DIY Remote Control for your CNC Machine – Part 1

(Build it for under $100)

Introduction and Scope of Project

I always like to tell readers early on in a "project" article, what we are building, why we are building it the way we are, and how we make it better. It's an engineer thing. Just by the fact that you are reading this magazine, proves you have some degree of engineering and creativeness in your veins. By telling you "up front" about the project goals or scope, you can decide quickly if this article is of interest to you and your CNC machine needs.

This project is about building a low cost DIY (Do It Yourself) remote control pendant or control panel for your CNC machine. We call it the MP2CP - MiniPendant (version 2) / Control Processor.

Our goals for the article:

- To make it as simple as possible to connect this device to the PC that controls your machine. No special drivers or macros.
- Making it as simple as possible to work with your PC CNC controller software.
- Providing functions that are "PC CNC controller software independent" meaning adapting function to your specific PC CNC controller software in order to perform with several controller applications such as Mach3, DeskCNC, and even Linux EMC2.
- Tailoring the functions to CNC types of operations – both general and specific
- Providing you with the hardware you can't easily produce and multiple lists of bill of materials and sources for parts you can acquire to keep the cost as low as your budget will allow.
- Provide you with several example CAD drawings in a number of formats (as well as photos and videos) so you can customize your panel/pendant layout and enclosure to meet your needs and budget.
- End up with a functional device that will meet your needs, yet can be expanded to meet new requirements. There's always room for improvement.

There are many possibilities and variations for this project, but it also has some boundaries as to what systems it will work with and to what degree.
Although originally designed to operate with Windows based CNC control programs such as the very popular Mach3 (www.machsupport.com) , in Part 2 we'll show you how it can be configured to work with other Windows CNC control programs. We even have it working on the equally popular EMC2 running on the Linux operating system. EMC2 is used by many Sherline CNC users.

The only skills required to build this pendant are the basic construction skills of using a pattern layout, drilling holes, and basic soldering of wires to switches. Most readers of the Digital Machinist magazine will possess these skills to some degree. If you need a little help, there are plenty of helpful folks on the any of the CNC forums such as the CNCzone and Mach3 Yahoo Groups.

If you're still reading, you must be at least curious to where this article is going.

There are so many possibilities of construction and configuration of this remote control pendant; we have divided the series into 3 parts.

What to expect in Part 1

Part 1 (this article) explains our goals and some boundaries. It will explain why we chose the particular connection interface to the PC. We'll also explain how this project evolved from an established proven product that already exists in the marketplace, the MP2. **Most importantly, by the end of Part 1, you will have the information (and examples) on how to build a functional remote control pendant that works with the Mach3 control software**. If you use another CNC control program, you may need to wait for Part 2 in the next Digital Machinist issue to see how to customize it to your PC CNC control program

Customization Explained in Part 2

With the building of the physical remote control pendant/control panel behind us, Part 2 will introduce the PC Configuration application that will let you customize almost every operation of the MP2CP and tailor it to your specific needs. You will be able to change parameters and output special "hotkey" sequences as well as test them to make sure you are getting what you expect. You'll be able to save different configuration "sets" so if you use the pendant to control your plasma gantry, the functions will be different than when you use it to control your routing table. This is where your "creative juices" begin to flow.

Bells and Whistles in Part 3

In Part 3, we'll cover special control panels for unique applications. We'll also discuss MP2CP built-in "macro" functions like the Z-axis Touch-Off function. We'll show you how to add an LCD (liquid crystal display) to the MP2CP establishing "soft" pushbutton capability. We'll also be connecting the MP2CP to one of several "off the shelf" relay boards to allow control of devices independent of your control program (Mach3, DeskCNC, etc.), but synchronized with commands to your controller PC.

