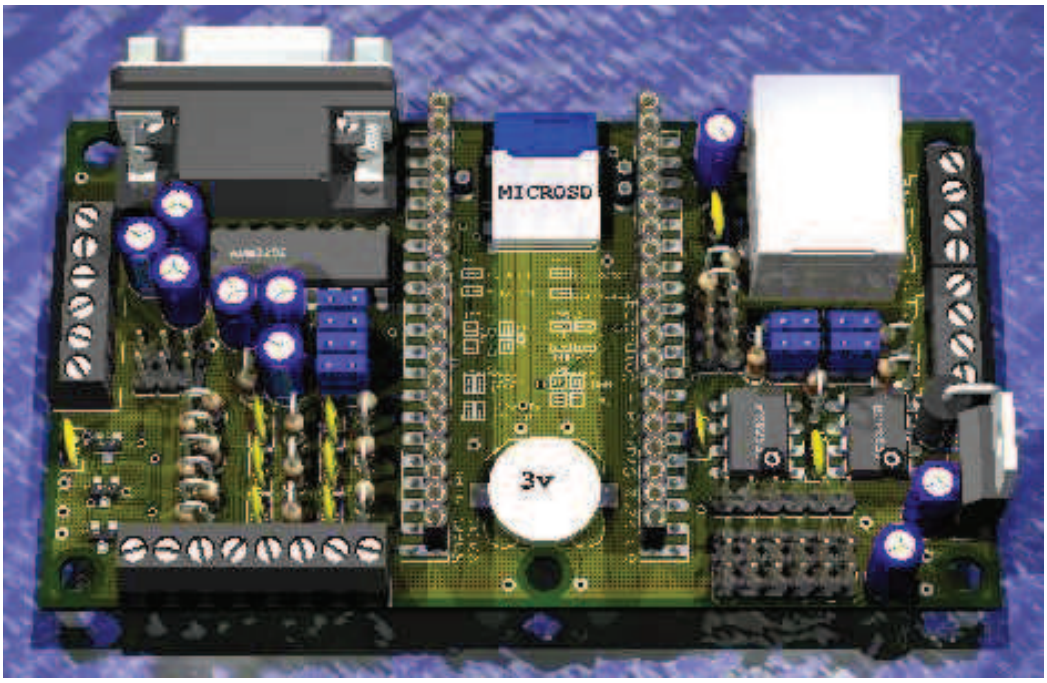


Figure 1 SmartBoard Baseboard

1 SmartBoard Baseboard v1.01

This document is a design and usage guide for integrating the NXP LP1768 mbed into various applications using the SmartBoard Baseboard.

The virtual image shown in Figure 1 is actually from a prior revision of the design. While retaining the same overall footprint, additional flexibility is available in version 1.01, documented here.

