DATEXEL

Modbus TCP to Relay output and 8 Digital inputs.
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CSQ ISO 9001 Edition of : 2015 — IQNet

**Modbus TCP/IP server
8 Digital Inputs
4 Relay Outputs**

User Guide – MODBUS TCP/IP protocol
Firmware Version : 8020

DAT 8130

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	Description	Access
40002	Firmware [0]	RO
40003	Firmware [1]	RO
40004	-Reserved-	RO
40005	-Reserved-	RO
40007	Node ID	R/W
40011	System Flags	R/W
40012	Power Up / Safe	R/W
40013	Watchdog timer	R/W
40031	Digital Outputs	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

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
0x01E9	00489	Output #0	R/W
0x01EA	00490	Output #1	R/W
0x01EB	00491	Output #2	R/W
0x01EC	00492	Output #3	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
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
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

NOTES:

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
Two read-only registers, containing the firmware version.

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: 1 Decimal (01 Hex). INIT value: 245 Decimal (F5 Hex).

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

Watchdog Event Enable: this bit enables 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. This bit must be set in logic on power up.

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							

40012 : POWERUP/SAFE
At the power-on (PowerUp) and in case of watchdog alarm (Safe), the output are automatically forced to the value set in this register. Each bit of the register corresponds to a digital output, in function of the following table:
- Default value: 0

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Output	-	-	-	-	#3	#2	#1	#0	-	-	-	-	#3	#2	#1	#0
Descr.	Power Up								Safe							

40013 : WATCHDOG TIMER
Contains the value of the Watchdog timer, in seconds. If the Watchdog is enabled and the device doesn't receive a command before this timer expires, the Watchdog bit will be set to 1 (see the description of "System Flags").
- Default value: 10 (10 sec.)

40031 : DIGITAL OUTPUTS
This register allows to command directly the state of the output relays (0 = OFF ; 1 = ON).
It is also possible to read and drive the outputs 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
Output	-	-	-	-	-	-	-	-	-	-	-	-	#3	#2	#1	#0

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	-	-	-	-	-	-	-	-	#7	#6	#5	#4	#3	#2	#1	#0

40033 : DIGITAL INPUTS RISE LATCH
The bits of this register are used to indicate than an event of change of logic state from 0 to 1 (rise latch) has occured of digital input. The latch event shows for each digital input the single change of state and is not updated by the system. In case it is necessary monitoring this parameter continuously, the single bit or the group of bits must be reset to 0 after the rising edge has occured.
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 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
Input Latch	-	-	-	-	-	-	-	-	#7	#6	#5	#4	#3	#2	#1	#0

40034 : DIGITAL INPUTS FALL LATCH

The bits of this register are used to indicate than an event of change of logic state from 1 to 0 (fall latch) has occurred of digital input. The latch event shows for each digital input the single change of state and is not updated by the system. In case it is necessary monitoring this parameter continuously, the single bit or the group of bits must be reset to 0 after the falling edge has occured.

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 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
Input Latch	-	-	-	-	-	-	-	-	#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 *Unsigned 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 *Unsigned 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 *Unsigned 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 *Unsigned Integer 16 bit* format. The maximum value of frequency measurable is 300.00 Hz.

