
Project introduction ...

This project contains the MicroMite+ Explore64 stamp module (PIC32MX470 CPU) along with our custom designed peripheral "E 64 Bridge" PCB that allows a complete standalone modular Embedded BASIC Laptop computer with the following features:

1. User selectable mini PS2 or USB keyboard. Uses "offshore" USB or PS2 breakout modules.
2. Back feeding prevention (5V VIN jumper) when using both the 5V USB PC computer power and 5V external power.
3. LCD TFT display with touch (SSD1963 5" or 7") with an easy to connect IDC 40 ribbon connector.
4. High efficiency DC-DC (5V-3.3V) step-down power converter module for LCD TFT display electronics.
5. Precision RTC (DS3231/DS3232) I2C module with battery backup.
6. "E 64 Bridge PCB" for all computer peripheral signal and power interconnects. Also, has a built-in Darlington sound buzzer.
7. All modular components (CPU, RTC, sounder, keyboard and power supply) can be easily user repaired or replaced.
8. Firmware for CPU could be upgraded by removing the MM+ Explore64 module and having a vendor upgrade it or by the PicKit 3 way.
9. Exposed development headers can used with external bread boarding.
10. Power status LEDs. Green for 5V power and amber for 3.3V power.

Embedded BASIC Laptop additional features:

Micro controller MicroMite+ PIC32MX470 running at 120 Mhz. (see note below)

100KB for BASIC programs, 108KB RAM on the MicroMite+ at 120MHz processes ~ 49,019 lines/sec.

Bootup time < 1 second.

Precision TXCO RTC with battery backup. (Real Time Clock - DS3231). Temperature controlled for ~1 minute per year.

SD Memory storage, cards up to 64GB/FAT16/32, for user programs, fonts and image files.

7" color TFT LCD display with touch. Routines for graphics and touch are already built into the firmware.

Built-in colour MMBasic editor - for program code development.

Headers on-board can be used for hardware and software development.

No PC, network or IDE required "after" setup/config. for "normal" operation.

NSA proof with additional hardware and software.

Up to four serial ports, two SPI ports and two I2C ports.

USB 2.0 console interface (in addition to the serial interface)

Support for SSD1963 based displays in 4.3", 5" and 7" sizes

Touch panel support including interrupts on touch down and up.

Advanced graphics controls.

Interface for a PS2 keyboard. (A compact mini keyboard is being used for data input)

Supply power is from AC mains wall wart or from a USB Lithium power/charging pack/bank for portable operation.

User Embedded BASIC Laptop computer applications ...

1. Educational stand-alone BASIC computer. With a proper optional high current USB battery pack, the computer can run for hours without AC mains.
2. Data logging terminal. Having a precision on-board RTC with battery backup allows precise logging times.
3. Data communications terminal.
4. Home automation controller.
5. Secure data vault. With no PC and no network connection, data is somewhat secure. (Security can be greatly enhanced with additional hardware and software)
6. Data acquisition computer.
7. Game computer.
8. Hardware development computer. With plenty of GPIO still available, testing and developing new widgets can be easily accomplished.
Exposed female headers on the "E 64 Bridge PCB" allows for easy breadboarding.

Preliminary special hard to find project parts (BOM) for the Embedded BASIC Laptop:

MicroMite+ Explore64 module. (MicroMite.org or Grogster's website)

Keyboard USB type A breakout module. - Sparkfun

Mini keyboard MC-Saite with USB type A connector. - Ebay

LM2596 DC-DC step down converter module. (+5V to 3.3V adjustable) -Ebay

TFT LCD 5" or 7" SSD1963 display with touch and with 40 pin connector.-Ebay

Extreme care should be taken to make sure you get the right TFT LCD model or you will waste your money!

Real Time Clock with battery backup (precision) DS3131/DS3232) - Ebay

TIP 120 Darlington drive transistor. - Digikey

Buzzer - 3-5V internal drive. - Digikey

IDC 40 pin ribbon with male connector enclosed with a keyed header. - Digikey

IDC 40 pin ribbon with female connectors - 6" or greater. - Ebay

Power supply 2A 5V regulated wall wart with 2.1 mm x 5.5 mm power jack connector (centre is positive) - Amazon

USB battery pack - high current with LCD status display (needs 2.1 mm x 5.5 mm to USB type A male adapter). For portable computer use. (mAh to be determined) - Amazon

Blow moulded enclosure case. 10.25" x 6.5" x 3.65" - Amazon

Custom designed peripheral "E 64 Bridge PCB". Duplicate our design by using on-line track patterns and component layout pictures.

