DATEXEL

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**Distributed I/O device
4 relays + 4 digital inputs
on RS-485 network**

User Guide – MODBUS protocol
Firmware Version : 6100

DAT 3130

PRELIMINAR DESCRIPTION

All the data variables shared by a Modbus module are shown in tables, where each data is linked to one address.
Each data can be of two types:

- "COIL", composed by a single bit, can be associated to digital input (switch), digital outputs (relays), logic states (alarms).

- "REGISTER", composed by 2 bytes (16 bits), can be associated to analog input or outputs, variables, set-point, etc...

A register can also include the image of more coils, for example the 16 digital inputs of a device can be read and write as bit, one by one, addressing the relative coil , or they can be read or write as a single 16-bit port addressing the associated register, where for example the last significant bit will respond to the first coil.

In the Modbus protocol, coils and registers are divided in banks:
0xxxx and 1xxxx = Coils (bits)
3xxxx and 4xxxx = Registers (words)

REGISTERS TABLE

Register	Description	Access	E^{2}P
40001	Test	R/W	
40002	Firmware Version	R	
40003		R	
40004	Device Name	R/W	*
40005		R/W	*
40006	Communication	R/W	*
40007	Address	R/W	*
40008	RX/TX Delay	R/W	*
40009	Digital Inputs (Coils)	R	
40010	Digital Outputs (Coils)	R/W	
40011	Coils	R/W	
40012	PowerUp/Safe Value	R/W	*
40013	Watchdog Timer	R/W	*

NOTE:
The registers marked with ' * ' in the ' E^{2}P ' column are saved in EEPROM each time they are written, to be automatically reloaded to each power-on of the device.

IMPLEMENTED MODBUS FUNCTIONS

Function	Description
01	Read multiple coils (0xxxx bank)
02	Read multiple coils (1xxxx bank)
03	Read multiple registers (4xxxx bank)
04	Read multiple registers (3xxxx bank)
05	Write single coil
06	Write single register
15	Write multiple coils
16	Write multiple registers
08	Diagnostic

NOTE:
For DAT3000 series devices, the bank 0xxxx is a mirror of bank 1xxxx, as the 3xxxx bank is a mirror of bank 4xxxx, as for i.e. the first register can be read indifferently as 30001 (with the function 04) or 40001 (with the function 03)

COILS TABLE

Coil	Description	Access	E^{2}P
00001	Input #0	R	
00002	Input #1	R	
00003	Input #2	R	
00004	Input #3	R	
00005	Low rise Latch #0	R/W	
00006	Low rise Latch #1	R/W	
00007	Low rise Latch #2	R/W	
00008	Low rise Latch #3	R/W	
00009	High rise Latch #0	R/W	
00010	High rise Latch #1	R/W	
00011	High rise Latch #2	R/W	
00012	High rise Latch #3	R/W	
00013	Synchronism #0	R/W	
00014	Synchronism #1	R/W	
00015	Synchronism #2	R/W	
00016	Synchronism #3	R/W	
00017	Output #0	R/W	
00018	Output #1	R/W	
00019	Output #2	R/W	
00020	Output #3	R/W	
00021	-- (reserved)	R/W	
00022	-- (reserved)	R/W	
00023	-- (reserved)	R/W	
00024	-- (reserved)	R/W	
00033	Watchdog Enable	R/W	
00034	Watchdog Event	R/W	
00035	PowerUp Event	R/W	

REGISTER DESCRIPTION

40001 : TEST
This register is used to perform the following functions:
- Synchronized sampling (see the "Procedures" section).

