TECHNICAL BULLETIN G32_7
Issue 08-01
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January 2008

CANLED - CBUS module for driving 64 LEDs

Introduction

CANLED is a module for displaying 64 LEDs. It 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.

CANLED is a 'consumer' only module which accepts and learns events sent over the CBUS by other (producer) modules. It drives 64 separate LEDs using a 4 row by 16 column matrix. The column driver IC has a resistor to enable the LED current (brightness) to be adjusted. The column driver is a current sink so no external LED resistors are required.

CANLED can learn and store 254 separate events and any event can turn on or off an individual LED. Additionally, the polarity of the response relative to the command can be set for each event so an event can turn a LED on or off. There are also OFF events available which act in reverse to the equivalent ON event turning off the ones that the other would turn onAn extra feature of the CANLED module is a 'toggle' mode where an event will turn on one LED will turn off the next LED in sequence and similarly the other way round for an OFF event. This can be set for any LED pair and doesn't apply to all the LEDs at once so some can work as toggled pairs and some as individual LEDs. In addition the voltage is enough to allow two LEDs to be driven in series from each output.

This toggle facility is particularly intended for control panel use where a switch sending ON and OFF commands for a single event will operate two LEDs to indicate the switch or turnout position.

CANLED 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.

The Schematic is at the back of this TB

Power supply.

This module accepts its own AC supply of 9 to 15v (RMS) AC at 50/60 Hz. or it can be supplied directly with +5V through the CBUS connector. The AC is rectified by a bridge rectifier (BR1) and smoothed to DC by capacitor C1. Note that some other CBUS modules also require a similar AC supply and the same transformer can be used for all.

There is a separate voltage regulator (U3) which supplies the rest of the circuit with a fixed 5v. This +5v is also available on the CBUS connector for powering modules that do not have their own AC inputs. The maximum current available from this regulator is 1 amp. With all 64 LEDs illuminated and an average current of 10mA per LED, the module current is about 700mA. If an AC supply is used, the power dissipated in the 5V regulator is substantial. With a 15v RMS supply, the power is 10 watts and even with only 50% utilisation is 5 watts. A heatsink of not more than 10^{O}C/watt is recommended. A preferable arrangement for this module is to supply the +5V directly from an external supply. The regulator may be omitted completely in this case.

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. 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. The CANLED module has the ability to supply 5v to other modules that do not have the 15v AC supply input. If this is a requirement, then the link as shown in the diagram must be fitted. This also applies if an external 5V is used for this module as recommended. Where a number of modules are powered off the same 15 v AC supply, it is preferable to also connect the 0v line but the link must not be fitted or high currents may flow between these modules in the 0v line. (where a set of modules are all powered off the same 15v transformer, it is possible to omit the 0v line altogether.) Also where the modules are AC powered, the 5v line on the CBUS connector must not be connected to other powered modules. If you have a mixture of powered and non-powered modules, the 5v supply should be 'shared out' so no single module supplies all the unpowered ones.

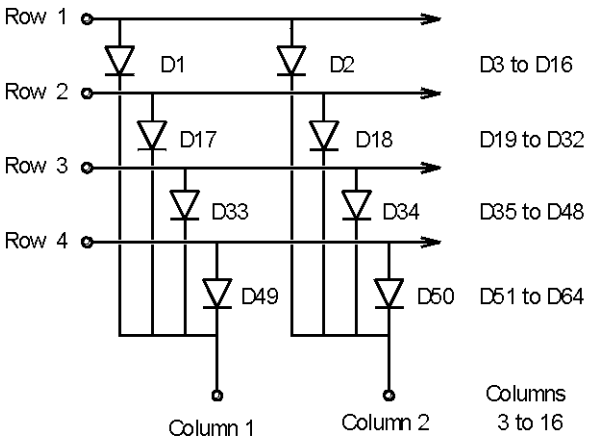
Connecting the LEDs.

The LEDs use a multiplexed array. This has 4 rows and 16 columns. The LED wiring connects to the D type socket on the PCB. Only 20 wires are required for all 64 LEDs. Refer to the schematic for the relationship between the row/column numbers and the socket connections. The average LED current is set by resistor R2. The suggested value gives an effective current of 10mA. If low current LEDs are used, then the average current may be reduced by increasing this resistor. This will also affect the brightness.

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 CANLED module has a 6 way DIL switch for selecting the LED and a group of four 'jumpers' for other functions.

The 6 'Sel' switches select which LED the 'event' will apply to. There are 64 LEDs numbered 1 to 64. The six switches allow a selection of one of the 64 LEDs 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 six switches down, this gives a value of binary 000000 and selects LED 1. All switches up gives 111111 and selects LED 64.



