ETE/V6291/DW/04-10

Vitolink® power line & serial communication protocol©

1. Introduction

In this document the Vitolink power line & serial communication protocol is explained.
The Vitolink power line modem is a method for sending data over the existing power lines. More info about system components can be found in the 'Vitolink hardware specifications'.

When a control signal has to be sent, a series of small interrupts in the line voltage are forming a digital control signal. Sending a 1 is generating a small interrupt in the line voltage at Zero crossing and 0 is no interrupt at zero. (See document Vitolink® hardware specification©). The Vitolink power line has a baudrate of 50 bps.

The control signal for the power line protocol is two or three bytes long and is explained in paragraph 2.

The serial line communication between the cluster controller and MAINCON-S controllers (up to 32) is explained in paragraph 3. The cluster controller sends three or four bytes data to the MAINCON-S controllers.
The cluster controller can also receive 2 information bytes from the MAINCON-S controllers.

2. Power line protocol

The power line protocol is used for communication of 'data signals' over the power line itself between a main controller (MAINCON-S) and load controllers.
A 'data signal' starts always with the start bit to 1 and ends with the stop bit to 1. There are two types of 'data signals':

- A *'command signal'* of 2 bytes long sends a command to the addressed load controller
- A *'parameter transfer signal'* of 3 bytes long sends a parameter to the addressed load controller.

2.1 Power line 'command signal' structure

A 'command signal' is 2 bytes long (see fig. 1).
A 'command signal' starts with the start bit 1 (small interrupt at zero crossing), followed by 7 command bits and 7 address bits and ends with stop bit 1.

Requirement for command bits : <= 108.

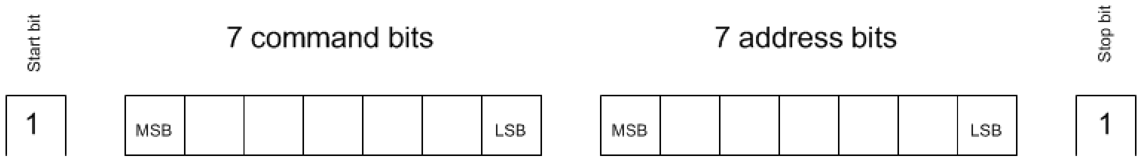

figure 1: 'Command signal' structure for power line communication (2 bytes)

2.2 Power line 'parameter transfer signal' structure

A 'parameter transfer signal 'is 3 bytes long (see fig. 2).
A 'parameter transfer signal' starts with start bit 1 followed by 7 command bits, 8 parameter bits, 7 address bits and ends with stop bit 1.
Requirement for command bits : > 108.

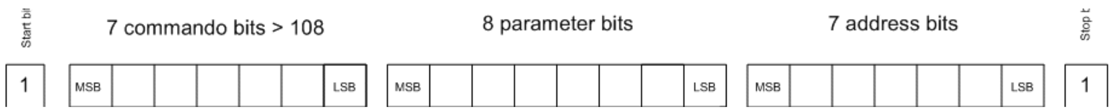

figure 2: ‘Parameter transfer signal’ structure for power line communication (3 bytes)

2.3 Definition of the command and address bits

The command bits and address bits are not free to choose and are assigned in table 1&2.

Table 1: Definition of the command bits

7 bits command			
Value	**Binary value**	**Definition**	**Structure**
0 1 2 . . 100	0000000 0000001 0000010 . . 1100100	Load off 1 % power 2 % power . . 100 % power	2 bytes . . . . 2 bytes
101 102 103 104	1100101 1100110 1100111 1101000	Free To Define (TD) free To Define (TD) free To Define (TD) free To Define (TD)	2 bytes . . 2 bytes
105	1101001	Check load: defect and end or life	2 bytes
106	1101010	Address allocation: load connected and on	2 bytes
107	1101011	Address allocation: load connected and off	2 bytes

108	1101100	Address allocation: load connected and on or off	2 bytes
109	1101101	free To Define (TD)	3 bytes
110	1101110	free To Define (TD)	3 bytes
111	1101111	free To Define (TD)	3 bytes
112 . . 127	1110000 . . 1111111	Addressed byte parameter 1 transfer . . Addressed byte parameter 16 transfer	3 bytes . . 3 bytes

16 different parameter bytes (parameter 1 .. 16) can be transferred from the MAINCON-S controller to the load controllers with a 3 bytes parameter ‘transfer signal’ structure.

Table 2: definition of the7 address bits.