Board Revision: v1.01
Document Revision: v1.02

2 Table of Contents

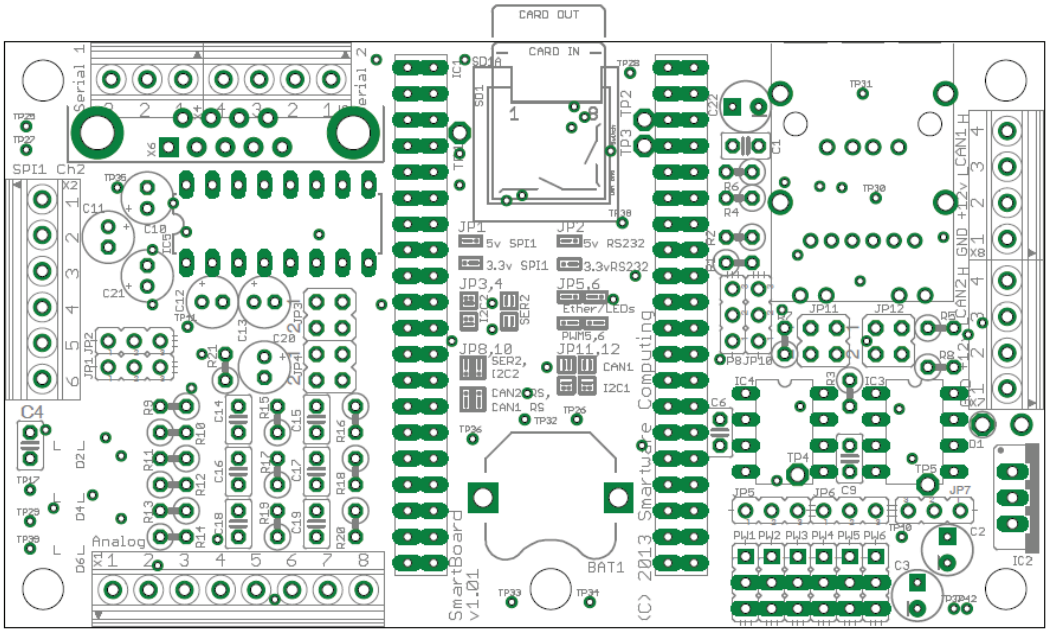
2.1 Sections

2.2 Figures

5 Circuit Assembly

There is very little that is critical about assembling the components onto the PCB, however this section does provide a few guiding elements.

Where practical, all parts are through-hole parts for ease of assembly – this includes the component installation, as well as ease of soldering. This also eases the effort should there be a need for rework.



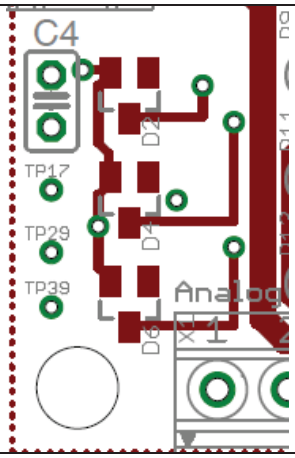
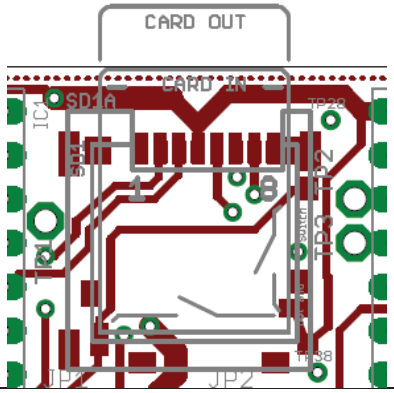
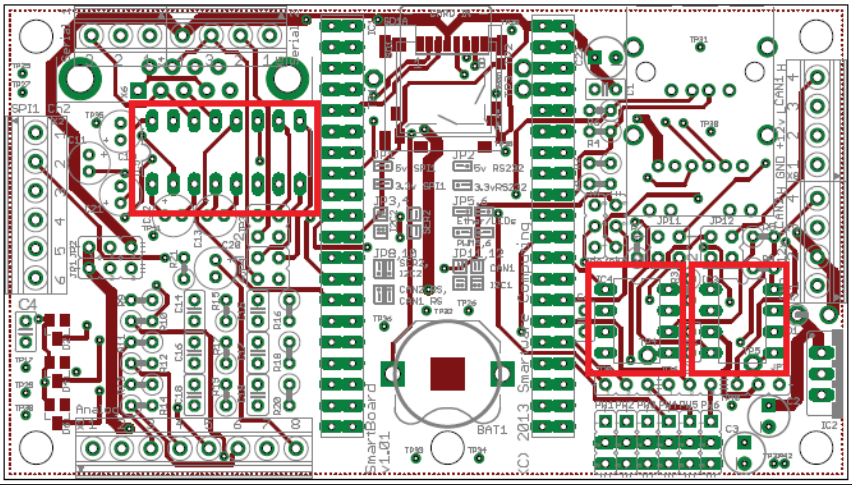
5.1.1 Surface Mount Parts

