User Manual

Revision 2.000
English

Gateway / Bridge
CANopen to Modbus RTU Slave

(Order Code: HD67002)

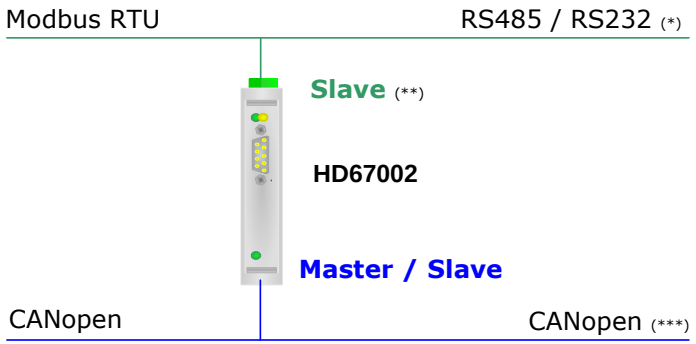
for Website information:
www.adfweb.com?Product=HD67002

for Price information:
www.adfweb.com?Price=HD67002

Benefits and Main Features:

- Very easy to configure
- Low Cost
- Master/Slave CANopen
- Slave Modbus
- Galvanic isolation
- Industrial temperature range:
  -30°C / 70°C (-22°F / 158°F)

Logical Scheme



(*) for Ethernet TCP/IP, See: www.adfweb.com?Product=HD67004
(**) for ModBus, See: www.adfweb.com?Product=HD67002
(***) for other CANBus protocol, See: www.adfweb.com?Product=HD67001

Similiar Products

Benefit

For others Gateways / Bridges:
CANopen to Modbus
See also the following links:
www.adfweb.com?Product=HD67001 (Modbus RTU Master)
www.adfweb.com?Product=HD67004 (Modbus TCP Master)
www.adfweb.com?Product=HD67005 (Modbus TCP Slave)

For others Gateways / Bridges:
For **CAN bus 2.0A** and/or **CAN bus 2.0B** to **Modbus**
See also the following links:
www.adfweb.com?Product=HD67011 (Modbus RTU Slave)
www.adfweb.com?Product=HD67012 (Modbus RTU Master)
www.adfweb.com?Product=HD67014 (Modbus TCP Slave)
www.adfweb.com?Product=HD67015 (Modbus TCP Master)

Do you have an your customer protocol?
See the following links:
www.adfweb.com?Product=HD67003

Do you need to choose a device? do you want help?
Ask it to the following link:
www.adfweb.com?Cmd=helpme

INDEX:

UPDATED DOCUMENTATION:

Dear customer, we thank you for your attention and we remind you that you need to check that the following document is:

- Updated
- Related to the product you own

To obtain the most recently updated document, note the "document code" that appears at the top right-hand corner of each page of this document.

With this "Document Code" go to web page www.adfweb.com/download/ and search for the corresponding code on the page. Click on the proper "Document Code" and download the updates.

To obtain the updated documentation for the product that you own, note the "Document Code" (Abbreviated written "Doc. Code" on the label on the product) and download the updated from our web site www.adfweb.com/download/

REVISION LIST:

Revision	Date	Author	Chapter	Description
1.000	09/07/2004	Mt	All	First release version
1.005	19/06/2005	Ddt	All	documentation code changed
1.006	22/06/2007	Av	All	Revision
1.100	26/06/2007	Av	All	Software changed
2.000	05/06/2007	Av	All	New document format

WARNING:

ADFweb.com reserves the right to change information in this manual about our product without warning.
ADFweb.com is not responsible for any error this manual may contain.

TRADEMARKS:

All trademarks mentioned in this document belong to their respective owners.

CHARACTERISTICS:

The Configurable CANopen Modbus RTU Slave Gateway allows the following:

- two-directional information between networks CANopen and ModBUS
- electrical isolation between two BUSes
- to write SDO from ModBUS Word
- to read SDO from ModBUS Word
- to read EMCY from ModBUS Word
- to read PDO from ModBUS Word
- Communication Serial RS232/485
- Temperature range -30°C to 70°C

The Gateway can be configured up to a maximum 1600 SDO.

While the maximum number of the following:

- EMCY
- EMCY Word
- PDO
- Store PDO

Depend on the available memory of the Gateway and the number defined SDO.

CONNECTION SCHEME:

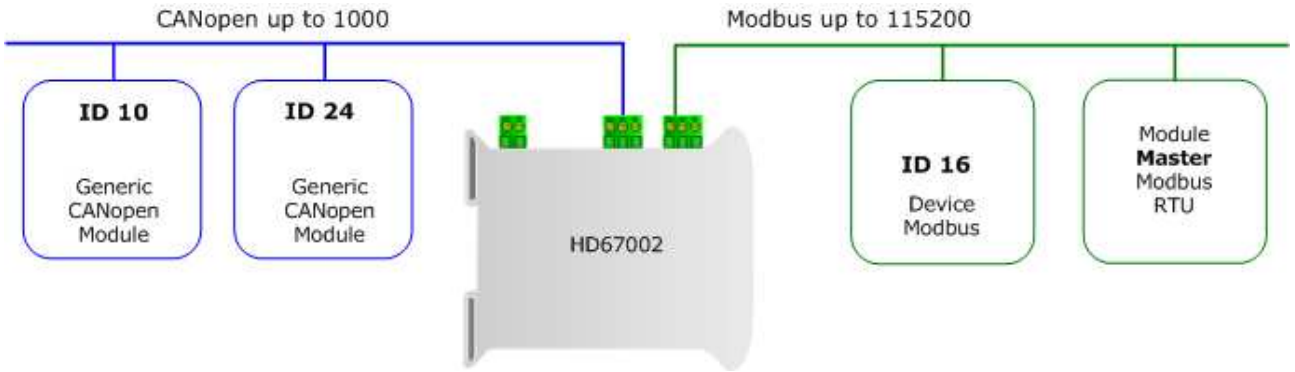


Figure 1: Connection scheme of HD67002 between a CANopen and Modbus TCP

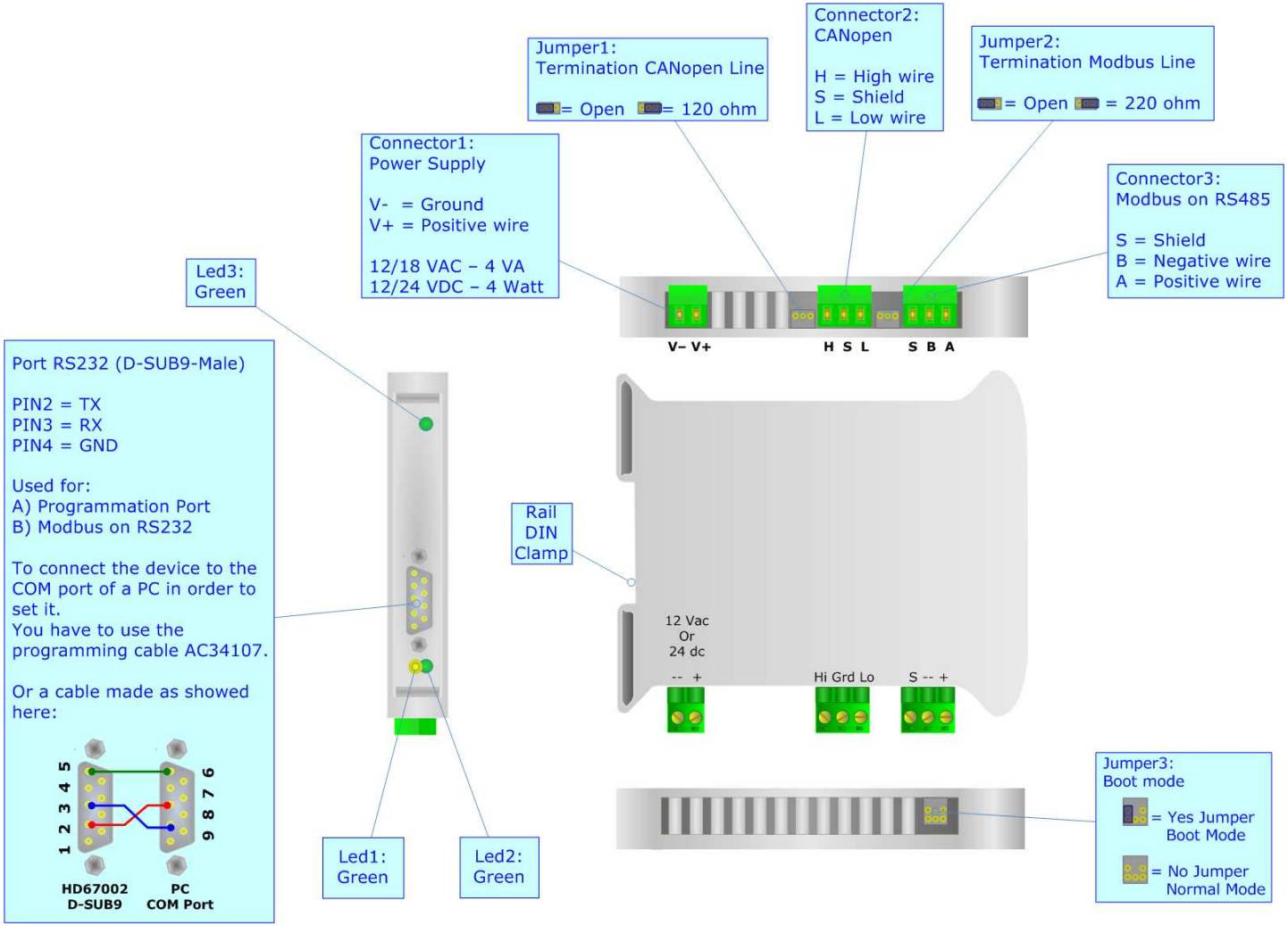


Figure 2: Connection Scheme for HD67002

CONFIGURATION:

The "Gateway CANopen to Modbus", allows a CANopen network to communicate with a Modbus network.

You need Compositor SW67002 software on your PC in order to perform the following:

- Define that the SDO of the CANopen are accessible from Modbus.
- Define how to update SDO in CANopen from Modbus.
- Define that the EMCY of the CANopen are accessible from Modbus.
- Define how and which EMCY generated in CANopen can be filtered.
- Define which and how the PDO of CANopen are accessible from Modbus.
- Update the new configurations of the device.
- Save, duplicate, modify, export the configurations.

USE OF COMPOSITOR SW67002:

To configure the Gateway, use the available software that runs with Windows, called SW67002.
(The SW67002 is downloadable on the site http://www.adfweb.com/home/download/download.asp)

When launching the SW67002 the right window appears:

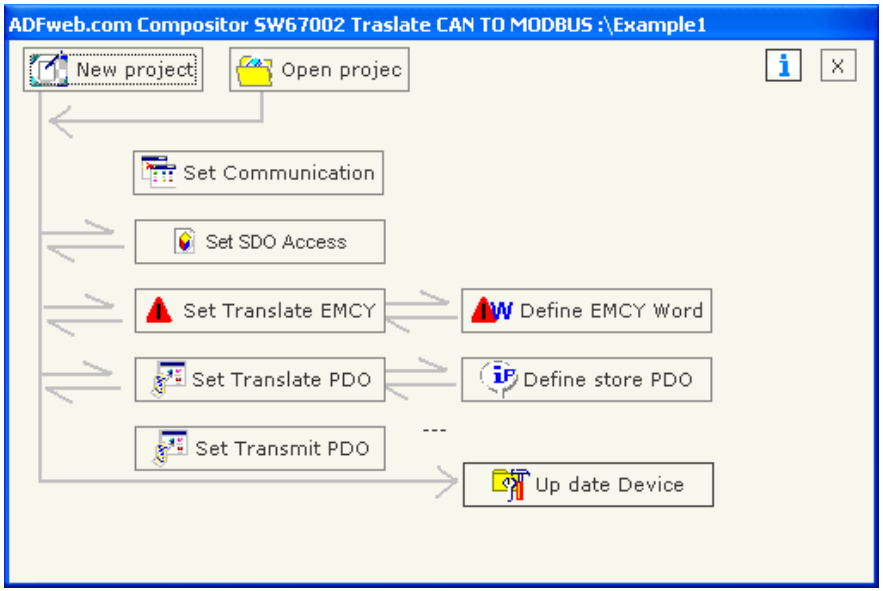


Figure 3: Main window for SW67002

The following explains the function of the buttons:

NEW PROJECT / OPEN PROJECT:

The "New Project" button creates the folder which contains the entire device configuration.
A device configuration can also be imported and exported:

- To clone the configurations of a Programmable CANopen to Modbus Gateway in order to configure another device in the same manner, it is necessary to maintain the folder and all its contents.
- To clone a project in order to obtain a different version of the project, it is sufficient to duplicate the project folder with another name and open the new folder with the button "Open Project".