LED matrix connections. (two columns shown)

The following table gives all the possible combinations

SEL5	SEL4	SEL3	SEL2	SEL1	SEL0	LED
On	On	On	On	On	On	1
On	On	On	On	On	Off	2
On	On	On	On	Off	On	3
On	On	On	On	Off	Off	4
On	On	On	Off	On	On	5
On	On	On	Off	On	Off	6
On	On	On	Off	Off	On	7
On	On	On	Off	Off	Off	8
On	On	Off	On	On	On	9
On	On	Off	On	On	Off	10
On	On	Off	On	Off	On	11
On	On	Off	On	Off	Off	12
On	On	Off	Off	On	On	13
On	On	Off	Off	On	Off	14
On	On	Off	Off	Off	On	15
On	On	Off	Off	Off	Off	16
On	Off	On	On	On	On	17
On	Off	On	On	On	Off	18
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On	Off	Off	On	On	On	25
On	Off	Off	On	On	Off	26
On	Off	Off	On	Off	On	27
On	Off	Off	On	Off	Off	28
On	Off	Off	Off	On	On	29
On	Off	Off	Off	On	Off	30
On	Off	Off	Off	Off	On	31
On	Off	Off	Off	Off	Off	32

SEL5	SEL4	SEL3	SEL2	SEL1	SEL0	LED
Off	On	On	On	On	On	33
Off	On	On	On	On	Off	34
Off	On	On	On	Off	On	35
Off	On	On	On	Off	Off	36
Off	On	On	Off	On	On	37
Off	On	On	Off	On	Off	38
Off	On	On	Off	Off	On	39
Off	On	On	Off	Off	Off	40
Off	On	Off	On	On	On	41
Off	On	Off	On	On	Off	42
Off	On	Off	On	Off	On	43
Off	On	Off	On	Off	Off	44
Off	On	Off	Off	On	On	45
Off	On	Off	Off	On	Off	46
Off	On	Off	Off	Off	On	47
Off	On	Off	Off	Off	Off	48
Off	Off	On	On	On	On	49
Off	Off	On	On	On	Off	50
Off	Off	On	On	Off	On	51
Off	Off	On	On	Off	Off	52
Off	Off	On	Off	On	On	53
Off	Off	On	Off	On	Off	54
Off	Off	On	Off	Off	On	55
Off	Off	On	Off	Off	Off	56
Off	Off	Off	On	On	On	57
Off	Off	Off	On	On	Off	58
Off	Off	Off	On	Off	On	59
Off	Off	Off	On	Off	Off	60
Off	Off	Off	Off	On	On	61
Off	Off	Off	Off	On	Off	62
Off	Off	Off	Off	Off	On	63
Off	Off	Off	Off	Off	Off	64

There is also a 4 position jumper block on the PCB. This has 4 functions. Learn, unlearn, polarity and toggle. A jumper in gives a logic low or an ON state.

To train the CANLED module, you need a CBUS 'producer' module which creates events. This could be a CANACE3 control panel scanner, a CANACE8C switch input module or a PC program which creates events via a CAN-RS module.

Connect the various modules and apply power. Connect the LED array. Select the LED you want the event to operate with the Sel switches according to the above table. Put the 'learn' jumper in (ON). Send the event. If it is an ON event, then the corresponding LED will turn on. Try it with the same event number but as an OFF event. The LED should now go off. Remove the learn jumper. Test the event again. The LED should go on or off as expected. The next option is the use of the 'Pol' jumper. With the Pol jumper out, an ON event will turn a LED on and vice versa. However, it is possible to reverse this by putting the Pol jumper in when learning the event. Now an OFF event should turn the LED on and an ON event turn it off.

The other option with the CANLED module is the ability to have a single event toggle two adjacent LEDs. This is particularly intended for control panels where a switch or pushbutton sets a turnout using a single ON or OFF event to set the direction. This same event can now indicate the turnout position using two LEDs. With both the learn

and toggle jumpers in, set the LED switches to the first LED of the pair. Send the ON event. The first LED will light. Now send the same event as an OFF. The next LED in sequence will light and the first one will go off. If the polarity jumper is also fitted, the sequence is reversed. Note that it is possible to set another event which will actuate either of the same LEDs separately. When using the toggle facility, it is best to consider the LEDs as pairs and number them alternately. However, not all the LEDs may be required to work in pairs, e.g. when setting a route so this option remains.

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 LED. 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.

Limitations.