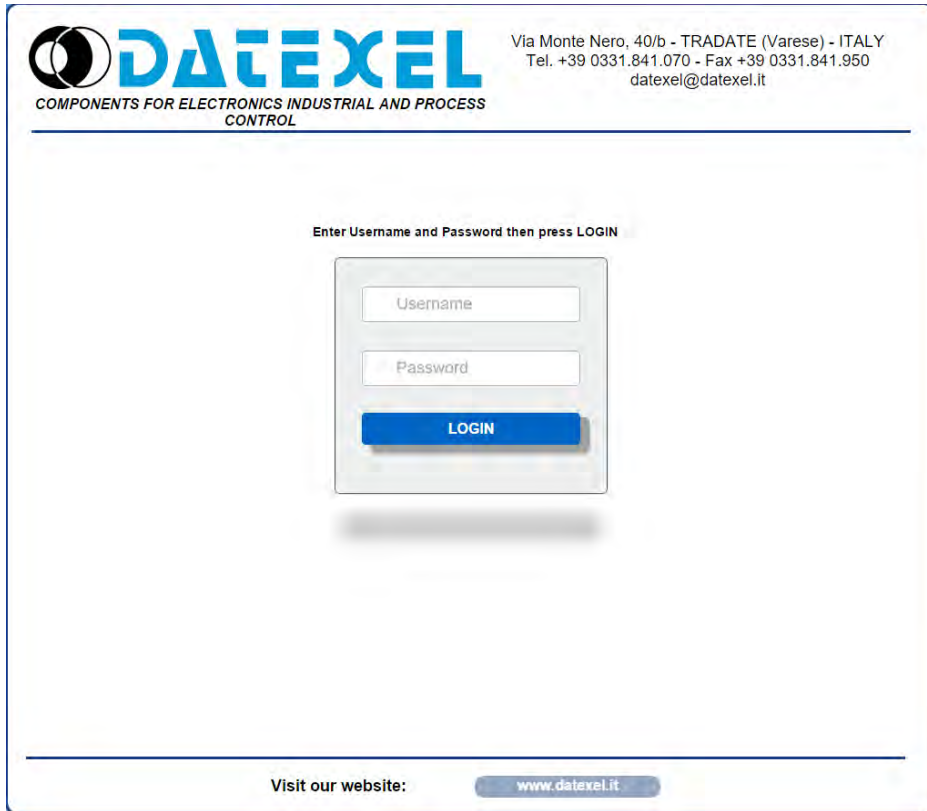## 40039-40 (LO-HI) : 32 BIT COUNTER DIGITAL INPUT 0

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 an *Unsigned Long 32 bit*.

It is possible to reset the value by direct writing. At each power-on of the device the value is set to 0.

Note: This register is **not** retentive. When the device is turned off, the value contained in this register is lost.

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 an *Unsigned Long 32 bit*.

It is possible to reset the value by direct writing. At each power-on of the device the value is set to 0.

Note: This register is **not** retentive. When the device is turned off, the value contained in this register is lost.

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 an *Unsigned Long 32 bit*.

It is possible to reset the value by direct writing. At each power-on of the device the value is set to 0.

Note: This register is **not** retentive. When the device is turned off, the value contained in this register is lost.

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 an *Unsigned Long 32 bit*.

It is possible to reset the value by direct writing. At each power-on of the device the value is set to 0.

Note: This register is **not** retentive. When the device is turned off, the value contained in this register is lost.

WEB SERVER STRUCTURE

To access the server, run the web browser and edit in the *address bar* the device IP address (default IP address: 192.168.1.100).
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.
The web browser supported are: *Chrome, Firefox, Opera, Internet Explorer, Edge* and *Safari*.
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.
In all the web pages, on the top part of the window there are the buttons:
"*Page Back*" to go back to the page previously visualized; "*Home*" to return to the main page; "*Logout*" to quit and get back to the Login page.

To access the page with the menus of configuration of the device select the language and click the button "OK".
The following window will appear.

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.
Digital Input: allows to visualize the parameters related to the digital inputs.
Digital Output: allows to visualize the parameters related to the digital outputs and if necessary to modify them.
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: allows to set the parameter of Gateway Mask for the correct addressing of the device.
Socket Timeout: when there is no data transmission, this parameter indicates the time that must elapse before Modbus TCP sockets (port 502) are closed.
Click "*Save*" to apply and store the modified parameters. 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, composed by <u>max 15 alphanumeric characters</u>, is visualized beside the IP address in the software *"Search Device"*; 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).

Click "*Save*" to apply and store the modified parameters.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.

