Button Firmware
UNIV 1.0.1.33

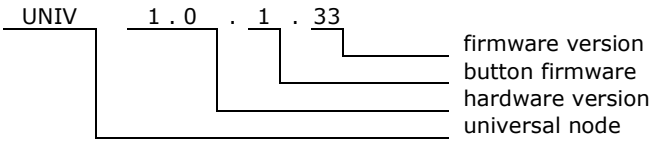
1. Features:

- 8 channel button module. Up to 8 buttons with free voltage contacts can be connected to the module
- 7 types of button behaving is recognized: button pressed, released, pressed for 400ms, pressed for 4s, released within 400ms, released between 400ms and 4s, released after 4s
- There is a 20ms reaction time. Button has to be pressed for at least 20ms to activate module. It avoids contacts bouncing.
- 8 LEDs can be connected to indicate status of other devices on the network.
- Included temperature and thermostat feature when Dallas sensor is connected.
- 6 control instructions for LEDs (On, Off, Toggle), and for thermostat (set temp, temp up, temp down)
- 3 blocking instructions
- Up to 96 conditions for receiving bus messages can be set to control the module by other nodes.
- Self-control feature – pressed button can control LEDs in the same module
- Allows writing notes in the processor memory
- Uptime counting
- Self-health check
- Receive and transmit FIFO buffers for CAN

2. Compatibility:

- Firmware for **UNIV 1.0.1.3. application.**
- Firmware is not fully compatible with previous versions. The BUTTON FRAME includes diode status now. It might require configuration changes in actuators controlled by button module.
- Firmware can be uploaded into devices with bootloader version 2.5 or compatible.

3. Firmware version



4. Overview

This is a button module. Can work with up to 8 push buttons or other switches with voltage free contacts. Module is able to distinguish a few types of button behaving: pressed, released, pressed for 400ms, pressed for 4s, released within 400ms, released between 400ms and 4s , released after 4s. For each situation the unique message is sent to the bus. It is possible to choose for each button separately what massages should be sent.
This firmware controls LEDs connected to switches. LED can be toggled by message received from the bus or locally by pressed button.
Button module has temperature sensor and thermostat feature when Dallas sensor is connected. Module sends message to the bus when sensor temperature changes by 0.5°C. It can be used as thermostat. It will send information when temperature is above and below a thermostat switching temperature. Adequate hysteresis can be set with resolution 1°C. Thermostat switching temperature can be adjusted from other modules on the network eg. button module, or infrared receiver.
Up to 96 conditions for receiving bus messages can be set to control LEDs and thermostat from other nodes.

5. Firmware

Firmware can be uploaded by using HAPCAN Programmer, which can be downloaded from site http://siwilo.com/hapcan/software.

5.1. Button message

Module sends message to the bus, when status of input changes. When LED status changes this frame is not sent. The table below shows meaning of each byte in the button frame.

Table 1. BUTTON frame

Frame type	Flags				Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x301	3	2	1	0	Node Nr	Group Nr	0xFF	0xFF	CHANNEL	BUTTON	LED	0xFF	0xFF	0xFF

0x301 – universal module frame, button application

- 3 - - not used flag, read as "0"
- 2 - - not used flag, read as "0"
- 1 - - not used flag, read as "0"
- 0 RE - response flag. Flag is equal "1" if node was requested. If flag is equal „0" it means that status of input has just changed.

Node Nr - node number on the network

Group Nr - group number of the node on the network

CHANNEL - input channel 0x01 (button 1) – 0x08 (button 8)

BUTTON - actual input status
0x00 – open
0xFF – closed
0xFE – closed and held for 400ms
0xFD – closed and held for 4s
0xFC – closed and open within 400ms
0xFB – closed and open between 400ms and 4s
0xFA – closed and open after 4s

LED - actual LED status 0x00 – off, 0xFF – on

5.2. Current temperature message

The module sends message when sensor temperature changes by 0.5°C. Construction of this message is shown in Table 2. This message can toggle other modules on the network.

Table 2. CURRENT TEMPERATURE frame

Frame type	Flags				Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x304	3	2	1	0	Node Nr	Group Nr	0xFF	0xFF	0x11	TEMPMSB	TEMPLSB	THERMOS VALUE	HYSTER	0xFF

0x304 – universal module frame, temperature sensor application

- 3 - - not used flag, read as "0"
- 2 - - not used flag, read as "0"
- 1 - - not used flag, read as "0"
- 0 RE - response flag. Flag is equal "1" if node was requested. If flag is equal „0" it means that status of output has just changed.

