Product Description, Operation and Assembly Instructions for Color Carrier Module as used with a 32 Bit Experimenter

KibaCorp is introducing a new color carrier module for use with the 32 bit Experimenter. Figure 1 shows this carrier module in operation with the 32 bit Micro Experimenter. The color carrier uses the 32 bit Experimenter Arduino compatible plug in interface. On board the color carrier module is the 4D Systems uLCD-144 (SGC) 65K 128x128 pixel serial interface LCD Color Display Module. No special power connections are needed as the color carrier works directly off the +5V DC supplied to the Experimenter and the Experimenter +3.3VC on board regulator output. The carrier module is fully assembled and only requires mounting of the uLCD-144 display to the carrier using two 2-54" mounting screws and associated spacers. Specifics are discussed in this document.

Figure 1 Color Carrier Module in operation with ULCD-144 and 32 bit Experimenter

The uLCD-144 used by the carrier is a 128xRGBx128 resolution, 65K true to life colors, LCD TFT screen, with LED backlight coloring, and measures 1.44" diagonal size. This uLCD-144 module can be individually purchased at 4D systems (http://www.4dsystems.com.au/) the carrier is available from Nuts and Volts web store. Nuts and Volts also offer a complete display/carrier combo.

The Color carrier module provides a complete ULCD-144 interface capability that includes sound, multi-position (five) input switch capability, as well as a direct PS/2 interface to the Experimenter. The sound capability includes the ability to generate any sound from 20-20K Hz for any duration up to 65K milliseconds. This sound capability easily supports simple music tones that are typically in sophisticated

cell phones for operator alerts. The multi-position switch allows detection of a five input switch position from up, down, left, right and press, and, in fact, is a mimicker of a simple joystick interface.

The 4D Systems uLCD-144 (SGC) serial LCD Display Module has other capabilities not covered in this configuration. They are beyond the scope of the present demos and can be more fully covered using the 4D Systems uLCD-144 (SGC) serial LCD Display Module data Sheet from 4D Systems. The uLCD-144 Module can work standalone through an associated SD-FLASH card to do slide shows as well as video. The 4D Systems uLCD-144 (SGC) serial LCD Display Module is capable of being programmed in its own script language native to its on board GOLDELOX-SGC processor. Again this is beyond the scope of the present demo offering.

 Our offering focuses on the use of the uLCD-144 with the Microchip's full color graphics library including primitives and widgets as well as an uLCD-144 extension for the multi-switch and sound generation. A hardware demo is provided just for this purpose. When you run this demo the uLCD-144 will first clear screen and then notify you that a sound test will occur. Several sounds will be generated. After this the demo will notify you of an input switch test. Here the program will wait while you select one of the five switch positions using the carrier joystick. A total of five switch positions will be accepted before the program enters keyboard test. Here the program will accept up to five input ASCII characters before ending and then displaying and activating an Analog meter widget.

The other demonstration code provided works with the applications described in the Nuts and Volts April 2012 article for the 32 bit Experimenter to include:

- Multi-Button Widget Display using just two physical pushbuttons for control for five different LEDs
- Slider Widget Control of an LED
- Dynamic Widget Analog Meter and Widget Digital Meter of Potentiometer value input
- Real Time Clock Calendar (RTCC) setting using widgets and keyboard
- RGB LED light control using three slider widgets
- Full Color primitives demo with image, text, lines, circles bars

All demos are available from either the Nuts and Volts Website or the KibaCorp Website. They are preconfigured as Microchip MPLAB 8.xx version projects and the C32 'C' Complier. All software tools are freely available from www. Microchip.com. and can be programmed directly into the Experimenter using a PICKIT3 or MPLAB ICE programmer/experimenter.

The 32 Bit Experimenter communicates to the uLCD-144 using UART3 asynchronous communication with 115K baud 8 bit data, no parity and 1 stop bit. The command protocol follows the ULCD-144 prescribed in the uLCD -144 data sheet and GOLDELOX-SGC Command Set - Software Interface Specification (all available for download from 4D systems).

The driver for the Color Carrier and ULCD-144 are contained in all project files as 4DDriver.h and 4DDriver.c.These files support the Microchip graphics library for both primitive graphics (text, images, fonts, circle, bars, lines etc.) as well as widgets. The supported widgets are:

- Button
- Static text Box
- Edit Box
- Check Box

- Slider
- Analog meter
- Digital meter

Sound and Joystick operations

In addition these driver files support sound and joystick operations using the following uLCD-144 command set. Example code is provided in one of the demos.

