User guide Modbus Display
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Remote Graphic Display communicating on RS-485 with Modbus RTU protocol

User Guide – MODBUS RTU protocol
Firmware Version: 9560

DAT9550

All the data shared by a device communicating by Modbus RTU 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 addressing the registers when functions of reading and / or writing of registers and coils are used, use the tables shown below, adding 1 if the device is polled by external unit.
The module's internal registers can be accessed via direct Modbus RTU command.

REGISTERS TABLE

Register	Description	Access
0	Status	R/W
1	Firmware Version	RO
2		RO
3	Name	R/W
4		R/W
5	Port 1 Set (RS485 Master)	R/W
6	Address	R/W
7	Port 1 Timeout	R/W
8	Function Keys	RO
9	Actual Page	RO
10	System Flags	R/W
11	Display Options	RO
12	WatchDog Time	R/W
13	--Reserved--	RO
14	--Reserved--	RO
15	Reset Timers	RO
16	COM Errors	R/W
17	Gateway Mask [L-H]	R/W
18	Port 0 Set (RS485 Slave)	R/W
19	Port 2 Set (RS232 Slave)	R/W
20	Timers Enable	R/W
21÷34	--Reserved--	RO
35÷926	General Purpose (RAM)	R/W
927÷959	--Reserved--	RO
(*) 960÷1019	Retentive Registers (EEPROM)	R/W

SUPPORTED MODBUS FUNCTION 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

COILS TABLE

Coil (Hex)	Coil (Dec)	Description	Access
0x00A0	00160	Watch-dog Enable	R/W
0x00A1	00161	Watch-dog Event	R/W
0x00A2	00162	Power-Up Event	R/W

NOTES:
The registers and coils marked in the 'Access' column with the words RO are read-only registers (Read Only).
The registers and coils marked in the 'Access' column with the words R/W are read and write registers (Read / Write).
(*) Pay attention to the use of retentive registers in EEPROM (960-1019) as they can not be written continuously.

Functions 01, 02 and 15 support reading and writing up to a maximum of 32 consecutive coils.
Functions 01, 02 and 15 support reading and writing up to a maximum of 32 consecutive coils.
The maximum number of registers that can be read through Modbus functions 03 and 04 (see "Supported modbus functions codes") are: 64
The maximum number of registers that can be written by Modbus function 16 (see "Supported modbus functions codes") are: 64

DESCRIPTION MODBUS REGISTERS

%R0 (40001): STATUS

This read-only register indicates the device status. The values that this registry takes are:
Stop → 101
Halt / Step → 102
In all other cases (Debug, Run, Release and Animate) → 255

%R1/%R2 (40002 / 40003): FIRMWARE VERSION

Field of 2 read-only registers, which contains the firmware identifier given by the manufacturer.
- Manufacturer's default: 9560 (ASCII)

%R3/%R4 (40004 / 40005) : NAME

Field of 2 registers (4 bytes or 4 ASCII characters) available to the user, can contain the name of the device or an acronym that identifies the function within the system. Each of the 4 bytes can contain any value from 0 to 255, thus also ASCII characters.
The default value of this field contains the module identifier in ASCII characters.
- Manufacturer's default: "9550" (ASCII).

%R5 (40006) : PORT 1 SET (RS485 Master)

In the lower part of this register it is possible to set the communication parameters (baud rate, parity and stop bit) relative to the serial port RS485 Master (Port 1).
- Manufacturer default: 38400 bps, parity NONE, stop bit 1

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

Parity	P1	P0
None	0	0
Even	0	1
Odd	1	0

Stop bit	Sb
1	0
2	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

%R6 (40007) : ADDRESS

Contains the Modbus address of the module; addresses from 1 to 249 are allowed.
Each module connected to the same network must have a unique address.
- Manufacturer's default: 1

%R7 (40008) : PORT 1 TIMEOUT

Indicates the value of the time within the device must wait for the answer from the slave devices connected to its RS485 Master port (Port 1). Beyond this time, any answers that arrive will be ignored.
This value is expressed in milliseconds.
- Manufacturer's default: 100

%R8 (40009): FUNCTION KEYS

This register shows the status of the function buttons. Each button is associated with a bit:

Pressure:
→ 0 = button currently not pressed
→ 1 = button currently pressed
Latch:
→ 0 = the button has not been pressed
→ 1 = the button has been pressed

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Button	F4	F3	F2	F1	↑	↓	←	→	F4	F3	F2	F1	↑	↓	←	→
Action	Press								Latch							

%R9 (40010): ACTUAL PAGE

In this register it is possible to set the page to be shown on the display:
→ 0 = page 1
→ 256 = page 2
→ 512 = page 3
→ 768 = page 4

The maximum number of pages that can be configured through the software is 4.