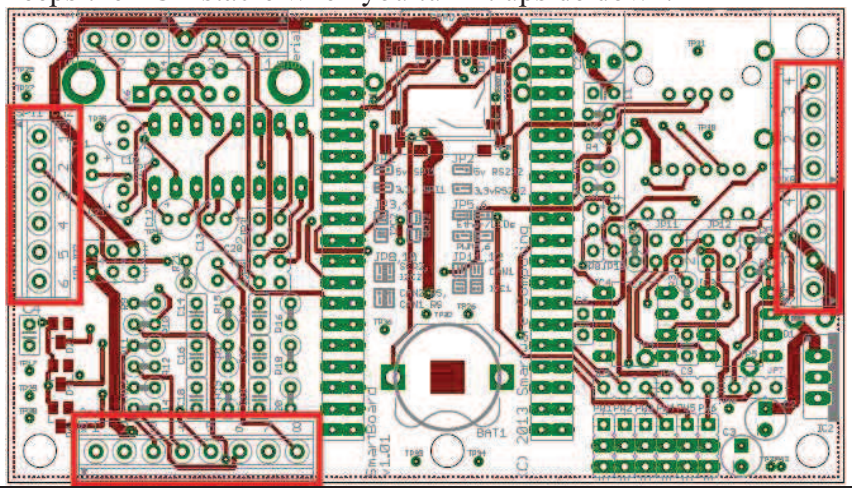
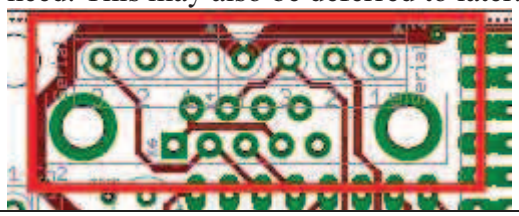
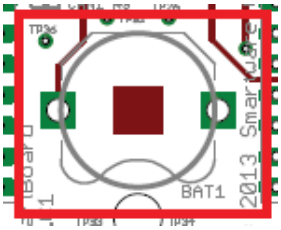
Among the surface mount parts are the analog input protection diodes and the micro SD card socket.

5.1.2 Alternate Parts

The flexibility of this design includes some capability for alternate parts. This section calls out the alternates.

The serial RS-232 channel using a fairly large DB-9 connector may be left out, and instead combinations of two other screw terminal connectors may be installed. This grants access to two serial ports. Of these two serial ports, one is RS-232, and the other can be RS-232 or I^2C channel 2.

The smallest, and most challenging to solder, parts are first. SUGGESTION: Clean your iron, workspace, and practice your fine-pitch soldering on a scrap project before starting here.	
D2, D4, D6	Install three diodes in the lower left corner of the top-side. CAUTION: These parts look nearly identical to D8 and D9. Take care not to confuse them. NOTE: D3, D5, and D7 will be installed on the bottom. Save this step for nearly the last, to keep the PCB stable on your workbench. 
SD1	Install the surface mount connector for the micro SD card. This will be the most difficult installation due to the fine-pitch spacing and the position of the leads in the housing.  Note that there are two layouts over top of each other, permitting the use of either of two connectors. Careful visual inspection is recommended following the installation.
IC3, IC4, IC5	Install each of these sockets, noting the orientation is to the top for IC3 and IC4 sockets and to the left for IC5. 

X1, X2, X7, X8	Install the terminal strips. This combination, when installed, keeps the PCB stable when you turn it upside down. 
X4, X5, or X6	The design permits use of either a pair of screw terminals or the use of a DB-9 connector. Install whichever is appropriate for the need. This may also be deferred to later. 
BAT1	Prior to installing the battery holder itself, place a thin layer of solder on the large square pad in the center. Inspect this layer to ensure it is smooth and thin. Remove any excess and reheat to smooth it out if necessary. This thin layer ensures good contact with the battery when installed.  Next, install the socket.

8 Electrical Interfacing

8.1 Power Inputs

There's quite a bit to look at with respect to the power supply circuitry. Depending on the needs, there are several ways to get power to the mbed. This section goes into that detail.

8.1.1 USB Powered

The breakout board is capable of being configured to operate solely from the USB connector on the mbed itself. Simply plug a USB cable into the host PC and the USB-B connector on the mbed itself. For more demanding applications, an external power supply will be needed.

8.1.2 External +12v Power Source

A voltage between about 6 or 7 and up toward 26 to 36 can be connected on either the CAN 1 or CAN 2 connector – depending on which regulator is selected as shown below. Pin 2 on each CAN connect is tied to the +12v line and from there it is reverse protected where it connects to the 3 terminal regulator. Depending on the needs, it is possible to feed 12v into one of these pins and draw 12v from the other for external circuitry (to avoid harness splicing). The PCB design should be able to carry a few amps between these two connectors.

NOTE: If CAN is not needed, a 2-pin connector could be installed instead of the 4-pin – just use the Pin1 and 2 positions. This reduces the possibility of mis-wiring, and can lower the cost a small amount if a number of the same device is being built.