Now if you're still reading, you probably fall into one or both of these categories:

- I think I could use a device like this and I'm interested to see how much work and cost is involved.
- I'm curious to see how the author plans to pull this off

Why you need Remote Control of your CNC machine

Here's the familiar scenario:
You've converted that mill to CNC, or built that plasma gantry machine, or purchased/built a CNC routing table. You've got a PC running Mach3 (or other control software) and all the associated motor controls right there at your fingertips. You've got a keyboard and mouse for starting, stopping, and jogging the machine to position. You've got a set of keyboard "hotkeys" that let you perform special functions provided by your PC control software. You now start making parts or art or

whatever you justified acquiring that CNC machine to do. Now after a few of those creations you've produced with your machine you discover that sitting in front of the keyboard and pressing keys (not to mention moving that mouse around to the special buttons to click on) is not the most efficient (or safest) way to operate your machine. You need to be over there watching your machine very closely because you've discovered that if something goes awry (as it already has…or will), you'll be scrambling to find the right key to press on the keyboard or scurrying with that mouse to click on that Pause (FeedHold) or Stop button on the screen.

You need a better way. You need something **in your hand** or at least in front of you wherever you are at your machine because you need to watch it and make sure it behaves as you intended. Most of us "veterans" can utter that famous phrase…..Been There, Done That!.....and paid the price! We have a box we keep with broken cutter bits that rammed into the table or work piece, and broken parts of CNC machines that we had to replace because We scrambled (too late) to find the STOP "hotkey" on the keyboard when we realized the machine was not acting like we expected.

This is the way I felt when I built my CNC plasma gantry machine back a few years ago. As many of you know, plasma cutting produces this carbon dust that gets into everything and PC systems don't survive well in this environment…not for long, anyway. So my gantry was outside under a carport and my PC was 10 feet away in my air conditioned lab. We admit that this was a "worse case" scenario but We also had a Sherline CNC mill and lathe in the lab as well as an old resurrected New Hermes engraver and all ran on the same Mach3 PC. Even these small machines in my lab needed a keyboard in front of them at all times to be safe. There had to be a better way.

History of the MP2/ZTO Leading to the MP2CP

A couple of years ago we started looking at the various remote control pendants available and decided none really fit all the requirements we thought we had, and decided to build our own from scratch. It helped that I had an electronics background and in a previous life was a design engineer (and more specifically keyboard engineer) for a large three letter blue computer company for over 30 years.

We wanted something simple to interface to the PC that did not require special drivers or "macros" and was somewhat independent of the control software. It needed to simply just plug in and work. So over the course of a few months, we designed and refined a CNC USB pendant that performed as we needed. We showed it to some fellow CNCers (who made suggestions and requests for more functions) and showed interest in owning one so we started Texas MicroCircuits (www.texasmicrocircuits.com) and our pendant evolved to be the MP2 (MiniPendant Version 2). Later, (from user requests), we added the Z-axis Touch-Off (ZTO) option that performed "outside" the Mach3 control software. For more information about the function and operation of the MP2 pendant and ZTO, please refer to the MP2 User Guide (and operational videos) on our website.
See figure 1 (photo of MP2/ZTO) http://www.texasmicrocircuits.com/DM/figure-01.jpg

Most Pendants are too expensive for my Budget

We agree. We started out to build a pendant that was around $100, but by the time we added an expensive extruded aluminum enclosure (and machined it), and high quality expensive pushbutton

switches, a knob for the rotary switch, and a custom engraved panel, the cost rose to around $275 ($375 if you added the ZTO option). That price was still pretty reasonable for the small production manufacturer that needed a turn-key pendant solution that just plugged in and worked, but for many of the hobbyists (or budget conscience garage businesses), this price was out of their range….at least in the present economy.

I still wanted a pendant I can build for under $100

We decided that we could bring the cost down to the range that a hobbyist might afford if he wanted to be a little creative and put on his "scrounging" hat, providing his own pushbuttons, possibly a joystick, an enclosure or control panel and the front labeled panel. Better yet, we could squeeze down the microprocessor board (to bring down the cost), the brains behind the pendant. In addition, we could provide the DIY guy with a list of several sources for the other components as well as CAD drawings for different layouts, enclosures and front panels. He should be able to make just about any pendant or control panel flavor he wanted for a $100 or less. To "sweeten the pot" as they say, we'd expand the functionality to provide for a configurable pendant that could be adapted to a variety of control programs (not just Mach3), and still provide such specific features as the Z-axis Touch-Off function with some additional hardware….all independent of the PC CNC control program. At that moment, the **MP2CP** was born.
See Figure 2 (photo of the MP2CP board w/kb cable, USB adapter and button cables).
http://www.texasmicrocircuits.com/dm/figure-02.jpg

How the MP2CP Works

The MP2CP (and the MP2) is a keyboard emulator using a PS/2 keyboard cable and a USB adapter.