40002 / 40003 : FIRMWARE VERSION
Read-only 2-register field, that hold the manufacturer firmware identifier.
- Manufacturer default: 6100 (hex)

40004 / 40005 : DEVICE NAME
2-registers field (4 byte or 4 ASCII characters) user free, that can hold the device name or a function identifier. Each byte can be writed with each value from 0 to 255, than ASCII characters too.
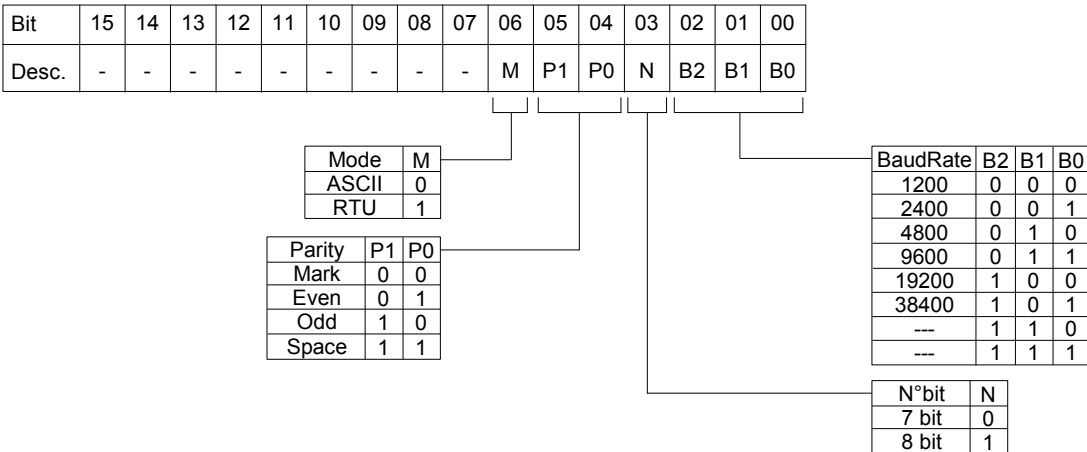The manufactures value of this field hold the device identifier.
- Manufacturer default: "3130" (ASCII).

40006 : 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

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

Mode	M
ASCII	0
RTU	1

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
---	1	1	0
---	1	1	1

N°bit	N
7 bit	0
8 bit	1

NOTES:
- the bit number is ignored, as for in ASCII mode it is fixed to 7 and in RTU mode it is fixed to 8.
- In RTU mode the parity is ignored (parity NONE)

40007 : ADDRESS
Specify the net address of the device; there are allowed the address from 1 to 255.
Each device connected to the same net must have a unique address.
The address 255 is used for broadcast functions (i.e. synchronized sampling)
- Manufacturer default: 01

40008 : RX/TX DELAY
Specify the value of the delay between the reception of a command and the response transmission, indicated in milliseconds.
- Manufacturer default: 1 (1 ms.)

40009 : DIGITAL INPUTS (COILS)
This register show digital inputs state (0 = OFF , 1 = ON).
The same values can be read by the coils table, of which this register is a mirror.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Descr.	Low rise Latch				Input				Sync.				High rise Latch			
Channel	#3	#2	#1	#0	#3	#2	#1	#0	#3	#2	#1	#0	#3	#2	#1	#0
Coil	08	07	06	05	04	03	02	01	16	15	14	13	12	11	10	09

40009 : DIGITAL OUTPUTS (COILS)
This register allow to drive directly the output state (0 = OFF , 1 = ON).
The same values can be read/write by the coils table, of which this register is a mirror.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Output	-	-	-	-	#3	#2	#1	#0								
Coil	-	-	-	-	20	19	18	17	-	-	-	-	-	-	-	-

40010 : COILS
This register is a mirror of the coils table: each bit of this register corresponds to a coil, as shown in the following table.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Coil	-	-	-	-	-	35	34	33	-	-	-	-	-	-	-	-

40012 : POWERUP/SAFE VALUE
When the device is tuned-on (PowerUp) and in case of watchdog alarm (Safe), the outputs are automatically forced to the value specified in this register. Each bit corresponds to an output, as shown in the table.
- Manufacturer default: 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
Value	Power Up								Safe							

40013 : WATCHDOG TIMER
Specify the value of the WatchDog Timer (see the "Procedures" section), indicated in steps of 0.5 seconds.
- Manufacturer default: 10 (5 sec.)

COILS DESCRIPTION

00001 / 00004 : DIGITAL INPUTS
Each coil show the corresponding input state (0 = OFF , 1 = ON).

00005 / 00008 : DIGITAL INPUTS LOW RISE LATCH
Each coil is associated to a digital input and is forced to 1 when a low-rise front happens (the input goes from ON to OFF); this coil still 1 until it is cleared by a writing or at the device reset.