8.1.3 5v Regulator Options

If the device will not source power to any external circuitry, or if that power demand is very low, then it may be practical to omit the regulator. Note that the mbed can draw its power from this regulator, as may be typical in an embedded (not PC connected) application.

8.1.3.1 5v Regulator – Low Current/Low Noise

For low power applications, a simple linear 5v regulator can be sufficient. This may also be appropriate if for designs reading sensitive analog signals. But do note that with a single ground on the mbed part, supporting both the analog and digital circuits; this can couple noise which affects the quality of the analog inputs. The TI TL750M05CKCSE3 is an inexpensive low dropout regulator in a TO-220 package. This part is rated to deliver up to 750 mA, if the power can be managed. The input voltage range is from 6 to 26. Add an additional 0.6v for the reverse protection diode. This part is likely to exceed the power dissipation rating at 26v unless properly managed.

NOTE: In some applications, this part may get hot, and it may be appropriate to provide external heat-sinking. The TO-220 tab faces

8.13.2 SPI Channel 1 Port 2

SPI Channel 1 can also be accessed on X2. Take care in software so that this port and the micro SD are used mutually exclusively.

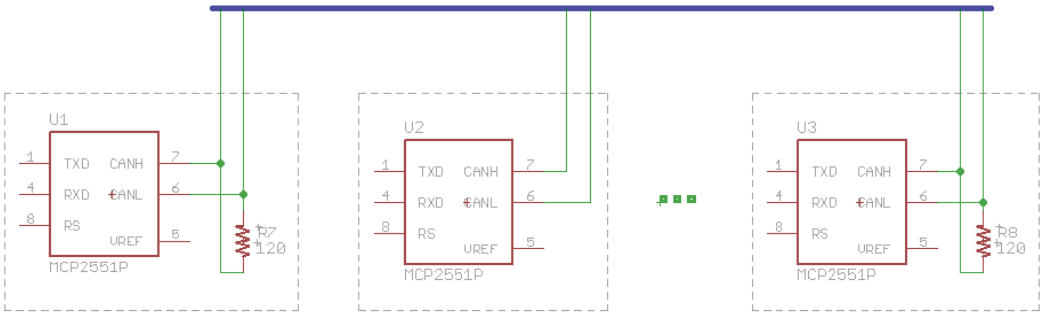
Also, external hardware can be powered from this board at either 5v or 3.3v depending on the JP1 configuration.

8.14 CAN Channel(s)

Controller Area Network (CAN) is a popular communication network on modern cars, trucks, boats, industrial systems, hospital beds, and more. Unlike RS-232, USB, and Ethernet, CAN can be multi-drop, as seen in Figure 12. Depending on the specific transceiver capabilities, there can be from 2 to 20, or even 30 or more nodes on one single pair of wires. It is common to use twisted pair for improved noise margin.

Typical data rates for CAN range from 20 kbits/sec up to 1 megabits/sec. A longer network typically is configured for a slower data rate.

A CAN-based network has other attributes that make it both reliable and robust. Search online for one of the many tutorials and to understand the characteristics of CAN.



8.15 Figure 12 CAN Network

This design supports up to 2 channels of CAN communications.

Important to a CAN network are the terminating resistors. As shown in Figure 12 there is one in each module at the “geographic end” of the network. The module(s) in the middle should not have the termination. Too many terminators will reduce the design margin and signal quality.

While locations on the PCB support installation of termination resistors, the best-practice is to put them in the harness. In this way, any one board could be swapped for another without having to do the surgery to add or remove the PCB based termination.

8.15.1 CAN Channel 2

CAN channel 2 is available on connector X7.

10 Bill of Materials

Following is the bill of materials for a single kit. Refer to this during assembly to quickly identify a part. Note, however, that parts are not shown to scale. The last column shows the Digi-Key part numbers.