The present firmware sets the number of stored events to 254. If you try to set more than this, nothing will happen. This allows nominally 4 events per LED but you can have more for some and less for others up to the 254 maximum.

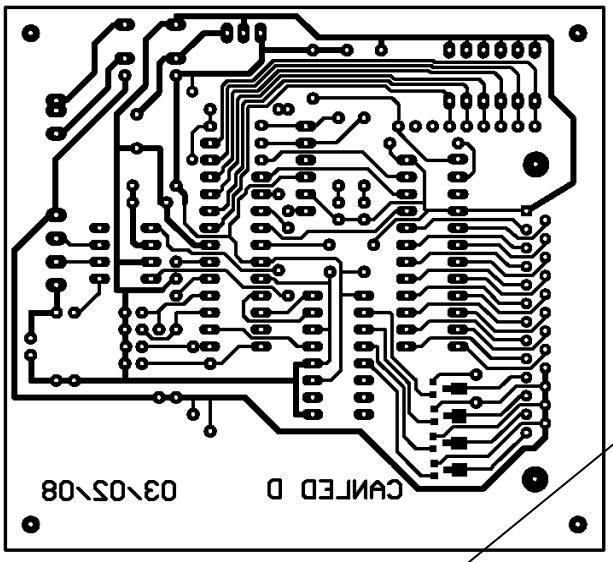
You can alter the polarity for an existing LED or put it in toggle mode but you cannot remove a LED from an event once set. If you want to remove a LED, you need to erase the whole event and teach it again.

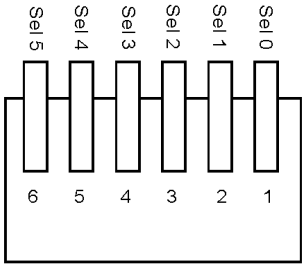
If you have forgotten which events the module has been taught, then you cannot tell it to unlearn an event that you don't know it has! In this case there is a 'clear all' option. This removes completely all stored events. To do this, set the unlearn jumper in with the learn jumper out. Remove power from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

Remember to remove the unlearn jumper after this process.

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 R10 and R11.

S1 is for use with the Full Model (FLiM) scheme. It will be used in conjunction with the two LEDs to put a module into setup/learn mode so that it can be programmed 'in situ' with its Node Number. It is provided for compatibility with the future system and is standard for all SLiM modules. Further details will be provided with the FLiM system.

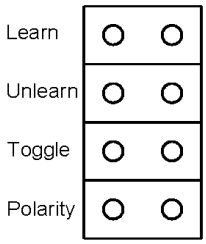




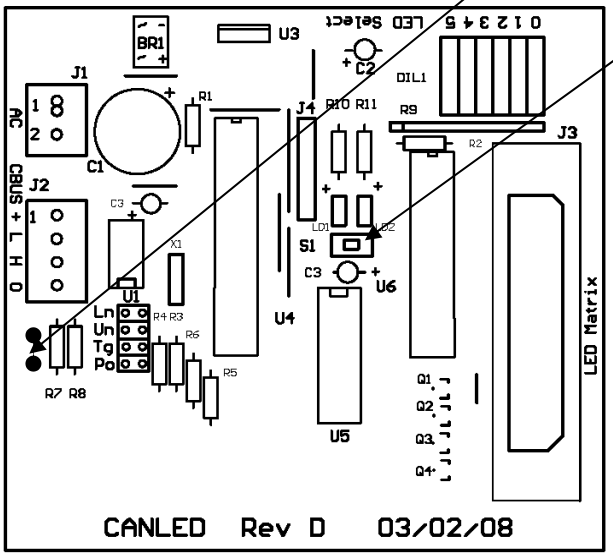
DIL switch Top view

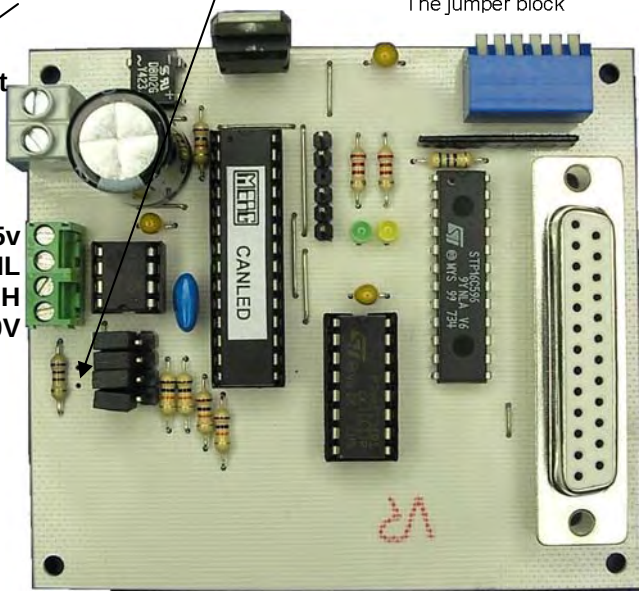
Link to short out R7 if using a dedicated power supply or sharing a 5v supply with other modules.

