

CAT310DB1 DEMONSTRATION BOARD FOR CAT310 – 10 CHANNEL LED DRIVER

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1. INTRODUCTION

This document describes the CAT310DB1 Demonstration Board for the CAT310 LED driver. This board shows an application of the CAT310 driving 10 high brightness LEDs through an 8-bit microcontroller control.

The CAT310 is a 10-channel LED driver designed for automotive and other general LED lighting applications. The driver is controlled through a serial interface incorporating a 10-bit shift register and data latch. The LEDs are driven from the OUT0 to OUT9 outputs through CMOS switches. The output current per each channel can be set up to 50 mA using the external series resistors, depending on the supply voltage and the LED forward voltage.

An enable input, BLANK, allows to turn on/off all the output drivers. The CAT310 features over voltage and over current limiting protection on the outputs.

Detailed descriptions and electrical characteristics of the CAT310 are in the device data sheet.

2. CAT310DB1 BOARD HARDWARE

The demonstration board uses the CAT310 to drive 10 LEDs of different colors, Red, Yellow, Green, White and Blue. The CAT310 is controlled through a serial interface using an 8-bit microcontroller. The user can chose to drive on/off or blink any LEDs combination using the commands through the on-board pushbutton switches or through a PC serial interface. The board is powered from an attached 3V battery. The block diagram of the board hardware schematic is shown in Figure 1.