Qty.	Image	Reference	Description	D.K. Part #
1		X1	TERM BLOCK 3.5MM VERT 2POS PCB	ED2635-ND
1		X4	TERM BLOCK 3.5MM VERT 3POS PCB	ED2636-ND
3		X5, X7, X8	TERM BLOCK 3.5MM VERT 4POS PCB	ED2637-ND
1		X2	TERM BLOCK 3.5MM VERT 6POS PCB	ED2639-ND
1		X1	TERM BLOCK 3.5MM VERT 8POS PCB	ED2641-ND
1		BAT1	HOLDER BATTERY COIN 12MM DIA THM	3001K-ND
2		IC1	DUAL ROW SOCKET CONN HEADR FMALE 40POS .1" DL AU	S9200-ND
1		IC5	IC SOCKET STRAIGHT 16POS TIN	AE9992-ND
2		IC3, IC4	IC SOCKET STRAIGHT 8POS TIN	AE9986-ND
13		JP1, JP2, JP5, JP6, JP7, JP8, JP10, PW1, PW2, PW3, PW4, PW5, PW6	SIL VERTICAL PC TAIL PIN HEADER	952-2264-ND

11 Application Examples

11.1 Couch Calendar

The Couch Calendar is a concept for a small display, much like the “photo frame” appliances. In this case, it draws calendar events from an account on a WebDAV server in the iCal format. It also syncs its clock to a stable network time protocol source. As a convenience, it shows a few weather related items – outside temperature, humidity, and wind direction and speed.

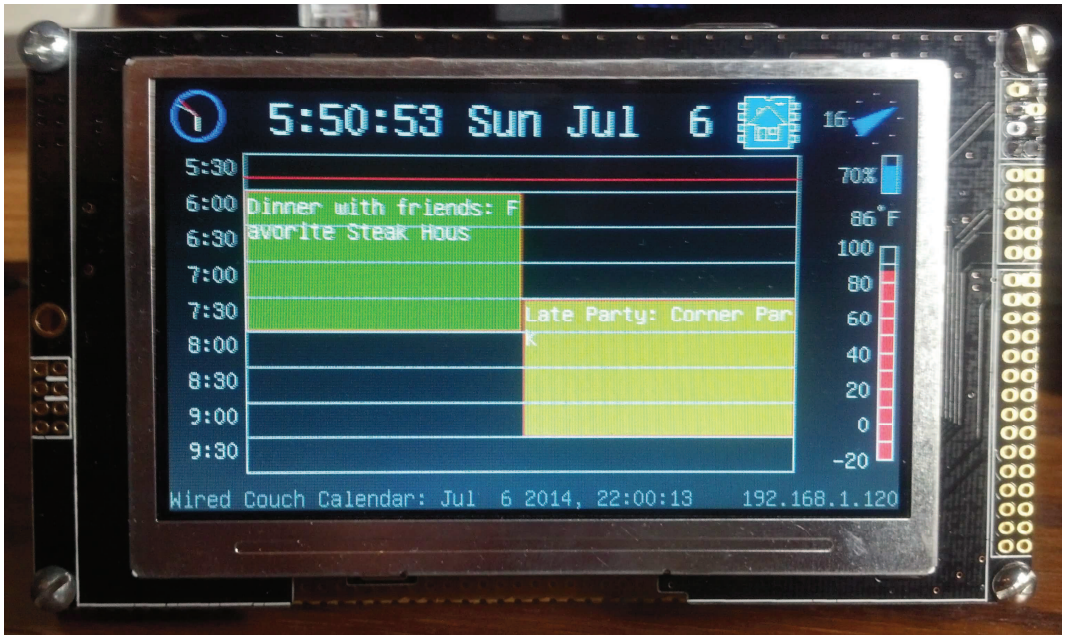


Figure 13 Couch Calendar Display

Tipped forward, the stack of components is visible. From the bottom up is the display module, a piece of perf-board as a mechanical mount for the SmartBoard, upon which is the mbed module. This system receives power via the USB interface on the mbed, and its information source comes via Ethernet.

