

Introduction

For the correct management of a MODBUS network the master must know how to query each slave that is which kind of communication, which function codes and which addresses for the slaves and their parameters. In the present document all information for master configuration are given:

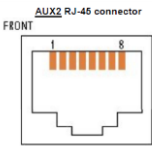
1. details about physical layer (RTU, baud rate etc.);
2. implemented function codes;
3. exchange parameters address map.

Address map is provided in the **DINUPS MODBUS MAP** table at the end of this document. For each parameters, the modbus address, the range, the scale factor and/ or offset and the default values are provided.

Electrical characteristics

The unit (DC-UPS) is configured as SLAVE in a MODBUS network. It complies with the following specifications:

1. Transmission mode: MODBUS RTU
2. Electrical Interface: RS485 half-duplex serial line
3. baud rate: 4800 / 9600 (default) /19200 /38400 bps
4. data format: 8 data bits
5. parity: even (default) / odd / none
6. stop bits: 1 (if parity **odd** or **even**) / 2 (if parity **none** has been selected)
7. slave address: configurable from 1 (default) to 247
8. termination: 120 Ohm
9. polarization: failsafe
10. cable: standard UTP RJ-45
11. connector type: RJ-45
12. connector name: AUX2
13. pin-out (fig. below): A = pin 2, B = pin 1, Common = pin 3



Summary of implemented modbus functions:

Function code 3 (0x03): Read Holding Register

Request

Function code	1 Byte	0x03
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Registers	2 Bytes	1 to 125 (0x7D)

Response

Function code	1 Byte	0x03
Byte count	1 Byte	2 x N*
Register value	N* x 2 Bytes	

*N = Quantity of Registers

Error

Error code	1 Byte	0x83
Exception code	1 Byte	01 or 02

Function code 6 (0x06): Write Single Register

Request

Function code	1 Byte	0x06
Register Address	2 Bytes	0x0000 to 0xFFFF
Register Value	2 Bytes	0x0000 to 0xFFFF

Response

Function code	1 Byte	0x06
Register Address	2 Bytes	0x0000 to 0xFFFF
Register Value	2 Bytes	0x0000 to 0xFFFF

Error

Error code	1 Byte	0x86
Exception code	1 Byte	01 or 02

Function code 16 (0x10): Write Multiple Register

Request

Function code	1 Byte	0x10
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Registers	2 Bytes	0x0001 to 0x007B
Byte Count	1 Byte	2 x N*
Registers Value	N* x 2 Bytes	value

*N = Quantity of Registers

Response

Function code	1 Byte	0x10
Starting Address	2 Bytes	0x0000 to 0xFFFF
Quantity of Registers	2 Bytes	1 to 123 (0x7B)

Error

Error code	1 Byte	0x90
Exception code	1 Byte	01 or 02

Functional characteristics

Slave waits for a request from master. Master requests may be "unicast" (addressed to 1 slave only) or "broadcast" (addressed to all slaves simultaneously).

When a request is received, the slave checks the packet before performing the action requested in the packet. Different errors may occur: format error in the request, invalid action, etc... In case of error, a reply is sent to the master.

Once the required action has been completed, a unicast message requires that a reply must be formatted and sent to the master. If the slave detects an error in the received frame (frame error or invalid address), no response is returned to the master.

Broadcast requests may be only write requests; no response is returned to the master.

Parameters are classified in 6 categories:

1. communication
2. monitor
3. alarms
4. history
5. configuration
6. events

Some of configuration parameters may be set by using both HW (by jumper, trimmer and time buffering selector) and SW. The unit remains configured as "stand-alone" and uses HW settings (jumpers, trimmer etc.) until, after power-on, it receives a valid unicast request. At the first valid request it responds and configures itself as "slave" using MODBUS parameters and ignoring HW settings.

NOTE – When the unit works as slave, "BATTERY CHARGING LEVEL" trimmer MUST be turned all clockwise in position MAX, because the maximum charging current is set only by modbus master via SW; the trimmer limits only the absolute maximum value of charging current (ex. 20A for CBI2420A).

All parameters that slave exchanges with master are 16 bit MODBUS Holding Registers (HR), with address range 40001-40114. Only registers present in the **DINUPS MODBUS MAP** table at the end of this document are used, the other ones always read 0. HR are used in 3 different ways:

1. Analog value: in some cases such value is to be scaled by multiplying the register content by a fixed multiplier (ex. battery voltage and current).
2. Digital value: binary variable (ex. Alarm flag).
3. Mode or state Indicator: ex. The states of the finite state machine of the system, which may assume a limited set of values .