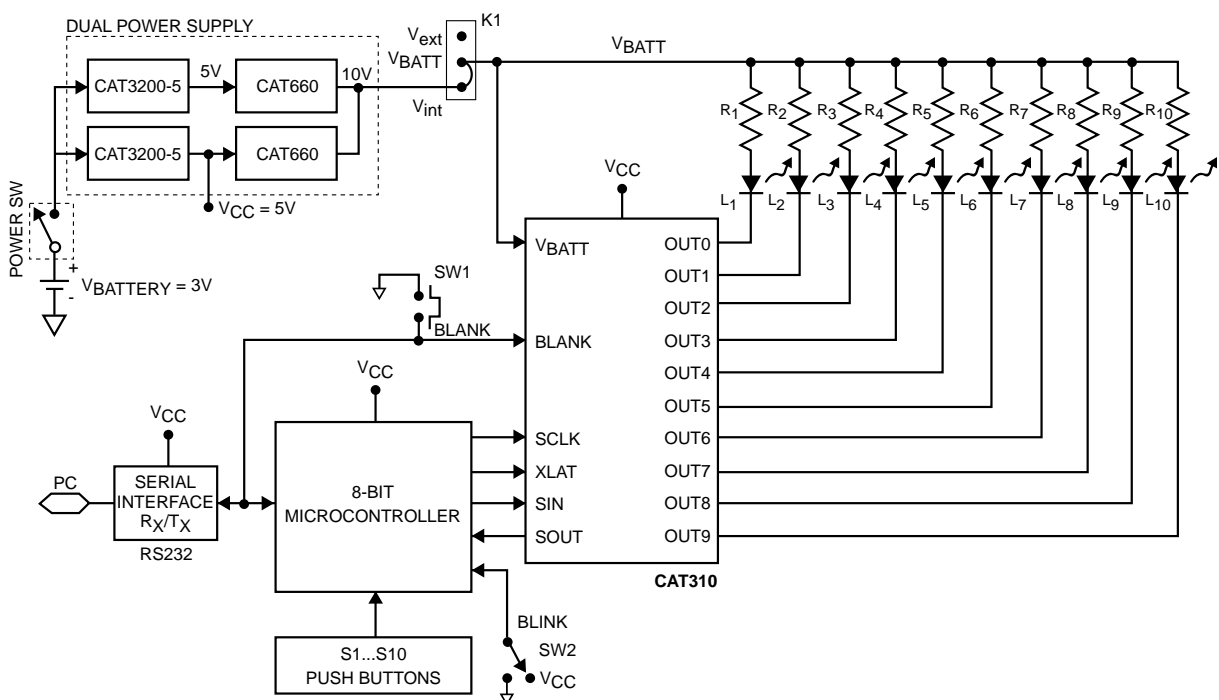


Figure 1. CAT310DB1 Block Schematic

The data is transmitted serially between the microcontroller and the CAT310. Using the commands received through the S1 to S10 on board pushbuttons or from the PC, the microcontroller transfers the data serially on the SIN input of the CAT310. The input data is shifted with the MSB first into the CAT310 internal 10-bit shift register. This data is latched into a 10-bit data latch using the XLAT signal. The data is transferred through the latch when the XLAT is high. To drive a LED on, the data written to the corresponding latch bit must be “1” and the BLANK input low. When the BLANK input of the CAT310 is high (the associated pushbutton is not pressed), the output drivers are turned into the high-impedance state and all the LEDs are off.

If the on-board BLINK switch is ON, the microcontroller samples the “blink” status for any LED (L1 to L10) selected by the corresponding pushbutton (S1 to S10). The LED selected with the BLINK switch ON is programmed to blink with a 600ms period (300 ms ON, 300 ms OFF).

The current through each LED, L1 to L10 is set by the ballast resistors, R1 to R10. The supply voltage for the LEDs, VBATT, is provided through the K1 connector from the internal voltage, Vint (default jumper position) or from the externally connected voltage, Vext.

The internal voltage, Vint (10V / 100mA) is supplied on board using the charge pump voltage converter devices, CAT3200-5 and CAT660, two chains in parallel. CAT660 is used in the “voltage doubler” configuration. For the default configuration (Vint connected to VBATT) the current through each LED has been set to 10 mA approximately, using on board resistors (R1 to R10).

The user can drive the LEDs from an externally connected voltage, Vext, moving the jumper from the K1 connector from the default position (Vint) to the position marked with Vext. The voltage connected externally at Vext test point should be in the range specified by the device data sheet. Changing the series resistors, the user can set the output current to other value, in the specification limits.

The CAT3200-5 provides also the regulated voltage (+5V) for the microcontroller, the CAT310 and the RS232 serial interface device.

Test points are available to apply the external voltage, Vext, or to measure some of the internal voltages as Vint, VBATT, or the outputs of the CAT310 device (B1 to B10).

To maximize the battery life (2 x 1.5V AA cells), the battery voltage is applied only when the “POWER” switch is ON.

The component placement, top side for the CAT310DB1 board is shown in Figure 2. The CAT310DB1 board picture is shown in Figure 3.

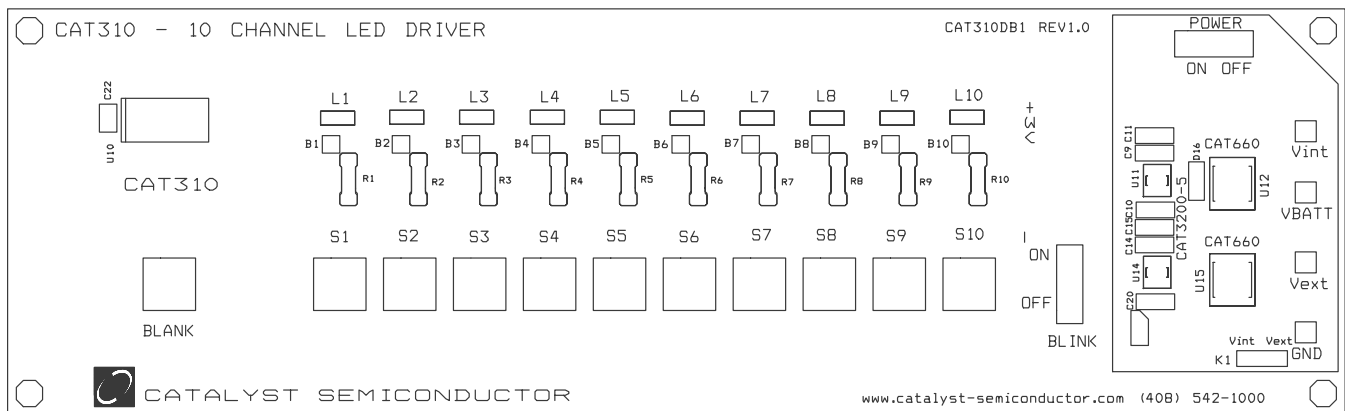


Figure 2. CAT310DB1 Component Placement - Top Side



Figure 3. CAT310DB1 Board

The detailed schematic, the PCB layout and the list of components for the CAT310DB1 are shown in the Appendix attached in the end of this document.

