the reading click the button "Stop". The columns are divided as follows.
Input State (ref. Reg "Digital Inputs") : allows to visualize the state of digital inputs. The indicator light become red when the digital input's state is 1.
Rise Latch (ref. Reg "Digital Inputs Rise Latch"): signals the passage of digital input from 0 to 1 (rising edge)
Fall Latch (ref. Reg "Digital Inputs Fall Latch"): signals the passage of digital input from 1 to 0 (falling edge).
The reporting is made for a single passage of state. To reset all latch press the button "Clear Latch".
Counter (ref. Registers "32 bit Counter Digital Input"): displays the value in the counter register associated to the digital input.
Frequency (ref. Registers "Frequency Digital Input"): displays the value in the counter register associated to the digital input.

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 "DAT8188". 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.
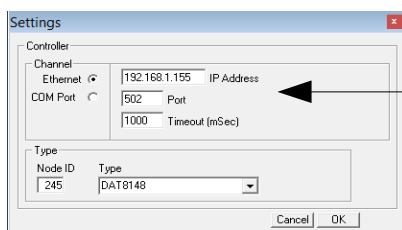
IP address assigned by DHCP visualised in the menu Search.

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. In alarm condition the values of the outputs are automatically set as defined in the register "PowerUp/Safe" that is the condition to which the outputs must be set to avoid damage to the system in case of danger. The value set could not be the same of the value of the outputs before the reset so the user, after the reset has to resend the command to set the output port.
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 reset the coil "Watchdog Event": the led stops to blink and will be possible to command the outputs.

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

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 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
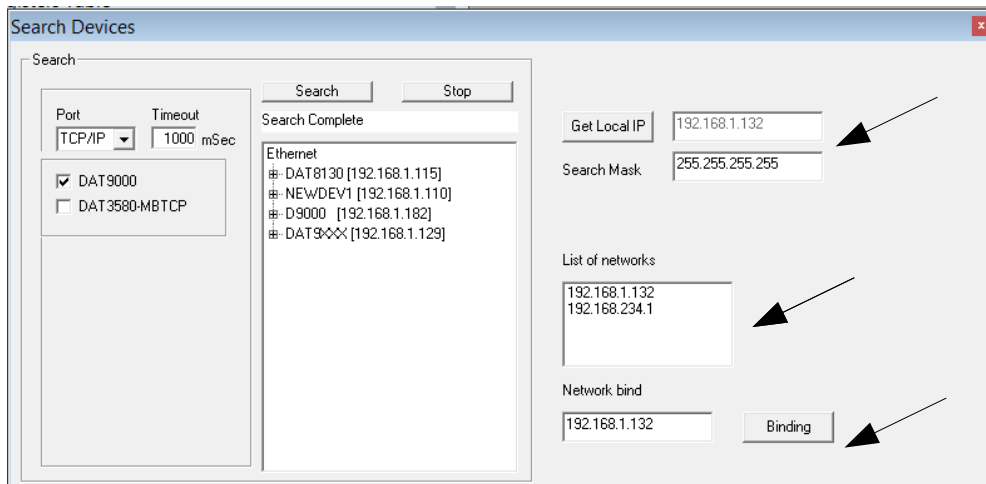
Make sure the IP identified is used in the Network which the device is connected to.
Click the button "Search"; in the field "List of networks" the available networks for the PC in use will be shown. The IP addresses visualized are those assigned to the PC from each network.
Click, if present, the interested 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
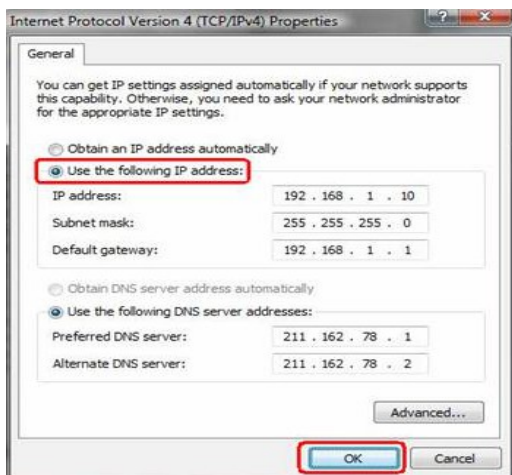
Now the device of DAT8000 series is searchable and the user can change its IP with the desired one. It must be different from the other ones in the network (right click → Set IP address).
Once the device's IP address has been modified, the device will not appear in the results of Dev9k. So the user has to modify the network parameters of PC again in order to display the device.
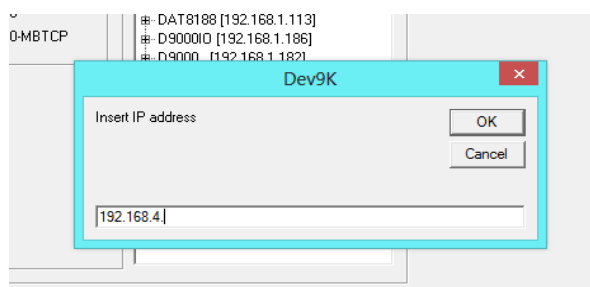
ADDITIONAL COMMANDS TO DETERMINE THE NETWORK IN USE
It is possible to use the following additional commands to determine to which network is connected the PC.
To use it run the command Prompt (cmd.exe) as Administrator in the Windows in use .
Command "Ipconfig"
It is possible to visualize the nets used 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.
Command "ping"
To determine if a device is connected on the net it is possible to write 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.
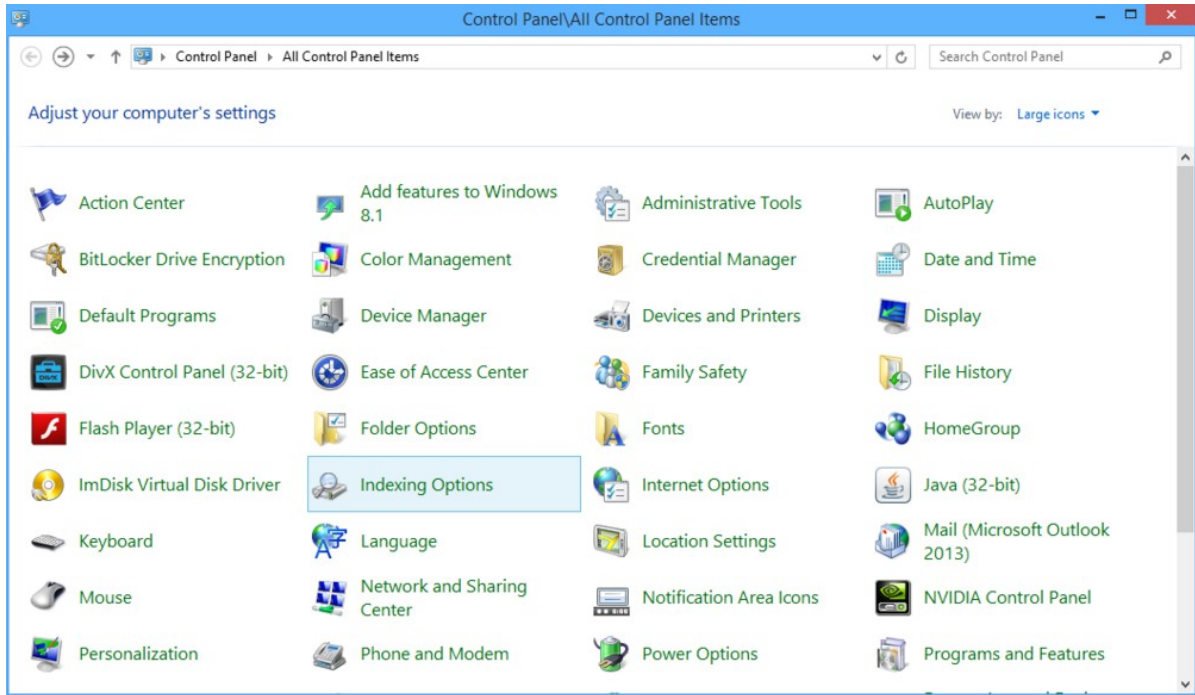If the systems returns the message Host Unreachable the device is not connected in the net in use.