The 3 Modbus functions for HR management are supported:

1. function code 3: read holding register
2. function code 6: pre-set single register
3. function code 16: pre-set multiple register

Communications parameters settings

Devices are configured for communications at 9600 bps with even parity and one stop bit by default. The permissible slave address range is: 1-247. The address must be unique for every slave present in Modbus network. Parameter 0 (HR 40001) stores the address of the slave unit. Default value for this parameter (that is slave address factory setting) is: 1.

It is possible to modify this value writing the new desired value (1-247) to HR40001. We detail step-by-step the slave address configuration procedure below:

1. connect the slave unit with default address 1 alone with master, disconnecting every other possible slave unit, in order to avoid addressing conflicts;
2. master sends to slave the new desired address at holding register 0 (40001);
3. henceforth, master queries the slave at the new address, and slave accepts unicast queries only at such address;
4. master can force slave address storage in slave non-volatile memory by setting "save to flash" parameter, so that slave preserves its address at next power-on;
5. after such address configuration it is possible to connect every other slave unit already configured.

Similarly it is possible to modify serial communication default settings (baud rate and parity), that are stored at addresses 1 (HR 40002) and 2 (HR 40003). Obviously, if this last are modified, master must query the slave using such modified settings. Notice that in the case where parity none is selected in HR 40003, the master must be configured for communications with two stop bits instead of one.

Restoring communications parameters to factory settings

However, there is the possibility to force factory settings restoration of communication parameters (0-2: slave address, baud rate, parity) by means of an exclusively HW procedure (in the case where current slave settings memory is lost). We detail step-by-step restoration procedure below:

1. switch off slave unit: disconnect AC mains and battery;
2. turn "TIME BUFFERING" selector in position 7;
3. turn "BATTERY CHARGING LEVEL" trimmer all counter clockwise in position MIN;
4. press "BATTERY START" button and then switch on slave unit connecting AC mains or battery;
5. keep pressed "BATTERY START" button for 10 seconds; during these 10 seconds the 3 LEDs stay steady ON; at the end of these 10 seconds all 3 LEDs (together with 2 relays) switch off and switch on again sequentially for 3 times, and then the unit starts up with default communication settings restored;
6. henceforth, "TIME BUFFERING" selector and "BATTERY CHARGING LEVEL" trimmer are available again for their standard function;

NOTE – If during the 10 seconds "BATTERY START" button is released or "TIME BUFFERING" selector or "BATTERY CHARGING LEVEL" are changed , the unit starts up immediately (without 3 LEDs triple blinking) and communication settings remain the previous ones; the factory ones are NOT restored.

Restoring configuration parameters to factory settings

Whatever the current set of values of parameters, there is the possibility of restoring factory settings of configuration parameters by means of a SW command. Configuration parameters factory settings are stored in slave non-volatile memory and are activated every time the master sends to the slave the "Factory settings" command. Then, the master can send "Save to flash" command to save these settings again in slave non-volatile memory.