3. STAND-ALONE BOARD OPERATION

The CAT310DB1 can be used as an independent board to drive up to 10 multicolor LEDs. The following steps are an example of how the user can drive different LEDs connected to the output of CAT310 using on-board switches.

3.1. Driving the LEDs

- a) Turn ON the “Power” switch. Set the initial state for “BLINK” switch to OFF.
- b) Select any desired LED (L1 to L10) to be ON, pressing the associated pushbutton switch (S1 to S10). The action of any of these momentary switches has a toggle function: first time pressing a switch selects the associated LED on, the second action deselects the LED.
- c) Press the “BLANK” pushbutton to enable the CAT310 outputs. As a result, the LED(s) selected at the previous step, will be lightning. The LEDs remain ON as long as the “BLANK” momentary switch is pressed.
- d) Set the “BLINK” switch to ON position. Select the LED(s) you want to blink by pressing the associated S_i ($i = 1$ to 10) pushbutton.
- e) Press the “BLANK” pushbutton to enable the LEDs (if it is not already ON).
- f) Deselect the blinking for a specific LED i by pressing second time the associated S_i pushbutton and set the “BLINK” switch to OFF position.

3.2. Driving LEDs with an external voltage and over voltage protection

The output drivers of the CAT360 can withstand a voltage up to 17V typically for the normal operation. If the voltage exceeds an overvoltage threshold of 17V – 20V, the output driver will become protected through the VBATT sense input which is connected to a voltage detector. All the CAT310 outputs, OUT0 to OUT9 are turned into the high impedance state.

- a) Disconnect the jumper at the K1 connector from the position Vint and set to Vext position.
- b) Apply the external voltage between Vext and GND test points; $V_{ext} < 17\text{ V}$.
- c) Measure the current through each LED by the current drawn from the external power supply with one LED selected ON at a time.
- d) The user may choose to change the ballast resistor in series with the LED to set other LED current (not exceeding $I_{OUT\ max} = 50\text{ mA}$).
- e) Measure the driver outputs voltage at the OUT0 to OUT9 pins using B1 to B10 test points.
- f) With the LED(s) selected ON and BLANK pushbutton pressed increase the external voltage, V_{ext} , above 17V. Do not exceed the absolute maximum value of 40V!
- g) Observe the LED(s) becoming OFF. Measure the voltage at the OUT0 to OUT9 pins (B1 to B10).

4. CAT310DB1 Board Controlled through the PC Serial Interface

The board can be controlled from a PC connected through the serial interface. The user can send the commands to drive on/off or blink any LEDs configuration using a friendly graphical user interface (GUI).

The CAT310DB1 software requires the following minimum system configuration:

- Microsoft Windows 98SE or above
- 100K of available hard disc space
- Serial Interface Port

The software is available on the CAT310DB1 software distribution CD-ROM or can be downloaded at www.catalyst-semiconductor.com/evaluationtools.

The CAT310DB1 software is an executable program which can be run from any directory or CD.

The following steps should be followed to control the CAT310DB1 demo board from the PC:

- a) Connect the CAT310DB1 board to the PC serial port through a cable with 9-pin connectors (extender type). For a limited quantity the connection cable is provided.
- b) Power the CAT310DB1 board by turning the “POWER” switch ON.
- c) Run the “CAT310DB1.exe” program from the directory where the software was installed.
- d) The CAT310DB1 user interface window opens (Figure 4).
- e) From the “SERIAL INTERFACE” menu, select the appropriate communication port. The selected port (default COM1) is marked with “=”. The “COM” selection becomes active by pressing any button from the GUI screen. Once the selected port is activated, the serial interface selection frame becomes inactive.

