HAPCAN
HOME AUTOMATION

BISTABLE RELAY FIRMWARE
UNIV 3.2.4.3

1. Features

- Firmware for 6 bistable relay module
- 3 control instructions (on, off, toggle)
- 3 blocking instructions
- 6 timers (1 for each relay) for instruction execution delay 1s-24h
- Allows defining up to 128 CAN messages which can indirectly control the module
- Settable relay power up state
- Settable relay coil polarity
- Uptime counter
- Health check monitor
- Transmit (42 messages) and receive (42 messages) FIFO buffers

2. Compatibility

- Firmware compatible with previous one UNIV 3.2.4.1
- Added CHANNEL NAME REQUEST frame (0x117).
- Firmware can be uploaded into processor with bootloader version 3.1 or compatible.

3. Firmware version

```
 UNIV      3  .  2  .  4  .  3
   |       |     |     |     |____ firmware version
   |       |     |     |__________ application version (bistable relay 16A)
   |       |     |________________ application type (relay)
   |       |______________________ processor version
   |______________________________ universal processor
```

4. Communication Frames (messages)

4.1. Relay message

The module sends message to the bus, when the status of relays changes.

Table 1. RELAY frame (0x302)

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x302	3 2 1 0	Node Nr	Group Nr	0xFF	0xFF	CHANNEL	STATUS	0xFF	INSTR1	INSTR2	TIMER

0x302 – universal module frame, relay

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 - message sender node number

Group Nr - message sender group number

CHANNEL - output channel

STATUS - actual status of outputs 0x00 – relay off, 0xFF – relay on

INSTR1 - instruction that is waiting for execution, or 0xFF if none instruction

INSTR2 - second byte of instruction that is waiting for execution, or 0xFF

TIMER - delay value of waiting instruction, or 0x00 if none waiting

4.2. Status request

Status of module can be checked by sending from computer STATUS REQUEST frame (0x109) (Table 2).

Table 2. 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

0x1090	– 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 RELAY frames. The meaning of bytes is the same as in Table 1.

Table 3. Response to STATUS REQUEST

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x302	0x1	Node Nr	Group Nr	0xFF	0xFF	0x01	STATUS	0xFF	INSTR1	INSTR2	TIMER1
0x302	0x1	Node Nr	Group Nr	0xFF	0xFF	0x02	STATUS	0xFF	INSTR1	INSTR2	TIMER2
0x302	0x1	Node Nr	Group Nr	0xFF	0xFF	0x03	STATUS	0xFF	INSTR1	INSTR2	TIMER3
0x302	0x1	Node Nr	Group Nr	0xFF	0xFF	0x04	STATUS	0xFF	INSTR1	INSTR2	TIMER4
0x302	0x1	Node Nr	Group Nr	0xFF	0xFF	0x05	STATUS	0xFF	INSTR1	INSTR2	TIMER5
0x302	0x1	Node Nr	Group Nr	0xFF	0xFF	0x06	STATUS	0xFF	INSTR1	INSTR2	TIMER6

4.3. Uptime request

Table 4. 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 5. 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

4.4. Health check request

Table 6. 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 7).

Table 7. 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 to 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 to 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 8 must be sent. There is no response to this message.

Table 8. 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

4.4. Channel name request

The module sends 5 frames for each channel containing name of channel (relay).

Table 1. CHANNEL NAME REQUEST (0x117).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x117	0x0	KOMP ID1	KOMP ID2	CHANNEL	0xXX	Node Nr	Group Nr	0xXX	0xXX	0xXX	0xXX

0x1170 – CHANNEL NAME REQUEST frame

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

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

CHANNEL - requested channel number, 0x00-all channels

Node Nr - node number of requested module

Group Nr - group number of requested module

0xXX - inessential data

Table 2. Response to CHANNEL NAME REQUEST (0x117).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x117	0x1	Node Nr	Group Nr	FRAMENR	Char1	Char2	Char3	Char4	Char5	Char6	Char7
0x117	0x1	Node Nr	Group Nr	FRAMENR	Char8	Char9	Char10	Char11	Char12	Char13	Char14
0x117	0x1	Node Nr	Group Nr	FRAMENR	Char15	Char16	Char17	Char18	Char19	Char20	Char21
0x117	0x1	Node Nr	Group Nr	FRAMENR	Char22	Char23	Char24	Char25	Char26	Char27	Char28
0x117	0x1	Node Nr	Group Nr	FRAMENR	Char29	Char30	Char31	Char32	0x00	0x00	0x00

0x1171 – Response to CHANNEL NAME REQUEST frame

Node Nr - node number on the network

Group Nr - group number of the node on the network

FRAMENR - bits <7:3>-channel number, bits <2:1>-frame number (1-5)

CharX - single char

5. Module control

The module can be controlled directly from PC, or indirectly by other modules. In both situation all instructions in the table below can be used. Blocking instructions can't be used in direct control.

