Model Electronic Railway Group

TECHNICAL BULLETIN G32_08
Issue 08-12
Andrew Crossland

CANSERVO8 CBUS module for driving R/C Servos

December 08

Introduction

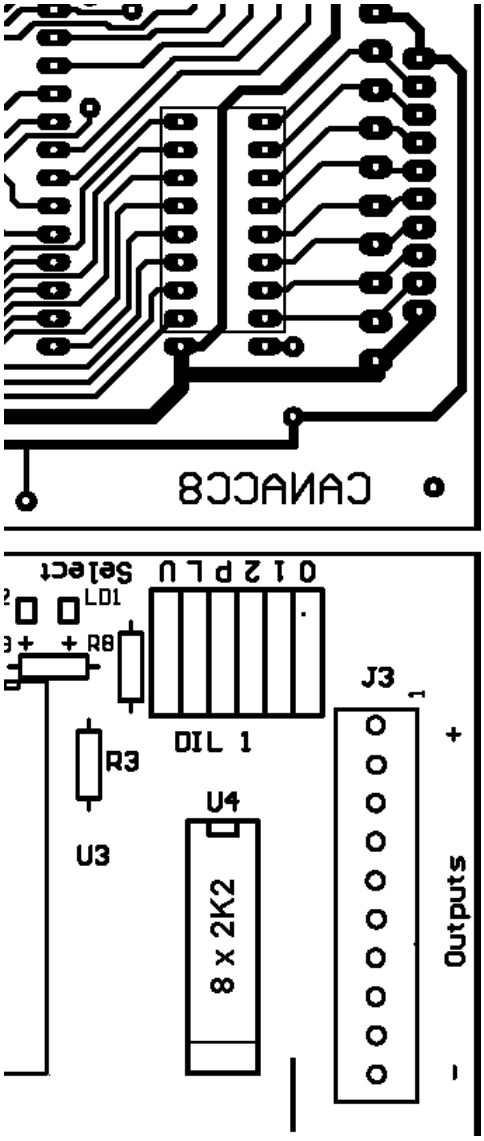
CANSERVO8 is an 8 output servo driver module. There is a 1 Amp source with voltage controllable from 5-15v. It is one of a number of layout control modules for use with the CBUS system, which is a general purpose layout control bus (LCB) using the industry standard CAN bus. For more information on CBUS, see the G32_0. This module is based on the CANACC8 module so this document should be read in conjunction with MERG Technical Bulletin G32/1 (TB G32/1), the description of that module.

Introduction

CANSERVO8 is a 'consumer' only module which accepts and learns events sent over the CBUS by other (producer) modules. Standard remote control servos give a low cost solution for point control and other mechatronic applications.

CANSERVO8 follows 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 the Full Model modules (FLiM).

CANSERVO8 is built on the same PCB as the CANACC8. Please refer to the schematic in TB G32/1. However IC U4 (ULN2803) is not used in CANSERVO8. Instead, the inputs should be linked to the outputs with 8 number 2K2 resistors between pins 1-18, 2-17, …, 8-11. Either 8 number individual 2K2 resistors bent to 0.4" (11.6mm) can be soldered across the spaces or a 16 pin DIL resistor network, (Rapid Code No 63-0650) could be used taking up the top 16 pins of the 18 pin socket as shown on the adjacent detail of the PCB.



Power supply

See TB G32/1.

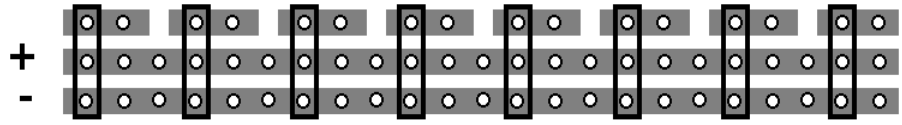
The output voltage from regulator U5 must be set to 5V to provide power to the Servos. If powering the servos directly from this output, the voltage should be set between 5 and 6 volts. Alternatively, and possibly preferably, the servo power should be a separate DC supply.

Output drive capability

The servo control outputs are driven directly by the PIC and are limited to 25mA sink or source current per pin or less than 200mA total sink or source across all port pins of the PIC. The 2k2 ohm resistors provide some protection for the PIC outputs. A higher value would be ideal, but has been found to cause quite a voltage drop in the control pulse with some servos. Some experimentation may show that a larger value can be used with your particular servos, depending upon the input impedance of the control input.

Connecting the module

See TB G32/1 for CBUS connection details. Outputs 2 to 9 on J3 are the control pulse outputs to the servos (often the yellow wire). A piece of stripboard could be used to mount standard 3-pin headers for connecting the servos, without butchering the existing leads.

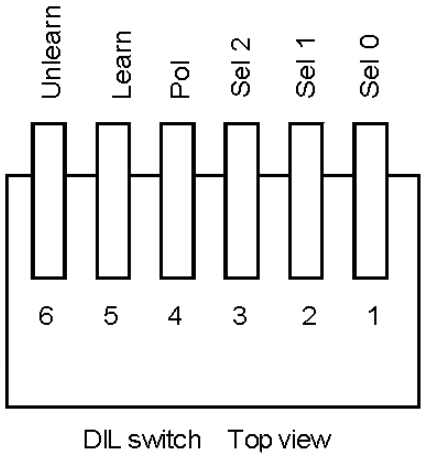


Main Differences to CANACC8

- The code has been ported to Microchip C18.
- CAN interrupts moved to low priority to guarantee jitter free timing for servo control.

Training the module

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 CANSERVO8 module has a 6 way DIL switch and a single pole pushbutton (S1) for training.



