DATEXEL

Isolated Modbus RTU IO Module
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CSQ
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UNI EN ISO 9001:2008

Universal Distributed I/O device on RS-485 network

User Guide – MODBUS protocol
Firmware Version : D470

DAT 3012

All the data shared by a device communicating by Modbus RTU / Modbus ASCII protocol are mapped in tables wherein to each data is associated a determined address.
Each data could 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 read and write functions are performed, use the tables indicated below to address the registers and coils.

REGISTERS TABLE

Registro	Descrizione	Accesso
40001	--Reserved--	R/W
40002	Firmware Version	RO
40003		RO
40004	Name	R/W
40005		R/W
40006	--Reserved--	RO
40007	Address	R/W
40008	--Reserved--	RO
40009	Digital Input	RO
40010	Digital Output	R/W
40011	System Flags	R/W
40012	Enable PowerUp/Safe Dig. Out	R/W
40013	WatchDog Timer	R/W
40014÷18	--Reserved--	RO
40019	Communication	R/W
40020÷26	--Reserved--	RO
40027	Analog Input #1	RO
40028	Analog Input #2	RO
40029÷32	--Reserved--	RO
40033	Analog Output #1	R/W
40034	Analog Output #2	R/W
41204	Reset Digital Counter	R/W
41205	Freq. Digital input #0	RO
41206	Freq. Digital input #1	RO
41207	Freq. Digital input #2	RO
41208	Freq. Digital input #3	RO
41209÷10	Counter Digital input #0 (32bit)	R/W
41211÷12	Counter Digital input #1 (32bit)	R/W
41213÷14	Counter Digital input #2 (32bit)	R/W
41215÷16	Counter Digital input #3 (32bit)	R/W
41217	Input Type	R/W
41221	PowerUp Analog Output #1	R/W
41222	PowerUp Analog Output #2	R/W
41223	Safe Analog Output #1	R/W
41224	Safe Analog Output #2	R/W

COILS TABLE

(*)Coil (Hex)	(*)Coil (Dec)	Descrizione	Accesso
0x0081	00129	Digital Input #0	RO
0x0082	00130	Digital Input #1	RO
0x0083	00131	Digital Input #2	RO
0x0084	00132	Digital Input #4	RO
0x0085	00133	Fall Latch #0	R/W
0x0086	00134	Fall Latch #1	R/W
0x0087	00135	Fall Latch #2	R/W
0x0088	00136	Fall Latch #3	R/W
0x0089	00137	Rise Latch #0	R/W
0x008A	00138	Rise Latch #1	R/W
0x008B	00139	Rise Latch #2	R/W
0x008C	00140	Rise Latch #3	R/W
0x0091	00145	Digital Output #0	R/W
0x0092	00146	Digital Output #1	R/W
0x0093	00147	Digital Output #2	R/W
0x00A1	00161	Watch-dog Enable	R/W
0x00A2	00162	Watch-dog Event	R/W
0x00A3	00163	Power-Up Event	R/W
0x00B1	00177	PowerUp Dig. Out #0	R/W
0x00B2	00178	PowerUp Dig. Out #1	R/W
0x00B3	00179	PowerUp Dig. Out #2	R/W
0x00B9	00185	Watchdog Dig. Out #0	R/W
0x00BA	00186	Watchdog Dig. Out #1	R/W
0x00BB	00187	Watchdog Dig. Out #2	R/W

SUPPORTED MODBUS FUNCTIONS 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
23(17)	Read/Preset Multiple Registers

NOTES:
(*) 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 DAT3000 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 functions 01, 02 and 15 support a maximum number of 32 consecutive coils for reading and writing .

DESCRIPTION MODBUS REGISTERS

40002 / 40003 : FIRMWARE VERSION
Field of 2 read only registers ; contains the firmware identifier provided by the manufactured.
- Default value: D470 (ASCII)

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: "3012" (ASCII).

40007 : ADDRESS
Contains the MODBUS address of the device; the values allowed are from 1 to 247 decimal.
Each node connected to the same line has a unique address.
The address 255 is used for broadcast function.
- Default value: 01

40009 : DIGITAL INPUTS
This register shows the state of the digital inputs (0 = OFF , 1 = ON).
It is possible to use this register to read and write at the same time all the bits without to implement the specific functions of read of coils (01-02).

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Descr.	Fall Latch				Input								Rise Latch			
Input	#3	#2	#1	#0	#3	#2	#1	#0	-	-	-	-	#3	#2	#1	#0
Coil	136	135	134	133	132	131	130	129	-	-	-	-	140	139	138	137

40010 : DIGITAL OUTPUTS
This register allows to drive directly the state of output transistors (0 = OFF ; 1 = ON).
It is possible to use this register to read and write at the same time all the bits without to implement the specific functions of read and write of coils (01-02-05-15).