When a new project is created or an existent project is open, it will be possible to access the various configuration sections of the software:

- **"Set Communication"**
- **"Set SDO Access"**
- **"Set Translate EMCY"**
  - Otherwise the **Define EMCY Word**
- **"Set Translate PDO"**
  - Otherwise the **Define Store PDO**

SET COMMUNICATION:

This section defines the fundamental communication parameters of two Buses, CANopen and Modbus**.**

By pressing the "Set Communication" button from the main window for SW67002 (Fig. 3) the window "Set communication" appears (Fig. 4):

- In the fields "DevID", the Gateway address is defined in the respective CANopen and Modbus;
- In the fields "Baud Rate", the velocity of the two Buses are defined;
- The check box "Set Operational State at Start-Up" is used to set the operational state of the device at start-up;
- The check box "Network Start at Start-Up" is used to send the command of the operational to the CANopen Network (i.e. when the device start up sen at Modbus Network a command and all device is in operational);
- The check box "Can Start on Modbus Command" is used for send the Modbus command (sender word) of Operational/Pre-Operational State to one or all devices in CAN network.
  - The sender word must have:
    - The high byte with the value of 1 for Operational or 2 for Pre-Operational.
    - The low byte must have the address of the device that is commanded to do the action (Operational/PreOperational)
      - Example if you want to set the state of Operational to the device canopen with address 3, You must write the word "259" in the field "Add. Word Modbus". Note: 257=0x01.11.
    - If the field "Add. Word Modbus" you can set 0, then this action commands all the devices.
- The Gateway has two alternative for PDO: 15RPDO and 3RPDO or 8 RPDO and 8 TPDO. Select the desired choice.
- The Gateway has two alternative outlets from the Modbus side: RS485 or RS232. Select the desired choice;
- In the field "Parity", the serial parity is defined;
- "SDO Timeout" is the maximum time that the device attends for the answer from the Slave interrogated;
- Data bits and Stop bits, are a serial parameter and they are fixed in order at 8 and 1 for default.

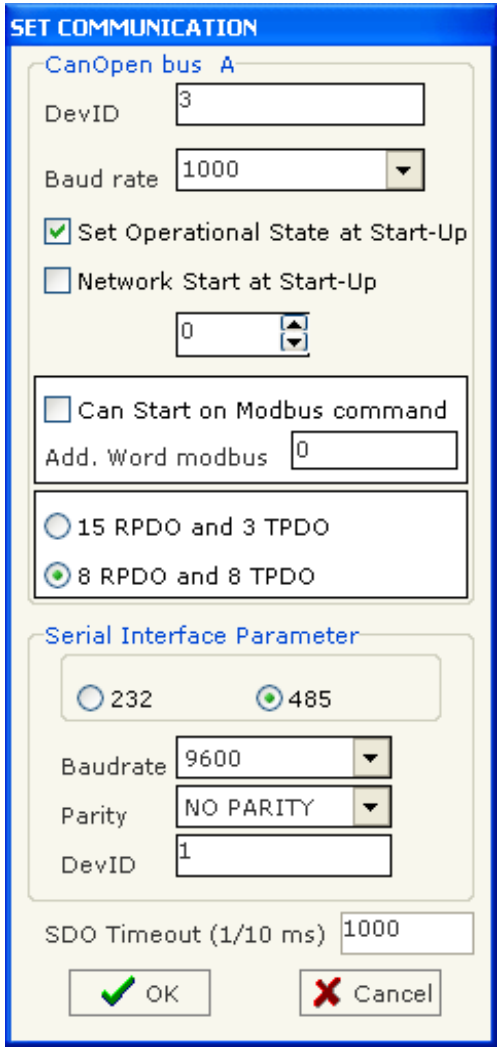


Figure 4: "Set communication" window

SET SDO ACCESS:

Section "Set SDO Access"

The following objects can be defined within the section "Set SDO Access":

- the SDO of the CANopen are accessible from a word ModBUS.
- Which word of the ModBUS are accessible from a SDO of the CANopen.

By pressing the "Set SDO Access" button from the Main Window for SW67002 (Fig. 3)
the window "SDO" appears (Fig. 5).

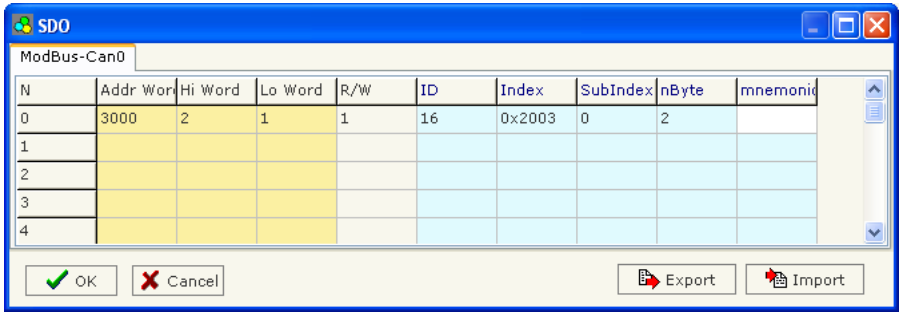


Figure 5: "SDO" window

The data of the columns have the following meanings:

- In the field "Addr Word" insert the address of the SDO that supports the ModBUS word;
- In the field "Hi Word" insert the correspondence between the high byte of the ModBUS word and a SDO byte (note: its number can be 0, 1, 2, 3, 4)
  - 1 = First byte of the SDO;
  - 2 = Second byte of the SDO;
  - 3 = Third byte of the SDO;
  - 4 = Fourth byte of the SDO;
  - 0 = No byte.
- In the field "Lo word" insert the correspondence between the low byte of the ModBUS word and a SDO byte (note: its number can be 0, 1, 2, 3, 4)
  - 1 = First byte of the SDO;
  - 2 = Second byte of the SDO;
  - 3 = Third byte of the SDO;
  - 4 = Fourth byte of the SDO;
  - 0 = No byte.
- In the field "R/W" insert number "0" if the SDO is only in reading or insert number "1" if the SDO is also in writing;
- In the field "ID" insert the address of the CANopen device;
- In the fields "index", "SubIndex" are the coordinates of the SDO in the CANopen;
- In the field "nbyte" indicates the length of the SDO.

Example 1:

If you want to write data in the form of SDO in the CANopen from the ModBUS network on the device at the address:

- Address 16
- Index 0x2003
- Subindex 0
- By dimensions 2 bytes
  By the following word ModBUS
- Addr Word 3000

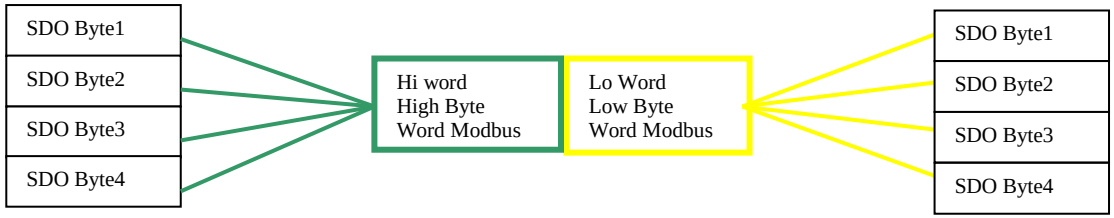


Figure 6: Scheme of the word configuration

In the above scenario (Fig 5):