%R10 (40011) : 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 %R12 (40013), 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 %R12 (40013), 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

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Set	-	-	-	-	-	162	161	160	-	-	-	-	-	-	-	-

Enable Watchdog Event
Watchdog Event
Power-up Event

%R11 (40012) : DISPLAY OPTIONS
Through this register it is possible to set the brightness and contrast of the display.
These values can also be configured using the function buttons on the front of the display.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Descr.	----				Contrast (0÷15)				----				Brightness (0÷15)			

%R12 (40013) : WATCHDOG TIMER
Contains the value of the WatchDog timer expressed in seconds. If the WatchDog is enabled and the module does not receive commands for a time equal to the value contained in this register, the WatchDog alarm is triggered (see description in the "Procedures" section). The device return back from the alarm at the first command has been received.
- Manufacturer's default: 10 (10 sec)

%R15 (40016) : RESET TIMERS (ONLY DAT9550)
Each bit of this register is associated with the reset of the relative internal timer (register %R20). If the bit relative to a specific timer is set to 1 while it is active and before it reaches the end of the countdown, the timer count is reset and restarts from 0 msec. The reset timer bit will be automatically reset by the system.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Descr.	Reset Timers															
# Timer	T7	T6	T5	T4	T3	T2	T1	T0	T15	T14	T13	T12	T11	T10	T9	T8

%R16 (40017) : COM ERRORS
Counter of communication errors on the Master port. The value of this register is incremented each time a Modbus command is sent to the master port and no response is received.

%R17 (40018): GATEWAY MASK [L-H]
In this register it is possible to specify the range of modbus addresses that the controller can consider as valid in relation to the commands sent through its own Master port when used as a Gateway. When the controller operates as a gateway and it is in stop condition, if it sends queries to a device whose address is not included in the mask, the command will be ignored. This register, appropriately configured, can eliminate echo problems on the RS485 network. The Gateway Mask is ignored if the addresses are interrogated directly by the controller through an internal project.
- Manufacturer's default: 0 (0000 Hex)

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Descr.	Initial Address Mask								Final Address Mask							

%R18 (40019) : PORT 0 SET (RS485 Slave)
%R19 (40020) : PORT 2 SET (RS232)
In the upper part of this register it is possible to set the communication parameters (baud rate, parity and stop bit) relative to the serial port RS485 Slave (Port 0) and of the virtual serial port RS232 Slave (Port 2). The communication parameters are common for both Slave ports.
The lower part of the register is reserved for the Delay RX / TX of the slave port and indicates the time delay that the device waits before transmitting the response to the connected master unit. The value can be between 1 and 255 and is expressed in milliseconds.
- Manufacturer default: 38400 bps, parity NONE, stop bit 1, Delay RX / TX slave 1

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

Parity	P1	P0
None	0	0
Even	0	1
Odd	1	0

Stop bit	Sb
1	0
2	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

%R20 (40021) : TIMERS ENABLE

Each bit of this register is associated to an internal timer.
The timer starts to count when the relative bit is set to 0. After the time specified for the timer has expired (through the proper Function Block in Dev9k), the same bit is automatically forced to 1, indicating that the timer has expired.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Descr.	Timers															
# Timer	T7	T6	T5	T4	T3	T2	T1	T0	T15	T14	T13	T12	T11	T10	T9	T8

%R35 (40036) → %R926 (40927) : General Purpose (RAM)

These three blocks of registers are areas of RAM that can be used by the user for the construction of their projects. The user, through these registers can perform mathematical operations, logical operations or store data from external devices with the use of specific modbus functions (reading, writing). These registers can be written continuously.

ATTENTION: these registers reside in the RAM memory therefore, in the absence of power supply to the device, the contained values will be lost.

%R960 (40961) → %R1019 (41020) : Retentive Registers (EEPROM)

These registers reside in EEPROM and therefore called retentive. In case of a power supply failure, the value contained in these registers will not be lost. They are often used to store constants that are used in several function blocks during the making of the project by the Dev9k software or to store values that must be not continuously changed (from a SCADA, HMI or PLC).

ATTENTION: these registers reside in the EEPROM memory therefore they can not be used to be written continuously. If this happens, the EEPROM would be irreparably compromised because limited cycles of writing are allowed.

PROCEDURES

USING THE "INIT" FUNCTION

The "INIT" function allows you to set the device in the default configuration, regardless of the software programming performed.

The INIT function force RTU mode, parity NONE, 9600 baud rate, bit number = 8, stop bit = 1, address 1

- Switch off the device.
- Connect only the device to be programmed to the RS485 network (slave).
- Connect the INIT terminal to terminal V-.
- Turn on the device.