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Output	-	-	-	-	-	#2	#1	#0	-	-	-	-	-	-	-	-
Coil	-	-	-	-	-	147	146	145	-	-	-	-	-	-	-	-

40010 : SYSTEM FLAGS
Contains the enable bits and system events of the device. The following parameters are configurable:

WATCHDOG ENABLE
Enables the WatchDog alarm. If the alarm is enabled and the device doesn't receive commands for a time higher than the one specified in register 40009, the WatchDog Alarm will be activated (refer to section "Procedures").
0 = Watchdog disabled.
1 = Watchdog enabled.

WATCHDOG EVENT
Indicates the state of the WatchDog Alarm. If the alarm is enabled and the device doesn't receive commands for a time higher than the one specified in register 40009, this bit is forced to 1. To erase the alarm set this bit to 0. If the bit is forced to 1 by a command of the Master unit, a Watchdog event will be simulated and consequently an alarm condition will be created.
0 = Normal condition
1 = Alarm condition

POWER-UP EVENT
This bit is forced to 1 each time the device is powered-on in order to indicated that the device has been switched-off or a reset is occurred. By the set of this bit to 0 and check its state it is possible to monitor if a reset of the device is occurred.
0 = reset not occurred
1 = reset not occurred
It is possible to use this register to read and write at the same time all the bits without to implement the specific functions of read and write of coils (01-02-05-15).

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

Watchdog Event Enable
Watchdog Event
Power-up Event
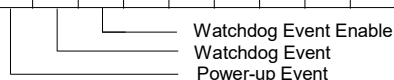
40012 : ENABLE POWERUP/SAFE DIGITAL OUTPUT
At the power-on (PowerUp) and in case of Watchdog Alarm (Safe), the state of outputs is automatically driven to the value set in this register.
Each bit corresponds to one digital output, in function of the table below:
- Default value: 0

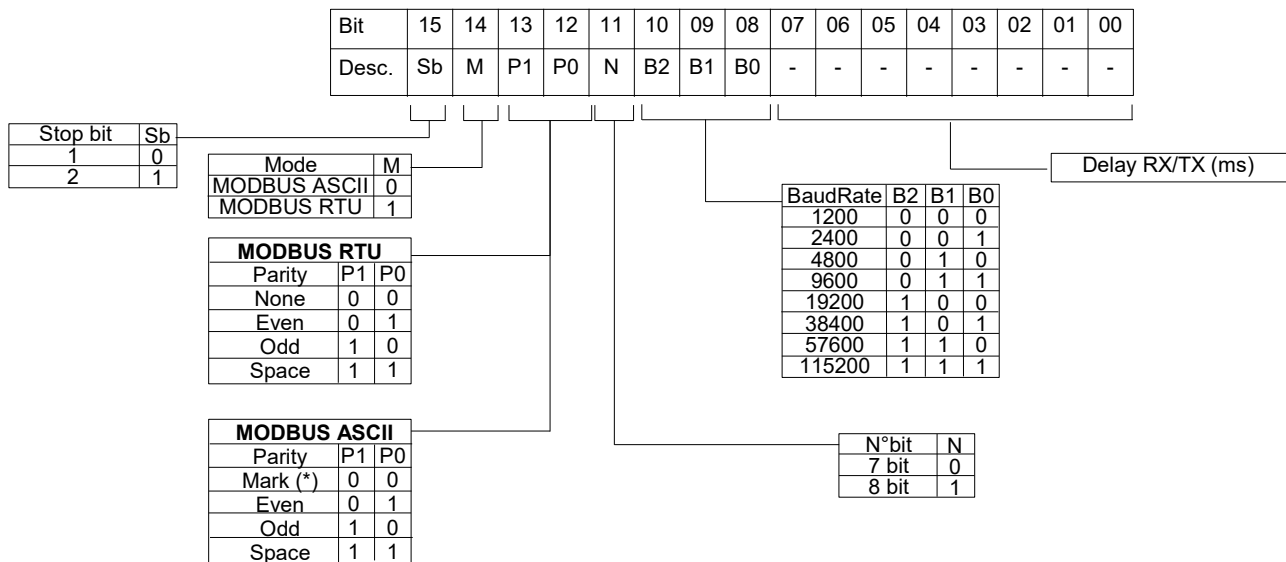| Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Descr.						PowerUp								WatchDog (Safe)		
Output	-	-	-	-	-	#2	#1	#0	-	-	-	-	-	#2	#1	#0
Coil	-	-	-	-	-	179	178	177	-	-	-	-	-	187	186	185

