ECONET EC+ / EC++
Industrial Communications

Application Note 021

Release 1.3 2021

APNt021 EPCUMR
En Rev.1.3

TURBO s.r.l. Dust Filter Components
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Introduction

In today's industrial automation market, new Turbo technologies bring many opportunities for industrial system developers to successfully address evolving challenges.

Automation systems require cutting-edge technologies to meet customer requirements for application ranging from programmable logic controllers (PLC's) and industrial computers to human machine interface (HMI), industrial peripherals and factory communication.

Turbo has developed a series of solutions for the industrial automation industry with a platform specifically focused on the industrial communication capabilities of the "Econet" family, that has been designed to implement the real-time communications technologies used in a broad band of industrial automation equipment.
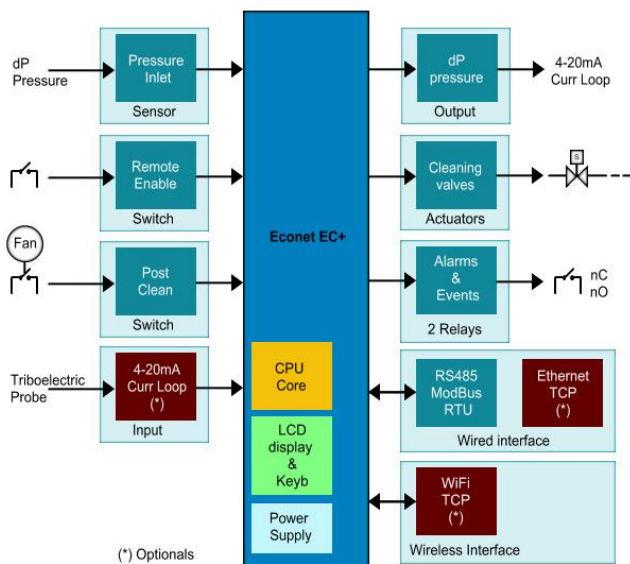
ECONET family

The "Econet family" is made up of a series of Economizer models built for controlling pneumatic cleaning functions of industrial dust collection systems.

Brief, the differential pressure on the cleaning system is digitally controller by "Econet" on-board pressure transducer, allowing to determine filter obstruction with accuracy. Thanks to a smart technology, the Econet are able to handle the activation of the cleaning valves autonomously, only when it is needed, in order to save (economize) the entire system functioning.
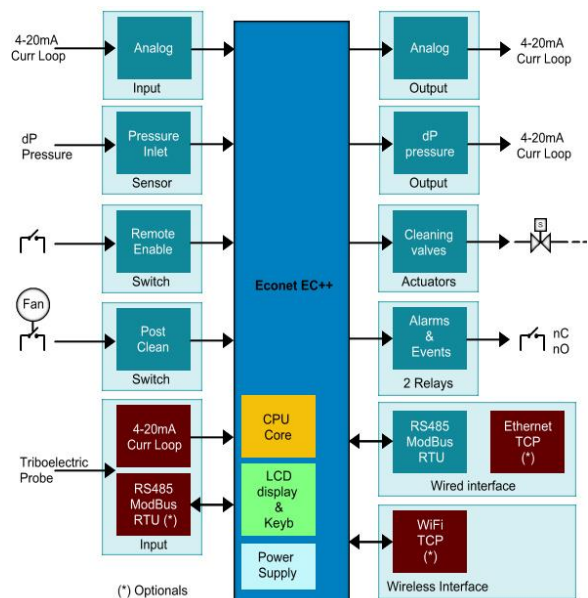
The Econet devices are provided of LCD graphical display for local programming and a lot of interfaces for system interfacing.

The Econet EC+ and EC++ schematic resources diagrams are shown below:

Econet EC+ version   Econet EC++ version

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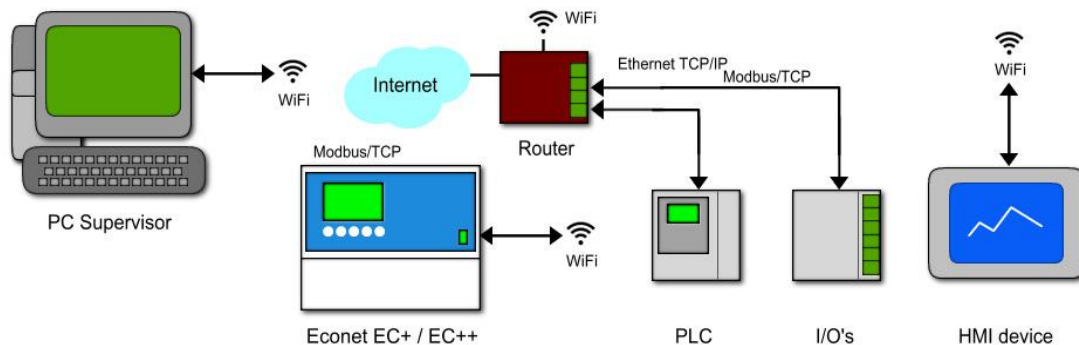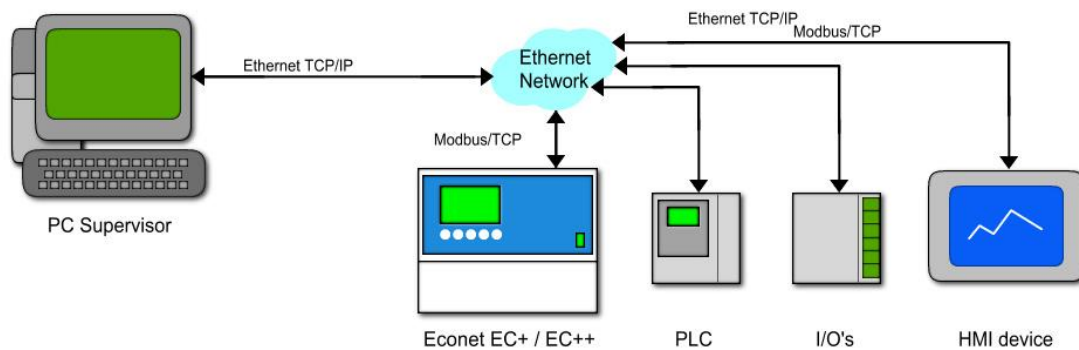
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ModBus communication

ModBus is an application layer messaging protocol (OSI level 7) which provide client/server communications between devices connected on different types of buses or networks.

Modbus is supported by the Econet EC+ and EC++ devices over serial RS485 RTU, Ethernet TCP/IP and WiFi TCP/IP networks. It allows the transfer of data from the Econet slave devices to a master remote supervisor, PLC, Personal Computer or HMI.

This is a typical RS485 serial network:
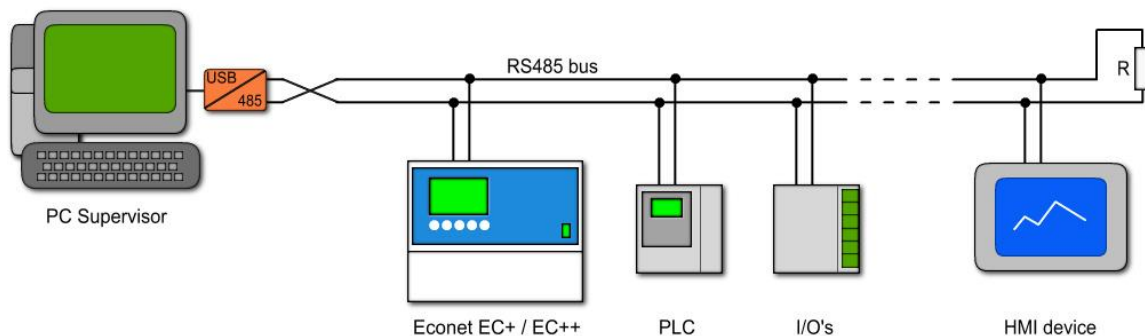
Thanks to a plug-in expansion board, the Econet devices can also support TCP/IP communication over Ethernet or Wi-Fi networks:

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Econet Wirings

The Econet EC+ and EC++ devices have a RS485 serial port placed on the terminal blocks and accessible from the end-user in order to connect they at the ModBus network.
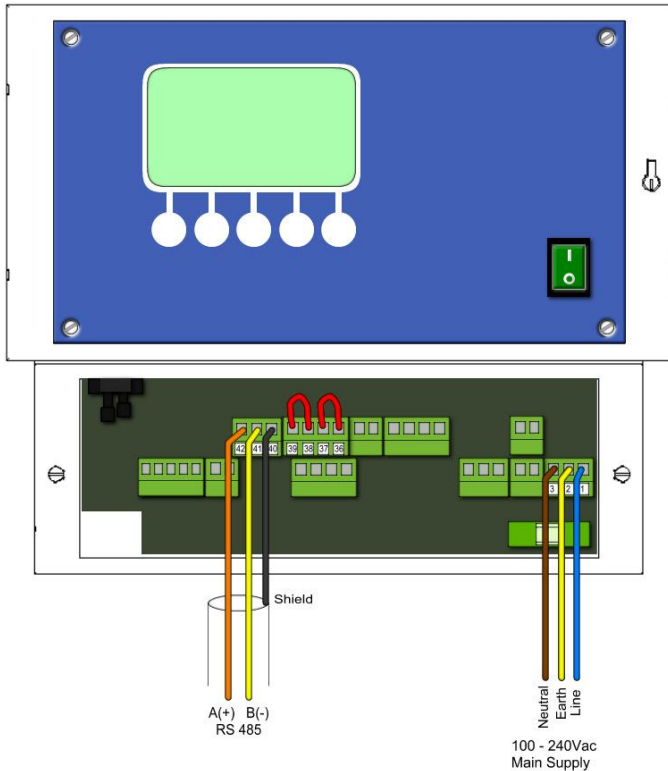
EC+ version

The ModBus RS485 serial port A is available at P9 upper header and the wirings are named:

42 = RS485 A (+) terminal
41 = RS485 B (-) terminal
40 = Shield terminal (optional)
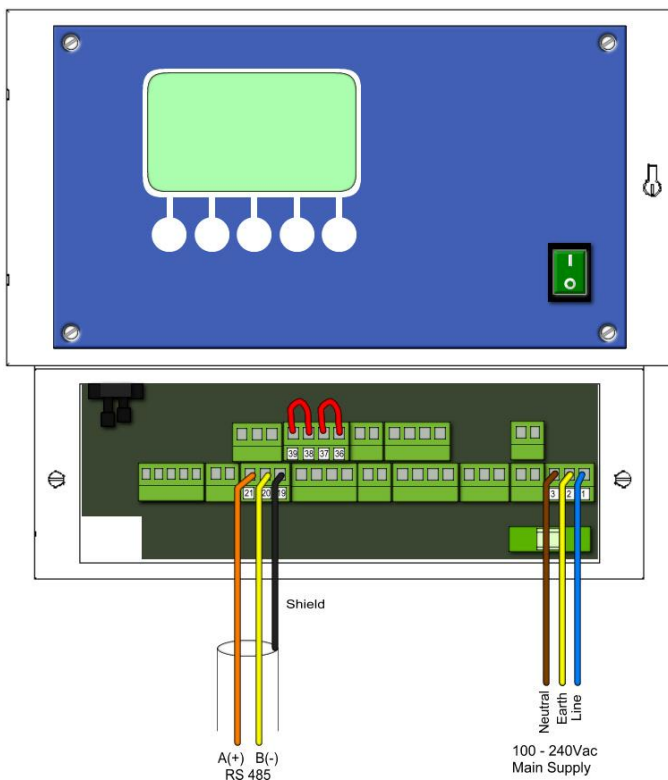
EC++ version

The RS485 serial port B is available at P9 lower header and the wirings are named:

21 = RS485 A (+) terminal
20 = RS485 B (-) terminal
19 = Shield terminal (optional)

Note: *in EC++ version the P9 upper header is reserved to Triboelectric probe interfacing.*

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If the Econet EC++ device version is provided of the optional "Ethernet plug-in board", the related header is accessible from the end-user on the lower left side in order to connect Econet at the TCP/IP network.