Switch S1, not shown in the photograph is for future use with FLiM



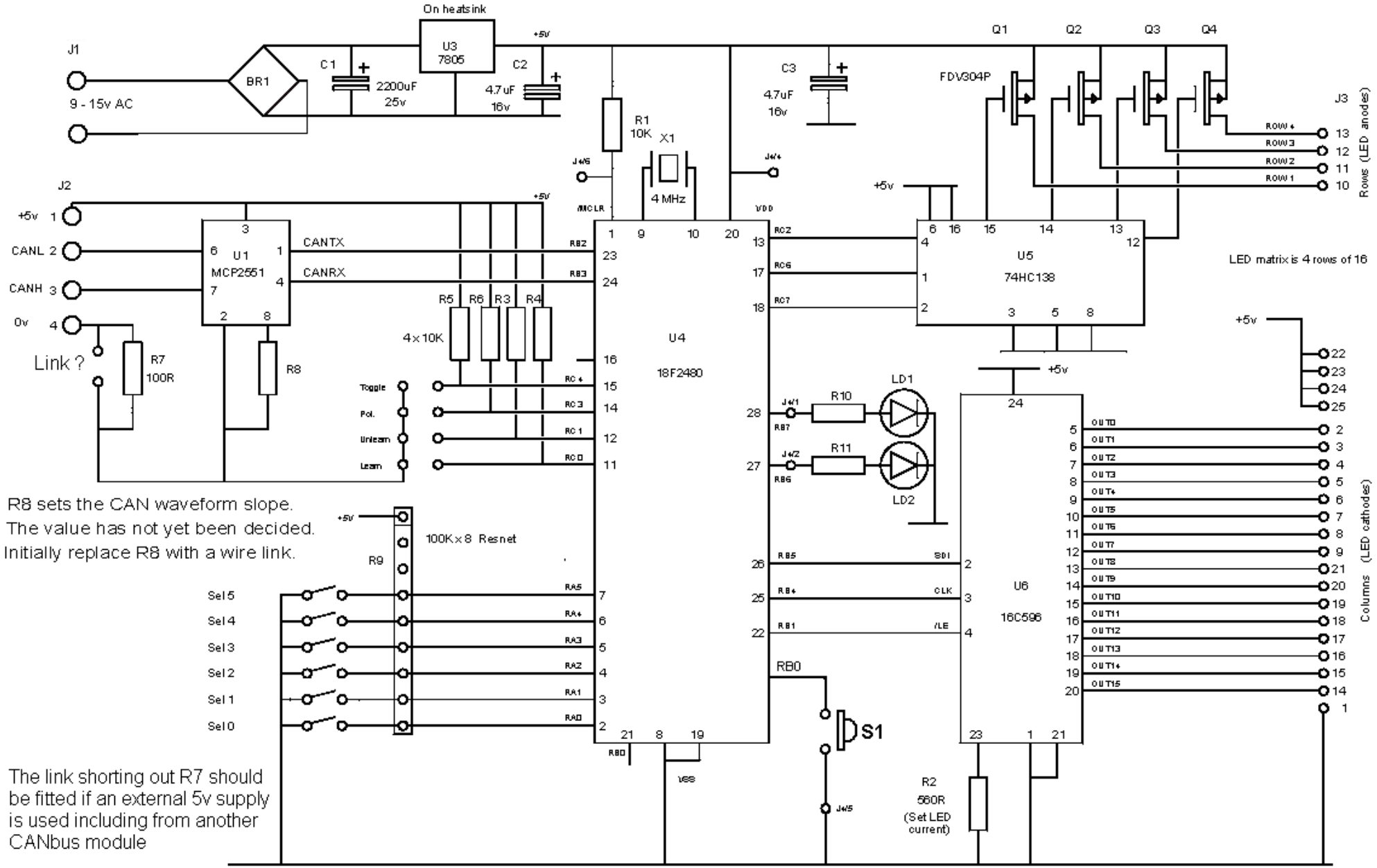
The jumper block





Input AC 15v

+5v CANL CANH 0V



CBUS Multiple LED driver module. M P Bolton Rev E 04/02/08 ©