40013 : WATCHDOG TIMER

Contains the value of WatchDog timer, expressed of intervals of 0.5 seconds. If the WatchDog is enabled and the device doesn't receive command for the time set in this register , the WatchDog Alarm will be activated (refer to section "Procedures").
- Default value: 10 (5 sec)

40019 : COMMUNICATION

Set the bits of this register as shown in the following table, to set the baud-rate, the bit number, the parity type and the protocol type.
- Manufacturer default:38400 bps, RTU mode, parity NONE, stop bit 1
The bottom of this register is reserved for the "Delay RX/TX" parameter. It indicates the value of the delay time between the reception of a query and the transmission of the response, expressed as milliseconds. This parameter can assume values between 0 and 255.
- Default value: 01(1 ms)

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Desc.	Sb	M	P1	P0	N	B2	B1	B0	-	-	-	-	-	-	-	-

Stop bit	Sb
1	0
2	1

Mode	M
MODBUS ASCII	0
MODBUS RTU	1

MODBUS RTU		
Parity	P1	P0
None	0	0
Even	0	1
Odd	1	0
Space	1	1

MODBUS ASCII		
Parity	P1	P0
Mark (*)	0	0
Even	0	1
Odd	1	0
Space	1	1

BaudRate	B2	B1	B0
1200	0	0	0
2400	0	0	1
4800	0	1	0
9600	0	1	1
19200	1	0	0
38400	1	0	1
57600	1	1	0
115200	1	1	1

N°bit	N
7 bit	0
8 bit	1

Delay RX/TX (ms)

NOTE:
- the number of bits is ignored, in ASCII mode is fixed to 7; in RTU mode is fixed to 8.
- (*) In ASCII mode, the "Mark" parity configuration with 1 stop bit is equivalent to the "No Parity" configuration with 2 stop bit

40027 : ANALOG INPUT # 1
40028 : ANALOG INPUT # 2 (only Volt and mA)

These registers contain the measure of each channel converted in engineering units:

- RTD, Tc → value in tenths of ° C (example: 1672 → 167,2 °C)
- Resistenza L (Low) → value in tenths of Ω (example: 1325 → 132,5 Ω)
- Resistenza H (High) → value in Ω (example: 435 → 435 Ω)
- mV → value in cents of mV (example: 10000 → 100,00 mV)
- Volt → value in mV (example: 5000 → 5,000 V)
- mA → value in uA (example: 4000 → 4,000 mA)

The data format is a 16 bit signed integer; the number of the decimals depends on the input type as shown in the table on the side.

Type	Decimals
mV	2
Volt	3
Thermocouple	1
RTD	1
Potenziometer	1
mA	3
Res L	1
Res H	0

40033 : ANALOG OUTPUT # 1
40034 : ANALOG OUTPUT # 2

The value written in these registers is converted to an analogue signal on the correspondent output.
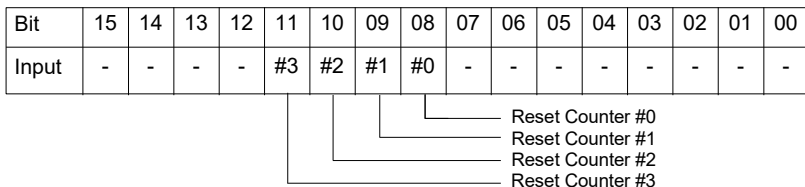The value are expressed as uA for current outputs:

0   = 0 mA
20000 = 20 mA

41204 : RESET DIGITAL COUNTERS

This log allows reset digital counters. To reset the counter, the bit relative to that counter must be forced to 1.
Write the log to force the bits according to the following table:

Counter #	Value (Dec)	Value (Hex)
0	256	100
1	512	200
2	1024	400
3	2048	800

To reset 2 or more counters at the same time, enter in this register the sum of counter values to reset:
Write 768 (300 Hex) to reset counters # 0 and # 1
Write 1536 (600 Hex) to reset counters # 1 and # 2
Write 1792 (700 Hex) to reset counters #0, #1 and #2
Write 3804 (F00 Hex) to reset contaters #0, #1, #2 and #3

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Input	-	-	-	-	#3	#2	#1	#0	-	-	-	-	-	-	-	-

Reset Counter #0
Reset Counter #1
Reset Counter #2
Reset Counter #3

41205 : FREQUENCY MEASUREMENT DIGITAL INPUT 0
41206 : FREQUENCY MEASUREMENT DIGITAL INPUT 1
41207 : FREQUENCY MEASUREMENT DIGITAL INPUT 2
41208 : FREQUENCY MEASUREMENT DIGITAL INPUT 3

These registers show the frequency measurement for each digital input channel.
The value, expressed in cents of Hertz, is in full 16 bit format.
The maximum measured frequency value is 200.00 Hz

41209-10 (LO-HI) : COUNTER DIGITAL INPUT 0 (32 BIT)
These registers show the pulse counter measure associated with the digital input channel 0. The value, which is incremented at each state change from 0 to 1 of the input channel (rising edge), is in unsigned integer format to 32 bit and occupies 2 registers (1 Long register).
At each power-up, the register value is forced to 0.
You can reset the value of this log by using log 41204 (Reset Digital Counters).

