ACC4_2 CBUS module for driving solenoid point motors.

Introduction

ACC4_2 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 the website (www.cbus.org.uk).

ACC4_2 is a ‘consumer’ only module which accepts and learns events sent over the CBUS by other (producer) modules. It drives 4 pairs of outputs suitable for solenoid type point (turnout) motors such as the Peco PL10. It contains its own Capacitor Discharge Unit (CDU) with sufficient capacity to drive at least two PL10 motors in parallel, as may be used for crossovers and slips. The CDU has a current limited fast recharge which prevents large current surges on the supply. The default output pulse duration is 50 msec. But this can be changed in Full mode.

ACC4_2 defaults to the SLiM (Small Layout interface Model) of CBUS which allows it to be set up and taught without any need for a programming device or computer. 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 modules running in the Full Model (FLiM). The firmware allows for running in either mode.

Please refer to the schematic ACC4_2_sch.pdf.

Power supply.

This module requires a 12V DC supply. Note that all other _2 CBUS modules require a similar 12V DC supply and the same supply can be used for all. Power input is via the CBUS connector pins 1 and 4.

To obtain sufficient voltage to operate solenoids reliably from the CDU circuit a voltage doubler circuit is provided. This circuit is firmware driven hence a _2 firmware version must be used. Version **ACC4_2a** or higher.

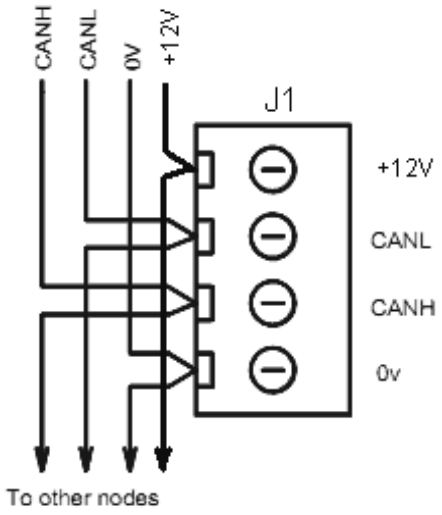
There is a separate voltage regulator (U2) which supplies the rest of the circuit with a fixed 5v. Diode D1 protects the 5V regulator and the rest of the low voltage circuit from connection to the wrong polarity. The maximum current available from this regulator is 1 amp and even with no external load, a small heatsink is necessary.

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.

Output drive capability.

Each of the outputs is switched by a power MOSFET rated at 15 amps or more (depending on the type used). However, no heatsinking is used as the pulse to the solenoid is fixed at 50 milliseconds. Note that there is no short circuit protection on these outputs and connecting them without an intervening solenoid may result in the MOSFET being destroyed.

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 preferably be a twisted pair but it is not essential, especially for short distances.
The 0V must also be connected to all modules.

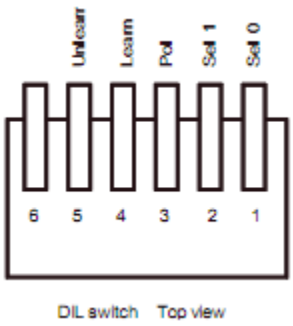
Where a number of modules are powered off the same 12 V DC supply, then their 12V input terminals should all be connected together.

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 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 a resistor across the bus at one point. The value is not critical and a 68 ohm resistor will suffice.

Note: Where the CBUS contains a mixture of the older AC powered modules and the current DC powered modules the 12V DC should be independent of the AC supply, **not** derived from the same transformer. Only the CANH, CANL and 0V should be connected between AC and DC powered modules.

Training the module in SLiM mode.



The training process is a unique aspect of CBUS and provides a very powerful method of configuration without the need for any programming device or knowledge of how the system works. The ACC4_2 module has a 6 way DIL switch for training but only 5 poles are used.
The two ‘Sel’ switches select which output the ‘event’ will apply to. There are 4 output pairs numbered 1 to 4. The two switches allow a selection of one of the 4 pairs using a binary sequence. When the switch is ‘down’ (ON as written on the switch) this represents a

logic 0. A switch in the up (OFF) position is a logic 1. With both switches down, this gives a value of binary 00 and selects output 1

The following table gives all the possible combinations.