Ethernet
Network

Neutral
Earth
Line

100 - 240Vac
Main Supply
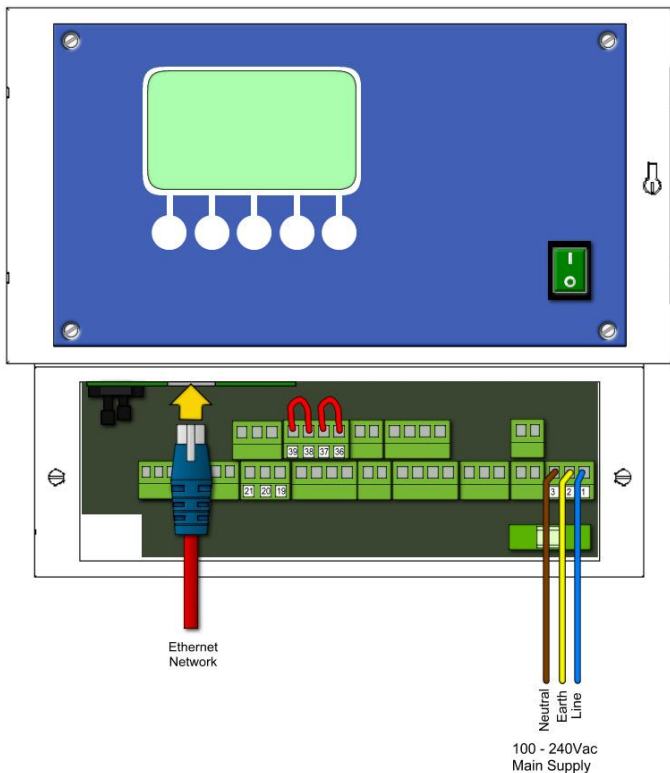
EC++ ETHERNET version

The Ethernet header is a standard plug placed on the lower left side of the device, near the on-board pressure sensor.
Following the yellow arrow in the figure, the user can plug the Ethernet cable.

If the Econet EC++ device version is provided of the optional "Wi-Fi plug-in board", the end-user don't need any cable but it shall have a standard Wi-Fi router in order to connect the device at the TCP/IP network.
The device will be supplied complete with an antenna already mounted on the box.

The RS485 communication cable

The length and quality of the RS485 line affect the quality of the signal. Though the theoretical maximum length of a RS485 Bus is 1200mt.

Requirements

Requirements for wiring in order to obtain good signal quality:

1) Section: min 2 +1 x0,32mm^2 (a twisted pair and a single pole)
2) Shielded
3) Twister pair cables
4) Resistant to UV rays (for outdoor installation only)
5) CAT.5 cable

Suggested RS485 cable :
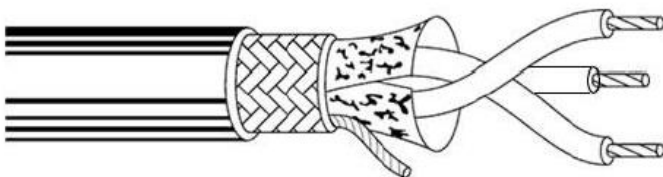
Manufacturer	:	Belden
Application	:	Industrial Automation
Product code	:	3106A
Poles	:	Twisted pair + single pole
Shielded	:	Yes
Type	:	UV resistant

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The Ground Terminal

Econet devices have the GND (ground) terminal in order to provide a voltage reference common to all RS485 bus transceivers.

In this case, all the GND pins of the devices must be connected to each other, using another wire of the RS-485 cable (not the cable used for shielding).

Do not connect the GND pin to ground!

Basic Communication Settings

After cabling, the Econet EC+ / EC++ versions shall be configured around the typical ModBus RTU addressing.
A dedicated menu on the local user interface was placed at this scope and the user shall navigate inside menu list to select Modbus menu:
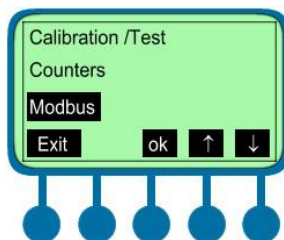
Press the "menu" button in the main window and navigate with "↓" and "↑" to reach Modbus menu.
Press "OK" button to enter in the communication settings parameters.
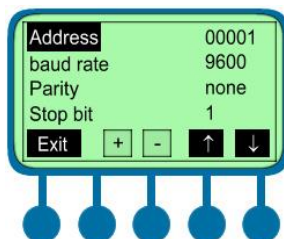
Press "+" and "-" buttons to configure the device address in the network, then move at the other parameters to configure speed, parity and stop bit following the network requirements.
Usually the ModBus devices use 8,N,1 communication format.

The right communication Speed

The parasitic capacity of the transmission line increases as the line length increases, thereby limiting the maximum bus speed. An empirical law provides the following values:

Speed (bps)	Max Length (mt)
115200	85
57600	170
38400	250
19200	500
9600	1000

A good rule is to respect a minimum distance of 1mt between multiple devices in the RS485 Bus.

