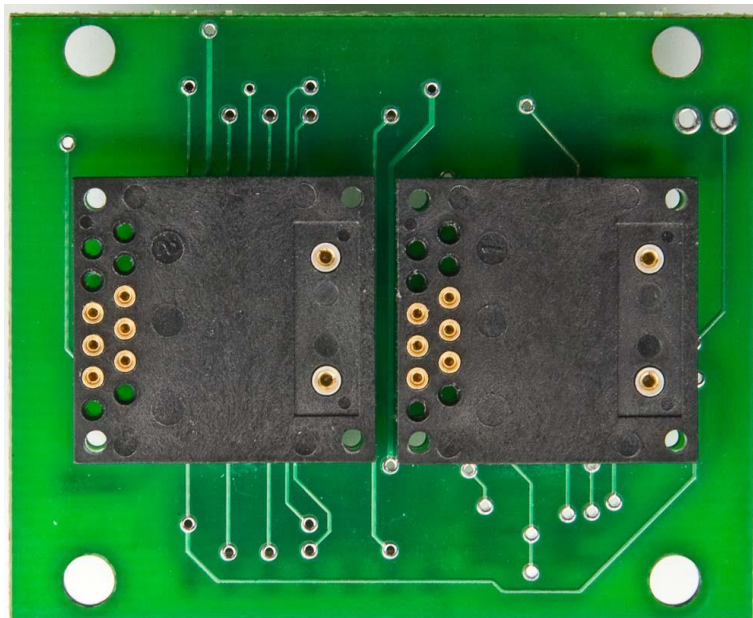


# LCD 64x32 Logic Boards User Manual

Revision H



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## 1. What are Logic Boards?

Logic boards are switch panels that have glue logic to convert addressing and switch scanning to serial. A logic board can be designed for any number of switches. Logic boards can be daisy-chained using a 14-pin ribbon cable allowing for a variable number of switches to be controlled from one port of a controller. The daisy-chain capability allows switches to be mounted at any desired location on a control panel. Switches/displays can be soldered directly to the logic boards or mounted on sockets for removability.

## 2. Standard Part Numbers

The logic boards listed below are standard production parts. There are additional prototype boards that are not listed. NKK Switches will work with customers to design and build custom logic boards in any desired specification.

Item	Part# with Socket and switch	Part# with switch	Description
1	IS-L02A1-CS	IS-L02A1-S	Logic Board, LCD 64x32 RGB, IS15EBFP4RGB, 2SW. Side by side stackable
2	IS-L02G1-CS	IS-L02G1-S	LOGIC BOARD, 1x2, LCD 64x32 RGB, IS15EBFP4RGB-09YN, 2SW. Side by side stackable
3	IS-L02H2-CS	IS-L02H2-S	LOGIC BOARD, 1x2, LCD 64x32 RGB, IS15ESBFP4RGB, 2SW. Side by side stackable
4	IS-L04G2-CS	IS-L04G2-S	LOGIC BOARD, 2x2, LCD 64x32 RGB, IS15EBFP4RGB-09YN, 4SW. Side by side stackable
5	IS-L16G2-CS	IS-L16G2-S	LOGIC BOARD, 4x4, LCD 64x32 RGB, IS15EBFP4RGB-09YN, 16SW. Side by side stackable

There is a signal booster for when too many logic boards are connected in a daisy-chain or when very long cables are used for interconnecting.

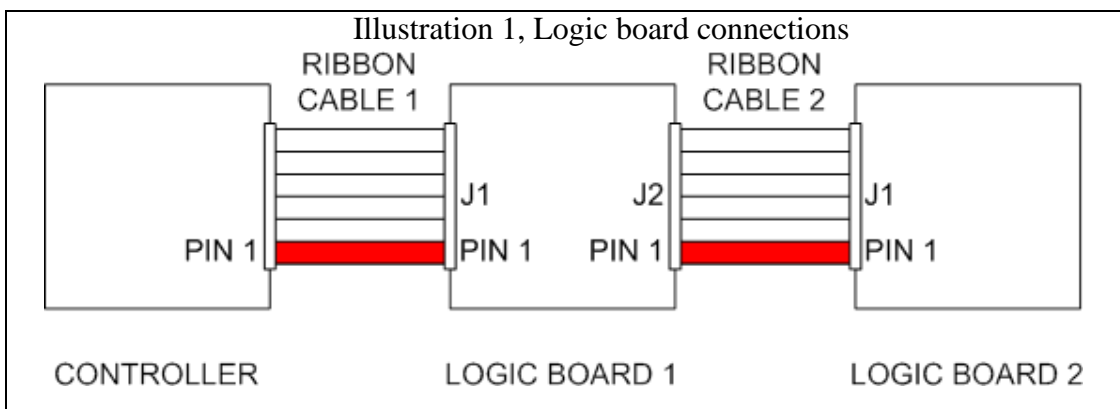
Item	Part#	Description
1	IS-LBUF01	Signal booster for both LCD36x24 and LCD64x32

**Note: Make sure the power is off when connecting or disconnecting logic boards to or from a controller or each other.**

**Note: Connecting logic boards improperly could damage either/both the logic boards and controller.**

### 3. Connectors

The SmartDisplay controller connects to the J1 header of the first logic board via a 14-pin ribbon cable. The J2 header of the first logic board connects to the J1 header of the second logic board and so on. The switch numbering starts with switch one on the first logic board. The first switch of the next logic board will be one number higher than the last switch of the previous logic board and so on.



**Note: Attaching the ribbon cable without the red line on pin 1 on each of the headers may cause damage to the controller or the logic board.**

#### Ribbon Cables

These cables are used for logic board connections. Custom length cables can be made to order.

Item	Part#	Length	Description
1	ISDCB81.2	1.2"	RIBBON CABLE, 14 CONDUCTORS, 28AWG, .050"
2	ISDCB83	3"	RIBBON CABLE, 14 CONDUCTORS, 28AWG, .050"
3	ISDCB88	8"	RIBBON CABLE, 14 CONDUCTORS, 28AWG, .050"
4	ISDCB812	12"	RIBBON CABLE, 14 CONDUCTORS, 28AWG, .050"
5	ISDCB824	24"	RIBBON CABLE, 14 CONDUCTORS, 28AWG, .050"
6	ISDCB836	36"	RIBBON CABLE, 14 CONDUCTORS, 28AWG, .050"

The logic boards have two connectors:

**J1 Input port:** 7x2 male header with 0.1" x 0.1" spacing.

This connector connects to a controller port or J2 of the previous logic board in the daisy chain.

Pin	Function	
1	Din	Connected to Din of the first shift register
2	GND	Ground
3	CLK	Clock for all shift registers
4	GND	Ground
5	NC	
6	Vsup	7V to 12V
7	LP	Latch all shift register outputs to all the drivers
8	NC	
9	SCK	Clock of all SmartDisplays
10	NC	
11	SDI	Data of all SmartDisplays
12	Vsup	7V to 12V
13	NC	
14	SWRD	Switch Read bus for all SmartDisplays

**J2 Output port:** 7x2 male header with 0.1" x 0.1" spacing.

This connector connects to J1 of the next logic board in the daisy chain.

Pin	Function	
1	Dout	Connected to Dout of the last shift register
2	GND	
3	CLK	Connected to CLK of J1
4	GND	
5	GND	
6	Vsup	7V to 12V
7	LP	Connected to LP of J1
8	NC	
9	SCK	Connected to SCK of J1
10	GND	
11	SDI	Connected to SDI of J1
12	Vsup	7V to 12V
13	GND	
14	SWRD	Connected to SWRD of J1

## 4. How to Control Logic Board Mounted LCD 64x32 Switches

If you are using NKK controllers, you can skip this section. This section covers details on how to control LCD 64x32 switches mounted on logic boards.