41211-12 (LO-HI) : COUNTER DIGITAL INPUT 1 (32 BIT)
These registers show the pulse counter measure associated with the digital input channel 1. The value, which is incremented at each state change from 0 to 1 of the input channel (rising edge), is in unsigned integer format to 32 bit and occupies 2 registers (1 Long register).
At each power-up, the register value is forced to 0.
You can reset the value of this log by using log 41204 (Reset Digital Counters).

41213-14 (LO-HI) : COUNTER DIGITAL INPUT 2 (32 BIT)
These registers show the pulse counter measure associated with the digital input channel 2. The value, which is incremented at each state change from 0 to 1 of the input channel (rising edge), is in unsigned integer format to 32 bit and occupies 2 registers (1 Long register).
At each power-up, the register value is forced to 0.
You can reset the value of this log by using log 41204 (Reset Digital Counters).

41215-16 (LO-HI) : COUNTER DIGITAL INPUT 2 (32 BIT)
These registers show the pulse counter measure associated with the digital input channel 3. The value, which is incremented at each state change from 0 to 1 of the input channel (rising edge), is in unsigned integer format to 32 bit and occupies 2 registers (1 Long register).
At each power-up, the register value is forced to 0.
You can reset the value of this log by using log 41204 (Reset Digital Counters).

41217 : INPUT TYPE (CHANNEL 0) AND (CHANNEL 1)

Contain the programming of the two analogue input channels.
Bit 0-7: programming input channel 0 (universal input).
Bit 8-15: programming input channel 1(universal input).
Enter the programming values (in groups of 8 bits) in the register according to the table on side:

Input	Value
Disabled	0
100 mV	1
10 V	2
20 mA	3
Tc J	4
Tc K	5
Tc R	6
Tc S	7
Tc T	8
Tc B	9
Tc E	10
Tc N	11
Res 500 ohm	12
Pt100	13
Pt1K	14
Ni100	15
Ni1K	16
Pot	17
Res 2Kohm	18

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

41221 : POWER-UP ANALOG OUTPUT #0
41222 : POWER-UP ANALOG OUTPUT #1

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 (0mA)

The values are expressed in uA for current outputs :

0 = 0 mA
20000 = 20 mA

41223 : SAFE ANALOG OUTPUT #0
41224 : SAFE ANALOG OUTPUT #1

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 mA)

The values are expressed in uA for current outputs :

0 = 0 mA
20000 = 20 mA

PROCEDURE

USE OF "INIT" FUNCTION
The "INIT" function allows to set the device in the default configuration, independently of the software configuration made.

The INIT forces: mode RTU, parity NONE, baud rate 9600, number of bit = 8, stop bit = 1, address 1

- Connect to the line RS485 only the device to configure.
- Switch-off the device.
- Connect the terminal INIT (H) to the terminal V- (I).
- Power-on the device.
- Check that the green led "PWR" on the front of the device is on.

If not, check the connection of power supply (terminals I and J) and RS485 (terminals A and B).

- Set the communication port with the following values:
        Mode = Modbus RTU
        baud-rate = 9600 bps
        parity = None
        n° bit = 8
        stop bit = 1

- the device will respond to the address 01 .
- Read or write the desired settings into the registers:
        40007 : "Address" to set the address of the device.
        40019 : "Communication" to set the baud-rate.
- Switch-off the device.
- Disconnect the terminal INIT from the terminal V-.
- Power-on the device.
- Set the communication port with the baud-rate configured in the register 40019.
- the device will respond to the address configured in the register 40007.

NOTE: the default configuration values are the following:
- Address : 01
- Baud-rate : 38400 bps
- Protocol : RTU
- Parity : None
- Stop bit : 1

WATCHDOG
The devices of the DAT3000 series have the Watchdog timer that, if enabled, activates an alarm each time that the communication between the device and the Master unit is not performed for a time higher that the one configured.
In alarm condition, the state/value of outputs are forced as set into the register "Safe" that is the condition to which the outputs and consequently the actuators must be set to avoid damage to the system in case of danger. Moreover as light signalling the green led PWR on the front starts to blink one time per second and is forced to 1 the coil "Watchdog Event".
To exit from the alarm condition, send a command to the device, reset the coil "Watchdog Event": the led will stop to blink and will be possible to drive the outputs again.