7 bits address		
Value	**Binary value**	**Definition**
1 2 . . 118	0000001 0000010 . . 1110110	Individual load address 1 Individual load address 2 . . Individual load address 118
119	1110111	Load address group A
120	1111000	Load address group B
121	1111001	Load address group C
122	1111010	Load address group D
123	1111011	Load address group E
124	1111100	Load address group F
125	1111101	Load address group G
126	1111110	Load address group H
127	1111111	All loads

By consequence 118 loads can individually addressed or 8 groups addresses.

2.4 Power line protocol examples

The control signal of figure 3 is two bytes long. The command byte ‘check lamp’ checks the end of life for the lamp with address 99.

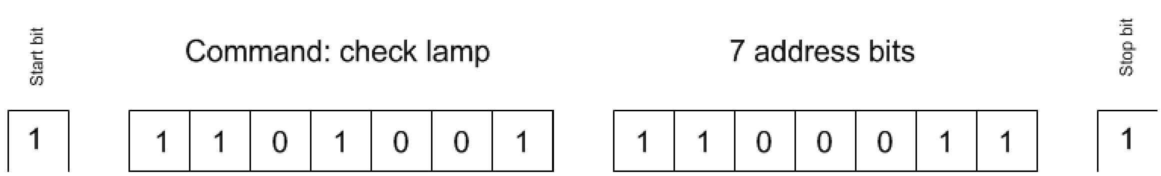

Figure 3: End of life check for addressed lamp 99.

The command byte in figure 4 = 106 (address alloacation and load connected on). This means that the load that is on and connected to the grid gets a new individual address.

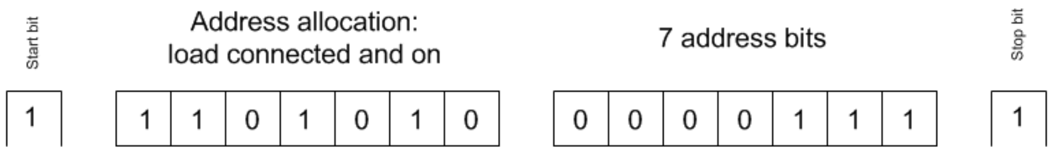

Figure 4: The new address for the load that is on and connected to the electricity grid becomes 7.

The control signal of figure 5 is three bytes long and a parameter is send to the addressed load controller. Parameter byte (255) is send to addressed load controller (8) and is changing parameter 1 (addressed byte parameter 1 transfer).

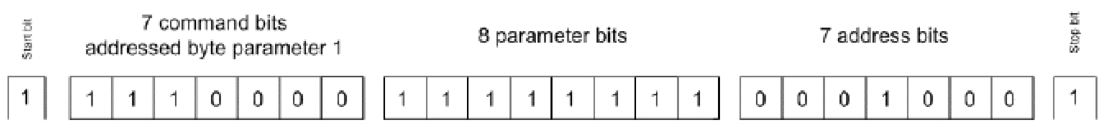

Figure 5: Addressed byte parameter 1 from individual load address 8 becomes 255

The 8 parameter bits can be have value from 0 till 255.

3. Serial line communication protocol

The serial communication protocol is used for communication of 'data signals' between a cluster controller and main controllers (MAINCON-S). Up to 32 MAINCON-S controllers can communicate with one cluster controller.
The cluster controller can send two types of 'data signals' to the main controllers:

- A ‘command *signal'* of 3 bytes long is used for sending a command to the addressed load controller and MAINCON-S controller.
- A *'parameter transfer signal'* of 4 bytes long is used for sending a parameter to the addressed load controller and MAINCON-S controller.

The cluster controller can receive 2 data bytes from the MAINCON-S controllers. The MAINCON-S controller sends information bytes back to the cluster controller (paragraph 3.4) . Those bytes contain information about:

- status check from the load (defect or end of life detection)
- Power measurements

3.1 Serial line ‘command signal’

The cluster controller sends 3 bytes to the MAINCON-S controllers: the MAINCON_S controller byte followed by the command byte and the address byte for the load controller (fig 6). The address byte MAINCON-S controller is explained in paragraph 3.4. The command byte and address byte load controller are the same as in paragraph 2 (table 1 & 2) and are always < 128.

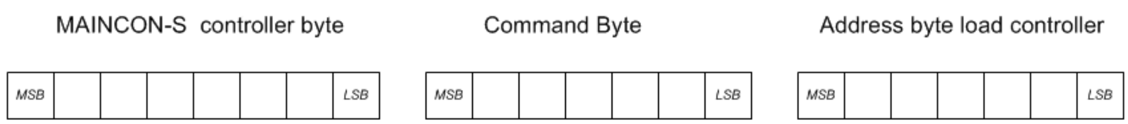

Figure 6: Serial communication protocol 3 bytes.