Just What Is a Keyboard Emulator?

Your PC keyboard (whether it is a PS/2 or USB) connects to your PC with a cable. Even a wireless keyboard has a receiver on the PC end that connects to the PC with a cable in most instances. When you press a key (key_down), the keyboard sends a unique "scan code" to the PC. When you release the key (key_up), another unique scan code is sent to the PC. These 2 unique scan codes enable you to press multiple keys at once, such as the Shift key and a 3 key and produce "#", whereas if you only pushed the 3 key, the keyboard would send the scan code for "3". There is a published set of specifications (originated by IBM and later expanded by Microsoft…and others) that dictate what scan codes these keys produce. Keyboard engineers use these specifications to write the firmware for the keyboard. In theory, every keyboard should produce EXACTLY the same data, timings, etc. as any other keyboard. In reality, this is not always true.

A keyboard emulator is a device that, in its simplest form, interfaces individual switches to a PC making their action "look" like someone is typing on a keyboard. For an example let's say we want to have a pushbutton switch that would let us Start a g-code program loaded into Mach3. That pushbutton switch is connected to a keyboard emulator.

The "hotkey" sequence (determined by Mach3) to Start the g-code is <Alt>R. That means if you were going to start the g-code execution from a keyboard you would first press down the Alt key,

then press the R key, next releasing the R key, and finally releasing the Alt key. Mach3 would interpret this as a Start command and the g-code would execute.

When we press the "Start" pushbutton connected to our keyboard emulator, it produces the scan code sequence – Alt key down, R key down, R key up, Alt key up. The Mach3 program thinks someone just typed an <Alt>R Start command at the keyboard and executes the g-code. Our keyboard emulator "looked" like a keyboard to the PC and to Mach3.

Keyboard emulators are simple and robust and most can be programmed for some very complex sequences or operations. **They are very good and reliable for any control that you could have performed with a keyboard.**

Why do I Need a USB Adapter?

The answer here is not immediately obvious, yet is twofold.

First, the PS/2 keyboard cable is inexpensive and can be obtained in lengths of over 100ft. The keyboard emulator with a PS/2 interface can easily and reliably work at distances up to 100ft. We've reliably run the MP2CP over lengths of 200ft with zero errors. The USB specifications limit the USB cable length to 5 meters (about 15ft), though in the real world this can be slightly longer, but no where near 100ft. Also, USB cables have shown to be less electrically noise resistant than PS/2 cables around plasma gantry tables and environments around TIG and MIG welders. We realize that most of you don't plan to operate 100ft from your PC, but many of our clients operate CNC tables that may take them as much as 25 ft from their PC and USB can be a bit "iffy" at this distance.

Second, most PCs used for CNC still have a PS/2 keyboard port and almost all have 2 or more USB ports. The main reason we use a USB adapter (which is supplied with all MP2 pendants and MP2CP boards) is because we don't know what type (or manufacturer) your PC motherboard is. Remember when we mentioned earlier that keyboard engineers would write the keyboard firmware to a set of specifications and that, in theory, every keyboard should act the exact same way as every other keyboard, but in reality this was not always true? The same goes for the engineer who wrote the firmware for the motherboard in your PC. You've probably heard of some guys complaining that a certain keyboard didn't work on their PC and they didn't know why. It all comes down to how the specifications were "interpreted" by the firmware engineers of the keyboard and motherboard. That's the real world.

We circumvented that problem entirely by providing a very well designed and robust PS/2 keyboard to USB adapter with our MP2 pendant and MP2CP. That USB adapter takes the scan codes from the MP2CP and converts them to USB format (in the adapter) and basically "bypasses" the firmware on the PC motherboard and talks directly to Windows. Windows has its own built in "Human Interface Device" (HID) driver that handles this USB adapter automatically. A similar built in driver exists for Linux. Remember one of our goals was NOT to require any special drivers or macros.

We've been using this communication method for over 2 years with over 100 devices in the field on many different PC brands and we've received no reported problems.

Several Manufacturers of KB Emulation used in CNC

There are many manufacturers of keyboard emulators. Most are general in nature and design. It is not the intent of this article to perform a detailed comparison of each of the products. However, below is a list of the more popular keyboard emulators we have personally tested in CNC pendants and control panel prototypes.