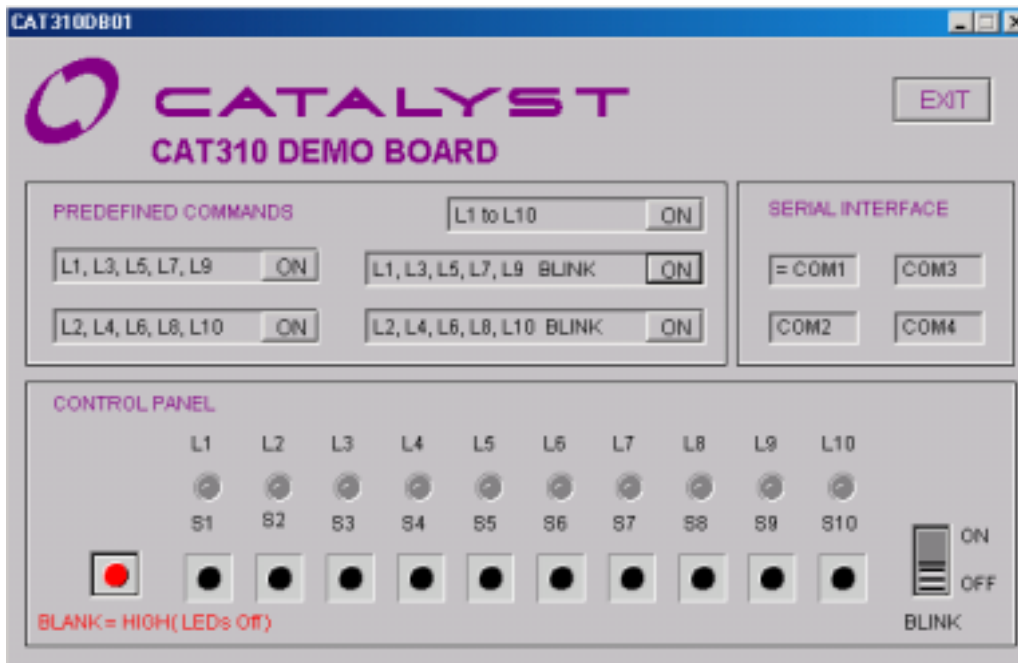


Figure 4. CAT310DB1 Software User Interface Window

Using the CAT310DB1 software the user can control the CAT310 board using the “PREDEFINED COMMANDS” or using the switches defined in the “CONTROL PANEL” section.

The predefined commands allow the user to send a macro command as the following:

- Set all the LEDs, L1 to L10, ON or OFF (Figure 5)
- Set LEDs L1, L3, L5, L7, L9, ON or OFF
- Set LEDs L2, L4, L6, L8, L10, ON or OFF
- Set LEDs L1, L3, L5, L7, L9, Blink ON or Blink OFF
- Set LEDs L2, L4, L6, L8, L10, Blink ON or Blink OFF