Command	cmd, option	
4DSL Cmd	Joystick(option)	
	cmd	4A(hex) or J(ascii) : Command header byte
	option	08hex : Return Buttons-Joystick Status 0Fhex : Wait for Buttons-Joystick to be pressed and released 00hex : Wait until any Buttons-Joystick pressed 01hex : Wait until SW1 (UP) released. 02hex : Wait until SW2 (LEFT) released. 03hex : Wait until SW3 (DOWN) released. 04hex : Wait until SW4 (RIGHT) released. 05hex : Wait until SW5 (FIRE) released.
Response	status	
	status	00hex : No Buttons pressed (or pressed button has been released). 01hex : SW1 (UP) pressed. 02hex : SW2 (LEFT) pressed. 03hex : SW3 (DOWN) pressed. 04hex : SW4 (RIGHT) pressed. 05hex : SW5 (FIRE) pressed.
Description	This command returns the status of the Buttons-Joystick in several options.	
Serial Example	Command Data: 4Ahex, 01hex Wait until SW1(UP) released.	

Example:

```
for (i=0;i<5; i++) {
    SetColor(RED);
    OutTextXY(10,10, "Switch ");
  OutTextXY(10,30, "test ");
    status =Joystick(0x0f); //wait for any buttons to
    if (status ==0)    OutTextXY(10,60, "No button ");
    if (status ==1)    OutTextXY(10,60, "UP ");
    if (status ==2)    OutTextXY(10,60, "LEFT");
    if (status ==3)    OutTextXY(10,60, "DOWN");
    if (status ==4)    OutTextXY(10,60, "RIGHT");
    if (status ==5)    OutTextXY(10,60, "FIRE");

    Sound (6, 1000);
    SetColor(WHITE);
        ClearDevice();
}
```

Command	cmd, note(msb:lsb), duration(msb:lsb)	
4DSL Cmd	**Sound(note, duration)**	
	cmd	**4E**(hex) or **N**(ascii) : Command header byte
	note	2 bytes (big endian) define the note or frequency of the sound. **0 :** No sound, silence. **1-84 :** 5 octaves piano range + 2 more. **100-20000 :** Frequency in Hz.
	duration	2 bytes (big endian) define the duration of the note (in milliseconds).
Response	**acknowledge**	
	acknowledge	**06**(hex) : ACK byte if successful **15**(hex) : NAK byte if unsuccessful
Description	This command will generate a specified note or frequency for a certain duration.	
Serial Example	**Command Data:** 4Ehex, 03hex, E8hex, EAhex, 60hex Play a 1KHz note for 1 min.	

Example:

```
 SetFont((void *) &Font35);
 SetColor(RED);
OutTextXY(10,10, "Sound ");
OutTextXY(10,30, "Test ");
 Sound (1, 1000);
 Sound (2, 1000);
 Sound (3, 1000);
 Sound (4, 1000);
 Sound (5, 1000);
 Sound (6, 1000);
 Sound (7, 1000);
 redLEDOFF();
 greenLEDOFF();
```

Keyboard operations

Examples:

```
initKBD();  //initialize key board operation
```
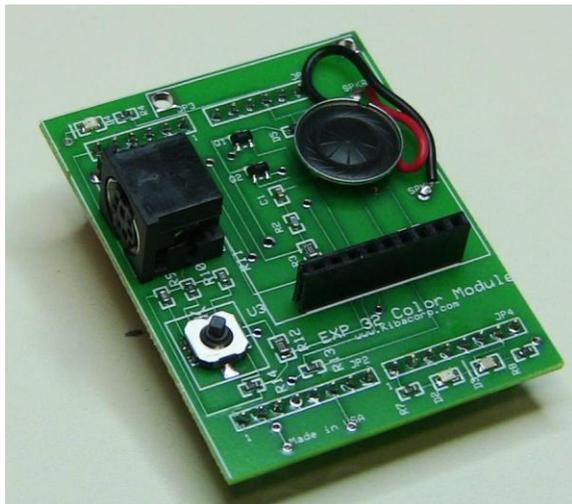
```
SetColor(RED);
OutTextXY(10,10, "Keyboard ");
OutTextXY(10,30, "Test ");
OutTextXY(10,60," ");
 int t =0;
 int j=0;
 do {
     greenLEDON();
     t = getcKBD();
     if (t ==1) {
      greenLEDOFF();
      Sound (6, 1000);
     OutChar( (XCHAR) c);
     j++;


     }
     }while (j<5);
     greenLEDOFF();
SetColor(WHITE);
ClearDevice();
```

The Color Carrier Module

The Color Carrier module without ULCD-144 is shown.