The Modbus master can read or write (note RW=1):

- to the address of the ModBUS side Gateway slave (note the one specified in the "Set communication")
- to the word ModBUS 3000 (note: Addr word 3000)
- the first byte of the SDO found in the low byte of the ModBUS word (note: Lo Word=1)
- the second byte of the SDO found in high byte of the ModBUS word (note: Hi Word=2)

The SDO:

- two byte dimension (note: nByte=2)
- belonging to a CANopen device ID 16 (note: ID=16)
- of the following coordinates: Index 2003 and Subindex 0

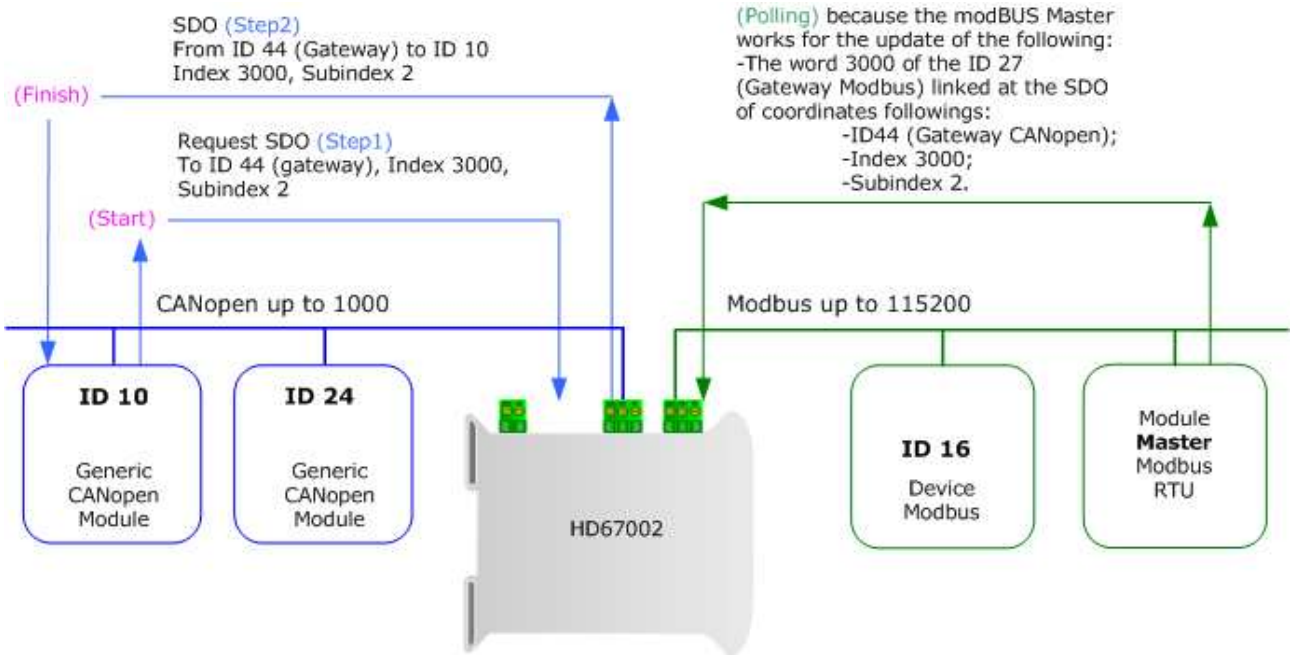


Figure 7: Chart of SDO request from Modbus side.

CONFIGURATION EMCY:

By pressing the "Set Translate EMCY" button from the Main Window for SW67002 (Fig. 3)

The window "Set Translate EMCY" appears (Fig. 8):

Below a figure to exemplification (Fig. 9):

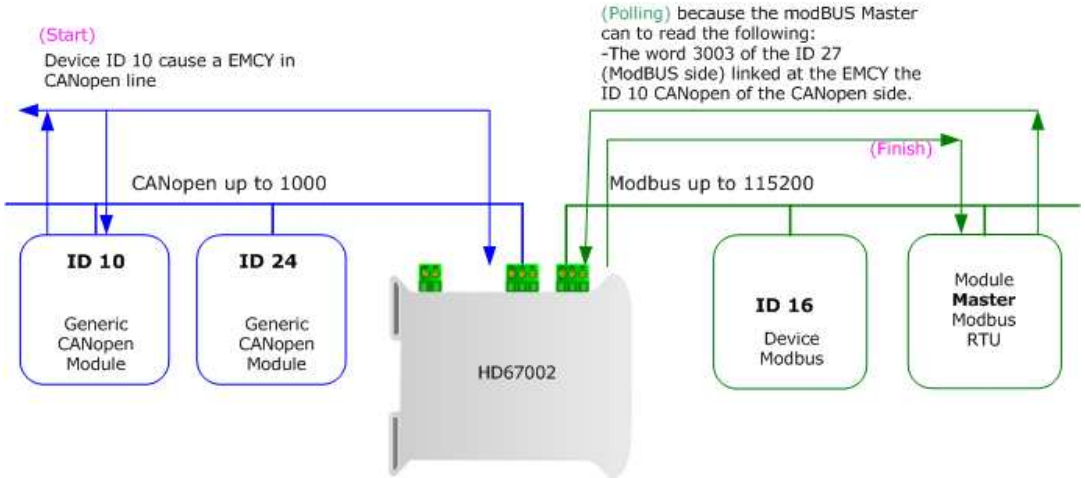


Figure 9: Chart of diffused EMCY in Modbus from CANopen.