Hagstrom (www.hagstromelectronics.com/) Cost ~$80 to ~$170

Hagstrom Electronic makes several keyboard emulators with both USB and PS/2 interfaces. They are programmable for multiple keystroke sequences. We have used several of their models (USB only) in our shop and they work well. No cables or connectors are supplied.

PoKeys55 (www.poscope.com/) Cost ~$81 - ~$90

The Pokeys55 module is a highly configurable, general purpose keyboard emulator popular with the Mach3 crowd. It has a robust set of programmable features. They have a driver that integrates the board's functions with Mach3. It comes in USB only. There are no cables supplied but the more expensive model comes with screw terminals.

I-PAC (www.ultimarc.com/) Cost ~$40 input + ~$30 output (LEDs)

The I-PAC series of keyboard emulators is designed for the arcade industry to interface with a PC, though it can be programmed for use in CNC keyboard commands. They provide both PS/2 and USB models. We tested the FS32 version. It is an input only device and does not drive LEDs or relays. To add this function, in addition to the FS32, you must purchase the Pac-Drive (USB only) which will drive LEDs and relays. We have used the FS32 and it works as expected. No cables are supplied but screw terminals come on models tested. They have drivers for Linux as well as Windows.
Ultimarc does sell a good selection of joysticks and large pushbuttons at very reasonable prices.

MP2CP (www.texasmicrocircuits.com/) Cost under $70 (**even cheaper for 2 or more**)

The MP2CP is a PS/2 (with supplied USB adapter) keyboard emulator that is designed and tailored with CNC control in mind. It provides all of the function our $275 MP2 provides plus is configurable (with optional cable and downloadable PC Configuration application) and includes extra functions like Program Load selections. It comes with internal "macro" firmware for Z-axis Touch-Off capability used currently with Mach3. All cables needed to connect joysticks, switches, and LEDs are supplied. It also comes with a PS/2 keyboard cable, Active USB adapter, and USB extension cable (if needed). Our website provides a detailed User Guide, instructional videos as well as many CAD drawings for different types of enclosures and front panels. It also lists multiple sources (and costs) for enclosures, switches, joysticks, LEDs, relay boards, LCDs, and other "bells and whistles" that can be attached to the MP2CP for enhanced CNC remote control capability.
See figure 3 (all 4 keyboard emulators in one pic.)
http://www.texasmicrocircuits.com/dm/figure-03.jpg

CNC Controller Programs

Mach3

Mach3 has a set of keyboard “hotkeys” that are assigned for many different functions. The MP2CP comes with this Mach3 set of commands as a “factory default”. They can be changed with an optional configuration cable and PC Configuration application (covered in Part 2 of this article series).

See figure 4 (Mach3 hotkey set - below)

Hotkey Set for Mach3 (incomplete)

Keystroke	Action Taken
Left/Right Arrow	Jog axis 1
Up/Down Arrow	Jog axis 2
PgUp/PgDown	Jog axis 3
Semicolon/Single quote	Jog axis 4
Alt key with any above	Fast Jog
Ctrl key with any above	Incremental Jog
Ctrl O	Return all axis to “0” position
Alt Z	Move Z axis to “safe” position
Alt T	Move Spindle to “tool change” position
Home	All valid axes travel to home position
Ctrl W	Rewind g-code File (go to beginning)
F1	Execute user written macro #1
F2	Execute user written macro #2
F3	Execute user written macro #3
Ctrl X, “0”,Enter	Zero X DRO
Ctrl Y, “0”,Enter	Zero Y DRO
Ctrl Z, “0”,Enter	Zero Z DRO
Ctrl A, “0”,Enter	Zero A DRO
F5	Toggle spindle on/off
\ (backslash)	Reset spindle speed override
/ (forward slash)	Reset feedrate override
Home	All valid axes travel to home position
Ctrl W	Rewind g-code File (go to beginning)

DeskCNC and other Windows Based CNC Controller Programs

DeskCNC has many of the same jogging keys assigned as does Mach3. In fact, most any of the Windows based CNC controller applications that have keyboard “hotkeys”, can be easily supported on the MP2CP by using our PC Configuration Application.
In Part 2, we will show you how to program the MP2CP to enable the “hotkey” set of DeskCNC on the MP2CP.

