Via monte Nero, 40/B – 21049 TRADATE (VA) ITALY
Phone: +39 (0)331841070 - e-mail:datexel@datexel.it - www.datexel.it

Distributed I/O device
4 isolated channels
V, mA outputs
on RS-485 network

User Guide – MODBUS protocol
Firmware Version : 1343

DAT 3024-ISO

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.

REGISTER TABLE

Posizione Registro	Descrizione	Accesso
40002	Firmware [0]	RO
40003	Firmware [1]	RO
40004	Name [0]	R/W
40005	Name [1]	R/W
40006	Baud-Rate	R/W
40007	Node ID	R/W
40008	Delay RX/TX	R/W
40009	Watchdog timer	R/W
40010	System Flags	R/W
40014	Outputs type	R/W
40015	Analog Output (0)	R/W
40016	Analog Output (1)	R/W
40017	Analog Output (2)	R/W
40018	Analog Output (3)	R/W
40023	Power Up Current (0)	R/W
40024	Power Up Current (1)	R/W
40025	Power Up Current (2)	R/W
40026	Power Up Current (3)	R/W
40031	Power Up Voltage (0)	R/W
40032	Power Up Voltage (1)	R/W
40033	Power Up Voltage (2)	R/W
40034	Power Up Voltage (3)	R/W
40039	Safe Current (0)	R/W
40040	Safe Current (1)	R/W
40041	Safe Current (2)	R/W
40042	Safe Current (3)	R/W
40047	Safe Voltage (0)	R/W
40048	Safe Voltage (1)	R/W
40049	Safe Voltage (2)	R/W
40050	Safe Voltage (3)	R/W

COILS TABLE

(*)Coil (Hex)	(*)Coil (Dec)	Description	Access
0x0009	00009	Watchdog Enable	R/W
0x000A	00010	Watchdog Event	R/W
0x000B	00011	PowerUp Event	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

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 30001 (with function 04) or 40001 (with function 03).

DESCRIPTION MODBUS REGISTERS

40002 / 40003 : FIRMWARE VERSION
Read-only 2-register field, that hold the manufacturer firmware identifier.
- Manufacturer default: 1343

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 written with each value from 0 to 255, than ASCII characters too.
- Manufacturer default: “3024” (ASCII).

40006 : COMMUNICATION
If the user wants to set the communication parameters by PC, it is necessary to set the bits of this register referring to the table below in order to configure baud-rate, parity and mode.
- Manufacturer default: 38400 bps, RTU mode, Parity: NONE, stop bit 1

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 Stop Bit	0
2 Stop Bit	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
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

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

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

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 : 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.)

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	-	-	-	-	-	-	-	-	-	-	-	-	-	11	10	09

Watchdog Enabled
Watchdog Event
Power-up Event

40014 : OUTPUT TYPE CONFIGURATION
Each bit of this register corresponds to the programmation of the output type for each channel (1 = voltage , 0 = current) ; all the outputs can be programmed independently as voltage or current.
- Manufacturer default: all 1 (voltage)

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

40015 : ANALOG OUTPUT VALUE # 0
40016 : ANALOG OUTPUT VALUE # 1
40017 : ANALOG OUTPUT VALUE # 2
40018 : ANALOG OUTPUT VALUE # 3

This register allow to drive directly the output value.
The values are expressed in mV for the voltage outputs and in uA for the current outputs:

0	= 0 mA	0	= 0 V
20000	= 20 mA	10000	= 10 V

40023 : POWER UP CURRENT 0
40024 : POWER UP CURRENT 1
40025 : POWER UP CURRENT 2
40026 : POWER UP CURRENT 3

When the device is tuned-on (PowerUp), the outputs are automatically forced to the value specified in this register.
The values are expressed in uA:

0 = 0 mA
20000 = 20 mA

- Manufacturer default: 0 (0 mA)

40031 : POWER UP VOLTAGE 0
40032 : POWER UP VOLTAGE 1
40033 : POWER UP VOLTAGE 2
40034 : POWER UP VOLTAGE 3

When the device is tuned-on (PowerUp), the outputs are automatically forced to the value specified in this register.
The values are expressed in mV:

0 = 0 V
10000 = 10 V

- Manufacturer default: 0 (0 V)

40039 : SAFE CURRENT 0
40040 : SAFE CURRENT 1
40041 : SAFE CURRENT 2
40042 : SAFE CURRENT 3

In case of Watchdog Alarm, the outputs are automatically forced to the value specified in this register.
The values are expressed in uA:

0 = 0 mA
20000 = 20 mA

- Manufacturer default: 0 (0 mA)

40047 : SAFE VOLTAGE 0
40048 : SAFE VOLTAGE 1
40049 : SAFE VOLTAGE 2
40050 : SAFE VOLTAGE 3

In case of Watchdog Alarm, the outputs are automatically forced to the value specified in this register.
The values are expressed in mV:

0 = 0
10000 = 10 V

- Manufacturer default: 0 (0 V)

PROCEDURES

HOW TO USE THE "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 to the terminal REF.
- 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 V+ and V-).

- Set the communication port with the following values:
  Mode = Modbus RTU
  baud-rate = 9600 bps
  parity = None
  n° bit = 8
  bit di stop = 1
- the device will respond to the address 01 .
- Read or write the desired settings into the registers:
  40006 : "Communication" to set the baud-rate.
  40007 : "Address" to set the address of the device.
- Switch-off the device.
- Disconnect the terminal INIT from the terminal REF.
- Power-on the device.
- Set the communication port with the baud-rate configured in the register 40006.
- 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 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 "safe current/safe voltage", that corresponding to the state in which the outputs must be put, and therefore the actuators are put, 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.

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