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Communicate with the Network

With The Econet EC+ /EC++ placed on the RS485 ModBus network, the end-user can choice to work with Turbo PC-Panel dedicated software or develop its own application using ModBus device registers. In the Network, the Econet are to be considered as slave devices. However, it is not permitted to directly control the main functions of the Econet, but to program the execution modes and their activations.

Econet PC-Panel Software

Turbo has designed a PC software, named "PC-Panel" for remote management of the Econet devices functionalities.
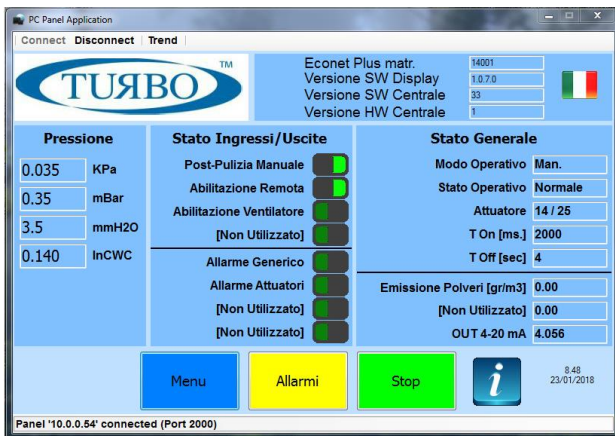
Developed on the Windows platform (WinXP, Win7/8, Win10), the "PC-Panel" software provide the user can interact with the device in order to configure parameters, read device status, start/stop cleaning cycles and monitor the entire system.

Thanks to a well-defined interface, the user can navigate through the tabs to monitor all the parameters and also the real-time values. The user interface is customizable with logo, languages and displayed information in order to meet all the user requirements.

An USB to RS485 Serial converter cable is sold with "PC-Panel software package". The cable provides a fast, simple way to connect devices with a RS485 interface to USB 2.0, supporting data transfer rate up to 3Mbaud.

The USB-RS485 drivers, available free from http://www.ftdichip.com, which are used to make the FT232R in the cable appear as a virtual COM port (VCP). This then allows the user to communicate with the USB interface via a standard PC serial emulation port. Another FTDI USB driver, the D2XX driver, can also be used with application software to directly access the FT232R on the cable though a DLL.

The RS485 serial converter is made of some colored cables where:

Orange = RS485 A (+) terminal
Yellow = RS485 B (-) terminal
Black = Shield terminal

The other terminals must be cut or placed in a separate position on a terminal block.

The figure shows RS485 cabling for an EC+ model where the serial port is placed as previously explained.
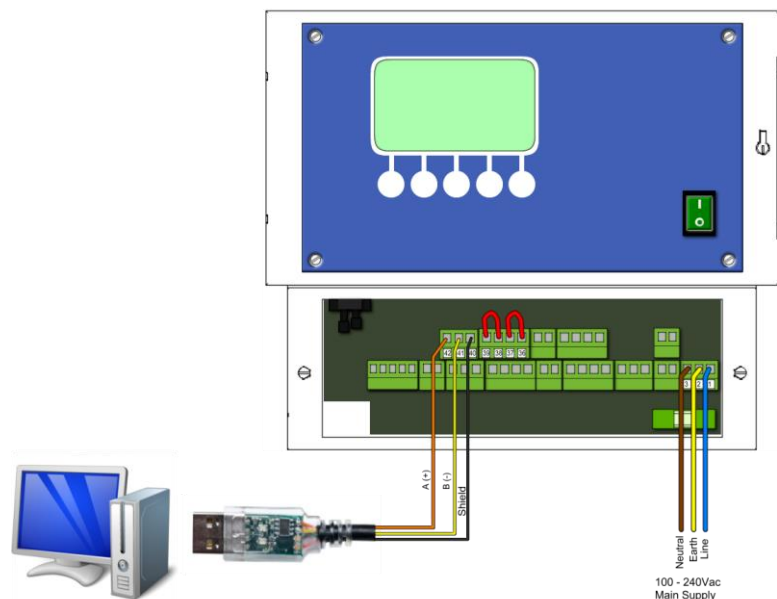
Note: *Please refers to Turbo Sales dept. to purchase and obtain the PC-Panel software package and license.*

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Econet Modbus message

Following the ModBus protocol standard requirements, it is possible to write and read the Econet registers in order to configure parameters, perform functions and check the device status in real-time operations.