Node Nr - node number on the network

Group Nr - group number of the node on the network

0x11 - data type in message (0x11 - temperature frame)

TEMPMSB - most significant byte of measured temperature

TEMPLSB - least significant byte of measured temperature

THERMOS VALUE - set value of thermostat switching temperature 0xC9 – 0x7D (-55°C - +125°C)

HYSTER - switching hysteresis (1- 90°C)

The temperature data is presented by TEMPMSB and TEMPLSB registers as 9bit sign extended two's complement number. The sign bits 'S' indicate if temperature is positive or negative. For positive numbers S=0 and for negative S=1. Please refer to Dallas sensor datasheet for details.

TEMPMSB

S	S	S	S	S	2^6	2^5	2^4

TEMPLSB

2^3	2^2	2^1	2^0	2^{-1}	0	0	0

Table 3. Temperature register format for Current Temperature frame.

5.3. Thermostat message

When measured temperature drops below, or rises above thermostat switching temperature, the module sends thermostat message. Hysteresis value makes module to not react immediately for temperature changes around switching point. This message can toggle other modules on the network.

Table 4. THERMOSTAT frame

Frame type	Flags				Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x304	3	2	1	0	Node Nr	Group Nr	0xFF	0xFF	0x12	THERMOS STATUS	0xFF	0xFF	0xFF	0xFF

0x304 – universal module frame, temperature sensor application

Node Nr - node number on the network

Group Nr - group number of the node on the network

0x12 - data type in message (0x12 - thermostat frame)

THERMOS STATUS - current thermostat status (0x00 - temperature below thermostat switching value, 0xFF - temperature above thermostat switching temperature)

5.4. Status request

Status of module can be checked by sending from computer STATUS REQUEST frame (0x109) (see Table 5).

Table 5. STATUS REQUEST frame (0x109).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x109	0x0	COMP ID1	COMP ID2	0xXX	0xXX	Node Nr	Group Nr	0xXX	0xXX	0xXX	0xXX

0x109 – STATUS REQUEST frame

COMP ID1 - computer identifier (must be unique on the network)

COMP ID2 - computer identifier (must be unique on the network)

Node Nr - node number of requested module

Group Nr - group number of requested module

0xXX - inessential data

As response the module will send 10 status frames (Table 6). Meaning of bytes is the same as in Table 1, 2 & 4.

Table 6. Response to STATUS REQUEST.

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x301	0x1	Node Nr	Group Nr	0xFF	0xFF	0x01	BUTTON	LED	0xFF	0xFF	0xFF

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x301	0x1	Node Nr	Group Nr	0xFF	0xFF	0x02	BUTTON	LED	0xFF	0xFF	0xFF

...

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x301	0x1	Node Nr	Group Nr	0xFF	0xFF	0x08	BUTTON	LED	0xFF	0xFF	0xFF

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x304	0x1	Node Nr	Group Nr	0xFF	0xFF	0x11	TEMPMSB	TEMPLSB	THERMOS VALUE	HYSTER	0xFF

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x304	0x1	Node Nr	Group Nr	0xFF	0xFF	0x12	THERMOS STATUS	0xFF	0xFF	0xFF	0xFF

Temperature registers in current temperature status frame give 12bit resolution (see Table 7).

TEMPMSB

S	S	S	S	S	2^6	2^5	2^4

TEMPLSB

2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}

Table 7. Temperature register format for current temperature status frame.

5.5. Uptime request

Table 8. UPTIME REQUEST (0x113).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x113	0x0	COMP ID1	COMP ID2	0xXX	0xXX	Node Nr	Group Nr	0xXX	0xXX	0xXX	0xXX

0x1130 – UPTIME REQUEST frame

- COMP ID1 - computer identifier (must be unique on the network)
- COMP ID2 - computer identifier (must be unique on the network)
- Node Nr - node number of requested module
- Group Nr - group number of requested module
- 0xXX - inessential data

Table 9. Response to UPTIME REQUEST (0x113).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x113	0x1	Node Nr	Group Nr	0xFF	0xFF	0xFF	0xFF	UPTIME3	UPTIME2	UPTIME1	UPTIME0

0x1131 – Response to UPTIME REQUEST frame

- Node Nr - node number on the network
- Group Nr - group number of the node on the network
- UPTIME - (UPTIME3*256^3+UPTIME2*256^2+UPTIME1*256^1+UPTIME3*256^0) in seconds

5.6. Health check request

Table 10. HEALTH CHECK - STATUS REQUEST (0x115).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x115	0x0	COMP ID1	COMP ID2	0x01	0xXX	Node Nr	Group Nr	0xXX	0xXX	0xXX	0xXX

0x1150 – HEALTH CHECK REQUEST frame

- COMP ID1 - computer identifier (must be unique on the network)
- COMP ID2 - computer identifier (must be unique on the network)
- 0x01 - status request
- Node Nr - node number of requested module
- Group Nr - group number of requested module
- 0xXX - inessential data

As response the module will send two frames (Table 11).