DINUPS MODBUS
Map

Modbus Address	Value	Meaning	Default	Range	Scale factor/offset	Unit	Notes	Read/Write
40001	Address	Address of slave unit	1	1-247				Read/write
40002	Baudrate	Baud rate for serial communication	9600	4800/19200/38400		bps		Read/write
40003	Parity	Parity bit for serial communication (0=None, 1=odd, 2=even)	2	0-2				Read/write
40005	Charge state	State of charge algorithm: 0=None / 1=Recovery / 2=Bulk / 3=Absorption / 4=Float state		0-4				Read only
40006	State DC-UPS	1=Charge / 0=backup state		0-1				Read only
40007	Nominal V output	Shows output nominal voltage: 12 / 24 / 48		12/24/48		V		Read only
40008	Output battery1	Voltage battery1		0-65535		mV		Read only
40014	Charge current battery 1	Charge current battery 1		0-65535		mA		Read only
40017	Discharge current battery 1	Discharge current battery 1		0-65535		mA		Read only
40023	Charge level battery 1 (open Lead ,seal lead, AGM)	Charge level battery 1 (scale factor: 0,1; ex: 800=80%)		0-1000	scale factor: 0,1	%		Read only
40026	Temp Battery 1	Temperature Battery 1 (offset: 20°C; ex. 0=-20°C, 20=0°C)		0-90	offset: +20°C	C°		Read only
40029	Temp on board	Temperature inside the charger (offset: 20°C; ex. 0=-20°C, 20=0°C)		0-90	offset: +20°C	C°		Read only
Battery alarm								
40032	Battery Alarm 1	bit0=Inverted, bit1=not connected, bit2=C.C element, bit3=sulphated element/not good connections, bit4=boost				bit 15 bit 0	bitx=1->alarm	Read only
Voltage battery alarm								
40035	Battery 1	bit0=High voltage / bit1=low voltage (backup under 1,83V/cell)/ bit2=low voltage (battery start under 1,5V/cell)				bit 15 bit 0	bitx=1->alarm	Read only
Load alarm								
40038	Load Alarm 1	Short circuit , overload		0-1			1=alarm	Read only
System Alarm								
40043	Failure inside the charger	bit0=Internal failure in battery 1, bit1=not used, bit2=not used, bit3=Life test not possible in battery 1, bit4=not used, bit5=not used		0-1		bit 15 bit 0	bitx=1->alarm	Read only
40044	Failure sensor temperature	bit0=Temperature sensor failure in battery 1, bit1=not used, bit2=not used					bitx=1->alarm	Read only
40046	AC power input	0=Mains/1=No mains		0-1			1=alarm	Read only
40047	On board temperature Alarm	1=Temperature on board too high		0-1			1=alarm	Read only
Charger								
40048	Charge cycles	Number of completed cycles		0-65535			write only 0 (reset)	Read/write
40049	Charge cycles	Number of aborted charge cycles		0-65535			write only 0 (reset)	Read/write
40050	Ah charged	Total Ampere hours charged: scale factor 0,1 (ex. 1000=100Ah)		0-65535	scale factor 0,1	Ah	write only 0 (reset)	Read/write
40051	Total run time	Total run time in charger mode		0-65535		min	write only 0 (reset)	Read/write
40056	Temperature on board	Number of temperature shutdowns		0-65535			write only 0 (reset)	Read/write
40057	Main/backup	Number of mains or backup cycles		0-65535			write only 0 (reset)	Read/write
40058	boost	Number of boost cycle		0-65535			write only 0 (reset)	Read/write
General								
40066	Factory settings	Set the default factory value for configuration parameters	0	0-1			write only 1	Read/write
40067	Product name	Name of device (0=DCUPS480W, 1=SFP126-245A, 2=CB CYCLIC, 3=CBI NAUTIC)		0-3				Read only
40068	DC UPS/CB	Set the function CB / DC UPS	0	0-1				Read/write
Charge current								
40072	Maximum current	Set the maximum charging current allowed		0-35000 / 0-20000 / 0-10000		mA	12V / 24V / 48V	Read/write
40073	Bulk voltage	Setting max bulk voltage for Cell	2400	0-2500		mV/cell		Read/write
40074	Max. bulk timer	Maximum bulk timer	10	0-24		h		Read/write
40075	Min. bulk timer	Minimum bulk timer	120	0-240		sec		Read/write
40076	Max Bulk timer start voltage	Starts bulk timer	1830	0-2200		mV/cell		Read only
Absorption setting (open Lead ,seal lead, AGM)								
40077	Abs. Voltage	Absorption voltage	2375	0-2500		mV/cell		Read/write
40078	Max absorption	Maximum absorption timer	5	0-24		h		Read/write
40079	Min absorption	Minimum absorption timer	15	0-240		min		Read/write
40080	Return amps	Return amps (% of maximum charge current)	6	0/50		%		Read/write
40081	Return amps tim	Return amps timer	30'	0/240		sec		Read/write
Float setting (open Lead ,seal lead, AGM)								
40082	Float voltage	Float voltage	2230	0-2500		mV/cell		Read/write
40083	Force Bulk charge	1=force the bulk charge, 0=force the float charge	0	0-1				Read/write
40084	Return to bulk	Return to bulk voltage	2000	0-2200		mV/cell		Read/write
40085	Return to bulk	Return to bulk time delay	30	0-240		sec		Read/write
Traction (open Lead ,seal lead, AGM)								
40086	Traction Bulk	Traction bulk voltage	40	0-50		mV/cell		Read only
Battery Type/test battery								
40091	Lead/AGM/NiCd/NiMH	Setting algorithm: 0=openLead (2,23V/cell), 1=seallead (2,25V/cell), 2=AGM(2,3V/cell), 3=NiCd-NiMH (algorithm -AV)	0	0-3				Read/write
40092	Setting life test	Life test function ON(=1)/OFF(=0)	0	0-1				Read/write
Various								
40104	Time buffering	Time buffering for buck-up	no time	0-65535		sec		Read/write
40105	Battery capacity	Nominal capacity of battery	500	0-65535	scale factor: 0,1	Ah		Read/write
40114	Save to FLASH	Saves current configuration in slave non-volatile memory					write only 1	