CANACE8C CBUS 8 input combination module.

Introduction

CANACE8C is one of a number of layout control modules for use with the CBUS system. This is a general purpose layout control bus (LCB) using the industry standard CAN bus. For more information on CBUS, see the introductory article on this website.

CANACE8C is primarily a ‘producer’ module which sends events over the CBUS to consumer modules. It has 8 inputs for switches or logic levels and a change in any of these sends an ON or OFF event corresponding to which switch was changed. If the module is used with pushbuttons on the inputs, it is useful just to generate ON events when the PB is pressed without the accompanying OFF event when released. Fitting jumper S6 changes all inputs to send just ON events when in SLiM mode. If in FLiM mode, this capability is fully programmable and individual inputs can be set to ON only or ON / OFF.

However, CANACE8C can also learn input events so is also a CBUS ‘consumer’. Such ‘producer / consumer’ modules have been called ‘combi’ modules, hence the ‘C’ in the title.

On receipt of a learned input event, CANACE8C sends an output event which contains the logic levels (on or off) of the 8 inputs as the least significant byte (LSByte) of the event number (EN). This allows other producers, like control panels or a PC, to trigger an event from CANACE8C which reflects the switch inputs in the event. This allows the creation of conditional events depending on the input states which may be from block occupancy detectors so allowing different routes to be set depending on the occupancy of the various tracks. Another use of this facility would be for interlocking of tracks or complete routes. A further use could be the setting of routes or events with a rotary switch or switches so any of 256 routes could be selected on the switches and then triggered by another producer, say a button on a control panel. To distinguish a triggered event from just a switch change event, a bit is set in the next byte of the EN. As CBUS events can be ON or OFF, the CANACE8C module produces an ON output to an ON trigger event and an OFF output to an OFF trigger.

The triggered output aspect of this module is still being developed. By using the ‘Sel’ switches during a learn sequence, there can be 16 possible response types to each input event. Response type 0 is a sequence of 8 events corresponding to the input states. This allows a layout state to be reflected on a control panel as if the states had actually changed. Response type 1 allows for rotary switches and logic states to create unique events for route setting etc.

CANACE8C can operate in either the SLiM (Simple) or FLiM (Full) mode. The default is SLiM.

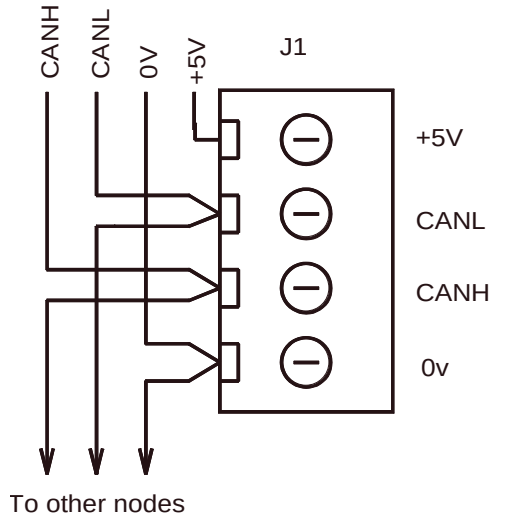
When in SLiM mode, CANACE8C can be given a Node Number (NN) by onboard switches and jumpers. No programming is necessary. For practical reasons, the present CANACE8C module allows 64 node numbers to be set. However, like all other SLiM modules, it responds with its CAN-ID when interrogated by ‘nodes’ which implement the self-enumeration scheme so is compatible with the Full Model modules (FLiM). In FLiM mode the node number limit is much greater.

Power supply.

CANACE8C is a basic node which requires an external 5 volt supply. This may be taken from other CBUS modules via the CBUS connector pins 1 and 4.

In SLiM mode, the green LED (LD2) will illuminate to show the circuit is working correctly. This is not just a power on indicator but confirms correct working of the processor. When in FLiM mode, the yellow LED (LD1) shows correct running.