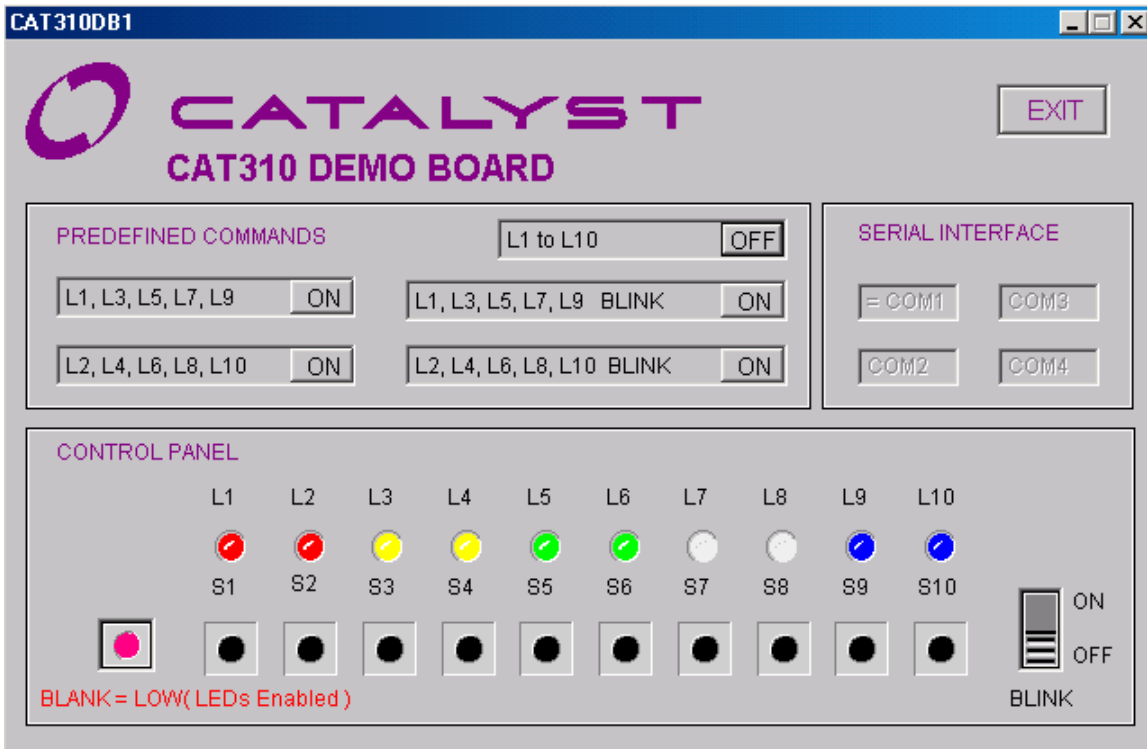


Figure 5. CAT310DB1 with all the LEDs ON using the Predefined Command

Figure 5 shows the window after the user has executed the predefined command “L1 to L10 ON. All the LEDs are lighting (BLANK = LOW). After the executing one of the predefined commands, in the window will be displayed the next command which can be executed. In this example, at the next action of the same button, L1 to L10 will be OFF.

From the Control Panel section of the window, the user can control manually any LEDs configuration using the individual switches, S1 to S10, BLANK and BLINK. This section allows the user to control the board through the GUI in the same way as provided by the on-board switches.

5. APPENDIX

The detailed board schematics, board layout and the list of components are shown in the following figures and table.

- Figure 6. CAT310DB1 Board Schematic
- Table 1. CAT310DB1 Demo Board List of Components
- Figure 7. CAT310DB1 Board Layout – Top Side
- Figure 8. CAT310DB1 Board Layout – Bottom Side
- Figure 9. CAT310DB1 Component Placement – Top Side
- Figure 10. CAT310DB1 Component Placement – Bottom Side