Please note the controller with the same port can control LCD 36x24 switches. If you want the same design to have the capability to control both type of LCDs, please check the LCD 36x24 logic board user manual as some of the indicated ground in the below table needs to be changed to meet LCD 36x24 logic board requirements.

Pin	J1 of the first logic board	Controller connection
1	Din	Microcontroller pin (output)
2	GND	GND
3	CLK	Microcontroller pin (output)
4	GND	GND
5	NC	GND
6	Vsup	7V to 12V. Closer to 7V is better
7	LP	Microcontroller pin (output)
8	NC	GND
9	SCK	Microcontroller pin (output)
10	NC	GND
11	SDI	Microcontroller pin (output)
12	Vsup	7V to 12V. Closer to 7V is better
13	NC	GND
14	SWRD	Microcontroller pin (input) and 2K pull down resistor to GND

Clock and data can be connected to SPI/UART mode 0 or any pin of a microcontroller. For SCK and SDI signals, please refer to the application notes for LCD 64x32 switches.

### Switch Numbering

On each logic board the first switch is in the upper left-hand corner and continues row by row with the last switch in the lower right-hand corner. The switch numbering starts with switch one of the first logic board, then the first switch of the next logic board will be one number higher than the last switch of the previous board.

## Selecting a Switch

The SS (Slave Select) of each switch is connected to the output of the latch driver. The input of the latch driver is connected to the serial to parallel shift register. One bit is shifted for each switch using Din and CLK. The last bit shifted will be for switch #1.

To select a switch for communication, bits should be shifted using Din and CLK, so all the switches have a high bit, except the communication target switch, then toggle the LP of that switch that gets selected. The communication to the switch is done via SCK and SDI. After communication to the switch is ended, all high bits are shifted via Din and CLK for all the switches, and LP is toggled so no switch is selected.

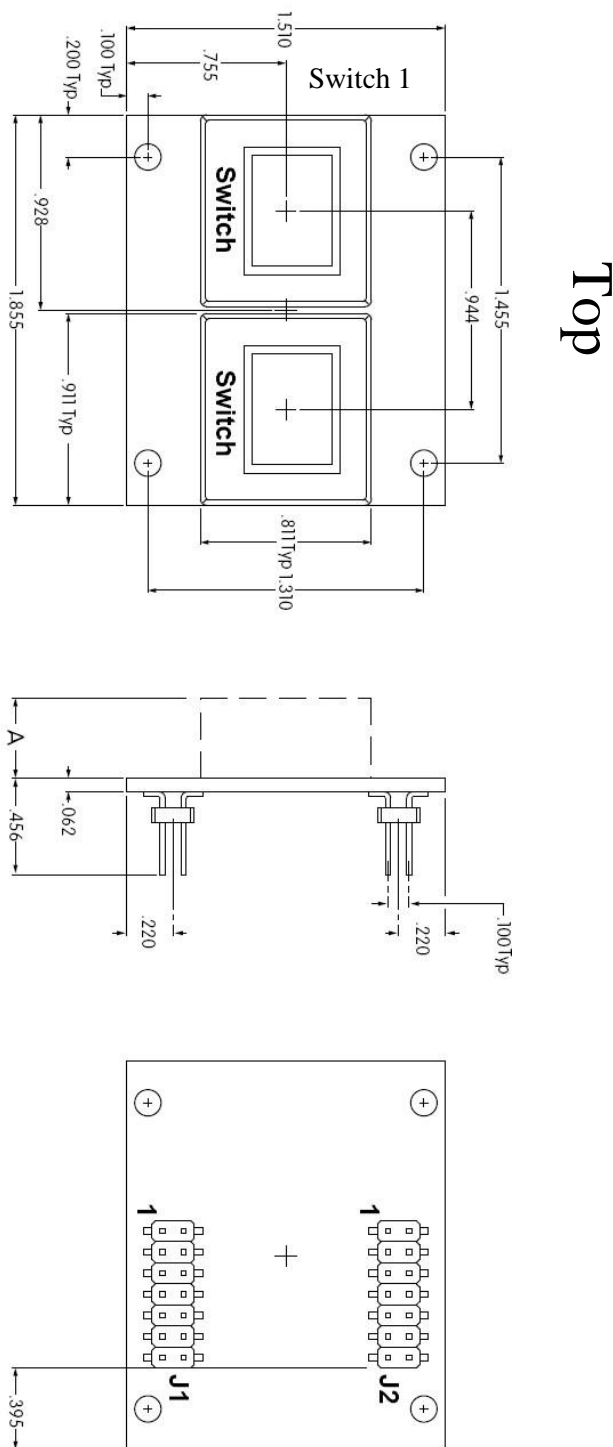
## Switch Scan

One terminal of each switch is connected to the SWRD (switch read). The output of the serial to parallel shift register is connected to another switch terminal via a diode. Four bits are shifted for each switch using Din and CLK. The third bit of the 4 bits shifted is used for the switch scan. The last 4 bits shifted will be for switch #1.

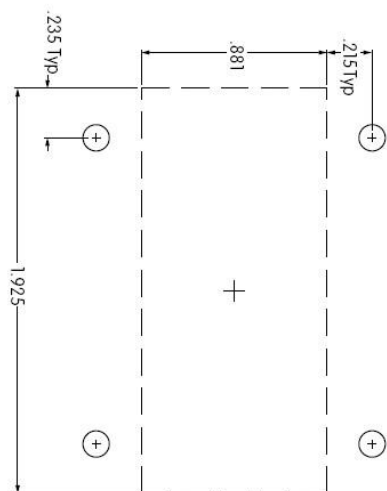
Switch scan is accomplished by sending low bits via Din and CLK for all the switches except the switch being scanned, then the SWRD is checked. If the SWRD is low, the switch is not pressed. If the SWRD is high, the switch is pressed. The switch scans should be more than 10ms apart to prevent de-bouncing reads, and less than 80ms to prevent missing a read.

## 5. Board Dimensions

All dimensions are in inches. Logic board dimensions for L02A1 and L02G1:

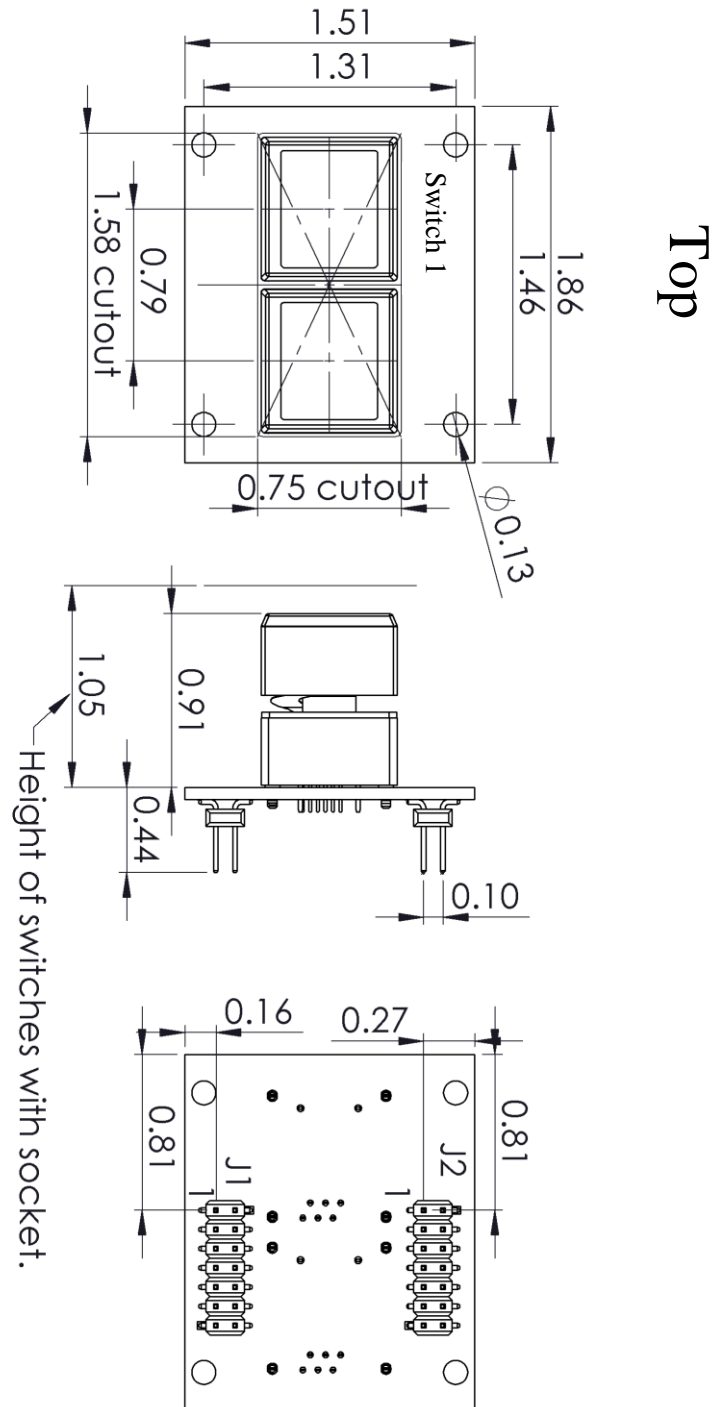


	Dimension A
Socket	0.154
Compact	0.905
Both	1.059

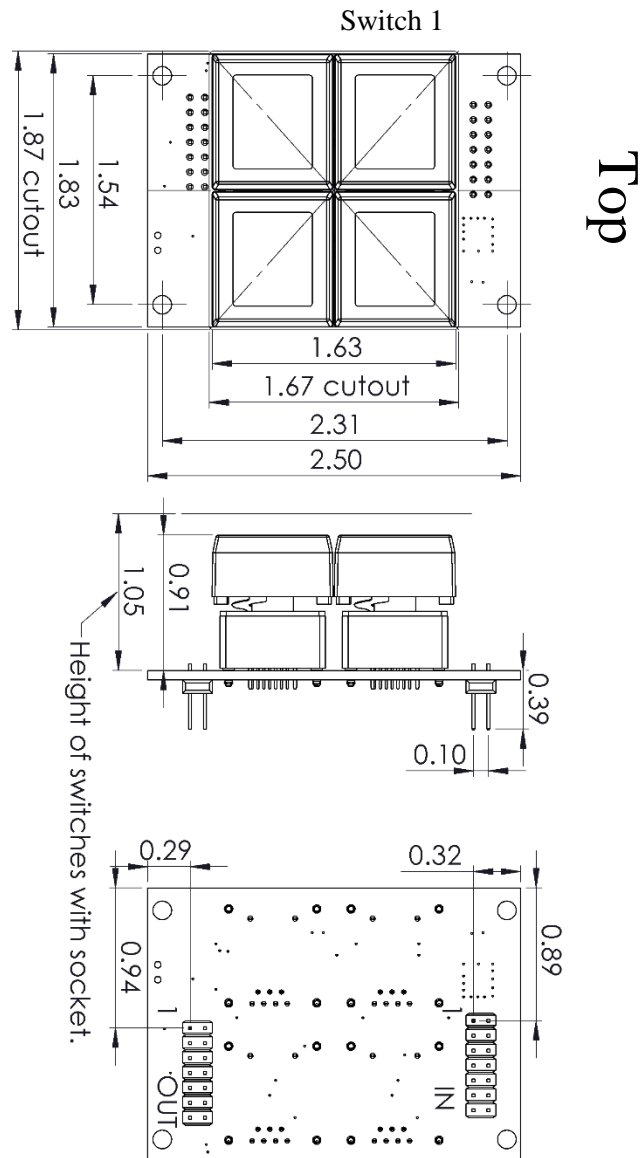




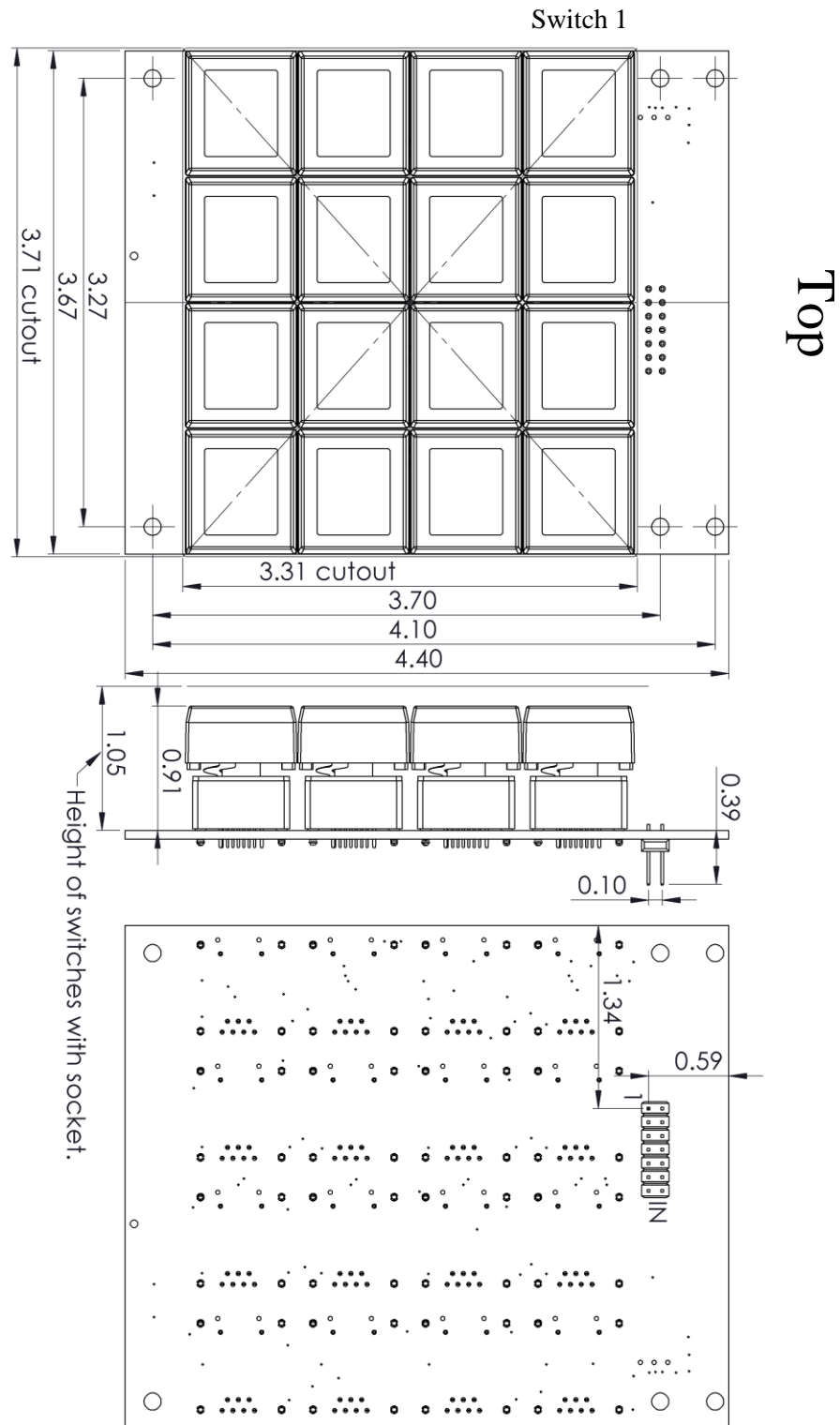
Logic board dimensions for L02H2:



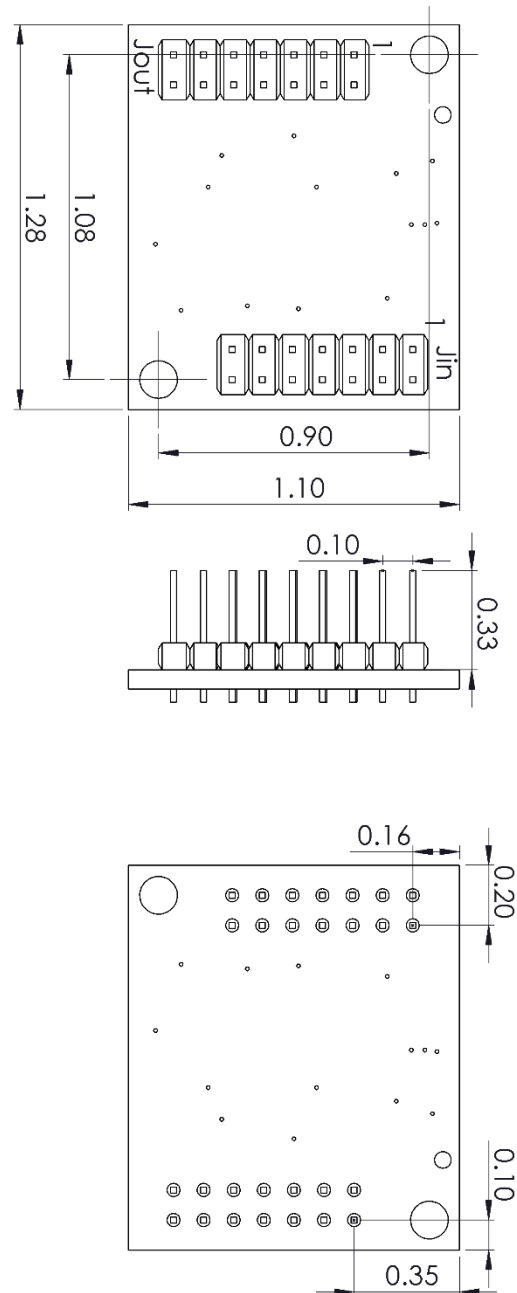
Logic board dimensions for L04G2:



Logic board dimensions for L16G2:

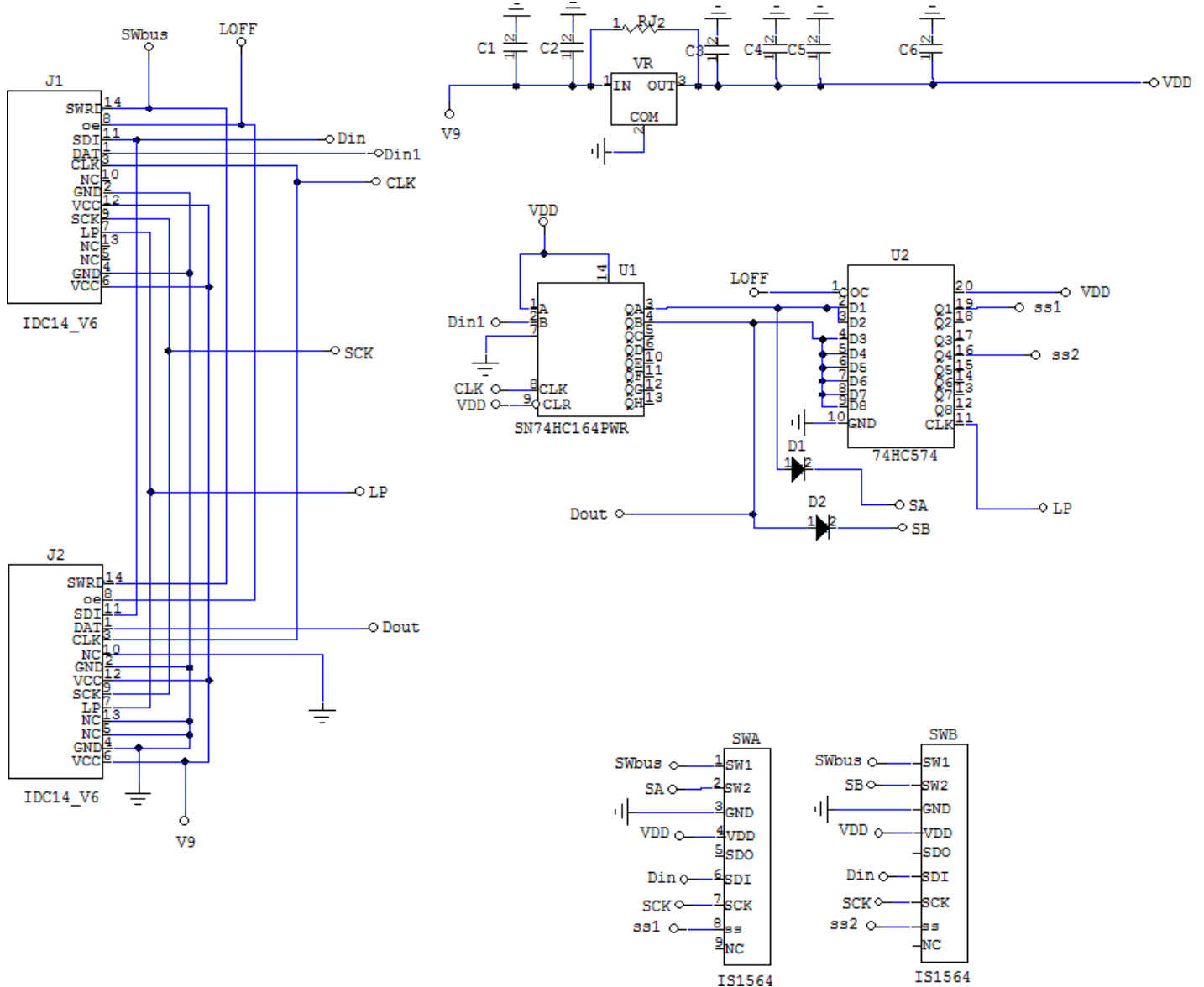


Logic board dimensions for LBUF01:

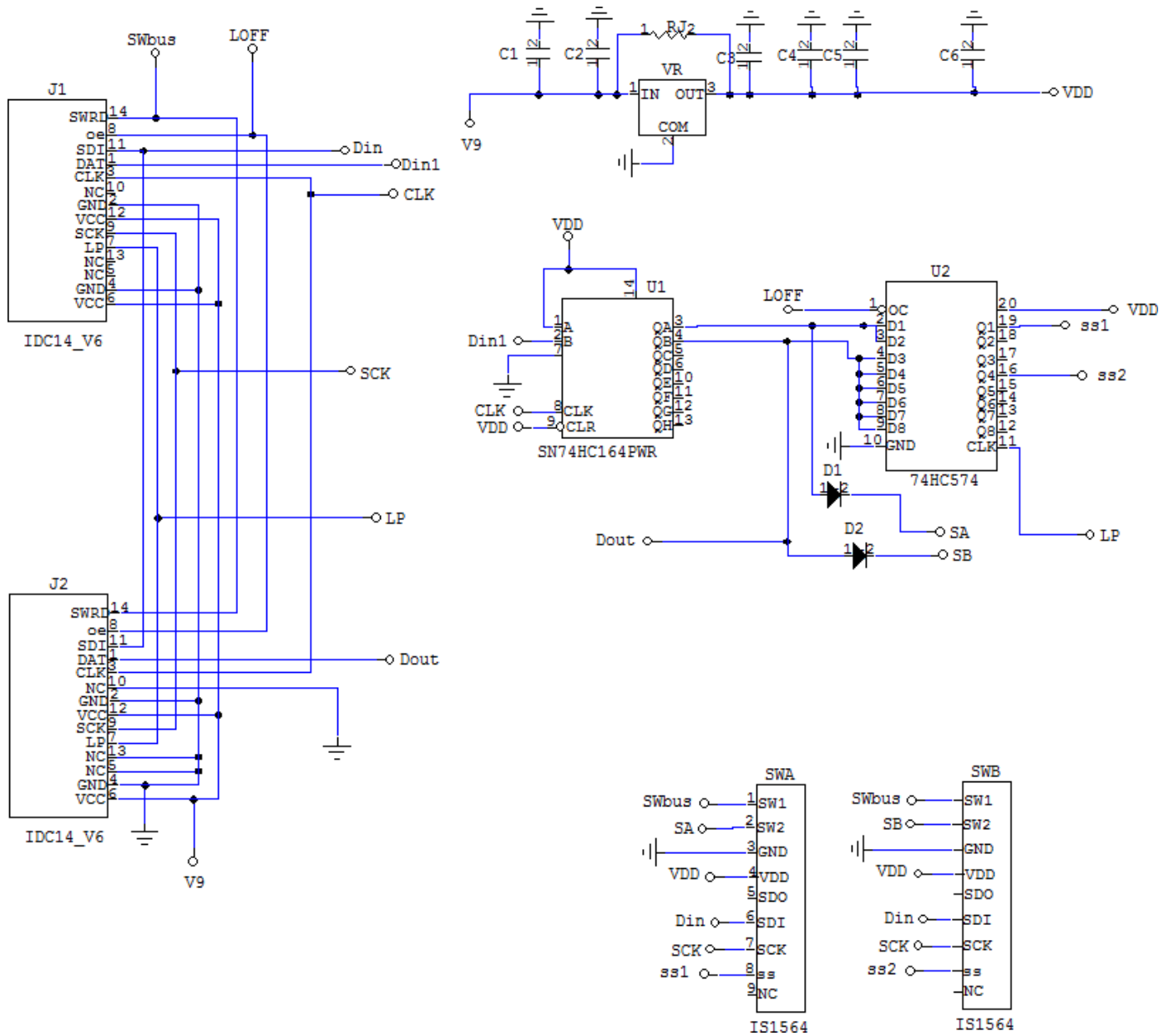


### 6. Schematics

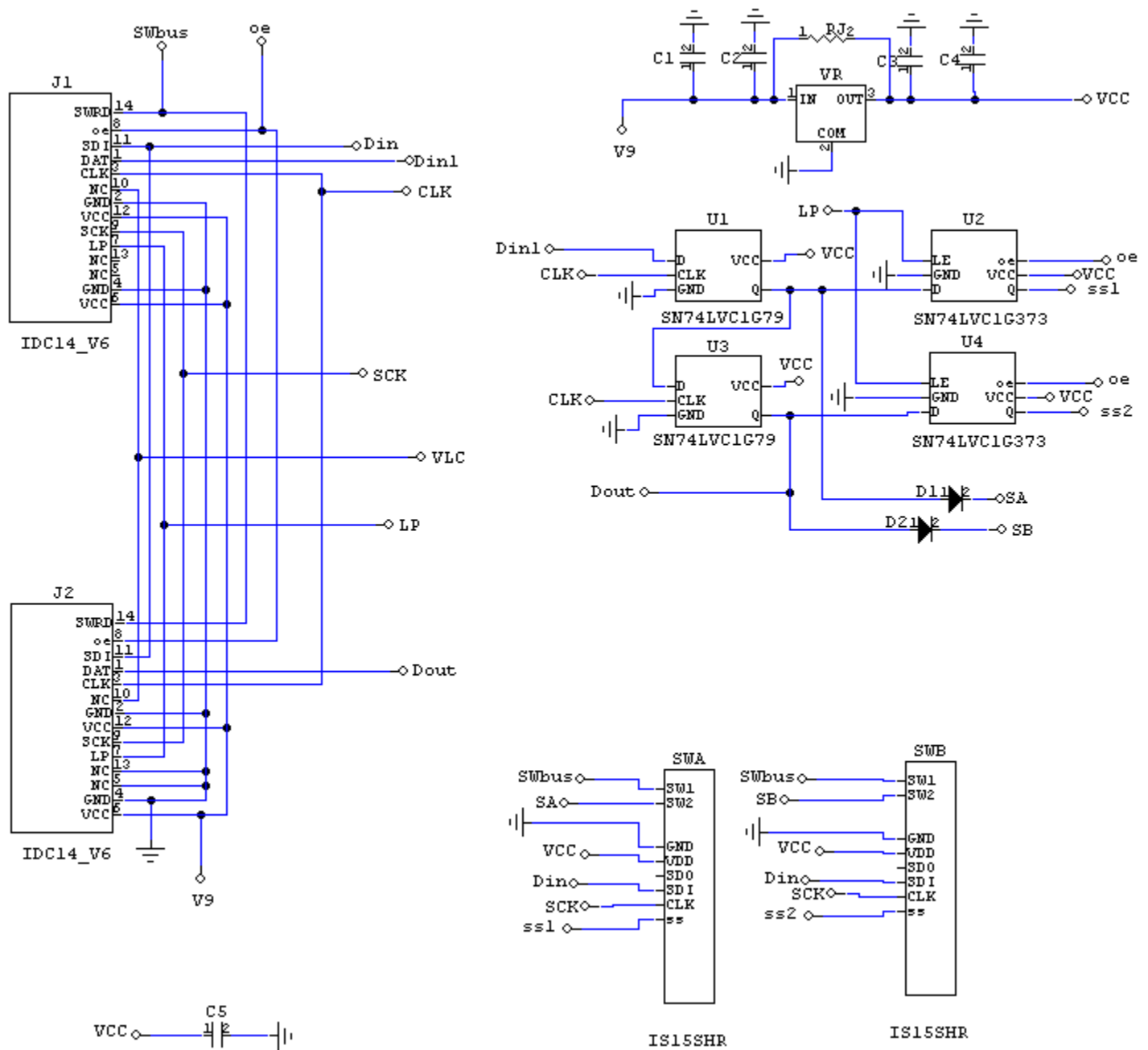
Schematic for IS-L02G1 Rev C:



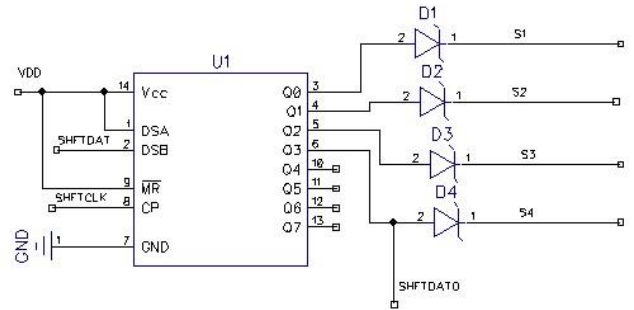
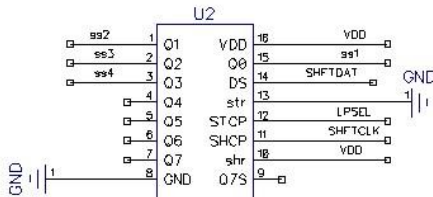
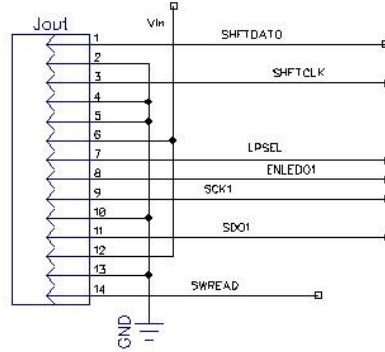
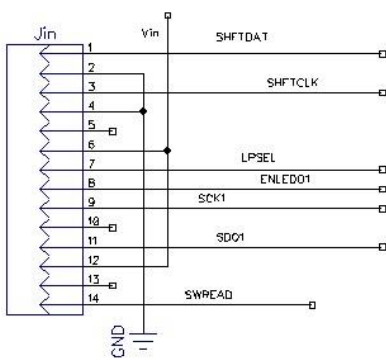
### Schematic for IS-L02A1 Rev D:



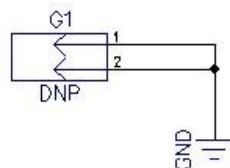
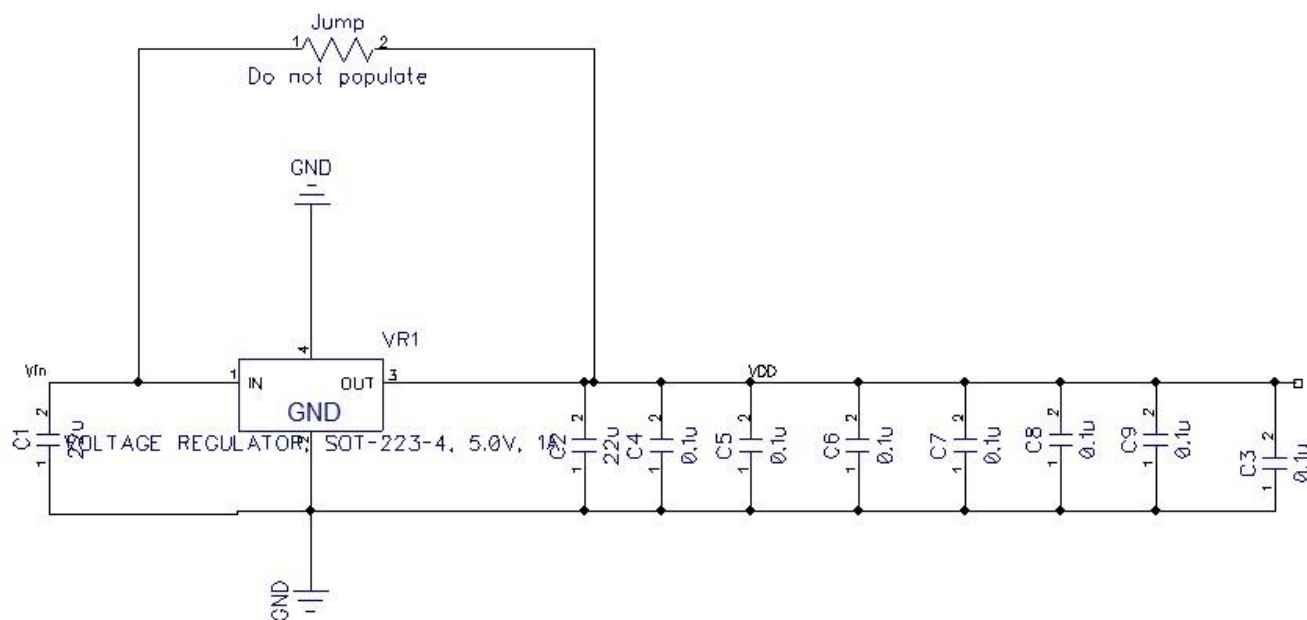
Schematic for IS-L02H2 Rev D:



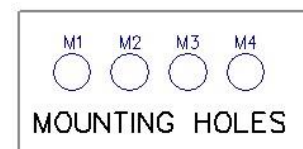
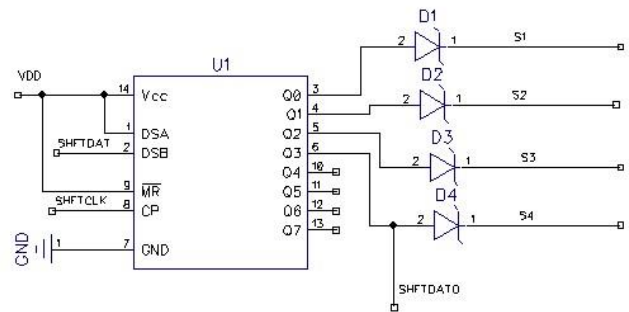
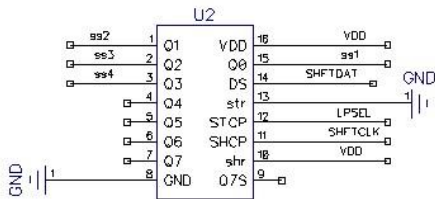
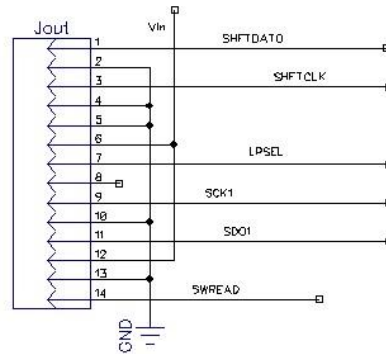
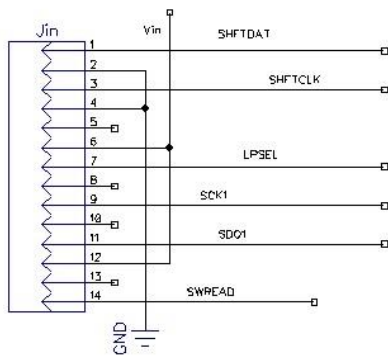
### Schematic for IS-L04G1 Rev A:

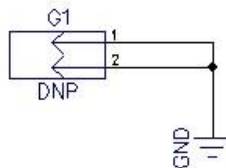
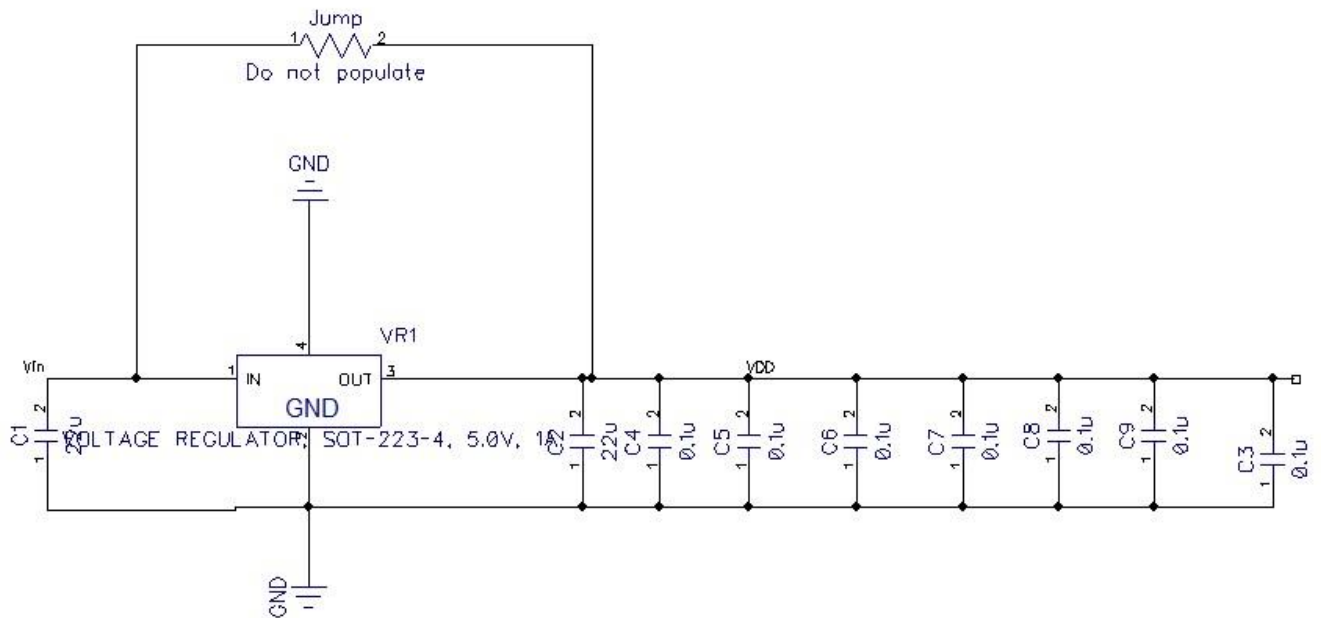
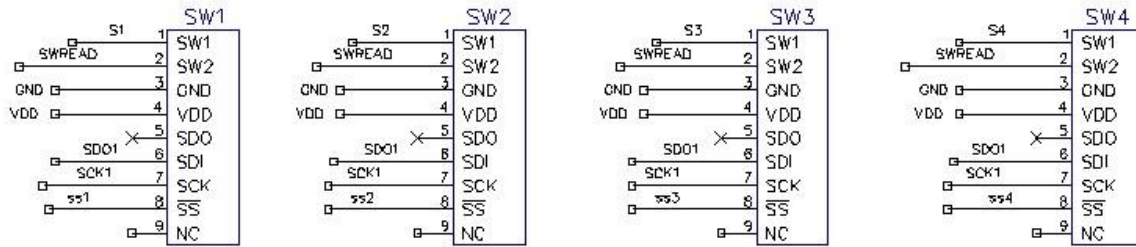




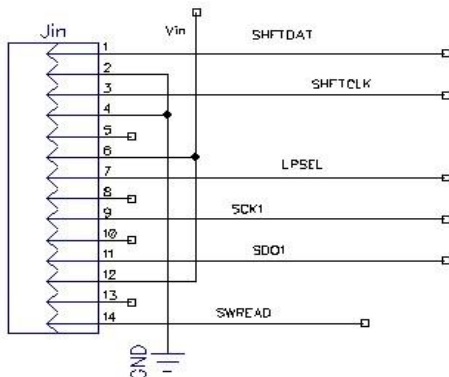
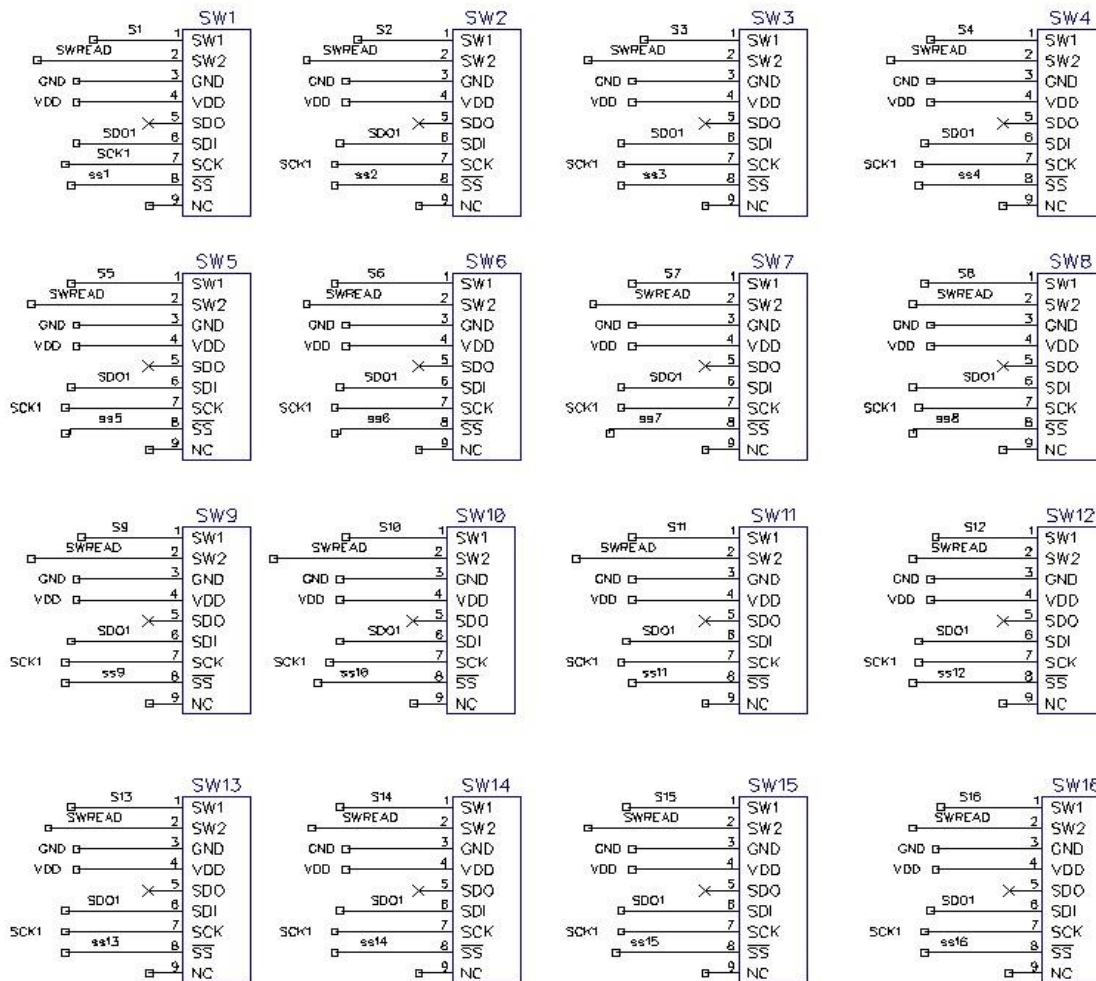