The parameter "*WebPage Version*" shows the version of the web-based user interface loaded on the device.
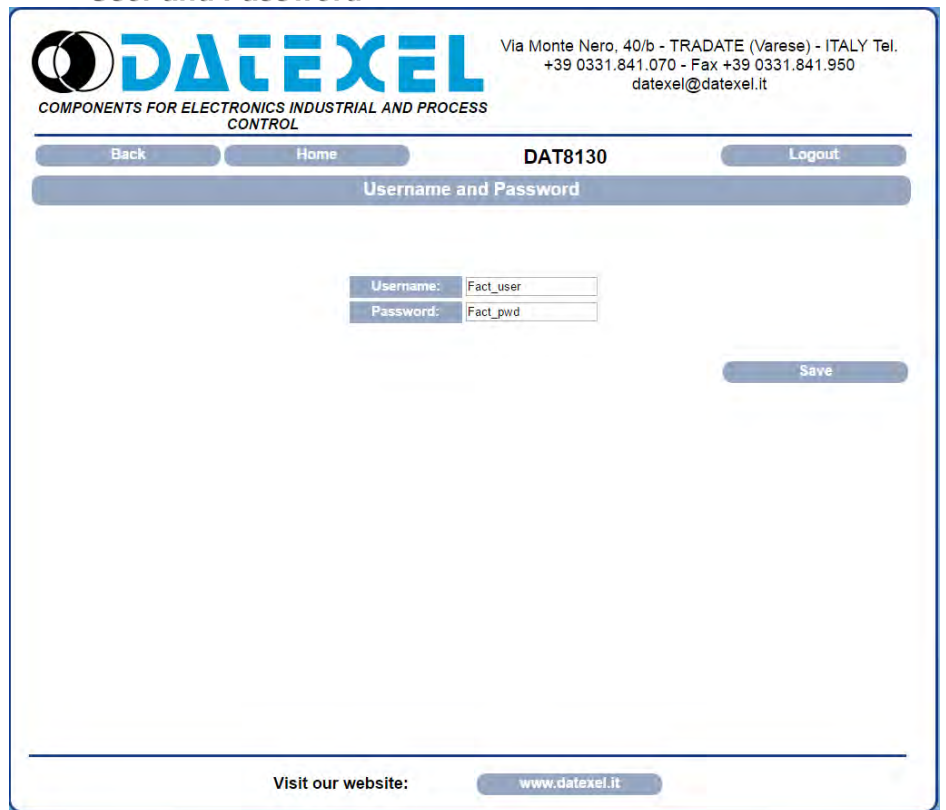
This section allows to set user name and password to access to the Webserver of the device.

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"*.

Click *"Save"* to apply and store the modified parameters.

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"): indicates the state of each digital input. The indicator will be filled (red) when the digital input's state is 1 (ON).

Rise Latch (ref. Reg "Digital Inputs Rise Latch"): signals the change of digital input from 0 to 1 (rising edge).

Fall Latch (ref. Reg "Digital Inputs Fall Latch"): signals the change of digital input from 1 to 0 (falling edge).

The reporting is made for a single change of state. To reset all latch press the button *"Clear Latch"*.

Counter (ref. Registers "32 bit Counter Digital Input"): indicates the current value of the counter register associated with each input.

Frequency (ref. Registers "Frequency Digital Input"): indicates the current value of the frequency register associated with each input.

The "*Reset Counter*" button allows you to reset the counter register associated to the digital input.