DIL switch Top view

Sel 2	Sel 1	Sel 0	Output
On	On	On	1
On	On	Off	2
On	Off	On	3
On	Off	Off	4
Off	On	On	5
Off	On	Off	6
Off	Off	On	7
Off	Off	Off	8

The three 'Sel' switches select which output the 'event' will apply to. There are 8 outputs numbered 1 to 8. The three switches allow a selection of one of the 8 outputs 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 all three switches down, this gives a value of binary 000 and selects output 1

Each time CANSERVO8 is powered up, the switches are tested to determine whether any reset or setup action is to be performed, as shown in Table 2.

Servo set mode is new to the CANSERVO8. Other modes are the same as CANACC8, apart from when unlearning stored events.

If S1 is pressed whilst powering up the board with UNLEARN ON and LEARN OFF there will be a complete reset. All servo settings will also be unlearned and the servo endpoints will be set to the mid position.

The outputs learn their events in the same way as the CANACC8, and other CANbus modules. The required output is set in the learn mode and the necessary event created and more than one output can be trained to a particular event.

See also TB G32/1.

UNLEARN	**LEARN**	**S1**	**Power Up**
ON	ON		Servo set mode
ON	OFF	OFF	Unlearn stored events
ON	OFF	ON	Unlearn stored events and all servo settings
OFF	N/A[1]		Normal mode

Note 1: CANSERVO8 will switch between normal and event learning modes at any time depending on the state of the LEARN switch. This is not strictly a power up option. See TB G32/1.

Table 2 Power Up Action

Servo Set Mode

Servos contain a motor, a potentiometer and electronics connected in a "closed-loop" allowing the position of the servo output shaft to be controlled in response to an input signal. The input signal takes the form of a pulse between 1ms and 2ms in width repeated approximately every 20ms.

For model railway control of points, etc., a simple binary control scheme allowing one of two positions to be selected, by applying one of two pulse widths, is generally sufficient. We refer to these two positions as the "endpoints". One endpoint is nearer the minimum *(*1ms pulse width) and one is nearer the maximum (2ms pulse width). In CANSERVO8 the endpoints are selected by CBUS OFF and ON events.

In servo set mode, the two endpoints for each servo can be adjusted and saved in permanent memory (EEPROM). Servo Set mode is entered if the UNLEARN and LEARN switches are both ON when the module is powered up. In the fullness of time anew PCB layout may be provided with extra switches to make the setting process more user friendly. An overriding design aim of CANSERVO8 was that it should follow the CBUS philosophy of allowing full configuration without the need for extra hardware (e.g. some form of "setting box") or a computer.

Once CANSERVO8 is in servo set mode, it remains in that mode until the next power cycle and the UNLEARN and LEARN switches become part of the "user interface" for servo configuration. To exit servo set mode, select a different mode on the UNLEARN and LEARN switches and cycle the power to CANSERVO8.

The function of the UNLEARN and LEARN switches is shown in Table 3.

UNLEARN	**LEARN**	**Mode**
ON	ON	Adjust ON endpoint
ON	OFF	Adjust OFF endpoint
OFF	N/A	Save servo position

Table 3 Servo Set modes

In the same way as for learning events (see TB G32/1), the SEL0 to SEL2 switches select the servo output to be configured. The servo connected to the selected output will move in response to inputs on the other switches.

The POL switch selects the way the servo control pulse is adjusted and depressing S1 adjusts it. If POL is OFF, the servo control pulse is reduced towards the minimum of 1ms. If POL is ON, the servo control pulse is increased towards the maximum of 2ms. The servo will move slowly reflecting the new position (control pulse width). It will stop if it reaches either the 1ms or 2ms limit.

It is possible to adjust both endpoints over the whole of the 1ms – 2ms range. No rule is enforced by CANSERVO8 as to which endpoint should be the shorter pulse width. For consistency, it is recommended that the endpoint selected with UNLEARN ON and LEARN OFF, which will be selected by a CBUS OFF event, be the shortest control pulse (nearest 1ms). Conversely the endpoint selected with UNLEARN ON and LEARN ON, which will be selected by a CBUS ON event, should be the longest control pulse (nearest 2ms).

If necessary, the servo endpoints can effectively be reversed by setting the POL switch ON when teaching an event. In that case a CBUS OFF event will select the “ON” endpoint and a CBUS ON event will select the “OFF” endpoint.

Pushing S1 performs the action selected by the current servo set mode, i.e., it moves the servo position or saves the current position in EEPROM.

Buzzing Servos

Some servos have been found to buzz continuously once they reach the desired endpoint. This is not desirable as it causes the servo to draw more current and increases dissipation (and temperature) in the variable voltage regulator. To workaround this, CANSERVO8 powers down all servos after five seconds if there is no incoming event during normal operating mode, or after one second if S1 is not pushed in servo setting mode. The friction in the servo gear chains allows the servos to maintain their positions unless deliberately forced to move.

Behaviour at Power Up

As already described, various operating modes are selected according to the state of the UNLEARN and LEARN switches at power up. In normal operating mode, the servo positions from the previous operating session will be restored.

Some servos have been found to twitch on power up. You should verify that this does not cause a problem in your application or design any mechanical linkages to cope.

Limitations

The speed of the servo movement is fixed and determined by the servo itself.

There is no facility to add “bounce” to the servo movement.

Planned Future Development

Implement speed control for the servo to give better slow motion action.

Add more pushbuttons to the PCB, to make the servo configuration less fiddly than using the DIP switch.

Implement FLiM to allow servo setting, via Node Variables, with a computer.

Acknowledgments

Acknowledgments are given to MERG members who have helped to design, implement and test CBUS, especially Mike Bolton on who’s CANACC8 design CANSERVO8 is based.