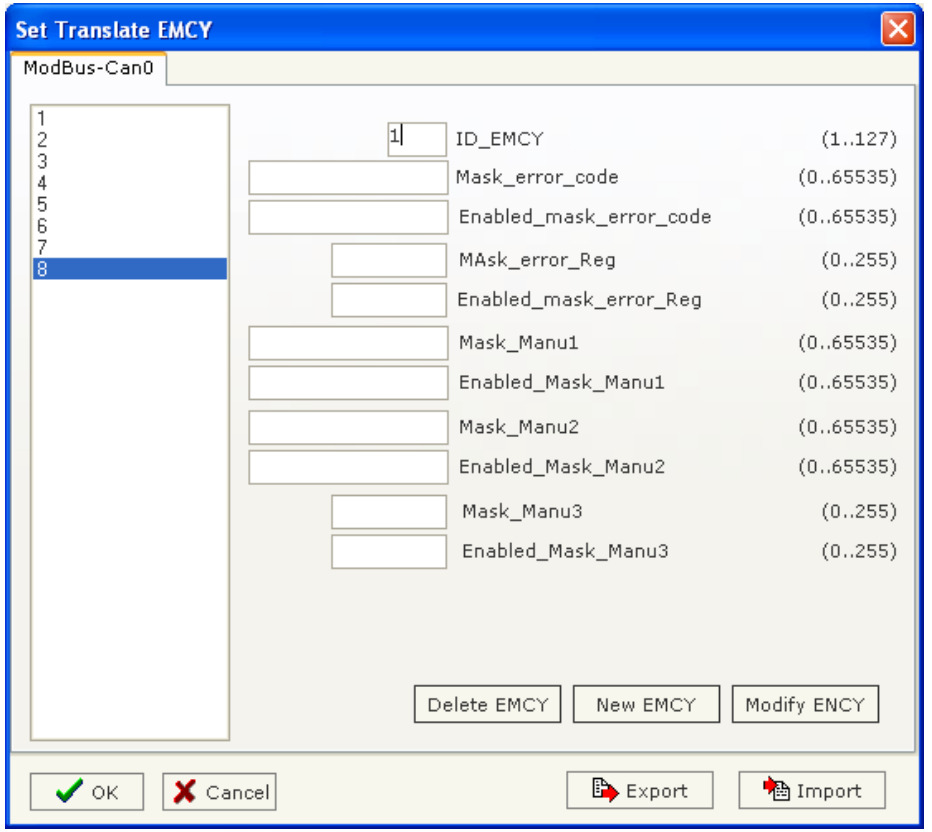


Figure 8: "Set Translate EMCY" window

CREATION OF AN EMCY:

In order to intercept the EMCY of a device, it is necessary to first define the EMCY and then fill in the window "SET Translate EMCY" as desidered.
Use the button "New EMCY" to define a new EMCY.

Packet CAN of the EMCY. How it result from registers structure (see left)

COB	ID of the propagation device
BYTE 1 = Error_code **(Low)**	
BYTE 2 = Error_code **(hight)**	
BYTE 3 = Error_reg	
BYTE 4 = Manu 1 **(Low)**	
BYTE 5 = Manu 1 **(hight)**	
BYTE 6 = Manu 2 **(Low)**	
BYTE 7 = Manu 2 **(hight)**	
BYTE 8 = Manu 3	

DEFINING STRUCTURE OF THE EMCY REGISTERS:

Reg.	Description	Filter Mask Gateway	Dimension Register
1	ID	ID_EMCY	7 bit
2	Error_code	Mask_Error_Code	16 bit
3	Error_reg	Mask_Error_Reg	8 bit
4	Manu1	Mask_Manu1	16 bit
5	Manu2	Mask_Manu2	16 bit
6	Manu3	Mask_Manu3	8 bit

TRANSLATION OF AN EMCY FROM CANOPEN TO MODBUS:

In order to intercept the EMCY of the device, it is necessary:

- push the "New EMCY" button at the bottom of the window, "SET Translate EMCY" .
- complete the field "ID_EMCY" with the CANopen device address whose EMCY you wish to intercept.
- Put the following zero values in the fields:
  - "**Enable_Mask_Error_Code"** = 0,
  - "**Enable_Mask_Error_Reg"**= 0,
  - "**Enable_Mask_Manu1**" = 0,
  - "**Enable_Mask_Manu2**" = 0,
  - "**Enable_Mask_Manu3**"= 0,

These operations enables the Gateway:

- to intercept all the EMCY coming from devices with the specific address from "ID EMCY" in the CANopen BUS.
- And the possibility to register the EMCY in a word on the ModBUS side of the Gateway.

EXAMPLE OF FILTER SETTINGS FOR THE EMCY:

ACTION:
The device of the ID 10 BUS generates an EMCY. The Gateway individualizes and memorizes it in a ModBUS Word.

CONSEQUENCE:
The Gateway (ID 27 on the ModBUS) verifies the set conditions on the window "Define EMCY word". Then it memorizes part of the EMCY coming from the CANopen BUS in a readable word from the ModBUS.

EXAMPLE OF THE CONDITION:
The translation must be done when the ERROR CODE register of the generated EMCY takes the value, for example = 0x0B15.
In this case, the message must be translated from CANopen BUS where it is available under the form of ModBUS Word (Note: the filter functions therefore in all other cases).

Therefore: **(see EMCY structure and the corresponded CAN Package)**
"Error Code"= 0x**0B15**

Means when:
Byte1 = **00001011** Byte2 = **00010101,**

In this case the following fields are inserted in the window **"SET Translate EMCY"**:

- ID_EMCY = **10**
- Mask_Error_Code = 0x**0B15** **(0000101100010101)**
- Enable_Mask_Error_Code (**1111111111111111) (All the BITS of Error Code will be examined).**

(Note: the window "SET Translate EMCY" accepts decimal and hexadecimal values in the format with the prefix "0x" or "$").

SPECIFIC LIMITATION OF THE FILTER MASK:

ACTION:
We want the EMCY to translate if:
Its "Error Code" Register has the value 0x007C or
Its "Error Code" Register has the value 0x0063, or
Its "Error Code" Register has the value 0x0062

(Note: the OR operations in all above conditions)

CONSEQUENCE:
The Gateway can transmit the EMCY only with values that raise the same bits, but in this case the messages also transmits with other specific conditions.

MOTIVE:

1° valore di Error_Code per traslare EMCY	0x007B = 0000 0000 011**1 1**01**1**
2° valore di Error_Code per traslare EMCY	0x0063 = 0000 0000 011**0 0**01**1**
3° valore di Error_Code per traslare EMCY	0x0062 = 0000 0000 011**0 0**01**0**

Enable_Mask_Error_Code to activate the comparison	1111 1111 111**0 0**11**0**
Mask_Error_Code to compare	0000 0000 0110 0110

The Mask must be calculated by doing the operations NOT XOR BIT to BIT of all values to be intercepted.

Instead, the activation must be calculated by doing the operations AND BIT to BIT of all values to be intercepted..

And so all the EMCY that will have the following "ERROR CODE" values, they will transmit.

0x0062 = 0000 0000 011**0 0**01**0**
0x0063 = 0000 0000 011**0 0**01**1**
0x006A = 0000 0000 011**0 1**01**0**
0x006B = 0000 0000 011**0 1**01**1**
0x0072 = 0000 0000 011**1 0**01**0**
0x0073 = 0000 0000 011**1 0**01**1**
0x007A = 0000 0000 011**1 1**01**0**
0x007B = 0000 0000 011**1 1**01**1**

Note how the BITS that are undetermined, create the extra EMCY values.

SUMMARY OF THE EMCY FILTER:

The EMCY generated by the device and the respective filter for Gateway are composed of the following:

- 5 Registers (Error_Code, Error_Reg, Manu1, Manu2, Manu3 respectively 16, 8, 16, 16; 8 BIT).
- 5 masks used to compare the 5 registers, of course, of the same dimension in BITS as the registers (respectively mask_eq_ec, mask_eq_er, mask_eq_m1, mask_eq_m2, mask_eq_m3)
- 5 activations BIT to BIT of the masks ((Enable_Mask_Error_Code, Enable_Mask_Error_Reg, Enable_Mask_Manu1, Enable_Mask_Manu2, Enable_Mask_Manu3, respectively 16, 8, 16, 16; 8 BIT)

CONSIDERATIONS:

When all BITS of all activation registers are at zero, all EMCY are transmitted by the filter, because there is not a single BIT that actives the comparison (BIT to 1). This is true for any value of entering data (5 EMCY registers generated) and for any mask value.