Sel 1	Sel 0	Output
on	on	1
on	off	2
off	on	3
off	off	4

To train the ACC4_2 module, you need a CBUS 'producer' module which creates events. This could be an ACE3_2 (CANACE3) control panel scanner, an ACE8C_2 (CANACE8C) switch input module or a PC program which creates events via a CAN-USB module.

Connect the various modules and apply power. Connect the 'devices' you want the ACC4_2 to operate to the output terminals. The output connector terminal 1 is a 0V reference and not normally used. There are two terminals carrying the positive supply for the solenoids. This avoids needing to place all four supply wires into one terminal.

Select the output you want the event to operate with the Sel switches according to the above table. Put the 'learn' switch to ON (down). Send the event. If it is an ON event, then the corresponding output will pulse on. Try it with the same event number but as an OFF event. The other output of the pair will be pulsed and the solenoid will move in the opposite direction. Move the learn switch to OFF (up). Test the event again. The solenoid should go left or right as expected.

Now comes the interesting bit. A single event can activate more than one output pair. Set the Sel switches to another output pair and put into learn mode. Send the same event as previously. Now both outputs will be activated. Repeat if wanted for more outputs. This process allows a single event (like a switch change on a control panel) to create a combination of outputs for setting routes. The ACC4_2 module has an inbuilt delay mechanism so if an event is set to activate more than one output, there is a delay to allow the CDU to recharge between activations.

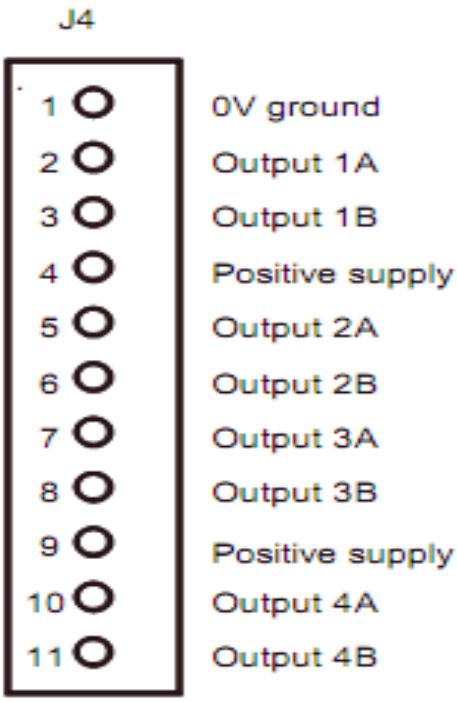
The next option is the use of the 'Pol' switch. With the Pol switch off, an ON event wil l turn an 'A' output on. However, it is possible to reverse this to the 'B' output by putting the Pol switch ON when learning the event. Consequently a single event can set some output pairs in one direction and some the other direction at the same time. For example, if output pair 1 is set normally and output pair 2 is set with the polarity reversed but with the same event, sending that event will cause the solenoids to move in opposite directions. An OFF event will reverse the outputs. This can be applied to any or all of the output pairs and can be different for different events. With one event, a pair of solenoids can move in the same direction and with a different event in opposite directions.

If you want the module to forget an event it has learned, (remove it altogether), set both the learn and unlearn switches ON and send that event.

Note that different events can set the same combination of outputs. This can be useful if you want switches on different control panels or a combination of control panel and PC events to have the same effect.

Notes.

The present firmware sets the number of stored events to 32. 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.



The output connector

You can add more outputs to an event and alter the polarity for an existing output but you cannot remove an output from an event once set. If you want to remove an output, you need to erase the whole event and teach it again.

If you have forgotten which events the module has been taught, then you cannot tell it to unlearn an event that you don't know it has!. In this case there is a 'clear all' option. This removes completely all stored events. To do this, set the unlearn switch to ON with the learn switch OFF. Remove power from the module and then reapply it. This will clear the memory. Remember to switch off the unlearn switch after this process.

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 this feature code version **ACC4_h** or higher is required.
For operation in the Full mode (FLiM), see the document 'Full_mode_operation.pdf

Resistor R10 determines the rise and fall times of the CAN waveform. The value should be 100K to minimise fast edges and possible EMI.

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 website.
These can be freely used for non-commercial purposes. Copyright to the designs is held by the authors.