3.2 Serial line ‘parameter transfer signal’

Four bytes serial communication is used when a new parameter byte is send to load controller(s).

The cluster controller sends 4 bytes to the MAINCON-S controllers: the MAINCON_S controller byte followed by the command byte, the parameter byte and finally the address byte for the load controllers (fig 7).

Figure 7: Serial communication protocol 4 bytes.

3.3 MAINCON-S controller byte structure = <3 type bits> and < 5 address bits>

In the MAINCON-S address byte are the 5 least significant bits used for addressing the MAINCON-S controllers. The cluster controller can address 32 MAINCON-S controllers. Each MAINCON-S controllers can have 118 loads. The cluster controller can address 118 * 32 = 3776 loads on this way.
The 3 most significant bits determine the kind of information that is send back from the MAINCON-S controller to the cluster controller if the command byte = 105 (decimal). With another value of the command byte have the 3 MSB no significance.

3.4 Definition of the MAINCON-S controller byte

Table 3: definition of the MAINCON-S Controller byte.

MAINCON-S address byte: 5 address bits (LSB)		
Value	**Binary value**	**Definition**
0	00000	MAINCON-S address 0
1	00001	MAINCON-S address 1
2	00010	MAINCON-S address 2
.	.	.
.	.	.
31	11111	MAINCON-S address 31

MAINCON-S address byte: 3 info bits (MSB) and 5 address bits (LSB)		
Value	**Binary value**	**Definition**
	000 + 5 address bits	End of life check load return to cluster controller if command byte = 105
	001 + 5 address bits	Individual power measurement addressed load return to cluster controller id command byte = 105
	010 + 5 address bits	Total Power measurement MAINCON-S controller return to cluster controller if command byte = 105
	011 + 5 address bits . . 111 + 5 address bits	To Define . . To Define

3.5 Send back information from the MAINCON-S controllers to the cluster controller

A special data transfer is reached when the command byte = 105 (check load command) in a three bytes serial information data signal. With this command byte information is send back from the MAINCON-S controller to the cluster controller.

If the command byte = 105, power measurements are done with POW-MOD1. The result of this measurement (information bytes 1 & 2) are send from the MAINCON-S controller to the cluster controller (fig 8). Those bytes contain information about the status of the load . The send back information depends on the 3 most significant address bits from the MAINCON-S controller.

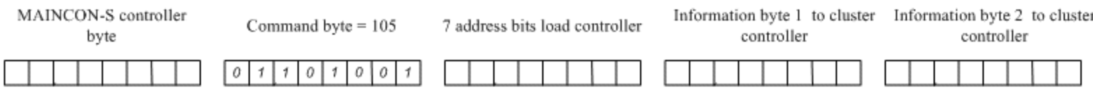

Figure 8: information bytes to cluster controller after command byte = 105.

Table 4: definition of the information bytes

Information byte 2	Information byte 1	Definition
00000000	00000000	Addressed Load NOK
00000000	00000001	Addressed load OK
00000000	00000010	Load age NOK
00000000	00000011	Load age OK
xxxxxxxx	xxxxxxxx	Power measurement value: Information byte 1 = Least significant value and information byte 2 = most significant value

Figure 9 shows the three bytes serial communication flowchart. The cluster controller can send every 1 second information to the MAINCON-S controllers, exception with command byte = 105. With this command byte the status of the load controllers is asked individually.
When the cluster controller has read the result of the power measurement (information bytes), a new message can send to the MAINCON-S controller.