- Set the communication port with the following values
Mode = Modbus RTU
baud-rate = 9600 bps
parity = None
bit number = 8
stop bit = 1
- The form answers at 01.
- Read or program the desired settings using the Dev9k 2.0 software
- Switch off the device.
- Disconnect the INIT terminal from terminal V-.
- Set the communication port with the programmed baud-rate
- The module answers with the programmed address

NOTE: The default programming of the modules in production phase is as follows:
- Address: 01
- Baud-rate: 38400 bps
- Parity: None
- Stop bits: 1

It is possible to check the communication parameters set using also the function keys on the front of the display.

WATCHDOG

The module is provided with the Watchdog timer which, if enabled, triggers an alarm every time the communication between the module and the master remains inactive for a time longer than the specified one.
During the Watchdog alarm state, the *"Watchdog Event"* coil is set to 1. To exit the alarm condition, send any command to the device and reset the *"Watchdog Event"* coil.

BROWSING MENU AND CONFIGURATION

FUNCTIONAL MENU DAT9550

At any time you can access the following menus:
- "Config" menu: where it is possible to set the communication parameters of the device such as Modbus address and communication baud rate and the parameters for brightness and contrast adjustment for the display.
- "Preset" menu: where it is possible to set the values of the local variables selected by the user.

SOFTWARE CONFIGURATION

The graphic pages must be set using the Dev9K software version 2.0 and later.
To program the device, proceed as follows:
-Connect the serial cable on the Modbus Slave RS-485 port.
- Power the device.
- Run the program.
-Set the parameters and program the device (manual operating manual reference).

FUNCTION BUTTONS

In display mode of the graphic pages.

- Navigation between the graphic pages
Press the "Page Up" button (▲) to scroll through the graphic pages in descending order.
Press the "Page Down" button (▼) to scroll through the graphic pages in ascending order.
Note: if only one graphic page has been loaded, pressing the buttons will have no effect.

Access the system menus.

To access the system menus, hold down the **"Right"** button (➤) and press the **"Page Up"** button (▲).
The "Preset" menu appears. It is possible to modify the parameters of this menu or access the "Config" menu.

- Edit the parameters of the "Preset" menu.
Press the **"Page Up"** button (▲) to scroll up the list of parameters.
Press the **"Page Down"** button (▼) to scroll down the parameter list.

When the desired parameter has been selected, press the **"F4"** (Enter) button; the first character of the parameter will be illuminated.
Use the **"Page Up"** button (▲) to scroll the available characters in ascending order or the **"Page Down"** button (▼) to scroll through the characters in descending order. When the desired character is selected, press the **"Right"** button (➤) or **"Left"** (◄) to select the next character to be edited.
Press the **"F4"** (Enter) button to confirm the changes or press the **"F3"** (Esc) button to cancel the changes made.
At the end of the parameter modification, press the **"F3"** (Esc) button to return to the display mode of the graphic pages.

- Access the "Config" menu from the "Preset" menu.
This menu can only be accessed from the **"Preset"** menu.
With the **"Preset"** menu active, press the **"F1"** button to access the **"Config"** menu.
This menu shows the actual programming of the device for communication parameters, display appearance adjustment and status parameters.

The communication parameters that can be managed are the following:
Baud-rate: shows which communication baud rate has been set.
Address: shows which is the Modbus address set.
Note: when the device is in INIT condition the configuration parameters will be forced as Baud-rate = 9600 bps and Address = 10.
Warning: these parameters can be modified but it is important that they correspond to those selected in the Dev9K software setup menus, otherwise communication with the device will not be performed correctly and a "Time-out" error will occur.

The manageable display appearance adjustment parameters are as follows:
Brightness (Bright): shows in a scale from 1 (minimum brightness) to 15 (maximum brightness) what is the brightness level set on the display.
Contrast: shows in a scale from 1 (minimum contrast) to 15 (maximum contrast) what is the contrast level set on the display with positive display; in a scale of 16 (minimum contrast) to 31 (maximum contrast) what is the set contrast level of the display with negative display.

The status parameters displayed are as follows:
Firmware: shows the number of firmware identifying the display.
Input Type: shows the type of analog input set.
It is possible to change the type of analogue input following the procedure *"Edit the parameters of the Config menu"*

- Edit the parameters of the "Config" menu.

Press the **"Page Up"** button (▲) to scroll up the list of parameters.
Press the **"Page Down"** button (▼) to scroll down the parameter list.

When the desired parameter has been selected, press the **"F4"** (Enter) button; the numeric value of the parameter will be illuminated.
Use the **"Page Up"** button (▲) to scroll the parameter options in ascending order or the **"Page Down"** button (▼) to scroll through the parameter options in descending order.
Press the **"F4"** (Enter) button to confirm the changes or press the **"F3"** (Esc) button to cancel the changes made.
At the end of the parameter modification, press the **"F3"** (Esc) button to return to the display mode of the graphic pages.