The Color Carrier Module has 9 pin straight row uLCD-144 interface, a PS/2 keyboard interface, a five position switch and two user controlled Leds (red and green) as well as a power on led and 32 Bit Experimenter (located above PS/2 interface). The JP1, JP3, JP2, JP4 interfaces are plug compatible to the left had side of the 32 bit Experimenter. Note that an 8 ohm speaker and driver electronics are located under the uLCD-144 display.

Assembly of Color Carrier module

The electronics assembly of the color carrier is complete and no other user assembly is required for it. However, there is mechanical assembly, as the ULCD-144 must be mounted onto the color carrier and it in turn must be mounted onto the 32 bit Experimenter.
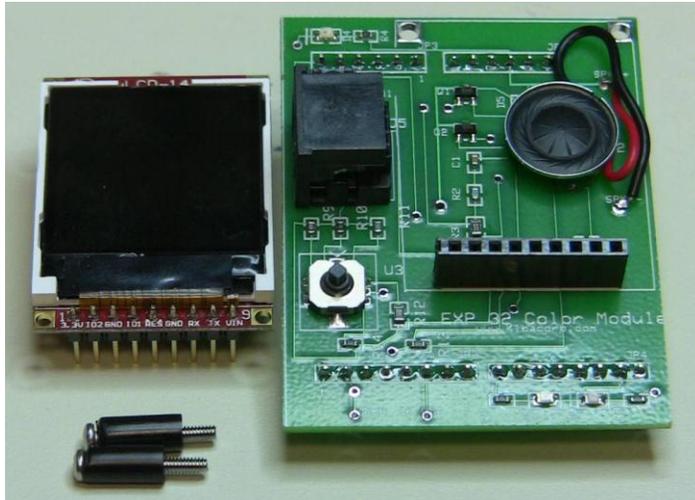
A complete color carrier and all associated components are shown. For assembly the uLCD-144 module requires a nine pin .1 "male header (supplied as part of carrier kit) to be soldered mounted from the bottom of the color display for maximum extension to the color carrier female connector. In addition the color display requires manual mounting hardware using dual 2-56 "screw and spacer mounting hardware.
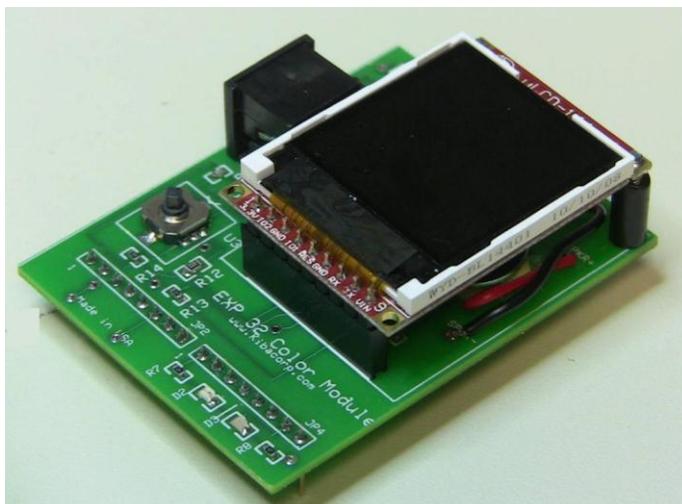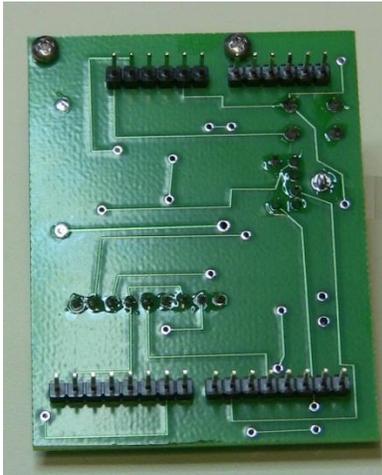
The full assembly is shown from right had side. Note mounting 2-54" screws are inserted from bottom through nylon spacer to the uLCD-144 mounting holes. Adjust screws CCW from bottom to achieve