CONFIGURATIONS EMCY WORD:

Section "Define EMCY Word"

THE ROLE:
We mentioned that an EMCY from BUS A can pass (filter permitting) to BUS B. In this case on the ModBUS Side.

NECESSITY:

After having transmitted the filter coming from CANopen, an EMCY remains available on the MosBUS Side of the Gateway. Therefore any ModBUS device can verify the EMCY conditions.

SOLUTION:
The Gateway acts as SDO server for the ModBUS.
The EMCY coming from CANopen gets reduced in a ModBUS word dimension of two bytes.

DEFINITIONS OF A EMCY WORD:

By pressing the "Define EMCY word" button from the Main Window for SW67002 (Fig. 3)
the window "EWMCY" appears (Fig. 10):

Steps for the definition of an EMCY Word:

- to create a word, use the "New " button in the window "Define EMCY Word"
- In the fields "Index SDO BUS B" and "SubIndex SDO BUS B", insert the coordinates of the SDO of the BUS B, where it is possible for the BUS B device to access a part of the last EMCY which came from a particular device of BUS A
- In the field "ID EMCY BUS A" the ID of the device that generates the EMCY of BUS A is inserted
- Now write each of the 16 BITS of the EMCY Word.

Writing the 16 BITS of the EMCY WORD:

Each EMCY Word is composed of the 16 BITS. Each bit is obtained by using the masks provided by the EMCY package. (Note: see the above structure of the EMCY package)

- Mask1 (Range 0..255)
- Pointer1 (Range 0.. 8)
- Mask2 (Range 0 ..255)
- Pointer2 (Range 0..8)

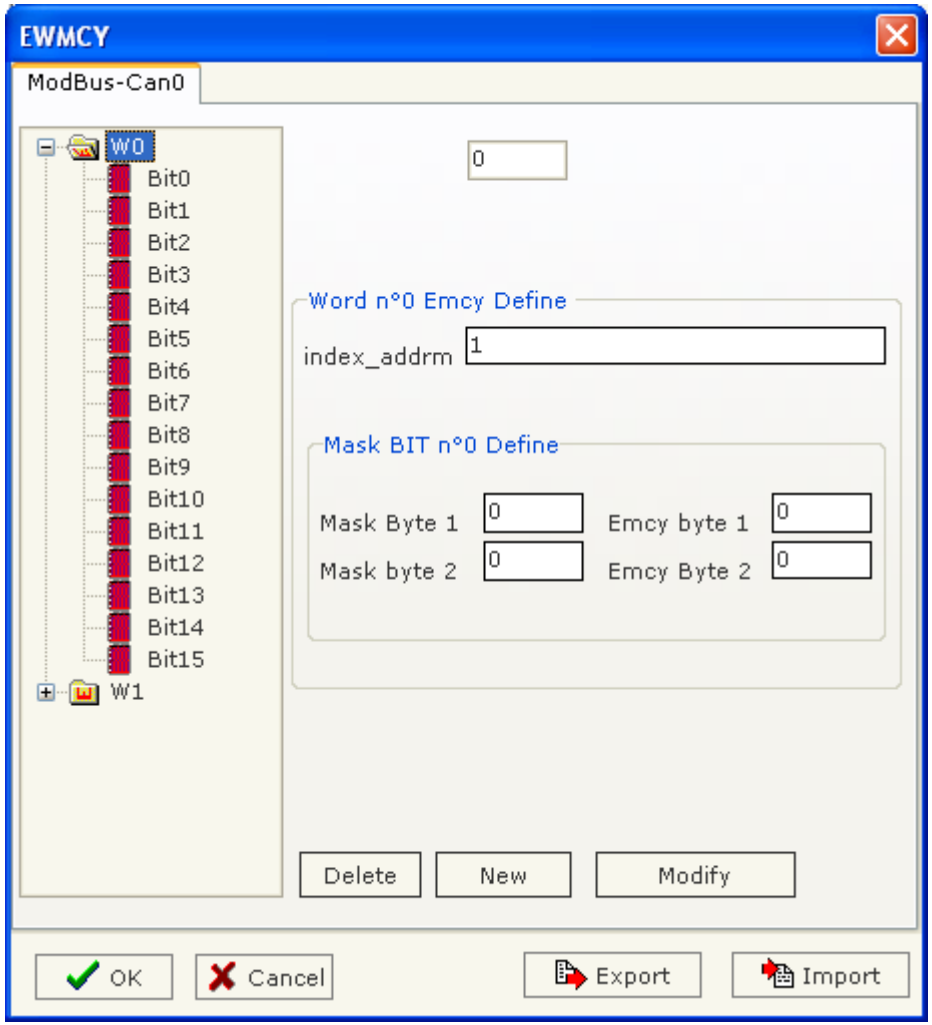


Figure 10: "EWMCY" window

The pointers 1 and 2 indicated which byte of the entering EMCY is to be examined.
The selected bytes by the pointers are put in AND with their respective masks.
The 0 or 1 result gets inserted in to the defined EMCY Word in the established binary position

Packet EMCY that was generated in the CAN

COB	ID **10**
BYTE 1 = Error Code	
BYTE **2** = Error Code	
BYTE 3 = Error reg	
BYTE 4 = Manu 1	
BYTE 5 = Manu 1	
BYTE **6** = Manu 2	
BYTE 7 = Manu 2	
BYTE 8 = Manu 3	

Pointer1 **BIT4** = **2** (Byte n°**2**)

Pointer2 **BIT4** = **6** (Byte n°**6**)

BYTE **2** = Error Code **(LW)**

AND

Mask1 **BIT4**

AND

BYTE **6** = Manu 2 **(HI)**

AND

Mask2 **BIT4**

=

1/0

1	2	3	4	5	6	7	8	9	10	.....	16
BIT MAP of the selected EMCY Word											

EMCY Word: how it is available in the ModBUS

NOTE:
if Pointer 1 >< 0 and Pointer 2 >< 0 and if only are true the following condition:
Mask 1 == data that is indicated from Pointer 1 and
Mask 2 == data that is indicated from Pointer 2.
➔ Because the bit is set to 1 in the EMCY Word

if Pointer 1 >< 0 and Pointer 2 == 0 is sufficient that the following condition is true:
Mask 1 == data that is indicated from Pointer 1
➔ Because the bit is set to 1 in the EMCY Word.
if Pointer 1 == 0 and Pointer 2 == 0 follows that the bit isn't set to 1 in the EMCY word