Digital Output
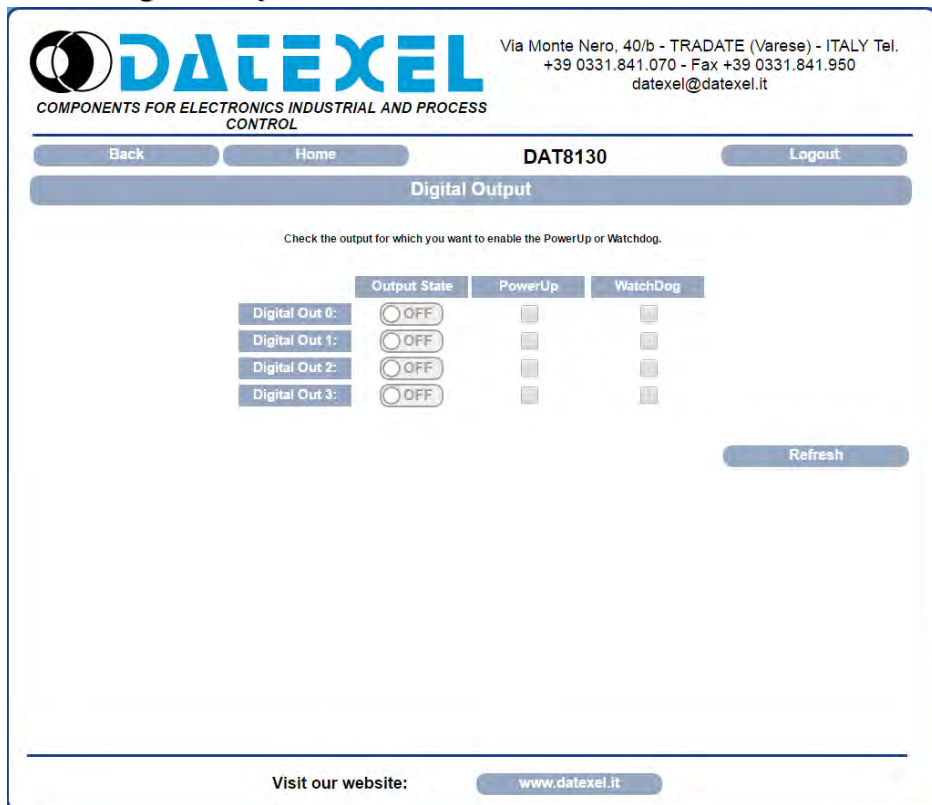
This section allows to visualize and drive the digital outputs. Each row is referred to one output. To execute the update of the page click "Refresh". The columns are divided as follow.

Output State (ref. Reg "Digital outputs"): indicates the state of each digital output. The indicator will be green when the digital output's state is ON (logic state 1), and gray with the digital output's state is OFF (logic state 0).

PowerUp (ref. Reg "PowerUp/Safe high part"): indicates and sets the output logic state for the Power Up event (ref. "System Flags" register).

WatchDog (ref. Reg "PowerUp/Safe low part"): indicates and sets the output logic state for the Watchdog event (ref. "System Flags" register).

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 to the device if the network parameters are unknown. In this case it is possible to set the new network parameters in order to access the device using a browser and to proceed with its configuration.

IP Address: XXX.XXX.XXX.XXX (assigned by DHCP if enabled)
            192.168.1.174 (if DHCP disabled, verify that the IP is not in use)
Modbus address: 245

By these information it is possible to access the device in INIT modality to set and check its configuration.
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;
- Install and run the software *"Search Device";*
- By the software, search the device on the network and connect to it (refer to the software User Guide);
- Set the new network parameters;
When the user finishes to work in INIT:
- Switch-off the device;
- Disconnect INIT connection;
- Power-on the device and connect to it by the new parameters configured using a browser;

Note: if the DHCP is disabled and the device is in INIT mode, the IP address is 192.168.1.174. In order to connect to the device, the PC and the device must be in the same network.

WATCHDOG

The devices of the DAT8000 series are equipped with the Watchdog timer. When enabled, if there is not communication between the device and the master for such time, in alarm condition the values of the outputs are automatically set as defined on the lower 8 bits in the register "PowerUp/Safe". This is the condition to which the outputs must be set when the system actives an alarm condition in order to guarantee the safety condition. The safe value could be different from the value of the outputs in working condition so the user, after the reset, has to resend the command to set the output ports. 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*".
Note: when the device is switched off, the bit "*Watchdog Enable*" is forced to 0. In order to have the "*Watchdog*" enabled, it is recommend to set the bit "*Watchdog Enable*" by the master unit at every power on.