00009 / 00012 : DIGITAL INPUTS HIGH RISE LATCH
Each coil is associated to a digital input and is forced to 1 when a high-rise front happens (the input goes from OFF to ON); this coil still 1 until it is cleared by a writing or at the device reset.

00013 / 00016 : DIGITAL INPUTS SYNCHRONISM VALUE
When the device receive the Sync command (see the "Procedures" section), the actual input values in the 00017÷00028 coils are saved in these registers, channel by channel, to be read in a following time.

00017 / 00020 : DIGITAL OUTPUTS
These coils allow to drive directly the output state (0 = OFF , 1 = ON).
- In alarm condition the outputs can not be driven.
- In Watchdog alarm condition the outputs are forced to the specified value.

00033 : WATCHDOG ALARM ENABLE
Enable the WatchDog alarm. If the alarm is enabled and the device does not receive any command for a time longer than the time specified in the 40013 register, the WatchDog alarm Event coil is forced to 1 (see the "Procedures" section).
0 = Watchdog alarm disabled
1 = Watchdog alarm enabled

00034 : WATCHDOG ALARM EVENT
This coil indicates the condition of WatchDog Alarm. If the alarm is enabled and the device does not receive any command for a time longer than the time specified in the 40009 register, this coil is forced to 1. To return from the alarm condition, set this coil to 0.
0 = Normal Condition
1 = Alarm Condition

00035 : POWER-UP EVENT
This coil is forced to 1 at each power-on of the device; this state indicates that the device has been switched off. It is possible to know if a reset of the device is happened clearing this coil and monitoring its state.
0 = reset not happened
1 = reset happened

PROCEDURES

HOW TO USE THE "INIT" FUNCTION
If the exact configuration of a module is unknown, it can result impossible to establish a communication with it.
The "INIT" function gives a solution to this throuble:

- Connect to the RS485 net only the device to configure.
- Turn off the device.
- Connect the INIT pin (D) to the GND pin (C).
- Turn on the device.
- Ensures that the "PWR" green LED on the front of the enclosure is lighted.

If not, control the voltage supply connections (I and J pins) and RS485 net connections (A and B pins).
  If the supply connection is right, and the led still unlighted, it can be necessary to invert the RS485 pins connection.

- Set the communication port to these values:
      baud-rate = 9600 bps
      parity = None
      n° bits = 8
      stop bits = 1
- The device now communicates at the address 01 with the RTU protocol.
- Read or program the desired settings on the registers:
      40006 : "Communication" for the baud-rate setting
      40007 : "Address" for the net address of the device
- Turn off the device.
- Disconnect the INIT pin from the GND pin.
- Turn on the device.
- Set the communication port at the baud-rate programmed in the 40006 register.
- The device now communicates with the addressprogrammed in the 40007 register.

NOTE: The default manufacturer programmation is the following:

- Address : 01
- Baud-rate : 38400 bps
- Protocol : RTU

WATCHDOG
The modules has been provided of a Host Watchdog timer which, when it is enabled, makes to start the alarm each time the communication between the module and the host is inactive for a period time greater then the programmed one. When the alarm goes on, the values of the outputs are automatically converted to the values set as 'safety value', that corresponding to the state in which the outputs must be putted, and therefore the actuators are putted, to avoid damages to the system in case of failure. Moreover, under the alarm condition the green LED on the front of the enclosure is blinking and the "Watchdog Event" coil is forced to 1.
To return from the alarm condition, reset the coil "Watchdog Event" coil: the LED stop blinking and it is possible to set the outputs.
There is also a Module Watchdog timer that monitor the internal CPU work and is active when the CPU don't function correctly for any reason, and resets the module. After the reset, all outputs will assume their initial default value ("power up value"), that may be different to the output value after the reset.

SYNCHRONISM
The Synchronism function is performed by a command sent to all devices connected on the net. When the devices receive the Sync command, all input states are saved in the relative register, to be read after time. Doing this, it is possible to read the value of all inputs at the Sync command time.
To send the synchronism command, write the value 10 in the "Test" register (40001) at the address 255.
NOTE: The sync values are not saved in EPROM.