SET TRANSLATE PDO:

By pressing the "Set Translate PDO" button from the Main Window for SW67002 (Fig. 3)
the window "RPDO" appears (Fig. 11):

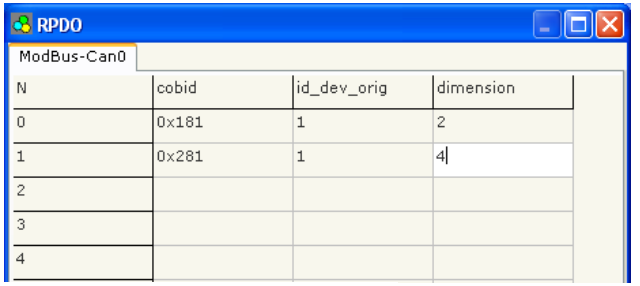


Figure 11: "RPDO" window

User who have to memorize a PDO from CAN open to Modbus needs to insert the coordinates of the PDO to be transmitted in the field "SET Translate PDO" of the window.

- In the field **"cobid"** insert the Cob_ID of the original PDO
- In the field **"id_dev_ori"** insert the address of the original device of **BUS A** (note: an alias can be inserted in the field instead of the actual address of the PDO generator)
- In the field **"dimension"** insert the number of byte of PDO

SET STORE PDO:

By pressing the "Define store PDO" button from the Main Window for SW67002 (Fig. 3)
the window "INFOPDO" appears (Fig. 12):

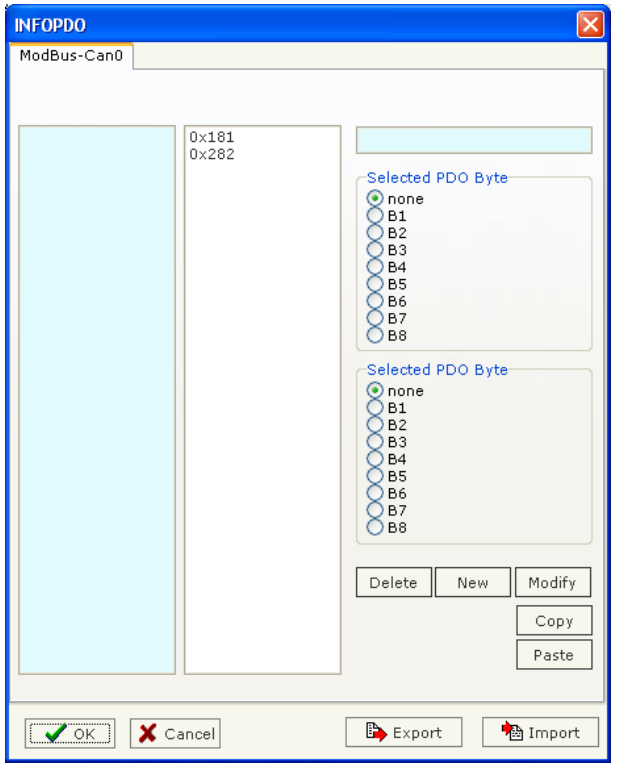


Figure 12: "INFOPDO" window

SET TRANSMIT PDO:

It is possible to write the PDOs using the Preset Multiple Registers Function (Modbus function 16).You have to write all the modbus register (that rapresent the PDO Data) with one modbus command.

By pressing "Set Transmit PDO" button the window "Transmit PDO" appears:

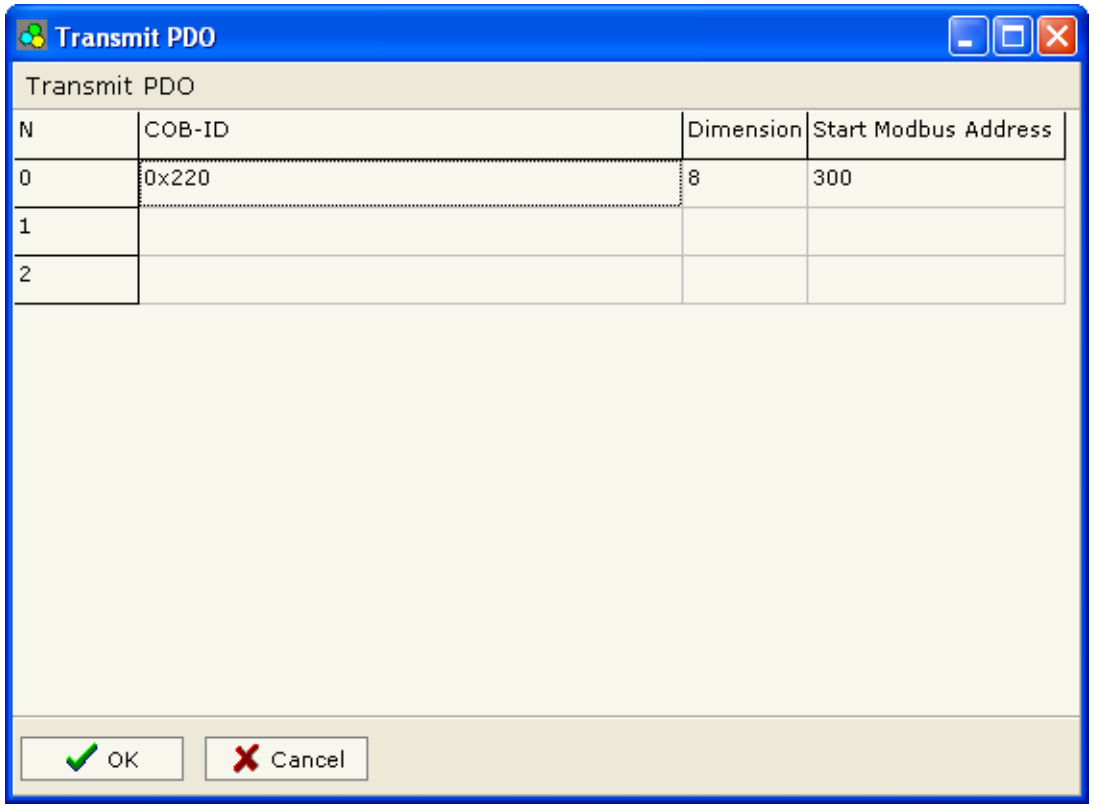


Figure 13: "Transmit PDO" window

User who have to write a PDO from Modbus to CANopen needs to insert the coordinates of the PDO to be transmitted in the field "SET Transmit PDO" of the window.

- In the field **"COB-ID"** insert the COB-ID of the PDO;
- In the field **"Dimension"** insert the number of byte of PDO;
- In the field **"Stert Modbus Address"** insert the number of modbus register that would you like start for writing the PDO.

