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CNC PLASMA GX1325
51" x 98" 1300X2500MM



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05-23-2007, 07:27 AM			#1
dz1			Join Date: Feb 2007 Location: United States Posts: 38
New router build			
<p>Enjoy watching every one elses projects grow so much thought i would share mine. This will be the second machine i built, first is a rock cliff which i am still happy with, just wanted bigger and to be able to try it with my plasma cutter also.</p>			

This machine was designed from scratch, ideas taken from umm every other build i have ever seen :) Everything was bought new except the two linear rails used for the z downfeed (dont have enough time to bargain hunt): Total cost was 2k. not everything is on yet, but do have all the parts.

Used the vbxbearings.com 20mm rods and slides for the x and y. Y seems ok but the x with the narrow spacing and moderate cross slide does have to much torsional flex at teh moment. I think i may add a piece of barstock behind the x rails, and then a bearing follower from the cross slide to help eliminate it, or bolt in another plate behind it and swap in some linear rails.

it was designed as a light duty machine to run a laminate trimmer or plasma so the follower bearings will probably do the trick. its fun anyway :)

I also made it for easy disassembly so I could move it around and into the basement. Top rails are held on with 4 1/2 bolts, cross braces are bolted on too, rest welded. Right now has some resonance when you tap the frame, but bolting on the table should finish sturding it up. For drive on the Y axis I went with a rack and pinion to drive both sides, 1/2 shaft will drive both with flange/pillow block bearings to be mounted on gantry. gearing is 1:1 on the rack gears and 4:1 on the belt drive off the stepper to the shaft.

ballscrew on the x axis, you can see a cheesy ball end mount. collar with 2 set screw on ballscrew then a roll pin to threaded ended going through bushings to mount to stepper. I will probably redo this a bit better want a little more length on the thread endand probably want to lightly weld steel collar to ballscrew. my lathe is not up to turning down the ballscrew even with carbide bit take to long :(on teh other end ballscrew is cupped by another aluminum sleeve just to keep it from whipping i will add a grease fitting to that end and call it a day. lost one tiny ball bearing from ballnut..scared to try to get it back in there not sure if one missing matters.

ballnut is welded onto another piece of steel then bolted to cross slide. didnt have a tap on hand to mount it proper but will be fine.

down feed is acme screw, i did make an antibacklash nut block for it, but it runs kinda tight will see what i use in the end. all steppers are 469oz xyolex with xyolex board. will be using mach3 to drive it. guess thats all i can think of for now..will post updates as i finish her up. :)

-dave

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05-25-2007, 09:57 PM

#2

[dz1](#)

Join Date: Feb 2007
Location: United States
Posts: 38

Finished Y rack

finished assembling the y rack tonight mounting the pillow blocks and pinions...ran into an unforeseen problem. i knew the top 20mm hardened rails sagged some under the weight of the gantry..soo..yup that makes the pinions travel downward as well and loose contact with the rack 😞

should have seen that one coming..if i ever build another one this size, i guess I am goign to try vrails to support the gantry weight...

anyway, so the fix for this one was to mount a pair of skate bearings that ride on top of the frame to take the weight off of the rails. bearings are mounted on a stud which goes through an eccentric bushing in the gantry side plate for adjustment. pinions now stay fully engaged for the full travel.

also i was going to use flange bearings with the rod going through the side plates , but ended up switching to pillow block bearings mounted on the back of the gantry side plates. this was an easier mounting option required less holes and was much easier to align and adjust. down side is i just lost another 2-2.5 inchs of y travel....oghh well tradeoffs

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05-31-2007, 07:36 PM

#3

[dz1](#)

Join Date: Feb 2007
Location: United States
Posts: 38

y belt drive and motor mount complete

completed the stepper mounting and belt tensioning setup for the y axis. milled out a pocket in the gantry side plate so the stepper shaft would protrude enough for the belt pulley and milled in some slots for the mounting screws and shaft so that you can adjust the stepper to adjust belt tension. you cant quite see it, but also had to mill a smaller channel down the middle of the pocket for the centering boss on the stepper. all in all a little ugly as I had to remount it 3 times on the mill but will do the trick.

on a side note i never realized the nema23 frames used a #7 hole for their mounting screw...already a perfectly drilled hole for a 1/4" coarse thread tap 😊 cast aluminum makes for effortless threading, wish i had thought of that one earlier.

in other news..going to ditch the x axis lead screw end mount in favor of a new design which will make for much simpler setup. new setup will reduce load capacity probably by a factor of 3-4 but should still be fine for what i am going to use the machine for.

should be mounting limit switches and starting to wire it up by this weekend !

