Universal Input to RS485 MODBUS
Phone: +1 561 779 5660 E-mail : Info@datexel.com - Web Site www.datexel.com

UNI EN ISO 9001:2000

Distributed I/O device
Universal analog input
on RS-485 network

User Guide – MODBUS protocol

DAT 3010

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^2P
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	Analog Input	R	
40010	(24 bit floating point)	R	
40011	Analog Input (16 bit)	R	
40012	Sync. Value	R	
40013	CJC Value	R	
40014	Watchdog Timer	R/W	*
40015	High Trip	R/W	*
40016	Low Trip	R/W	*
40017	CJC Offset	R/W	*
40018	Input Type	R/W	*
40019	Coils	R/W	*
40020	Hysteresis	R/W	*

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

COILS TABLE

Coil	Descrizione	Accesso	E^2P
00001	Safe Value OUT #0	R	*
00002	Safe Value OUT #1	R	*
00003	PowerUp Value OUT #0	R	*
00004	PowerUp Value OUT #1	R	*
00005	Trip Alarm type	R	
00006	Trip Alarm Enable	R	
00007	Watchdog Enable	R	
00008	-- (reserved)	R	
00009	OUT #0	R/W	
00010	OUT #1	R/W	
00011	IN #0	R	
00012	Open Detect	R	
00013	Watchdog Event	R/W	
00014	PowerUp Event	R/W	
00015	High Trip Alarm	R/W	
00016	Low Trip Alarm	R/W	

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 mirrir 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)

REGISTER DESCRIPTION

40001 : TEST
This register is used to perform the following functions:
- Analog inputs calibration (see the “Procedures” section).
- Synchronized sampling (see the “Procedures” section).

40002 / 40003 : FIRMWARE VERSION
Read-only 2-register field, that hold the manufacturer firmware identifier.
- Manufacturer default: 1100 (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.
- Manufacturer default: “3010” (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 univocal 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 / 40010 : ANALOG INPUT VALUE (24 BIT FLOATING POINT)
These registers contain the measure value of the input channel, converted in engineering units: The format is a 24bit floating point (40009 = Low Part Bassa ; 40010 = High Part)

40011 : ANALOG INPUT VALUE (16 BIT INTEGER)
These registers contain the measure value of the input channel, converted in engineering units. The format is a 16bit signed integer; the decimal number depends from the input type, as shown in the table.

Type	Unit	Decimals
± 25 mV	mV	3
± 100 mV	mV	2
± 250 mV	mV	2
± 1000 mV	mV	1
± 10 V	V	3
± 20 mA	mA	3
TC	°C	1
RTD	°C	1
Resistance	Ohm	1

40012 : SYNCHRONISM INPUT VALUE
When the device receive the Sync command (see the “Procedures” section), the actual input value in the 40011 register is saved in this register, to be read in a following time.

40013 : CJC VALUE
Thermocouple cold junction measure. The value is expressed in hundreds of degrees.

40014 : 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.)

40015 : HIGH TRIP VALUE
Set the High Trip value
If the Trip Alarm is enabled and the analog input value goes over the value of this register, the High Trip Alarm will be set.
This value has the same format of the analog input, as decribed for the register 40011.

40016 : LOW TRIP VALUE
Set the Low Trip value
If the Trip Alarm is enabled and the analog input value goes below the value of this register, the Low Trip Alarm will be set.
This value has the same format of the analog input, as decribed for the register 40011.

40017 : CJC OFFSET
Offset calibration value of the cold junction measure for thermocouples. The value is expressed in hundreds of degrees.

40018 : INPUT TYPE CONFIGURATION
Specify the sensor type connected to the input.
Write the programmation values in these registers as shown in the table below:
- Manufacturer default: 01h (25mV)

Value	Type
01h	± 25 mV
02h	± 100 mV
03h	± 250 mV
04h	± 1000 mV
05h	± 10 V
06h	± 20 mA
07h	Res. H (<2KOhm)
08h	Res. L (<500 Ohm)

Value	Type
0Eh	Tc J
0Fh	Tc K
10h	Tc T
11h	Tc E
12h	Tc R
13h	Tc S
14h	Tc B
15h	Tc N

Value	Type
17h	Pt100
18h	Ni100
19h	Pt1000
1Ah	Ni1000

40019 : 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	08	07	06	05	04	03	02	01	16	15	14	13	12	11	10	09

40020 : HYSTERESIS
Set the Hysteresis value for the Trip alarm
This value has the same format of the analog input, as decribed for the register 40011.

DESCRIZIONE COILS

00001 : SAFE VALUE OUTPUT #0
In case of watchdog alarm, the digital output #0 will automatically forced to the value specified in this coil

00002 : SAFE VALUE OUTPUT #1
In case of watchdog alarm, the digital output #1 will automatically forced to the value specified in this coil

00003 : POWER UP VALUE OUTPUT #0
When the device is turned on, the digital output #0 will automatically forced to the value specified in this coil

00004 : POWER UP VALUE OUTPUT #1
When the device is turned on, the digital output #1 will automatically forced to the value specified in this coil

00005 : TRIP ALARM TYPE (MOMENTARY / LATCH)
Specify the trip alarm type
0 = Momentary – the alarm will automatically return in the normal condition
1 = Latch – the alarm will stay active until a manual reset by writing coils 00015 e 00016

00006 : TRIP ALARM ENABLE
If the trip alarm is enabled, the output setting is made exclusively by the device.
1 = Alarm enabled
0 = Alarm Disabled

00007 : 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 40009 register, the WatchDog alarm Event coil is forced to 1 (see the “Procedures” section).
0 = Watchdog alarm disabled
1 = Watchdog alarm enabled

00009 : OUT #0
Set the DO0 digital output port. This command is overlayed when the Trip alarm function is enabled.

00010 : OUT #1
Set the DO1 digital output port. This command is overlayed when the Trip alarm function is enabled.

00011 : IN #0
Shows the state of the DI0 digital input.

00012 : OPEN DETECT
When the sensor connected to the input channel goes in break condition (sensor damage, unconnected wire or out-range), this coil is forced to 1.

00013 : 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 40014 register, this coil is forced to 1. To return from the alarm condition, set this coil to 0.
0 = Nornal Condition
1 = Alarm Condition

00011 : 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

00015 : HIGH TRIP ALARM
0 = the input signal (register 40011) is lower than the high alarm value (register 40015)
1 = the input signal (register 40011) is higher than the high alarm value (register 40015)

00015 : LOW TRIP ALARM
0 = the input signal (register 40011) is higher than the low alarm value (register 40015)
1 = the input signal (register 40011) is lower than the low alarm value (register 40015)

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 attuators 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 ("powerup 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.

CALIBRATION
The procedure of calibration is performed in factory on all the modules during the testing phase. However it can be convenient to make another calibration of the module according to the requirements of the user. To make this, it is necessary to use precision instruments and to correctly perform all the necessary steps, because any error reduces the accuracy and the good operation of the device.
NOTE: For the Thermocouple measure, the device uses the calibration of ± 50 mV input type.

To re-calibrate the device, follow this procedure:
1 – Turn on the device in INIT condition
2 – Conncet a calibrator to the input terminals, as shown in the datasheet.
3 – Program the input type to be calibrated (register 40018)
4 – Set the calibrator at the min value (refer to the datasheet values).
5 – Write on the "Test" register (40001) the value 20.
4 – Set the calibrator at the max value (refer to the datasheet values).
7 – Write on the "Test" register (40001) the value 30.
8 – Repeat point 2 to 7 for each input type to be calibrated.