FUNCTION BUTTON "P"

In case it is necessary to set 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 finished, both the leds will be set back to the default condition and the following parameters will be loaded:

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

Login:
- **Username:** Fact_user
- **Password:** Fact_pwd

Modbus:
Address: 1

SEARCH A DEVICE AND EDIT NETWORK PARAMETERS
USING "SEARCH DEVICE" SOFTWARE

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 "*Search Device*" clicking the button "Get Local IP" (Pict. 1)

Pict. 1
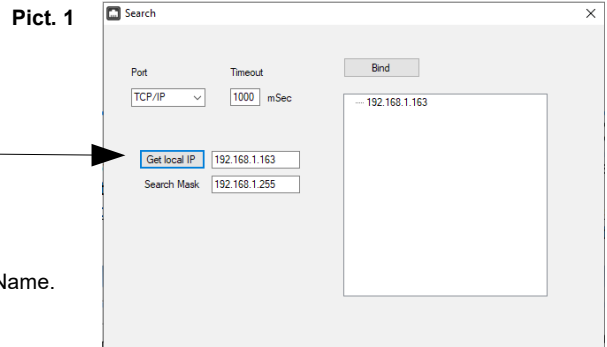
1) Select the correct network (if present in the list) and click on *"Bind"*.
2) Click on "Search" button to search device in the selected network.
3) After searching, the IP address of the device will appear followed by the NetBios Name.
   Make sure that the IP identified is used in the network which the device is connected to.
4) Select the IP, click the right mouse button and choose *"Connect / Set Device"*.
5) After connecting to the device, all the network parameters can be set through the configuration window.

Note: after changing the IP address of the Datexel device, it will not appear in the search results in the "Search Device". It will be necessary to change the PC network parameters again to display the device again in the search results.

(*) If the PC belongs to a different subnet from the default one expected for the device, it is necessary to change the IP of the Personal Computer.
To do this, open the *"Network and Sharing Center"* section of the operating system in use, go to the IPV4 network properties window of the PC (Pict. 2) and configure the network parameters compatible with the default IP of the device (see section *"Examples for Windows configurations"*).
After having appropriately changed the IP of the PC, perform steps 1) to 5) to change the IP of the device.
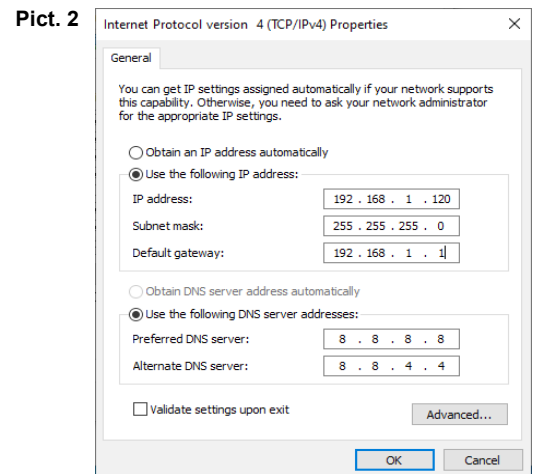
Factory/Default parameters:
IP Address: 192.168.1.100
Modbus address: 1
Subnet Mask: 255.255.255.0
Gateway Mask: 192.168.1.1

Pict. 2

It is possible to set only the IP address (but not the other network parameters) from the *"Search Device"* software by following the procedure:

1) Select the correct network (if present in the list) and click on *"Bind"*.
2) Click on the *"Search"* button to search for the device in the selected network.
3) After searching, the IP address of the device will appear followed by the NetBios Name.
   Make sure that the IP identified is used in the network which the device is connected to.
4) Select the IP, click the right mouse button and select *"Set IP address"* (Pict. 3a).
5) Set the new IP address and press OK (Pict. 3b)