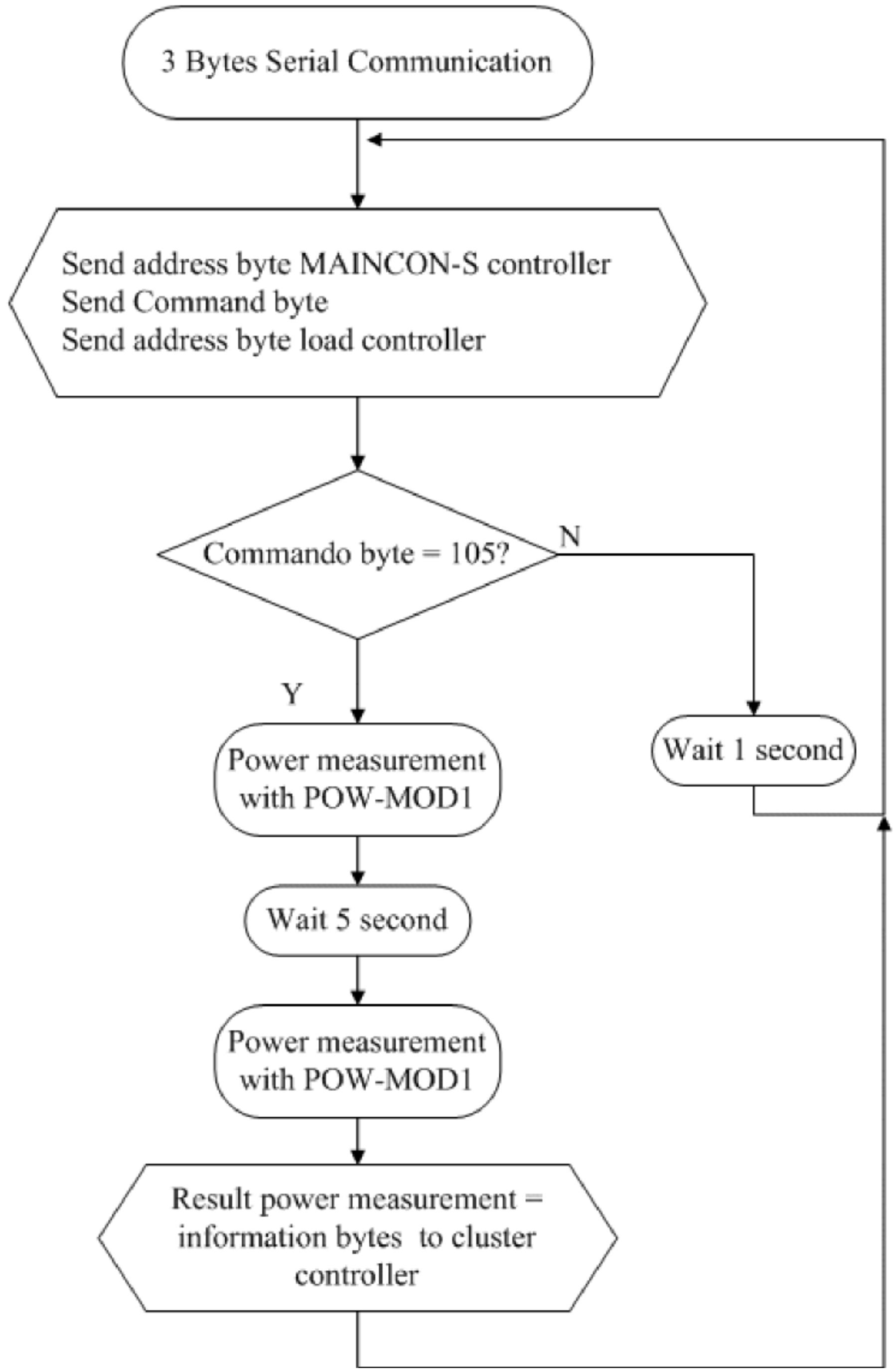

Figure 9: 3 bytes serial communication flowchart.

3.6 Four bytes serial communication flow chart.

The cluster controller can send every 2 seconds a new parameter byte to the MAINCON-S controllers (fig 10).

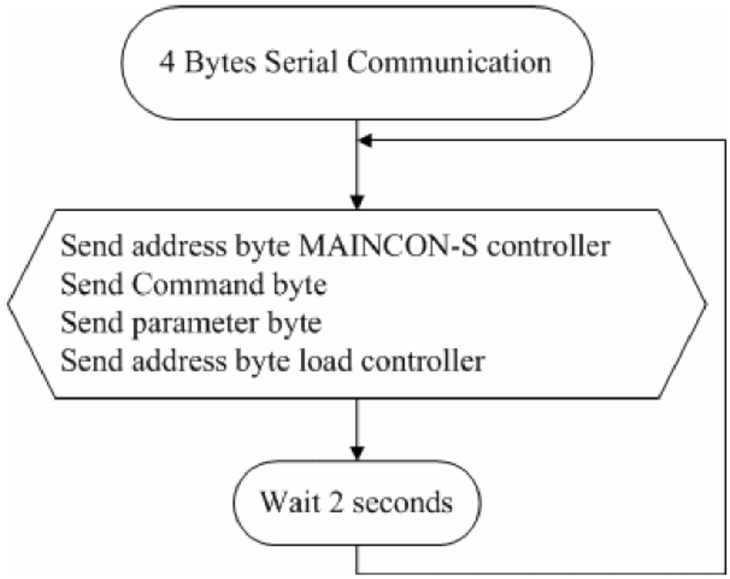

Figure 10: 4 bytes serial communication flowchart.