Table 11. Response to HEALTH CHECK - STATUS REQUEST (0x115).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x115	0x1	Node Nr	Group Nr	0x01	RXCNT	TXCNT	RXCNTMX	TXCNTMX	CANINTCNT	RXERRCNT	TXERRCNT

0x1151 – Response HEALTH CHECK REQUEST frame

- Node Nr - node number on the network
- Group Nr - group number of the node on the network
- 0x01 - frame 1 (current values)
- RXCNT - current level of receive FIFO buffer
- TXCNT - current level of transmit FIFO buffer
- RXCNTMX - maximum level of receive FIFO buffer since power up
- TXCNTMX - maximum level of transmit FIFO buffer since power up
- CANINTCNT - number of CAN interface restarts since power up
- RXERRCNT - current receive errors register
- TXERRCNT - current transmit errors register

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x115	0x1	Node Nr	Group Nr	0x02	0xFF	0xFF	RXCNTMXE	TXCNTMXE	CANINTCNTE	RXERRCNTE	TXERRCNTE

0x1151 – Response HEALTH CHECK REQUEST frame

Node Nr - node number on the network
Group Nr - group number of the node on the network

0x02 - frame 2 (maximum values saved in eeprom memory)
RXCNTMXE - maximum ever level of receive FIFO buffer
TXCNTMXE - maximum ever level of transmit FIFO buffer
CANINTCNTE - maximum ever number of CAN interface restarts
RXERRCNTE - maximum ever receive errors
TXERRCNTE - maximum ever transmit errors

To clear maximum values saved in eeprom memory the frame shown in Table 12 must be sent. There is no response to this message.

Table 12. HEALTH CHECK - CLEAR REQUEST (0x115).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x115	0x0	COMP ID1	COMP ID2	0x02	0xXX	Node Nr	Group Nr	0xXX	0xXX	0xXX	0xXX

0x1150 – HEALTH CHECK REQUEST frame

COMP ID1 - computer identifier (must be unique on the network)
COMP ID2 - computer identifier (must be unique on the network)

0x02 - clear request
Node Nr - node number of requested module
Group Nr - group number of requested module
0xXX - inessential data

5.7. Module control

Module can be controlled directly from PC, or indirectly by other modules. In both situations all 6 instructions can be used. LEDs can be controlled using 0x00-0x02 instructions. The thermostat value can be adjusted using 3 other instruction. New thermostat value will be stored in eeprom memory, in case of power failure, approximately 6s after adjusting.

5.7.1. Control instruction

The module understands 6 instructions shown below in the Table 13.

Table 13. Coding of instructions

Instruction	Instruction code			Description
	INSTR1	INSTR2	INSTR3	
Turn diode off	0x00	DIODEs	0xXX	Turns chosen in INSTR2 diodes off
Turn diode on	0x01	DIODEs	0xXX	Turns chosen in INSTR2 diodes on
Toggle diode	0x02	DIODEs	0xXX	Toggles chosen in INSTR2 diodes
Set thermostat to	0x03	0xC9 – 0x7D	0xXX	Sets thermostat to value equal INSTR2 (-55°C - +125°C)
Dec thermostat by	0x04	0x00 – 0xFF	0xXX	Decrease thermostat value by INSTR2
Inc thermostat by	0x05	0x00 – 0xFF	0xXX	Increase thermostat value by INSTR2

0xXX - any value

INSTR2	Description
<00000001>	- diode 1 only
<00000010>	- diode 2 only
<00000011>	- diodes 1 & 2
<00000100>	- diode 3 only
…	…
<11111111>	- diodes 1,2,3,4,5,6,7,8

bit <0> - diode 1
bit <1> - diode 2
bit <2> - diode 3
bit <3> - diode 4
bit <4> - diode 5
bit <5> - diode 6
bit <6> - diode 7
bit <7> - diode 8

5.7.2. Direct control

It is possible to control module by sending DIRECT CONTROL message. The message contains instruction, which will be executed by module. The module can be also controlled from HAPCAN Programmer.