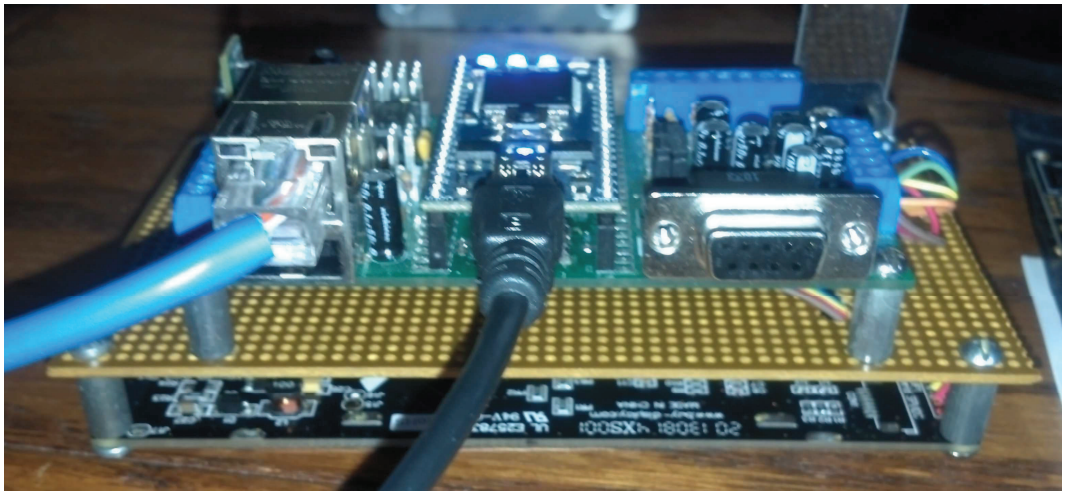


Figure 14 Couch Calendar Backside

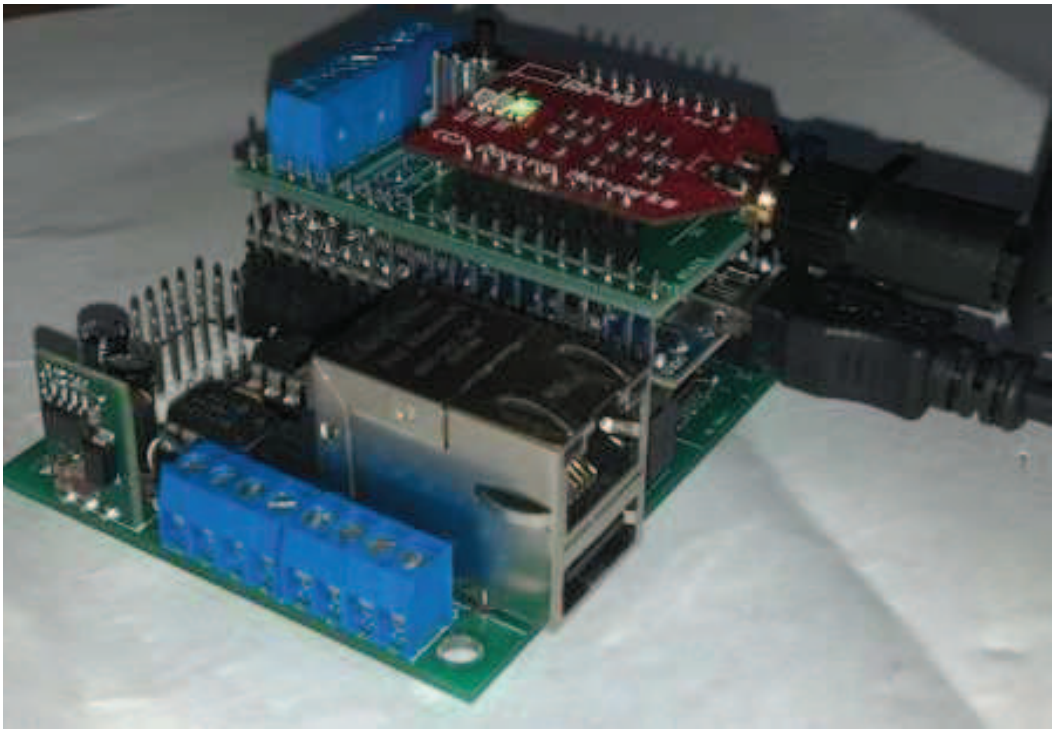


Figure 18 Wifly Module Stackup

This shows a Wifly module plugged in to a SmartBoard Wifly adapter. That in turn bridges over the mbed module down to the SmartBoard Baseboard.

11.4 CEC Control Interface

This module is another “bridge board” design that straddles over top of the mbed module. Visible is the HDMI connector. The only signal used on this connector is the 1-wire CEC communication signal. This signal is traveling along with the video signals, but is a low power and slow signal used to turn devices on and off, change the channel and volume, select input sources and so on.