EMC2

EMC2 is a very popular CNC controller application running on the Linux operating system. Many Sherline CNC owners use this CNC software. Our MP2CP adapter and USB adapter work on EMC2, requiring no special drivers or software. In Part 2, we will show how to program the MP2CP to enable the “hotkey” set of EMC2 on the MP2CP.
See figure 5 (EMC Axis hotkey set - below) acquired from EMC2 manual

These EMC key mappings are the defaults for the “AXIS” user interface.
There are other UIs available.

Keystroke	Action Taken
F1	Toggle Emergency Stop
F2	Turn machine on/off
`, 1 .. 9, 0	Set feed override from 0% to 100%
X, `	Activate first axis
Y, 1	Activate second axis
Z, 2	Activate third axis
A, 3	Activate fourth axis
I	Select jog increment
C	Continuous jog
Control-Home	Perform homing sequence
End	Touch off: Set G54 offset for active axis
Left, Right	Jog first axis
Up, Down	Jog second axis
Pg Up, Pg Dn	Jog third axis
[,]	Jog fourth axis
O	Open File
Control-R	Reload File
R	Run file
P	Pause execution
S	Resume Execution
ESC	Stop execution
Control-K	Clear backplot
V	Cycle among preset views

Differences between the MP2 and MP2CP

The main differences in our MP2 pendant and the MP2CP board is that we removed all of the relatively expensive custom hardware like the extruded aluminum enclosure, micro-engraved front panel, high quality pushbutton switches, LEDs, and "Thumbstick" navigator. This (and the labor to machine, engrave, and assemble it) was a major cost of the pendant. This cost reduction took us from a $275 "turnkey" pendant to a functionally equivalent printed circuit board, for the DIY guy who wants to save some money by building it himself, down to a complete pendant/control panel for under $100. The MP2CP board kit costs under $70. It comes supplied with a user settable 2 to 12 position rotary selector switch, switch cables and connectors, keyboard cable, and USB adapter with the MP2CP. These are the "harder to acquire" parts.

Removing the Expensive Stuff

We were able to extract the "brains" of the MP2 pendant and "squeeze" the printed circuit board down to a smaller size (i.e. less expensive). The more costly components such as the enclosure, engraved panel, and push buttons switches can be supplied by the DIY builder, in most instances, for much less money.

See figure 6 (photo of unassembled MP2 compared to an MP2CP)

http://www.texasmicrocircuits.com/dm/figure-06.jpg

Adding New Function

As a bonus, we built new function into the MP2CP that allows a user to connect their MP2CP to their PC via a configuration cable (you can buy or build) and configure it for custom settings or for use with other CNC controller programs besides Mach3, such as DeskCNC and even EMC2 running on Linux. This will be covered in more detail in Part 2 of this article. In addition, there will be available extra button functions and selector switch positions not available on the MP2 because of space constraints.

Providing Your Own Hardware

Many DIY builders have a "scrap" box with various samples of enclosures and pushbutton switches that they have "scrounged" over the years. Others have their favorite surplus supply stores where they can find good bargains of items like enclosures, switches, selector knobs, LEDs, etc. We will post (on both our website and the DM website), detailed lists of a wide variety of parts and sources for these from a number of internet vendors and surplus stores. Since many of the readers of this magazine are very familiar with building projects, we won't go into every detail on the step-by-step process to drill, machine, or mount the hardware necessary to produce a completed pendant or control panel in this article. We WILL provide much of this detail in files on the DM website as well as our own.

Enclosures

Selecting and acquiring an enclosure to mount the MP2CP and associated switches, joysticks, LEDs, etc. is only part of the process of building a pendant or control panel. Machining and/or drilling that enclosure takes time to design plans and execute them including machining or routing functions. We provide a wide variety of designs we have personally produced ranging from the very inexpensive to the more elegant solutions. We provide free files in a number of formats (DXF, PDF, etc.) and we do most of our designs in Corel Draw and VCarve (or Cut2D) by Vectric. These files are available on

the DM website as well as our own. We also plan to set up a Yahoo Group where other DIY builders can share their plans as well. We'll explain more about that in Part 2.
See figure 7 (photo of several enclosures)