Attached Thumbnails



dz1 Join Date: Feb 2007
Location: United States
Posts: 38**x stepper mounted**

doh parts didnt make it in for the weekend

finished the machining for the redesign of the x stepper mount and ballscrew coupling. i was goign to do it the traditional way, but would have had to remachine the parts anyway so figured I would lighten the work a bit and try an alternative design (thanks nick). probably didnt save any time, but this way should be sufficiently sturdy as well and guaranteed to have no wobble of leadscrew.

I will be putting a flat washer type thrust bearing between the stepper and teh shaft adapter shown, that will transmit the axial load on the leadscrew directly to the stepper casing and not send it into the stepper armature/shaft...probably need another setscrew on the adapter but two should hold...will put another set screw collar and thrust bearing on outside of stepper shaft as well to take the load from the other direction.

aluminum shaft adapter and leadscrew are both 5/8 and will use a clamp type collar to couple them which should guarantee concentricity unlike that old set screw setup i initially used. maybe not as strong, but i am betting it will be enough for a laminate trimmer/plasma machine if not, still some ideas left for a fix...

also not shown, but before on teh far end of the lead screw i had an aluminum sleeve around it to stop wobble..hard to get the lead screw out required full disasm of gantry...so now with the longer extension on the stepper end, i drilled a 5/8 hole through the far gantry side plate for ballscrew support over there....also makes its super nice to work on teh gantry now that i can just slide the cross slide wherever by hand cause the screw can pass through the gantry.

last major task is how to stiffen up X ways to reduce rotational deflection of the xslide (which happens way to easy right now when xslide is in the middle of the 49" span 😞)

gonna have to bolt some square tube behind it with a pair of bearings on in the front and back of it i think to absorb the load...good thing vxb gave me a 10 pack of skate bearings for free with my order heh.

any other ideas on a fix for that one appreciated 😊

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dz1 Join Date: Feb 2007
Location: United States
Posts: 38

all axis wired and moving, y axis came out to be little over 2000 steps/in with the gearing and can sustain 500 ipm, (surprised me with the gantry weight of about 80lbs) (425oz steppers)

x axis with direct drive to 13/64 lead ballscrew came out to almost 8000 steps/inch and can only reliably sustain 40ipm....that was on 1/8 step mode, guess I will bump it to half step on that axis and see how much that helps. ballscrew also gets some resonance going with drive stall soon thereafter...

the smallish 1/2" pinion drive shaft for the Y will need to a bearing added to the middle of that 4' span i

think, not sure what to do with the ballscrew,

with little over 40" of travel, would really like at least 80ipm on x

so to do list is now down to limit switches, work table, router mount, cable ways, and a couple support pieces such as that bearing, and a way to reinforce x ways...

for limit switches, I am going to make some 20mm setscrew collars with one flat face, slip them over the 20mm rods and screw the limit switches to the flat spot ...easy and adjustable.

maybe to reinforce the x ways, i could switch to the partially open style linear bearings and tack a piece of T-iron to it in spots? then back the T-iron with an 1/2" AL plate and bolt it to it...but the rods are hardened, the welds would quickly break humm.. or i could buy new 20mm rods too that are not hardened, but that would be like another 120+50 for the bearings...to much for a redo right now...

edit:

added two pics, one is the final layout of the gantry side plate with steppers, rack, ways, etc mounted, other is the ballscrew coupling i was talking about. in both pics you can see the thrust bearings and set screw collar used to take up X thrust load and keep it off the guts of the stepper...

these thrust bearings turned out to be smaller than intended, the washers dont even have grooves, and the bearings are just held in a plastic cage..catalog said rated for 23lbs thrust..anyway, I found another set of thrust bearings with roller bearings and steel cage for like a buck more and they have a huge thrust rating, just have to turn some small adapter bushings to center their 1/2 id to teh 1/4 od of the stepper..will probably wait until these ones blow up just to see how much abuse they can really take 😊

edit 2:

added pdf for all the part numbers and prices for the parts used

Attached Thumbnails



Attached Files

 [receipts.pdf](#) (462.6 KB, 100 views)

Last edited by dz1; 06-10-2007 at 10:13 AM.