Table 14. DIRECT CONTROL frame (0x10A).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x10A	0x0	COMP ID1	COMP ID2	0xXX	0xXX	Node Nr	Group Nr	0xXX	INSTR1	INSTR2	INSTR3

0x10A – DIRECT CONTROL frame

COMP ID1 - computer identifier (must be unique on the network)

COMP ID2 - computer identifier (must be unique on the network)

Node Nr - node number of requested module

Group Nr - group number of requested module

INSTR1 - instruction to be executed (byte1)

INSTR2 - instruction to be executed (byte2)

INSTR3 - not used

0xXX - any value

5.7.3. Indirect control

Indirect control means that module will react to messages sent by other modules on the network. It depends on configuration programmed into the module's boxes (memory cells). Configuration process can be made using HAPCAN Programmer.

5.8. Configuration

With this version of application parameters below can be configured:

- Module identifier (module number and group number);
- Module description (16 chars);
- Button settings
- Thermostat value on power up;
- Thermostat hysteresis;
- Text notes;
- Linking device with other modules (indirect control of module)

Configuration process can be done by using HAPCAN Programmer.

5.8.1. Module identifier

Every module on the network must have unique identifier. The identifier is made of two bytes, module number (1 byte) and group number (1 byte). Belonging to particular group might be important when linking devices.

5.8.2. Module description

Every module can have 16 char description, which makes easier for user (programmer) to distinguish nodes. Examples of node descriptions: living-button, living-lamp, bed2-button etc.

5.8.3. Button settings

For each button it is possible to configure what type of button behaving is recognized by module. Module can recognize when:

- button is pressed,
- button is released,
- pressed and held for 400ms,
- pressed and held for 4s,
- pressed and released within 400ms (quick click),
- pressed and released between 400ms and 4s,
- pressed and released after 4s.

For each behaving a separate message will be sent on the bus.

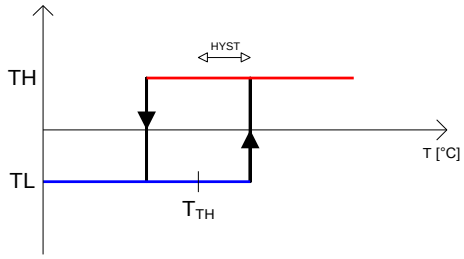
WARNING: It is very important to choose only messages which will be used on the network to keep traffic on the bus as low as possible.

5.8.4. Thermostat value on power up

The thermostat value on power up can be set between 0xC9 – 0x7D (-55°C - +125°C). It can also be chosen last adjusted value before power disconnection.

5.8.5. Thermostat hysteresis

Hysteresis prevents module from switching constantly around thermostat value. Thermostat will be switched to 0xFF (high state) if temperature rises above thermostat switching value + hysteresis value. It will be switched to 0x00 (low state) if temperature drops below thermostat switching point – hysteresis (see Figure 1).



T_{TH} – Thermostat switching point
TH – Thermostat in high state
TL – Thermostat in low state
HYST – Hysteresis value

Figure 1. Switching point and hysteresis.

5.8.6. Text notes.

Up to 1024 characters can be written into processor's memory.

5.8.7. Linking devices

The module has 96 memory cells (boxes). Each box can contain information about message sent by other node, and instruction which will be executed when that message is received.
This firmware has feature to set simple conditions of executing instruction. To do so you can use blocking instruction shown in the table below. As an example of simple condition can be situation when light has to be turned on by PIR when someone enters room, but should not be during a day. The HAPCAN Programmer simplifies configuration process.

Table 15. Coding of conditional instructions

Instruction	Instruction code			Description
	INSTR1	INSTR2	INSTR3	
ENABLE BOX	0xDD	X	Y	It enables chosen boxes – these boxes will be compared with next received message from the bus.
DISABLE BOX	0xDE	X	Y	It disables chosen boxes – these boxes will be passed when next message arrives from the bus.
TOGGLE BOX	0xDF	X	Y	It toggles boxes – enables when they are disabled and vice versa

INSTR2	Description
0x00	Box 1
0x01	Box 2
…	…
0x5F	Box 96

INSTR3	Description
0x00	+ 0 -(and not anyone)
0x01	+ 1 -(and 1 following)
…	…
0x5F	+ 95 -(and 95 following)

6. Document version

File	Note	Date
univ_v1-0-1-33a.pdf	Original version	December 2011