Pict. 3a

Pict. 3b
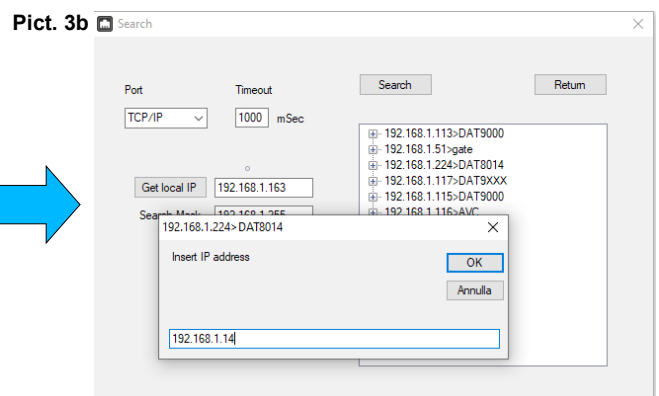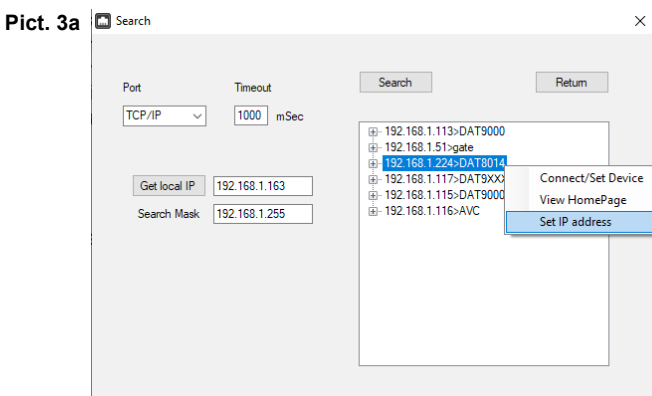
ADDITIONAL COMMANDS TO IDENTIFY THE NETWORK IN USE

The following additional commands can be used to identify which network the PC is connected to.
To use the following commands, run the Command Prompt (cmd.exe) as Administrator (Pict.1).

"Ipconfig" command
It is possible to display the networks available on the PC by typing this command and pressing Enter.
The system will return a list of all the PC networks (Pict.2). Before trying to establish communication with the device, the user must be sure that he is in the correct subnet.

"Ping" command
To verify if a device is connected to the network, you can use the *"ping"* command which is an administration utility for computer networks used to measure the time expressed in milliseconds, used by one or more packets to reach a network device and return 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 response from the device with the IP address used (Pict.3).
If the system returns the *"Destination host unreacheble"* message, the device is not connected to the network in use.
In this case, it is suggested to check the assignment of the network parameters.