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06-17-2007, 12:22 PM

#6 

[dz1](#) 

Join Date: Feb 2007
Location: United States
Posts: 38

x ways support rod and table on

got teh table all mounted and level, going to add one final cross support under the 3 main rods and an adjustable leg down to help keep it from bowing under weight (kinda light duty as is), when i mounted the frame cross braces i kinda guessed where final table height would have to be, turned out ok in that mounting the rods right under teh cross braces gave me a min xslide to table of .5" which is what i was going for. the table supports did get drilled and bushings welded in so they wont crush...the cross braces have not yet..i will eventually but will wait a bit..always forget how much work it is just to put the table

on..seems like a such a simple part...until you think about the requirements of being level in both directions, gettign the height right and making it rigid enough to take hte cutting forces..pretty critical part for something that "doesnt do anything"

finished beefing up the x ways so they wont torque anymore...added in a 1" x .06" wall square steel tube behind the bottom rail, then I mounted a plate contraction off of the linear bearing (hey it already had holes that fit a 10-32 tap perfect) and then mounted a couple bearings on eccentric "bolts" to ride the rail. seems to stiffen it up quite well, you also see in teh pict a piece of 1" x 3/16W stock sitting on top of the sqr tube...that will get a bunch of 1/2 in holes drilled in it then plug welded to the top of the tubing to further increase its strength.

Wish i had a pict of the eccentrics, i will add one next time it comes apart...the id of the bearing was .3125, so for a .25 mounting bolt I could not get enough throw for a real eccentric...so instead i mounted the .5" al rod in teh 4 jaw as far off center as i could and turned down a 1/4" shank on the end and threaded it to mount to teh plate. then on the other end, i just turned it to match the id of the bearing and threaded a small 10-32 down the center to retain the bearing...this setup gave me more throw then the conventional setup. still have to disconnect the lead screw and slide it by hand to see how smooth it is or if the support rod needs tweaked in or out...initial measurement shows .030 off from one end to the other (49") maybe rod flex will eat that without a problem, or i can ream out the holes on one end a bit and adjust it out..not bad at all though.

bleh 20mm unsupported rods are a pain in the ass when you reach 4ft spans..for another 75 per rod I could have gone supported (not really vxb didnt show the supported rods when i bought and i dont know if i would have spent another 300 to get out of a day and half labor): but anyway..lotso tinkering around to overcome this problem.

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06-17-2007, 12:33 PM

#7

[dz1](#)

Join Date: Feb 2007
Location: United States
Posts: 38

tooling overview

in case anyone is wondering what tooling is being used for this build

- small 9"x24" Southbend bench lathe (1950's era)
- small cheapo harbor freight milling machine (ITEM 44991-6VGA \$500)
- small cheapo harbor freight horizontal bandsaw
- 110v mig welder
- standard stand up drill press
- i did cheat and use my first MDF homebuilt cnc router with a drill attachment to layout the hole patterns in the down feed/cross slide pieces so the holes were perfect
- transfer punches (invaluable)
- harbor freight cheapo dial calipers

- standard tap and die set

thats all teh main stuff, then misc hand tools like drills, levels, tape measures, hack saws etc. but nothing really to fancy, the bandsaw and drillpress are more for convience rather than necessity.



06-24-2007, 01:34 PM

#8

[dz1](#)

Join Date: Feb 2007
Location: United States
Posts: 38

limit switchs installed and wired, finished final hookup of electronics box, despite using shielded wire for everything the motor wires still trip the limit switchs due to inductance i think ☹️

or i have a bad connection but i was pretty careful...time to debug again...goign to start with grounding the shield and drain wires, then if have to lower pullup resistor from 10k to 4.7k, then if have to remove the slide on switch connectors and solder wires directly on, then if that still doesnt solveit, i will have to find a different seperated pathway for the limit wires instead of bundling them with the motor wires (messier):

i ended up only installing 3 limit switchsm if i ever use the full size of the mahcine which should be rare i will use soft limits for the max, the limit switch mounts for the X/Y are a quick design, i was going to make them a pinch type clamp, but after looking at it i really didnt want to have to remove the rods to slip the blocks on, they are held on with a set screw mounted below center so that the side of it pushes the rod up and clamps it into the half round..had to tap them both twice cause wasnts off center enough x2 but they seem to hold nice and tight.