Connecting the module



The CANH and CANL wires go to all modules. They are polarity sensitive so CANH must go to CANH and CANL to CANL. These wires should ideally be a twisted pair although screening is not necessary. While it would be usual to wire the bus sequentially round the various modules, it is not essential and individual nodes can be ‘star’ connected if this is more convenient. The CBUS wiring should be kept separated from any DCC supply wiring to prevent possible interference.

The CAN bus requires ‘termination’ resistors at some point in the network. If the bus is wired sequentially round the modules, then a resistor of 120 ohms should be fitted across the bus at each end. For small layouts, it is sufficient to have resistor across the bus at one point. The value is not critical and a 68 ohm resistor will suffice.

Setting the node number in SLiM mode.

Purely due to hardware restraints, the CANACE8C module allows 16 node numbers selected as a binary sequence with the DIL switch DIP 1 positions Sel 0, Sel 1, Sel 2 and Sel 3. The actual binary numbers are from 0 (all switches on) to 15 (all switches off) but the CBUS convention does not allow a node number of 0 so the actual range is 1 to 16.

A further range of node numbers is possible by using the jumpers Sel4 and Sel5. These extend the range of node numbers up to 64 as in the following table. The jumper Sel6 is used to select “push button” mode (jumper in) or toggle mode (jumper out).

Note that if a layout contains any CANACE3 control panel modules, these may occupy the first 4 node numbers so other producers like CANACE8C should start at 5 or above.

Teaching the trigger events in SLiM mode.

The CANACE8C module can respond to up to 32 learned input events. If you try to set more than 32, no more will be added but the yellow LED (LD1) will flash to indicate the event stack is full.

To teach the module an event, put the ‘learn’ switch ON and then send the event to be learned. This can be an ON, OFF or request event. The CANACE8C will respond with an event sequence determined by the setting of the 4 Sel switches while in learn mode. Two modes are implemented so far.

With the switches set to 0000, when triggered, the node produces 8 successive ON or OFF events corresponding to the input states. This allows a triggered sequence to set states as if the input had changed. There is a small delay between each event so the CAN bus is not fully loaded.

With the switches set to 0001, the response is an ON event where the LSByte of the event is the 8 inputs. Additionally, to distinguish this from input changes, bit 0 of the next higher event byte is set. There are 256 possible events in mode 1.

After the learn process, turn off the learn switch and reset the Sel switches to the Node Number. The response is NOT triggered during the learn phase. To 'unlearn' the event, repeat the above but with both the learn and unlearn switches ON. All learned events can be cleared by putting the unlearn switch on and then cycling the 5V supply off and then on. Remember to turn the unlearn switch off after this procedure.

For testing the mode 1 output when in SLiM mode, pressing the small PB briefly will send the event. This is very useful for teaching or testing route setting etc. without requiring an actual trigger event.

Another 14 output event types or sequences are possible but are yet to be developed.

The inputs all have pullup resistors of 100K so can be connected to ON / OFF switches directly. Also they will accept logic level inputs of 5V and also may be connected to the transistor outputs of opto-isolators. Additional collector loads may be connected to the +5V supply if needed. The 5V supply may also be used to power external circuits or devices with the proviso that the current does not exceed the capability of the device supplying the CANACE8C module.

Limitations.

The presently available CAN transceivers set a maximum number of CAN nodes on any one 'segment' to 110. There is no limit to the number of consumer modules so care must be taken not to overload the CAN bus. The Full Model (FLiM) scheme allows for 65536 modules which will be programmable over the CBUS itself. Here, we intend to develop modules to bridge between many CAN segments (CAN-CANs).

The PCBs include provision for in-circuit serial programming and debugging (ICSP). The firmware also contains code for use with the CBUS bootloader so code can be updated over the CBUS. (see document 'CBUS_Bootloader.pdf)

The small pushbutton S1 is for switching between the SLiM mode and the Full (FLiM) mode. For operation in the Full mode (FLiM), see the document 'Full_mode_operation.pdf

The full schematic, a PCB layout which is in .PDF form and can be printed to the exact size for making masks and the PIC assembly and HEX code are available on the MERG website. These can be freely used for non-commercial purposes. Copyright to the designs is held by the authors.