Could be wire wrapped on a perf board or bus wired on a proto board.

Misc. parts

Female strip headers (0.1" space) Quantity 4 - 27 pin. - Ebay

Hookup wiring 22 gauge stranded. - Ebay

Velcro rolls or strips (industrial) - Hardware store or box store.

Used/new clipboard - Masonite enclosure plate. Used for securing all modules on stand-offs with Velcro inside on blow moulded enclosure lid. - School supply store

Stand-offs - metal with insulating washers or nylon stand-offs. For mounting on the Masonite plate for the LCD, RTC, DC-DC converter, E 64 Bridge PCB

and keyboard breakout module. - Hardware store or box store.

Status LEDs. with dropping resistors. (high efficient 2 ma. [Kingbright]) - Digikey

Printed circuit board power jack (breadboard compatible) (female 2.1 mm x 5.5 mm) – Digikey

Embedded BASIC Laptop
Power Consumption:

MicroMite+ running: 77 ma. - 80 ma. @ 100 Mhz
Keyboard: 100 ma. @ 5V
7" TFT Display Electronics: 100 ma. @ 3.3V
7" TFT Display Back light: 330-620 ma. @5V 10% brightness 133 ma. and 100% 433 ma.
SD card usage > 100 ma. peak?

Total approximate current draw ~ 900 ma. Further testing is required.

Specifications for the USB portable Lithium power pack or bank:

USB 5V battery/charger Lithium power pack - high current with LCD only status display with 0-100% indication. No LED status allowed.

The input charging rate needs to be very fast. 2 amps versus the normal 1 amp input.

High quality 18650 Lithium cells. For best performance.

Enough power for 1 day of normal laptop usage. (13,000 mAh)

We chose a 13,000 mAh power pack (Sentey Brio Lux 13,000 mAh) with high quality LG 18650 cells from an Amazon vendor for about \$24. (\$USD)

It takes about 4.5 hours to fully charge at the high charge rate of 2 amps. This is not a problem - it can charge overnight.

At ~ 1A per hour it would take ~ 9 hours to discharge on our Embedded BASIC Laptop.

The LCD power bank % status can be monitored at all times, for laptop use, by activating the LCD to stay on continuously.

Note: USB (Lithium) battery/charger packs are quoted in mAh but that's a "marketing" number which is very deceiving. The mAh is the current available from the nominal voltage of the Lithium pack around 3.7 V. The USB pack will also need to step-up the voltage to 5V. A crude calculation, is most USB packs, are at least 65-70% efficient but some we have seen this value is < 65%. So, a 13,000 mAh pack will only produce about 9100 mAh @ 70% efficiency.

Note: A \$4 \$USD "charge doctor" from ebay was purchased to monitor the USB voltage/current consumption of the Embedded BASIC Laptop.

Note: USB power bank needs 2.1 mm x 5.5 mm power female jack to USB type A male adapter.

Note: The 3.3V regulator on the MM+ Explore 64 stamp module outputs a maximum of only 250 ma.

Note: MM+ Explore 64 version 1c will have the "back-feeding protection diode"

Embedded BASIC Laptop enclosure construction tips:

Obtain a smooth piece of Masonite wood from a new/used clip board.

Machine/paint this piece of wood so it would fit into the inside top lid of a blow moulded case.

Attach and wire all electronic modules (LCD, E 64 Bridge, RTC, DC-DC power supply and keyboard breakout modules) with nylon/metal stand-offs on the Masonite.

(Placement is somewhat critical due to tight electronic module spacing on the mounting plate for this size of enclosure.)

Attach the Masonite board with modules with Velcro (industrial) to the inside lid.

Design and engineer a small optional cradle for the miniature keyboard so it can easily attached/d-attached from the blow moulded case edges.

We used a rivet tool with some L aluminum stock, misc. parts and reusable rubber twist ties.

We used foam rubber rectangle between the TFT LCD and the keyboard to protect the TFT LCD and keyboard for transport.

U are done ...

Note: The electronic Masonite plate, keyboard, power supply can be easily removed and used on a bench top. The keyboard can be used inside the blow moulded case or elevated higher by the hinge mechanical structure elevator or removed completely and laid on any surface.