http://www.texasmicrocircuits.com/dm/figure-07.jpg

Switches and Knobs

Pushbutton, toggle, selector switches, and knobs can cost anywhere from pennies to tens of dollars each depending on the specifications of the switch and budget of the DIY builder.
We will provide Bill of Material lists and a variety of sources for all the examples of switches and selector knobs we use or recommend. We encourage other DIY builders to share their designs and will post them on our website.
See figure 8 (photo of a variety of switches and joysticks)

http://www.texasmicrocircuits.com/dm/figure-08.jpg

Front Panels and Labels

The design and layout of a pendant/control front panel is as important in function as aesthetics. The panel of the MP2 is an engraved design made in 2 color engraving plastic (available at commercial engraving suppliers as well as inexpensively on eBay…search on "engraving plastic"). Many CNC routers and mills are able to perform the engraving function as long as the DIY builder has the CAD files at his disposal. We provide these files on the DM website as well as our own in addition to commercial and eBay sources for the inexpensive plastic and engraving cutters.

For the DIY builder who does not have "engraving" capability on his CNC machine, we also provide the example panels in color PDF (and Corel or Avery) format so he can print his panel on an inkjet or laser printer and have it laminated. Don't have Corel Draw? I've designed front panels using Avery DesignPro Limited for PC (free on the Avery website). Most office supply and mail box stores (like FedEx Kinko's, Staples, and The UPS Store) will print and laminate a page inexpensively. A laminated drawing, "X-Acto" knife, some double-sided tape, and a little patience have produced many nice "front decals" for my DIY panels. The panels you see here were designed and printed with Avery DesignPro Limited, then laminated. We just need to drill the holes and mount the PB switches and LEDs. See figure 9 (photo of other kinds of panels including laminated paper) http://www.texasmicrocircuits.com/dm/figure-09.jpg

MP2CP Details

Though the downloadable MP2CP User Guide (and DIY videos) on our website show extensive detail and varied use of the MP2CP, below are some of the more important mounting and wiring possibilities. Any parts used in mounting and wiring that are not included with the MP2CP are listed in a bill of materials and sources for each. **The MP2CP comes preconfigured for functions tailored to the Mach3 "hotkey" set.**

Mounting

The MP2CP board is 2.5" (63.5mm) x 2.8" (71.12mm) and has 4 mounting holes in addition to being able to mount it via the rotary selector switch. Short spacers are recommended in mounting the board to enclosures or panels. These inexpensive spacers are readily available at many electronic

hardware sources such as Mouser, Allied Electronics, McMaster-Carr, Digikey, etc. The mounting hole pattern layout and bill of material for all hardware mounting options are available on our website.
The MP2CP can be ordered mounted in basically 2 different ways with variations of each depending on the enclosure and panel design. The rotary selector switch (included) can be mounted on either the solder or component side of the MP2CP. This allows for mounting the MP2CP to the base of the enclosure or to the front panel. Bill of materials for both inexpensive mounting spacers and even selector switch shaft extensions are provided. Mounting flexibility is the key to a customized pendant/control panel. We mount this rotary switch at the factory per your selection.
See figure 10a and figure 10b (showing Rotary switch mounting on top and on bottom)

http://www.texasmicrocircuits.com/dm/figure-10a.jpg

http://www.texasmicrocircuits.com/dm/figure-10b.jpg

Wiring

The wiring of the pushbuttons switches and LEDs is shown in a drawing. More detailed connections, jumpers, and hardware configuration is provided in the User Guide on our website. This example is for a Mach3 configuration. Wiring diagram examples for EMC2 and others will be available on our web
See figure 11a (show Corel drawing of basic switch/LED wiring to MP2CP)

http://www.texasmicrocircuits.com/dm/figure-11a.jpg

See figure 11b (show wires soldered to switches/LEDs on one panel)

http://www.texasmicrocircuits.com/dm/figure-11b.jpg

User Guide

The downloadable User Guide and project videos provide detailed information and examples of the MP2CP function, mounting, wiring, and operation. It is not a “text only” manual but contains many photographs and drawings. There will be a separate PC Configuration User Guide to document the operation of the PC Configuration application covered in Part 2.