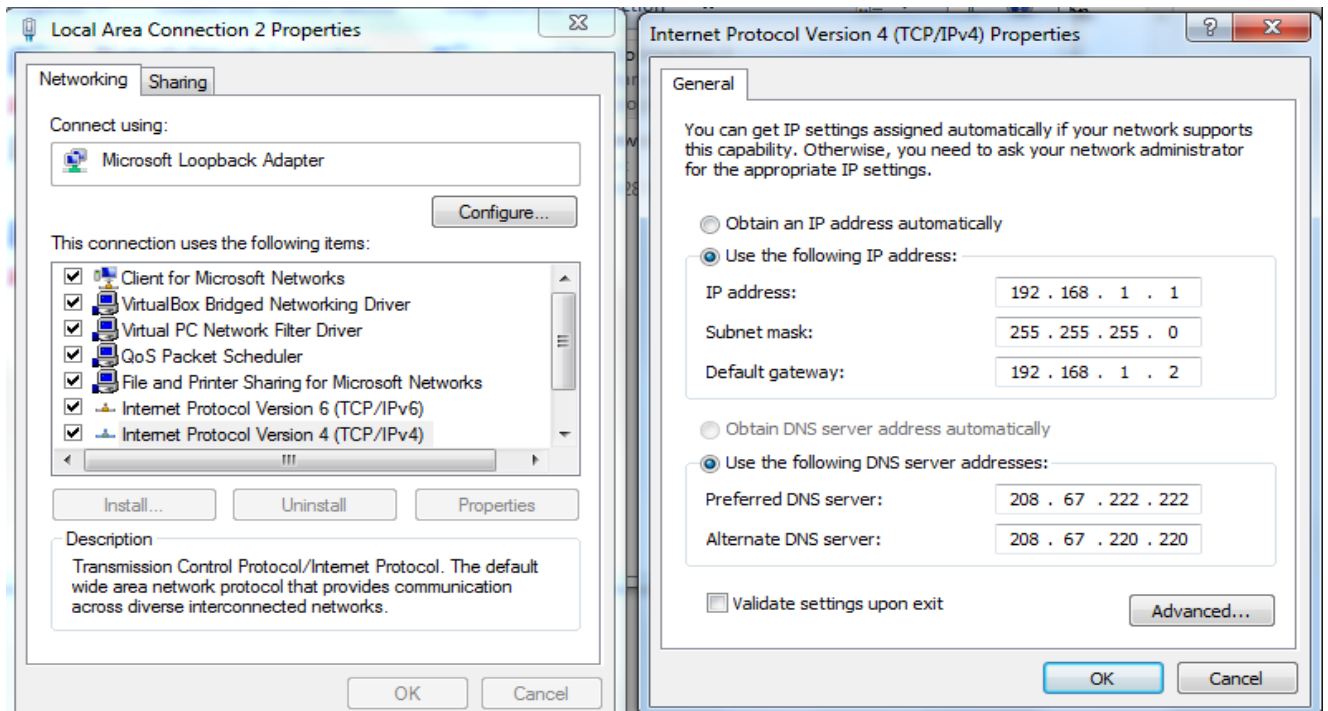In this case it is suggested to check the network assigment.

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.

RIF. FW : 8200
ED.12.15 REV.00