necessary height coincident with 9 pin uLCD-144 height. Don't over torque.
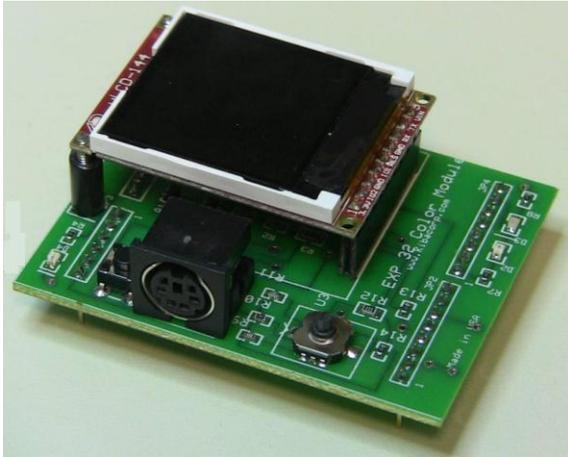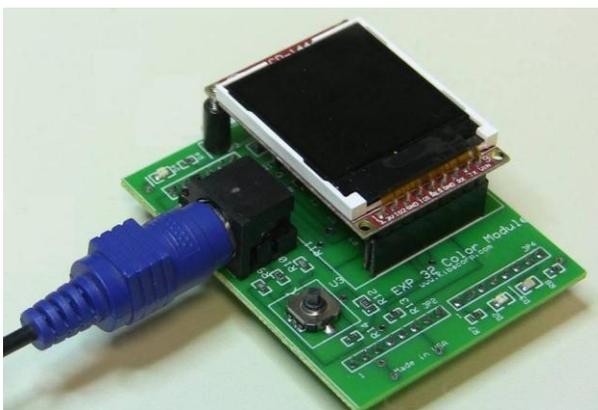

Here is a left hand view of final assembly.

Here is the final assembly from bottom. Mote two mounting screw header located on top of the board.

Mount the entire color carrier onto the Experimenter onto its Arduino compatible interface located on the left had side (as viewed form the top) of the 32 bit Experimenter.
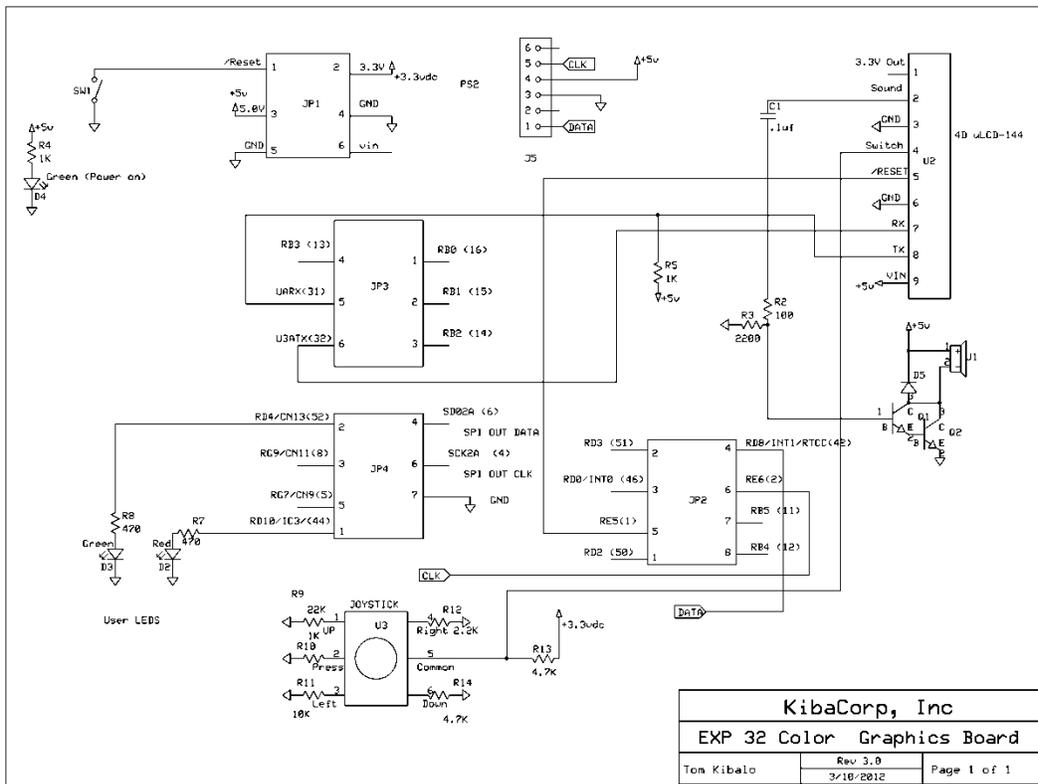
Here's final assembly showing color carrier, showing connection to a PS/2 keyboard on the left.

Here's is a color carrier and uLCD-144 module shown running meter demo.

Color Carrier Schematic