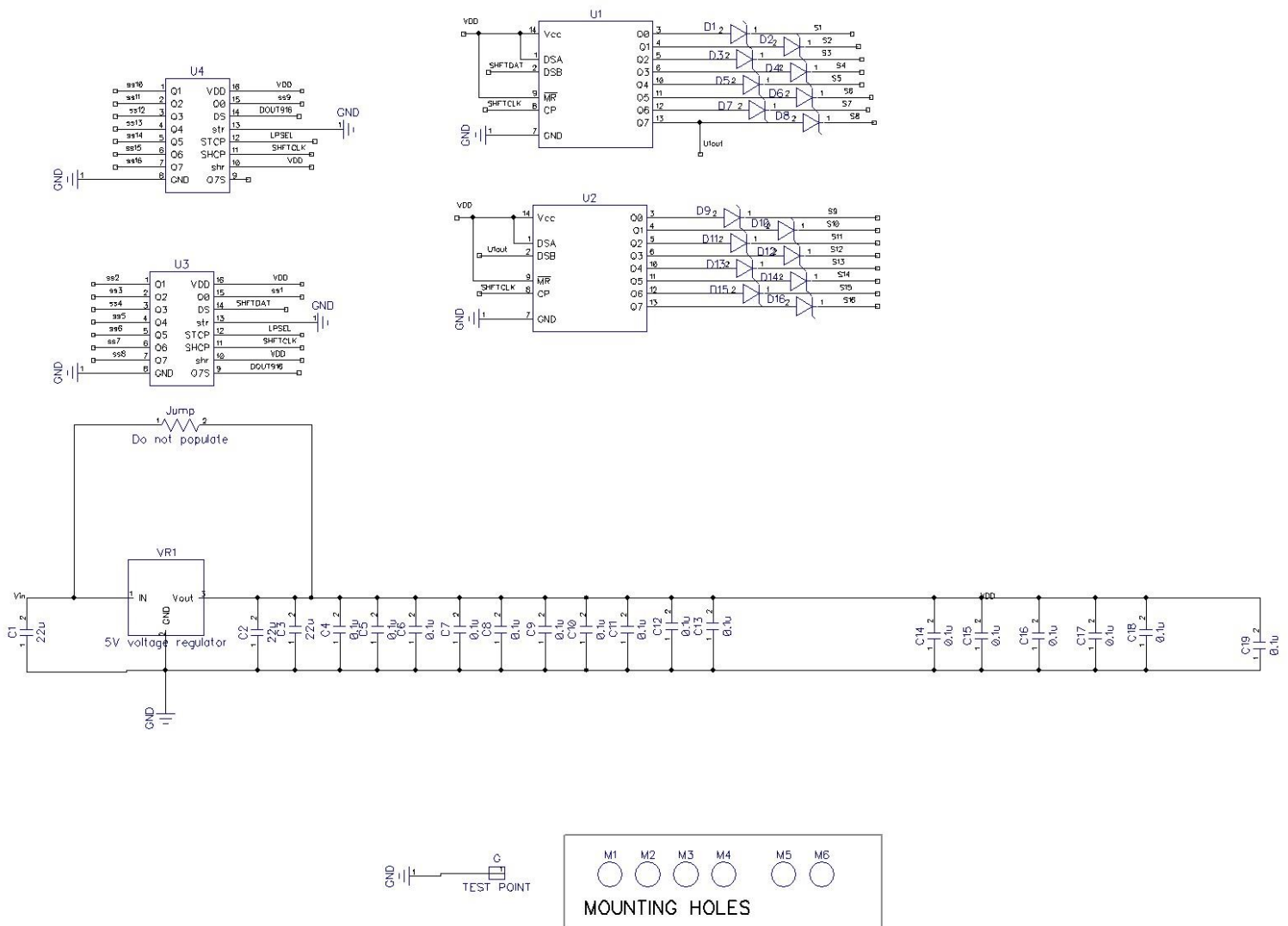
### Schematic for IS-L04G2 Rev A:



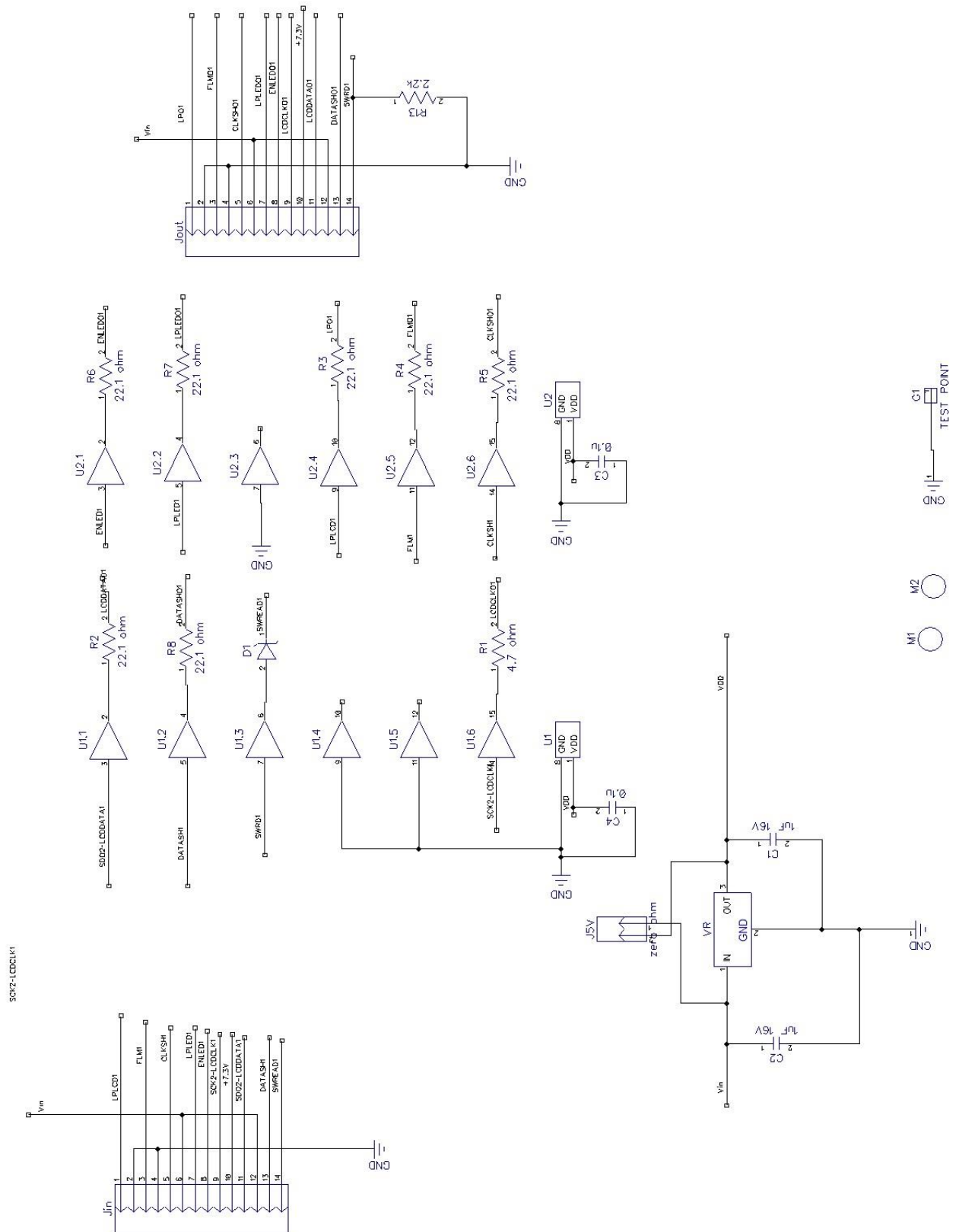


### Schematic for IS-L16G2 Rev A:





## Schematic for IS-LBUF01 Rev B:



## **7. Key Terms & Definitions**

### **Host:**

Any computer, terminal, or other device that sends commands over USB, RS232, or RS422.

### **Controller:**

A PCB with a microcontroller that controls one or more logic boards

### **Logic board:**

A PCB with one or more SmartDisplays that can be daisy chained

### **Byte:**

An eight-bit hex value ranging from 00H to FFH (Decimal 0 to 255). The bit format of a byte is: (B7 B6 B5 B4 B3 B2 B1 B0) where B7 is most significant and bit B0 is least significant bit.

### **Nibble/Hex digit:**

A four-bit value ranging from 0H to FH. A byte consists of two nibbles.

### **Communication format:**

There are two formats to transmit a byte:

1. Hex format - A hex byte is transmitted without any change to it. [xxH] will be used to denote this. All commands and some data are sent by using this format.
2. ASCII HEX format - Each nibble of the byte is converted to ASCII code and sent as a byte. [xxAH] will be used to denote this.

For example, the hex byte 5AH is transmitted in two bytes, 35H and 41H. The ASCII value for 5 is 35H and the ASCII value for A is 41H.

All addresses and most data are sent using this format.

## **Warranty**

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