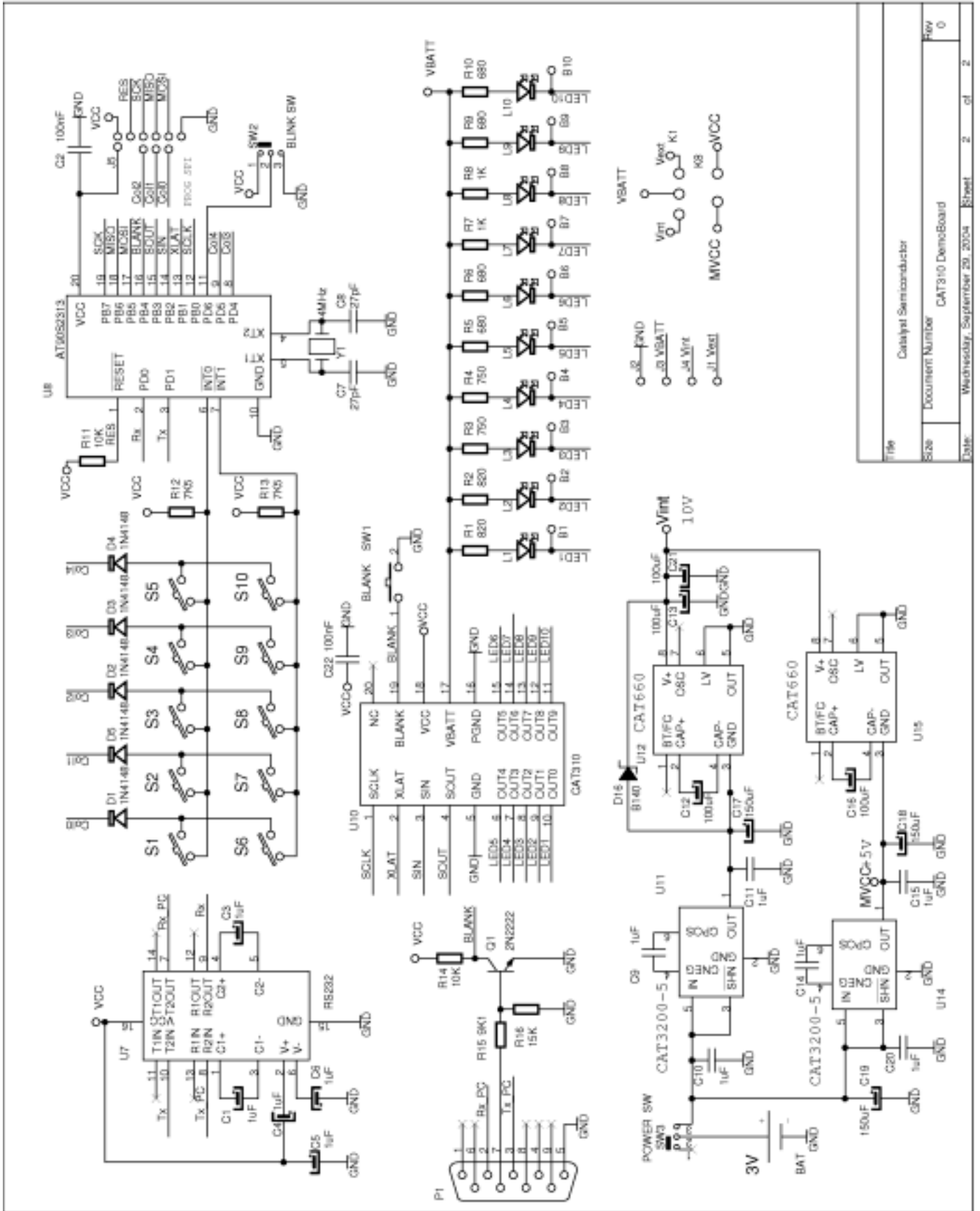


Figure 6. CAT310DB1 Board Schematic

Name	Manufacturer	Description	Part Number	Units
U12, U15	Catalyst	Charge Pump Inverter / Doubler	CAT660	2
U11, U14	Catalyst	Low Noise Regulated Charge Pump DC/DC Convertor	CAT3200-5	2
U10	Catalyst	10 Channel Latched LED Driver	CAT310	1
U7	Maxim	RS-232 Transmitters/receivers	Max232/SO	1
U8	Atmel	8-bit flash microcontroller	AT90S2313-10SI/SO	1
Q1		NPN, 30V, 0,1A, 0,25W, B200-450 SOT23	BC848B	1
Y1		Resonator 4MHz	Schukat Electronic QMIM004	1
L1, L2	LiteOn	Red LED, SMT	LTST-T670KRKT	2
L3,L4	LiteOn	Yellow LED, SMT	LTST-T670KSKT	2
L5, L6	LiteOn	Green LED, SMT	LTST-T670KGKT	2
L7, L8	Nichia	White LED, SMT	NSCW100	2
L9, L10	LiteOn	Blue LED, SMT	LTST-T670KBKT	2
D1 to D5		Switching Diode	LL4148	5
D15	LiteON	Schottky Diode, SMT	B140	1
C1, C3 to C6, C9 to C11, C14, C15, C20	Murata Electronics	Ceramic Capacitor 1uF / 10V, 10%, X5R, Size 1206	CVUF001K12X	11
C13, C21	AVX	Low ESR Tantalum Chip Capacitor, 100uF / 16V	TPSD107K016R125	2
C12, C16	AVX	Low ESR Tantalum Chip Capacitor, 100uF / 10V	TPSD107K010R010	2