Standard Modbus message for the Econet devices

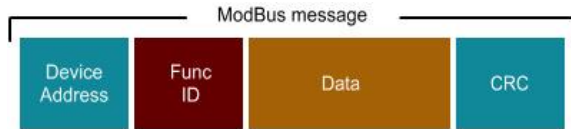|	
Device Address	Comprises between 1 and 247. The "0" value is not permitted.
Func ID	Func 03(Read Holding registers) and Func 06(Write Single register) are available in Econet devices.
Data	The Econet register (AND value if writing a register) ;
CRC	The cyclic redundancy check is calculated following CRC16 algorithm criteria.

Econet Modbus registers

The complete list of Econet EC+ / EC++ Modbus registers is listed below:

DEVICE Settings

Item	Register	Access	Default	Note
Device software version	0x0000	R	xx	Where xx = SW version
Device hardware version	0x0001	R	yy	Where yy = HW version
Device serial No.	0x000C	R/W	zz	Where zz = s/n set during factory test
Device menu language	0x000E	R/W	0	0=ITA, 1=ENG, 2=FR, 3=DE, 4=ESP
Device ModBus address	0x006A	R/W	1	1÷247
Device Communication speed	0x006B	R/W	2	0=38400 Baud 1=19200 Baud 2= 9600 Baud
Device Communication Parity bit	0x006C		0	0=No Parity 1=Odd Parity 2=Even Parity
Device Communication Stop bit	0x006D		1	0=2 Stop bit 1=1 Stop bit
Device LCD language	0x000E	R/W	0	0=ITA, 1=ENG, 2=FR, 3=DE, 4=ESP
Enable Multiple actuation	0x000D	R/W	0	0=Disable Multi-actuation function 1=Enable Multi-actuation function

BASIC settings

Item	Register	Access	Default	Note
Operating mode	0x0010	R/W	0	0=Manual 1=Automatic 2=Special 3=Proportional
Number of valves placed in the system	0x0013	R/W	3	Actuator mounted in the system
Valve activation time	0x0012	R/W	200	msec (firing time)
Valve pause time	0x0011	R/W	20	Sec (time between two valve activations)
Pressure measure unity	0x0014	R/W	2	0=H2O, 1=Bar, 2=Pa, 3=Psi
Pressure threshold for START Autom. cycle	0x0015	R/W	800	microH2O, microBar, mPascal, microPsi
Pressure threshold for STOP Autom. cycle	0x0016	R/W	400	microH2O, microBar, mPascal, microPsi

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Operating state parameters

Item	Register	Access	Default	Note
Pressure value	0x0002	R	0	Expressed in Pa
Pressure value	0x0003	R	0	Expressed in mBar/100
Pressure value	0x0004	R	0	Expressed in mmH20/10
Pressure value	0x0005	R	0	Expressed in inchWC/1000
Cycle operating state	0x0008	R/W	2	1=START 2=STOP
Post cleaning state	0x000A	R	0	0=No Post cleaning 1=Post cleaning is running
Valve in firing	0x000B	R		The valve in firing
Enable writing parameters with Local UI	0x000F	R/W	1	0=Disabled 1=Enabled

Advanced functions settings

Item	Register	Access	Default	Note
Post cleaning pressure START threshold	0x0020	R/W	100	microH2O, microBar, mPascal, microPsi
Post cleaning cycles (PCC)	0x0021	R/W	2	Number of PCC's to perform
Post cleaning Pause Time for valve	0x0022	R/W	10	sec
Post cleaning Firing Time for valve	0x0023	R/W	200	msec
Pre-coating function Enable	0x0024	R/W	0	0=Disabled 1=Enabled
Pre-coating pressure START threshold	0x0025	R/W	2000	microH2O, microBar, mPascal, microPsi
Special clean cycles	0x0026	R/W	2	Number of Special Cycles to perform
Special clean Pause Time at the end	0x0027	R/W	20	sec

Alarms settings

Item	Register	Access	Default	Note
Max dP pressure threshold	0x0030	R/W	3000	microH2O, microBar, mPascal, microPsi
Enable Min dP alarm	0x0031	R/W	0	0=Disabled 1=Enabled
Min dP pressure threshold	0x0032	R/W	200	microH2O, microBar, mPascal, microPsi
Enable Fan hour counter alarm	0x0033	R/W	0	0=Disabled 1=Enabled
Fan hour counter threshold	0x0034	R/W	1000	Expressed in hours (hh)