5.1. Control instruction

The Table 9 shows instructions, which can be executed by the module.

Table 9. Module control instructions

Instruction	Instruction Codding								Note	Control	
	INSTR1	INSTR2	INSTR3	INSTR4	INSTR5	INSTR6	INSTR7	INSTR8		Direct	Indirect
TURN OFF RELAY	**0x00**	CHANNEL	**TIMER**	0xXX	0xXX	0xXX	0xXX	0xXX	It will turn off chosen relays, and the rest will stay unchanged.		
TURN ON RELAY	**0x01**	CHANNEL	**TIMER**	0xXX	0xXX	0xXX	0xXX	0xXX	It will turn on chosen relays, and the rest will stay unchanged.	√	√
TOGGLE RELAY	**0x02**	CHANNEL	**TIMER**	0xXX	0xXX	0xXX	0xXX	0xXX	It will toggle chosen relays, and the rest will stay unchanged.		

0xXX – inessential data

CHANNEL	Note
0x01	- <00000001> - only relay K1
0x02	- <00000010> - only relay K2
0x03	- <00000011> - relay K1 & K2
0x04	- <00000100> - only relay K3
…	
0x3F	- <00111111> - relays K1,K2,K3,K4,K5,K6

bit <0> - relay K1, bit <1> - relay K2, bit <2> - relay K3
bit <3> - relay K4, bit <4> - relay K5, bit <5> - relay K6

TIMER	Note
0x00	- instruction will be executed immediately
0x01	- instruction will be executed with 1s delay
…	
0xFF	- instruction will be executed with 24h delay

ENABLE BOX	**0xDD**	**BoxX**	**BoxY**	0xXX	0xXX	0xXX	0xXX	0xXX	It enables chosen boxes – these boxes will be compared with next received message from the bus.		√
DISABLE BOX	**0xDE**	**BoxX**	**BoxY**	0xXX	0xXX	0xXX	0xXX	0xXX	It disables chosen boxes – these boxes will be passed when next message arrives from the bus.		√
TOGGLE BOX	**0xDF**	**BoxX**	**BoxY**	0xXX	0xXX	0xXX	0xXX	0xXX	It toggles boxes – enables when they are disabled and vice versa		√

0xXX – inessential data

BoxX	Note
0x00	- from Box 1
0x01	- from Box 2
…	
0x7F	- from Box 128

BoxY	Note
0x00	+ 0 -(and not anyone else)
0x01	+ 1 -(and 1 following)
…	
0x7F	+127 -(and 127 following)

5.2. Timer

Each relay has its own timer which can delay execution of the instruction. Delay can be chosen between 1s-24h set in TIMER register. Drawing below shows delay dependence of TIMER register.

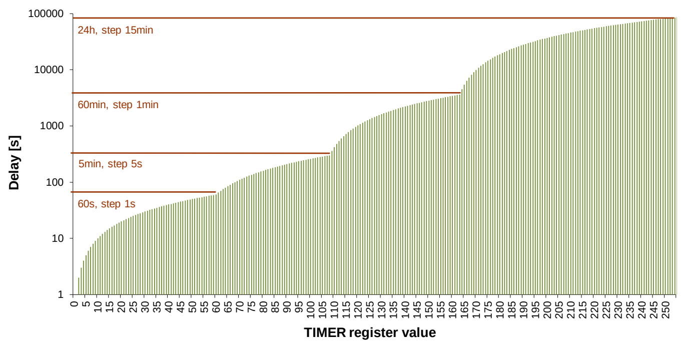


Figure 1. Delay/timer register relationship

5.3. Direct control

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

Table 10. DIRECT CONTROL frame (0x10A).

Frame type	Flags	Module	Group	D0	D1	D2	D3	D4	D5	D6	D7
0x10A	0x0	COMP ID1	COMP ID2	INSTR1	INSTR2	Node Nr	Group Nr	INSTR3	INSTR4	INSTR5	INSTR6

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
INSTR1-6	- instruction to be executed (byte1)

5.4. 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 boxes (memory cells).
This firmware has feature to set simple conditions of executing instruction. To do so, you can use blocking instruction (0xDD – 0xDF) shown in Table 9.