C7, C8	Kemet	Ceramic Capacitor 22pF / 63V, 5%, Size 1206	CCPF022K1206	2
C2, C22	Kemet	Ceramic Capacitor 100nF/ 63V, 5%, X7R, Size 1206	CVUF100K12X	2
C17 to C19		Electrolytic Capacitor 150µF/10V (Optional - Not Soldered)	CKUF150	3
R11, R14 , R15		10Kohm Resistor, 1/8W, SMT 1206	Schukat Electronic CR0603K010-1	3
R12.R13		7.5 Kohm Resistor 1/8W, SMT 1206	Schukat Electronic CR0603K007,5-1	2
R16		15 Kohm Resistor 1/8W, SMT 1206	Schukat Electronic CR0603K015-1	1
R1, R2		Metal Film Resistor 0.5W, 820 ohm	SMA207E820	2
R3, R4		Metal Film Resistor 0.5W, 750 ohm	SMA207E750	2
R5, R6, R9, R10		Metal Film Resistor 0.5W, 680 ohm	SMA207E680	4
R7, R8		Metal Film Resistor 0.5W, 1 Kohm	SMA207K001	2
S1 to S10	HDK	Momentary Contact Switch SPST (on)-off	Schukat Electronic DTS62K	10
SW1	HDK	Momentary Contact Switch SPST (on)-off	Schukat Electronic DTS67R	1
SW2, SW3		Slide switch EG1218	Digi-Key EG1903-ND	2
P1		Connector DB9	Schukat ElectronicSL09WSI	1
		250 Diameter 1" Plastic Stand Off	Schukat Electronic KDA6M3X10	4
		Battery Holder 2 x AA 1.5V cells, PC mount (Note)	DigiKey 2364	1

