CANACE8C CBUS 8 input combination module.

Updated 04/05/08 Now rev d

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. However, it 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 or sequence of events which allows other producers, like control panels or a PC, to trigger an event from CANACE8C which then reflects the switch input states in the event(s). This could allow 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.

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 follows the SLiM (Small Layout interface Model) of CBUS which allows it to be given a Node Number (NN) by onboard jumpers. No programming is necessary. The present CANACE8C module (Rev d firmware and REV C PCB) allows 127 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).

Note: The self-enumeration code had been temporarily disabled while code problems are sorted. Does not affect SLiM mode operation.

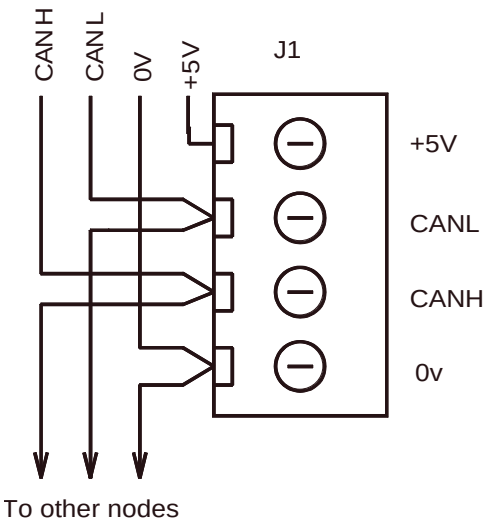
Please refer to the schematic CANACE8C_sch.pdf.

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.

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.

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.

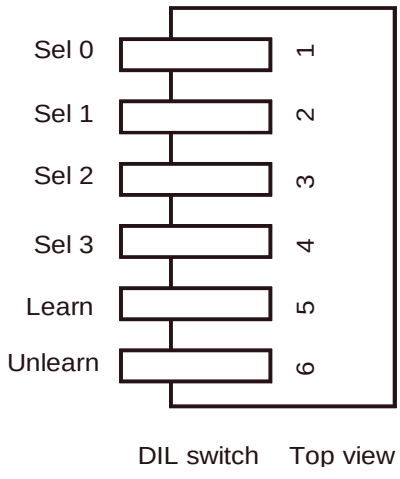
The CAN bus requires 'termination' resistors at some point in the network. If the bus is wired sequentially round the modules, then a resistor of 120 ohms should be fitted across the bus at each end.

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.

Purely due to hardware restraints, the CANACE8C module allows 16 node numbers. These are selected as a binary sequence with the DIL switch DIP 1 poles 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.
The use of the three extra jumpers allows the range to be extended to 128

The following table gives all the possible combinations.



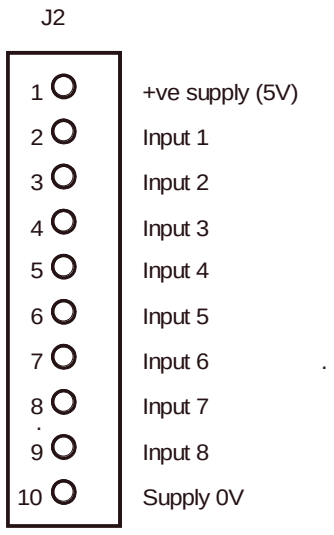
Sel 3	Sel 2	Sel 1	Sel 0	Node Number
on	on	on	on	1
on	on	on	off	2
on	on	off	on	3
on	on	off	off	4
on	off	on	on	5
on	off	on	off	6
on	off	off	on	7
on	off	off	off	8
off	on	on	on	9
off	on	on	off	10
off	on	off	on	11
off	on	off	off	12
off	off	on	on	13
off	off	on	off	14
off	off	off	on	15
off	off	off	off	16

As with all CBUS SLiM producer modules, no two modules should have the same Node Number. 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 event.

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 (d version) 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. 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.

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



The input connector

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. The inputs are protected against overvoltages.

The CANACE8C PCB has an additional three positions for jumpers. With the Rev c_2 code, these can be used to extend the Node Number range and are the next three bits (bits 4 to 6) of a NN. A jumper out is a logic low for the NN.

Limitations.

The presently available CAN transceivers set a maximum number of CAN nodes on any one 'segment' to 110. Although the current SLiM scheme only allows 16 producer modules *, 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 SLiM PCBs include provision both for in-circuit serial programming and debugging (ICSP) and two LEDs driven off the programming pins. These LEDs and associated resistors

are for diagnostic purposes and may be omitted. Where fitted, low current LEDs are recommended. For 2mA LEDs, a value of 1K8 or 2K2 is suitable for resistors R6 and R7.

The small pushbutton S1 is intended for use if the module is upgraded to the Full (FLiM) model. It is not used in SLiM mode or with the SLiM firmware and can be omitted.

A diagnostics and test program is being developed for CBUS. This will entail additions to the microcontroller firmware on the module which will be posted when available.

Resistor R5 determines the rise and fall times of the CAN waveform. Until such time as an optimal value has been determined, R5 should be just a wire link (zero ohms) which sets the maximum available rates.

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.

* The CAN_ACE8C with the Rev d code is an exception to this and can have a Node Number set with the switches and jumpers from 1 to 128.

Mike Bolton & Gil Fuchs 4th May 2008 CANACE8C Rev d ©