6. Configuration

Below are parameters that can be configured with this firmware. Configuration process can be done using HAPCAN Programmer.

6.1. 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). Identifier of the Ethernet Interface can be changed in HAPCAN Programmer in software settings.

6.2. Module description

Every module can have 16 char description, which makes easier for user (programmer) to distinguish nodes.

6.3. Relay Names

Each relay can be named with 32 chars.

6.4. Power up values

It is possible to configure relay states at startup after power loss. At startup relays can be set to ON, OFF or to the last set value. The last set value must be unchanged for at least 6s before power failure.

6.5. Relay coil polarity

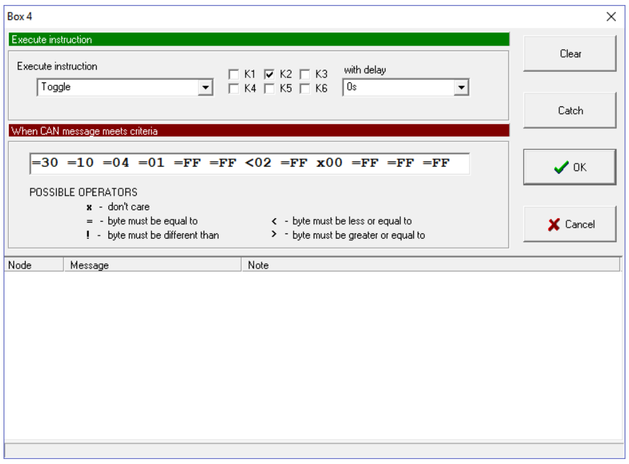
For each relay individually, you can determine the polarity of the coil: normal (if NO contact is closed when positive potential is connected to A1) or reversed (if NO contact is closed when positive potential is connected to A2).

6.6. Text notes.

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

6.7. Linking devices

The indirect control is used to program the dependencies between modules. It is a controlling the module by messages sent from other modules. Each module when changing its status (eg when button is pressed or released in the button module) sends information that can be used to control the same module, as well as to control other modules located on the bus. For this purpose, the module has 128 boxes (memory cells) into which you can enter messages to which the module is to react when it receives them from the bus. Each box contains information about what message should initiate the action and what instruction should be made when this message is received.


Box 4

Execute instruction

Execute instruction: Toggle

[ ] K1 [✓ K2] [ ] K3
[ ] K4 [ ] K5 [ ] K6

with delay: 0s

When CAN message meets criteria

```
=30 =10 =04 =01 =FF =FF <02 =FF x00 =FF =FF =FF
```

POSSIBLE OPERATORS
x - don't care
= - byte must be equal to
! - byte must be different than
< - byte must be less or equal to
> - byte must be greater or equal to

Node	Message	Note

In the figure on a side, the toggle instruction has been programmed, which changes the current state of the K2 relay at the moment of receiving a message from the module button o ID (4.1) - see the description of the BUTTON FRAME in the document "Firmware note" of the button module.

The message bytes are saved in hexadecimal format.

Operators at the front of bytes indicate that the module will react to a message received from the bus in which this byte:
x - can have any value
= - is identical to byte entered here
! - is different than byte entered here
< - is less or equal to byte entered here
> - is greater or equal to byte entered here

In this example:

=30 =10	– button message
=04 =01	– module ID is (4,1)
=FF =FF	– these bytes are not used and in button frame are always 0xFF
<02	– button number is less or equal 2, means button number 1 or 2
=FF	– button is pressed
x00	– it is a byte which gives LED status in the button module. Because we don't want to make instruction execution to be depended on this byte, so this bute can have any value.
=FF =FF =FF	– these bytes are not used and in button frame are always 0xFF

As a result, the module will execute instructions when the module receives a message from the button with ID (4.1), when button number 1 or 2 has been pressed. Instruction is executed regardless of the LED status in the button module.

Each own and received from the bus message informing about the change of module status is checked with each active (enabled) box in the order from box no. 1 to 128. Therefore, you can set the reaction to the same message in two or more boxes. For example, in the first box instruction can be executed without delay, and in the next box another instruction can be executed after the defined time. It is important to keep the logical order of instruction executing to get the desired operation of the module. Calling an instruction that is to be executed without delay will cancel the previously set instruction with a delay.
Boxes can be dynamically activated (enabled) and deactivated (disabled). Blocking instructions are used for this (Table 9). In this way, you can control which boxes are to be checked after receiving the message**.**

7. License

8. Document version

File	Note	Date
univ_3-2-4-3a.pdf	Original version	October 2022