Table 1. CAT310DB1 Demo Board List of Components

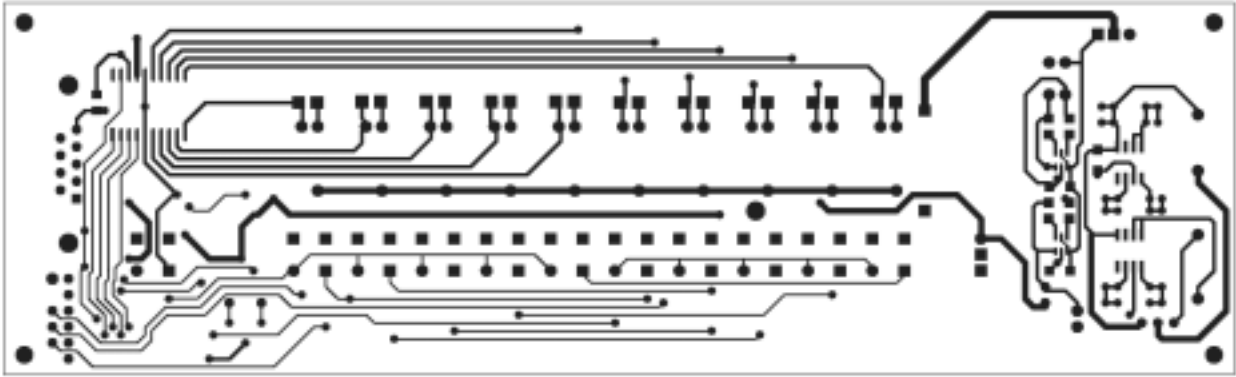


Figure 7. CAT310DB1 Board Layout – Top Side

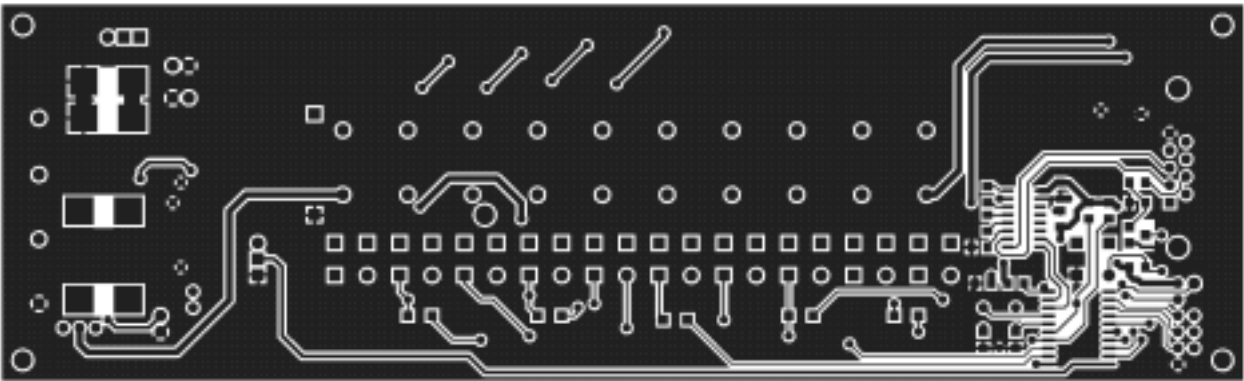


Figure 8. CAT310DB1 Board Layout – Bottom Side

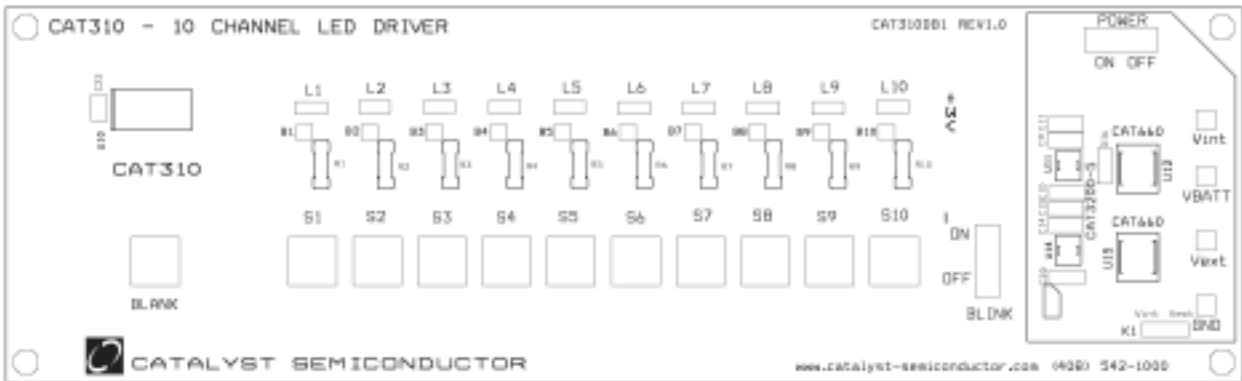


Figure 9. CAT310DB1 Component Placement – Top Side

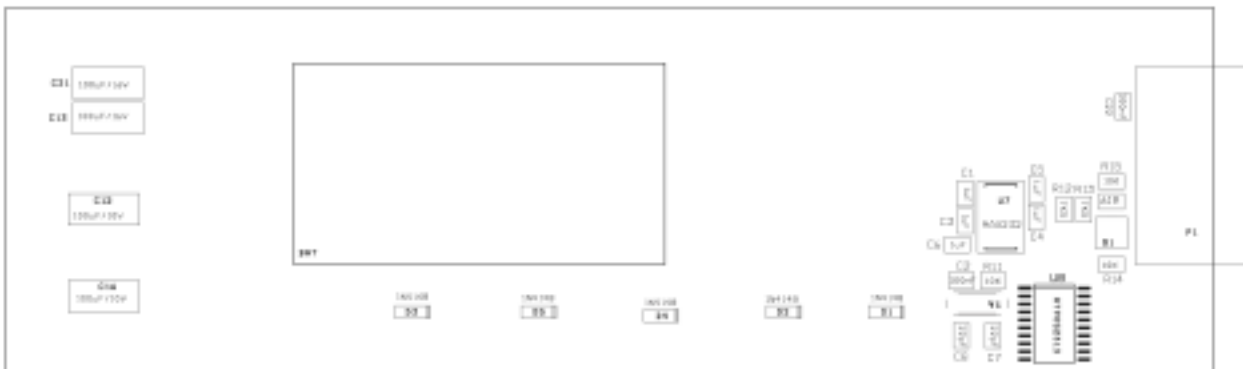


Figure 10. CAT310DB1 Component Placement – Bottom Side



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