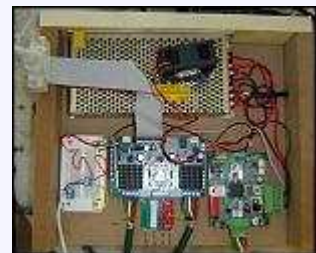
the electronics box...you can see my 1/3 dead xyolex, i blew the original y driver with a bad connection on my old machine, had to dremel the surface mount chip off the board to remove the dead short and regain use of the other two ☹️ then i soldered a couple small jumper wires from the IDE header and had them going off to a single axis xyolex board on the side..which i just blew this time around with a bad hookup (totally my bad gave it motor + where logic + was supposed to be oops) so anyway...now i have a one axis pmdx.com board over there on teh side which has more built in protections (which i do seem to need yes thank you 😊

so last todo's is tool mount, table supprot, and estop button. phew almost there.

edit:

so i got the limit switchs to mellow out on teh noise, or actually compensated for it...i tried all the above and i am still getting a noisy signal, one thing i know for sure is never ever tie the sheild wires from the limits and the shield from the steppers to a common ground..made it trigger without delay...after seperating the wires, soldering the crimp conectors on the switch ends, and lowering the pullup resistors to try to get a cleaner signal, still noisy..it must be the breadboard connections, but it stays for now maybe i will make up a simple board latter so i can solder it all up, for now i found the debounce setting in mach and bumped it up to abotu 100 to eliminate false trips

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Last edited by dz1; 06-25-2007 at 07:08 AM.



dz1

Join Date: Feb 2007
Location: United States
Posts: 38

first chips have flown!

two points of bad news..70ipm rapids on teh X are not trustworthy..lost of steps mid sign and hosed up the piece..twice..have to stick to 40ipm rapids i guess,

bad point two..had some burrs under the table where i drilled the rods..didnt bother to fully tram the table and had forgotten one screw so initial cuts were done with one section fo the table raised up about .120 in one spot..oops..down to .040 now, but once i remove the burrs should be pretty good (even .040 is visible with v carving where lines might only be .080 deep)

so..circles look good, no flat spots, the follower bearings did well reinforcing the ways against deflection.

as a side note, laminate trimmers are not happy with 1/4" deep cuts at 30ipm!
hehe, spindle got very hot, going to keep cuts down to 18ipm for life for life of the trimmer...its the damn perfect size..good power, just wish it was meant for a heavier service duty...

also after i found the debounce setting in mach, i got froggy and bundled the limit switch wire with teh stepper wire for the Z for the sake of cleanliness then zip tied on the 110v router power cord..now i am back to false limit switch triggers with a 100 debounce setting..grr

oghh and finished up the table support leg today, cross bar welded in hitting all 3 original table supports, stud welded down in center, push pin (like trailer hitch) holds 1" tube down leg with adjustable foot. before support table would flex about .060" with heavy hand weight down in center, now thats down to like .010" which I will call livable.

also sized out final cutting area size today, 34" deep x 40" wide, I could have been more careful on maximizing the depth, i did waste travel on both the rack and the hardened rods, but the machine foot print of 49x49 is about as big as i would have wanted it anyway i do still want to park in the garage in teh winter 😊

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dz1

Join Date: Feb 2007
Location: United States
Posts: 38

finally...the machine is done!

last set of pictures,

1st one shows the T-slot table i added, simple 3" pine strips with a square taken out of each side screwed down to teh sub-table and then planed smooth with the machine itself.

second picture is the 1st sign completed without err.

phew, that was allot of work!

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08-09-2007, 02:03 AM

#11

[mikie](#)

Join Date: Jul 2003
Location: Australia
Posts: 309

great work on your machine.



08-22-2007, 11:58 AM

#12

[dz1](#)

Join Date: Feb 2007
Location: United States
Posts: 38

Updates

Been using it the last couple months, working solid hasnt needed any adjustments or mods. Couple things i noticed. take to heavy or to fast fo a cut and the router bit can work its way down deeper into the piece. Collet seems to slip. 12-18ipm still seems to be good target cutting range for safe cutting. Still need to bolt machine to wall to lock it down from a slight rock fore/aft

Made a mounting arm to hold laptop, joystick, and electronics. also added a relay to control router from cnc4pc.com

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