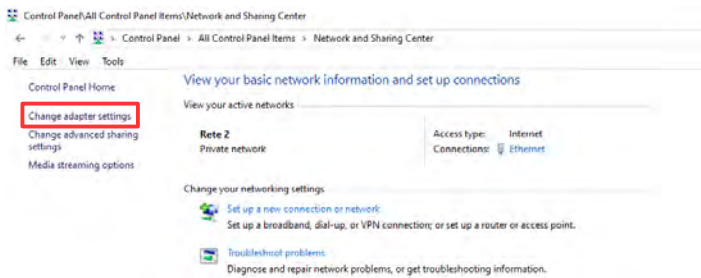**Pict. 1**

Pict. 2

Pict. 3

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)
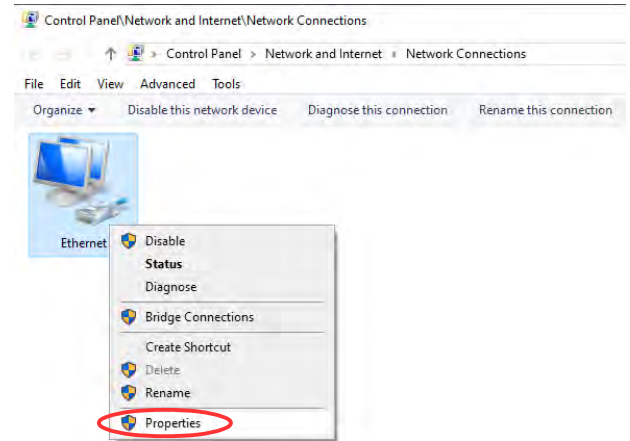
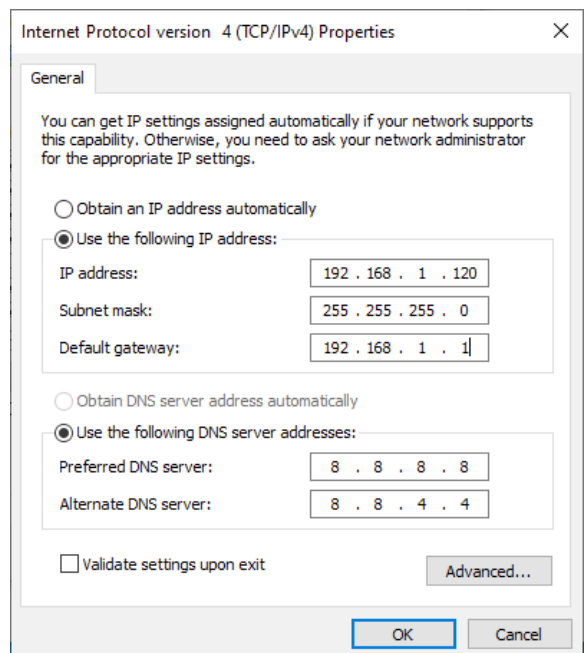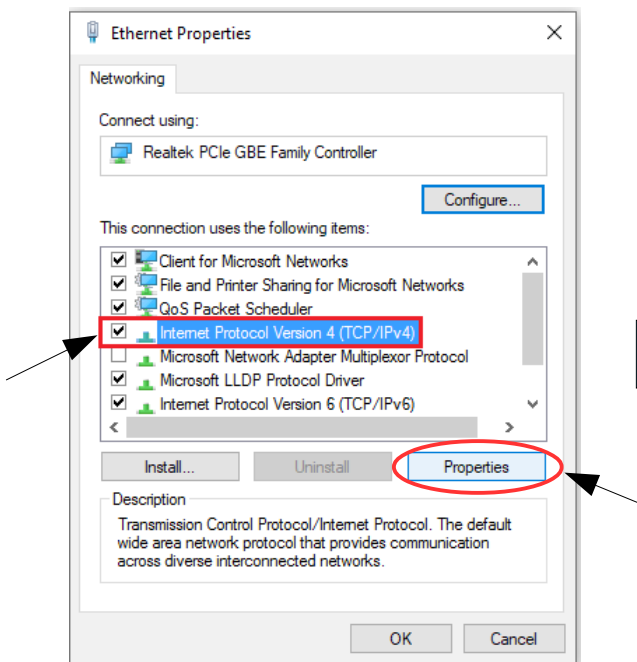1) Access to Control Panel → *Network and Sharing Center*
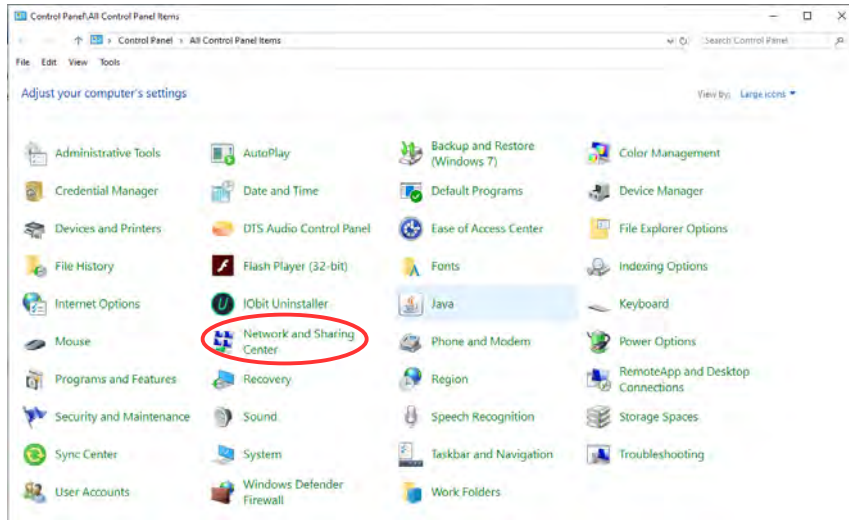
2) Network and Sharing Center → *Change Adapter Settings*

3) Change Adapter Settings → *select the interested network → right click → Properties*

4) Properties → *Internet Protocol version 4 → Properties*

5) Change parameters and click OK.

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