ADVANCED settings

Item	Register	Access	Default	Note
Enable Stop clean at the end of the cycle	0x0052	R/W	1	0=Disabled 1=Enabled
Shunt calibration value	0x0053	R/W	0	Warning: Factory calibration. Do not modify !
LCD backlight ON time	0x0054	R/W	0	0 = Always backlight ON, > 0 = On for seconds
Relay 1 default contact state	0x0055	R/W	1	0=Normally OPEN (No) 1=Normally CLOSED (Nc)
Relay 1 alarm mode	0x0056	R/W	0	0=Pulse mode 1=Latch mode
Relay 1 Activation time during alarm	0x0057	R/W	10	Expressed in sec. Used only if Pulse mode
Relay 2 default contact state	0x0058	R/W	1	0=Normally OPEN (No) 1=Normally CLOSED (Nc)
Relay 2 alarm mode	0x0059	R/W	0	0=Pulse mode 1=Latch mode
Relay 2 Activation time during alarm	0x005A	R/W	10	Expressed in sec. Used only if Pulse mode
Enable on-board buzzer	0x005B	R/W	1	0=Disabled 1=Enabled
4÷20mA OUT mode	0x005C	R/W	1	0= Not used 1=Output dP pressure value

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Test & calibration parameters

Item	Register	Access	Default	Note
dP to KPa constant conversion	0x0050	R/W	12500	Warning: Factory calibration. Do not modify !
Zero dP offset correction	0x0051	R/W	0	Used to correct dP value displayed
Number of valve to manually activate	0x0040	R/W	1	Used to test single valve activation
Zero dP offset calibration	0x0041	R/W	0	Warning: Factory calibration. Do not modify !
4mA Output calibration value	0x0042	R/W	600	Warning: Factory calibration. Do not modify !
20mA Output calibration value	0x0043	R/W	3000	Warning: Factory calibration. Do not modify !
Working hours counter (low byte)	0x0048	R	0	From the first device's Power-ON
Working hours counter (high byte)	0x0049	R	0	From the first device's Power-ON
Valve actuations counter (low byte)	0x004A	R	0	Increases each time a valve was activated)
Valve actuations counter (high byte)	0x004B	R	0	Increases each time a valve was activated)
Fan hours counter (low byte)	0x004C	R	0	Counter is active during Fan running
Fan hours counter (high byte)	0x004D	R	0	Counter is active during Fan running

Board parameters

Item	Register	Access	Default	Note
Alarm RESET	0x04FD	R/W	0	1=Reset alarms
Buzzer RESET	0x04FE	R/W	0	1=Reset alarms
Presence of alarms	0x0500	R	0	0=No alarms 1=Alarms occurred
Configuration alarm	0x0501	R	0	0=No alarm 1=Alarm occurred
Max dP alarm	0x0502	R	0	0=No alarm 1=Alarm occurred
Min dP alarm	0x0503	R	0	0=No alarm 1=Alarm occurred
Fan Hours alarm	0x0504	R	0	0=No alarm 1=Alarm occurred
Manual Post cleaning alarm	0x0505	R	0	0=No alarm 1=Alarm occurred
Remote enable alarm	0x0506	R	0	0=No alarm 1=Alarm occurred
Valve shunt global alarm	0x0507	R	0	0=No alarm 1=Alarm occurred
Valve 1 shunt alarm	0x0508	R	0	0=No alarm 1=Alarm occurred
Valve (n) shunt alarm	0x05yy	R	0	Where yy= 0x0520 + n (0÷126 valves)
Valve 127 shunt alarm	0x059E	R	0	0=No alarm 1=Alarm occurred
Most recent alarm	0x05A1	R	0	Last recent actuator position in fail
Previous 1 alarm	0x05A2	R	0	The position pf the 1st actuator failed
Previous 2 alarm	0x05A3	R	0	The position pf the 2st actuator failed
Previous 3 alarm	0x05A4	R	0	The position pf the 3st actuator failed
Previous 4 alarm	0x05A5	R	0	The position pf the 4st actuator failed
Previous 5 alarm	0x05A6	R	0	The position pf the 5st actuator failed
Missing valve actuation alarm	0x005D	R	3	Number of activation attempts before generating the alarm
Device Model	0x04D0	R	0	0=Econet Plus; 1=Econet Ultra
On-Board temperature	0x04ED	R	0	Expressed in Celsius
Digital IN1 value	0x04E2	R	0	0=Detected; 1= Not detected
Digital IN2 value	0x04E3	R	0	0=Detected; 1= Not detected
Digital IN3 value	0x04E4	R	0	0=Detected; 1= Not detected
Digital IN4 value	0x04E5	R	0	0=Detected; 1= Not detected
Digital OUT1 value	0x04E6	R	0	0=Active; 1=Not active
Digital OUT2 value	0x04E7	R	0	0=Active; 1=Not active
Digital OUT3 value	0x04E8	R	0	0=Active; 1=Not active
Digital OUT4 value	0x04E9	R	0	0=Active; 1=Not active