Examples of Enclosures and Panels

These are just some examples of the wide variety of enclosures and panels you can build/machine/engrave for your MP2CP pendant/control panel. All CAD files for these (and more) will be yours free for downloading on our website. Most of these examples are geared toward Mach3 configurations, but there will be several for EMC2 and others on our web.

Single Outlet Box

This is a simple and inexpensive implementation of the a pendant or control panel using a $3 plastic electrical outlet box available at Home Depot, Lowe’s, Ace Hardware and a number of other home improvement stores. This project shows one of the lowest cost and basic functional capabilities of the MP2CP. As a control panel, the user can mount it to the machine using the 4 mounting tabs or cut them off to use as a handheld pendant.
See figure 12 (photo of single box finished)

http://www.texasmicrocircuits.com/dm/figure-12.jpg

Double Outlet Box

This is a larger and more functional implementation of the MP2CP adding "navigational" buttons to control axis jogging but still uses a $5 plastic outlet enclosure from a home improvement store.
See figure 13 (photo of double box finished)

http://www.texasmicrocircuits.com/dm/figure-13.jpg

Desktop Cabinet

This sloping desktop enclosure is large enough to provide space for large (even backlit) pushbuttons. The enclosure is more expensive (but can be easily built by the DIYer) and the switches and/or joystick are very low cost and are obtained from an arcade supplier. This enclosure is being shown as a enclosure concept and not necessarily a complete product.

See figure 14 (photo of desktop box finished)

http://www.texasmicrocircuits.com/dm/figure-14.jpg

Ergonomic Handheld Enclosure

These plastic handheld pendant (instrument) enclosures can range from less than $10 to $30 or more from enclosure suppliers such as Box Enclosures www.boxenclosures.com (as well as Allied Electronics and Newark). They provide a nice large area for pushbuttons, joysticks or navigational buttons, LEDs, LCDs, and an engraved panel or laminated decal can be fabricated easily.
See figure 15 (photo of handheld finished with both engraved and laminated panel)

http://www.texasmicrocircuits.com/dm/figure-15.jpg

Boxed Enclosures w/Protective Boot and Stand

These plastic boxed enclosures can range from less than $10 to $30 or more with protective boot and stand. They provide a medium area for pushbuttons, navigational buttons (showing optional Thumbstick), and LEDs, and an engraved panel or laminated decal can be fabricated easily. These examples show an engraved panel With Mach3 and EMC2 functions
See figure 16 (photo of boxed enclosure finished with stand and boot)

http://www.texasmicrocircuits.com/dm/figure-16.jpg

Extruded Aluminum Control Panel w/LCD

This example of a control panel as opposed to a handheld pendant shows that the MP2CP can be mounted as an integral part of the CNC machine or electronics enclosure. Because the MP2CP is a USB device (to the PC), more than one of the devices (a control panel and a handheld pendant) can be used with the same CNC machine just like two USB keyboards can be used on the same PC.
This enclosure is being shown as a enclosure concept and not necessarily a complete product.
See figure 17 (photo of control panel finished)

http://www.texasmicrocircuits.com/dm/figure-17.jpg

Next Issue – PC Configuration Application

In the next issue (Part 2) we'll introduce the MP2CP Configuration Application and communication cable to the MP2CP that you can build (or buy).

See figure 18 (photo of prototype PC App screen shot) –

http://www.texasmicrocircuits.com/dm/figure-18.jpg

We'll also explain how all of the configuration options work and how you can adapt the MP2CP remote control you've built to almost any CNC controller program that has a keyboard "hotkey" set. There are several function parameters preset in the MP2CP that you may wish to tweak to your liking. You can also enable built in "macro" functions like the Z-axis Touch-Off if you have the optional ZTO module. Our website will list all of the other CNC controller program "hotkey" lists we can find so you can adapt your pendant to operate your CNC machine. Stay tuned as this is where the fun really begins.

About the Author

Randy Ray spent over 30 years as an engineer for IBM in the research and design of unmanned remote control systems, Smart Homes, laptops, and PC HID (including keyboards). He currently owns Texas MicroCircuits (www.texasmicrocircuits.com) and is the chief designer/engineer/manufacturer/custodian/lab-rat. He uses a Mach3 controlled CNC mill, lathe, plasma gantry, and engraver to manufacture his pendant products and prototypes.

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