UPDATE DEVICE:

Section "UP Date Device":
Insert the boot jumper, see figure 2.
In order to load the parameters after they are set, set the com port you used for update, you must click the button "execute update firmware" on the principal window.

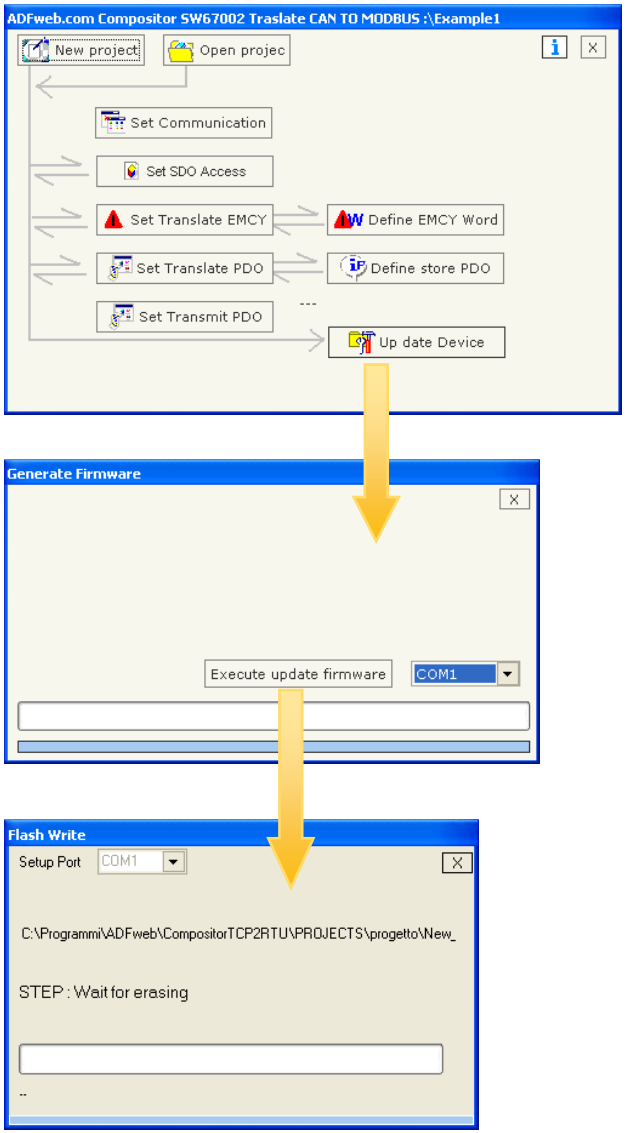


Figure 14: Update device procedure.

CHARACTERISTICS OF THE CABLES:

The connection from RS232 socket to a serial port (example one from a personal computer), must be made with a Null Modem cable (a serial cable where the pins 2 and 3 are crossed).
It is recommended that the RS232 Cable not exceed 15 meters.

The connection at RS485 socket must be done with twisted and shielded cable.
The terminal resistor must be inserted when the HD67102 is at the end of the line, using the Terminator jumper.

Can bus cable characteristics:

DC parameter:		Impedance	70 Ohm/m
AC parameters:		Impedance	120 Ohm/m
		delay	5 ns/m
Length		**Baud Rate [bps]**	**Length MAX [m]**
		10 K	5000
		20 K	2500
		50 K	1000
		100 K	650
		125 K	500
		250 K	250
		500 K	100
		800 K	50
		1000 K	25

MECHANICAL DIMENSIONS:

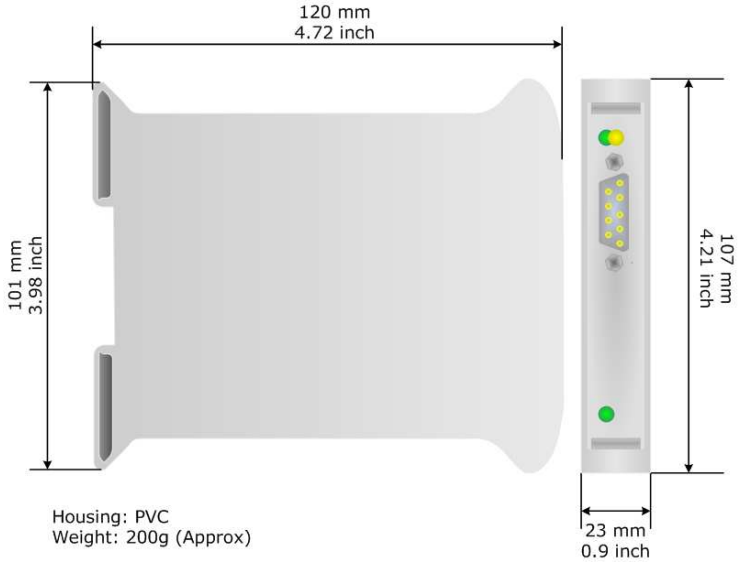


Figure 15: Mechanical dimensions scheme

ORDER CODE:

Order Code: **HD67002** **-** Gateway – CANopen to Modbus RTU Slave

ACCESSORIES:

Order Code: **AC34107** **-** Null Modem Cable Fem/Fem DSub 9 Pin 1,5 m

Order Code: **AC34114** **-** Null Modem Cable Fem/Fem DSub 9 Pin 5 m

Order Code: **AC34001** **-** Rail DIN - Power Supply 220/240V AC 50/60Hz – 12 V AC

Order Code: **AC34002** **-** Rail DIN - Power Supply 110V AC 50/60Hz – 12 V AC

WARRANTIES AND TECHNICAL SUPPORT:

For fast and easy technical support for your ADFweb.com SRL products, consult our internet support at www.adfweb.com.
Otherwise contact us at the address support@adfweb.com

RETURN POLICY:

If while using your product you have any problem and you wish to exchange or repair it, please do the following:

1) Obtain a Product Return Number (PRN) from our internet support at www.adfweb.com. Together with the request, you need to provide detailed information about the problem.
2) Send the product to the address provided with the PRN, having prepaid the shipping costs (shipment costs billed to us will not be accepted).

If the product is within the warranty of twelve months, it will be repaired or exchanged and returned within three weeks. If the product is no longer under warranty, you will receive a repair estimate.

PRODUCTS AND RELATED DOCUMENTS:

Part	Description	URL
HD67121	Gateway CANopen / Canopen	www.adfweb.com?product=HD67121
HD67001	Gateway CANopen / Modbus – RTU Master	www.adfweb.com?product=HD67001
HD67004 HD67005	Gateway CANopen / Modbus – Ethernet TCP	www.adfweb.com?product=HD67004
HD67134	Gateway CANopen / DeviceNet	www.adfweb.com?product=HD67134
HD67117	CAN bus Repeater	www.adfweb.com?product=HD67117
HD67216	CAN bus Analyzer	www.adfweb.com?product=HD67216