The Econet EC+ / EC++ devices are provided of Modbus registers dedicated for manage some specific functions. Please refer to the related documents to those features to be able to use them in the best possible way.

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Communicate with the Turbo HMI "Bega"

The Turbo portfolio also includes a HMI device, called "BEGA" to connect with Econet EC+ / EC++ devices via ModBus network.

The "BEGA" device acts as a remote machine interface for Econet devices. It is provided of WinCE 5.0 operating system and a pre-charged Turbo PC-Panel software ready to use.

Thanks to configuration files, the end-user can change logo's, information and others.

With the USB port it is possible to save logs of a lot of measures and events during the cleaning time.
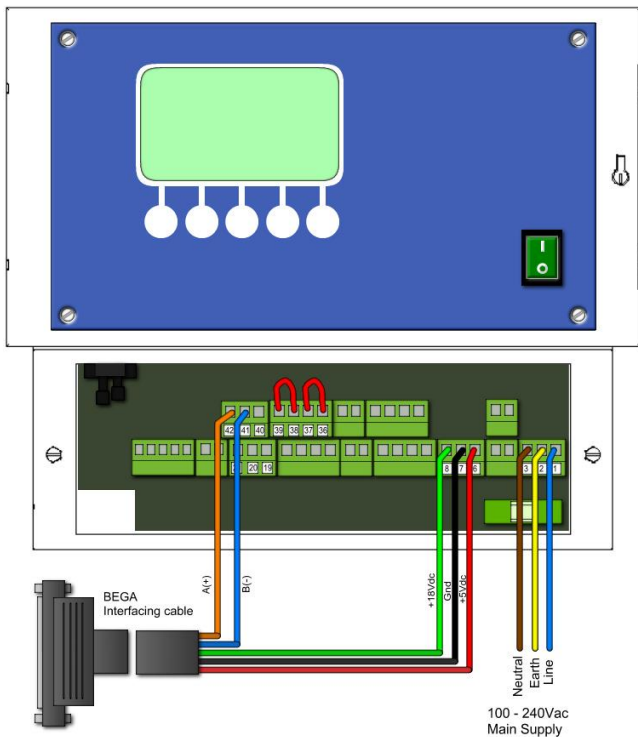
The "BEGA" HMI device is sold with a cable ready for connect the Econet EC+ /EC++ device.

The Econet devices provide a specific power supply at the BEGA and the communication is made on RS485 ModBus serial port already available.

Please refers to Turbo Sales dept. to purchase the BEGA HMI (Human-machine interface) device and obtain the related Hardware/software install documentation.

Ethernet and WiFi communication

The Econet EC+ /EC++ device coming out of Turbo factory with a default RS485 ModBus serial port.
However it is possible to buy a communication plug-in board as listed:

- Ethernet TCP/IP plug-in board;
- Wi-Fi TCP/IP plug-in board;
- Ethernet & Wi-Fi plug-in board;

Please refers to Turbo Sales dept. to purchase the pre-configured Econet devices with on-board Ethernet and Wi-Fi plug-in expansion.

Please refer *to* related documents to those features to be able to use them in the best possible way.

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Appendix A – Reference Documents

APNt023	*« Multiple actuation » application note*
APNt024	*« WiFi & ETH configuration » application note*
APNt025	*« Analog & digitale Triboelectrical probe » application note*

Appendix B –Revision History

Version draft	First draft	Dec 2017
Version 1.0	First Release	Jan 30th, 2018
Version 1.1	Updated communication cable section	Apr 23th,2018
Version 1.2	Updated register list	Sept 16th, 2019
Version 1.3	Updated Turbo HQ Address	Nov 3th, 2021

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