

TB295 – Yaskawa Sigma I and II with Centroid CNC11 based CNC controls

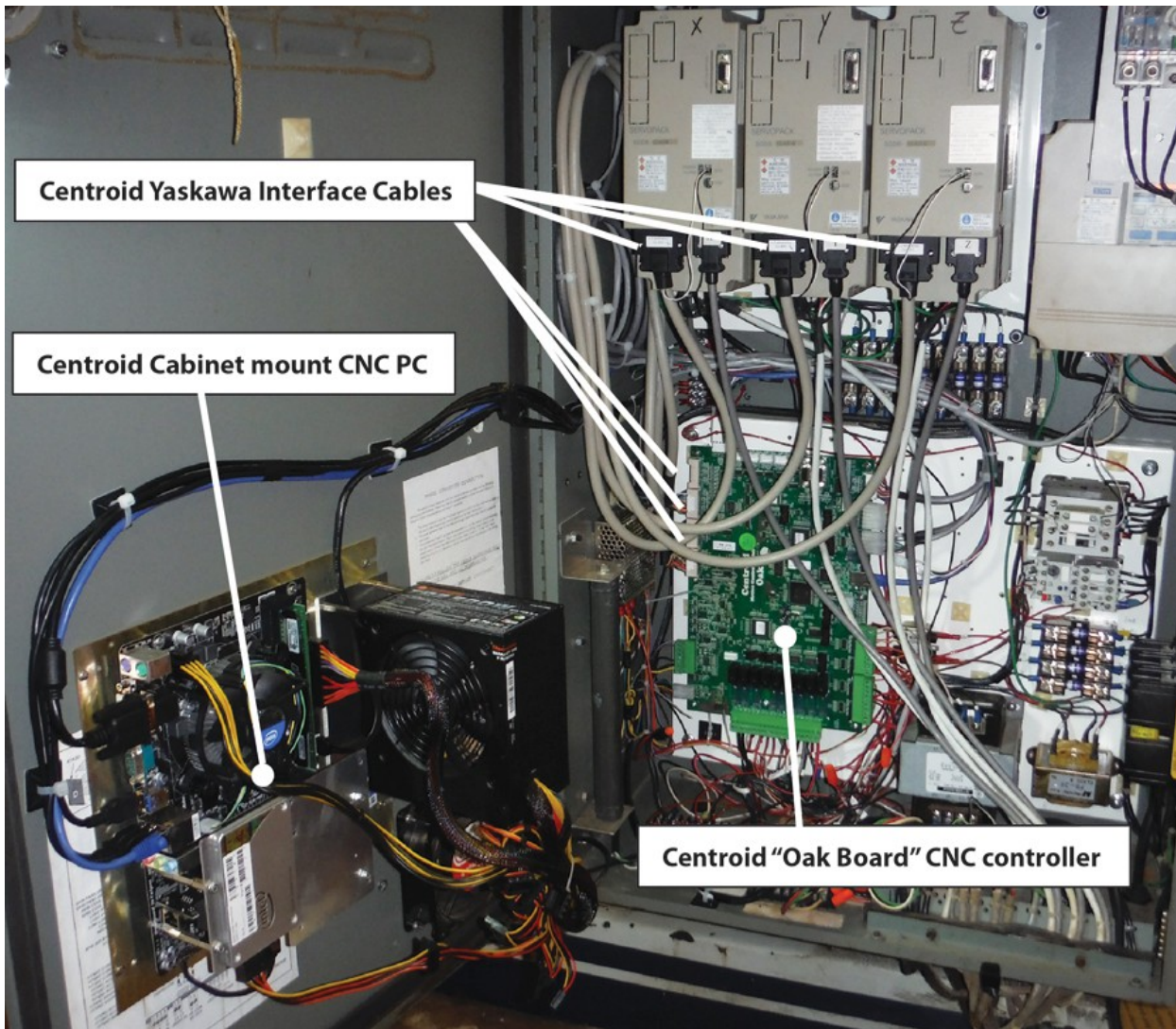
Overview: Excellent cnc machine tool motion can be achieved with the Centroid OAK CNC control board or MPU11/GPIO4/Opticdirect based systems running older Yaskawa Sigma I or Sigma II servo drives and motors. Centroid CNC11 Version 3.14+ supports Yaskawa Sigma I and II drives and motors in Position mode. With Autotuning in the Yaskawa drive and Auto delay calculation in CNC11 this configuration yields excellent results while being simple to setup and get running well in a short period of time. Running the Yaskawas in position mode as described in this Tech Bulletin is highly recommended over velocity mode setup. (if you have Yaskawa [Sigma V drives](#), please refer to [TB267](#))

CNC11 with Sigma I and II Setup Procedure

- 1.) Connect to Yaskawa drive using SigmaWin software and a serial cable with USB to serial adapter.
- 2.) Program the Drive parameters for Position Mode.
- 3.) Configure CNC11 parameters for Yaskawa Sigma I or II position mode.
- 4.) Use Yaskawa Autotune to tune the axes.
- 5.) Set Timing Delay using Centroid Autotune.

Wire system according to the [Oak or MPU11/GPIO4 system yaskawa schematics](#).

Here is a photo of an Oak board installed in a 15 year old control cabinet with Yaskawa Sigma I drives. Ready to for the drives and CNC11 to be configured. The Centroid Yaskawa cable, (Centroid part number #13134 works with Sigma,I,II,V drives) directly connects the Oak board to the Yaskawa Servo drives with two way digital drive communication with encoder feed back and drive load output (load meters). No extra encoder cables going back to the cnc cpu are necessary.



Items needed for the steps in this Tech Bulletin are: Laptop running SigmaWin+ software, Serial Cable and USB to serial converter, USB stick, Centroid system schematic, Latest Centroid CNC11 software, and for Sigma I only, a Yaskawa JUSP-OP02A1-E programming/operator module

1.) Connect to Yaskawa drive using SigmaWin software and a serial cable with USB to serial adapter.

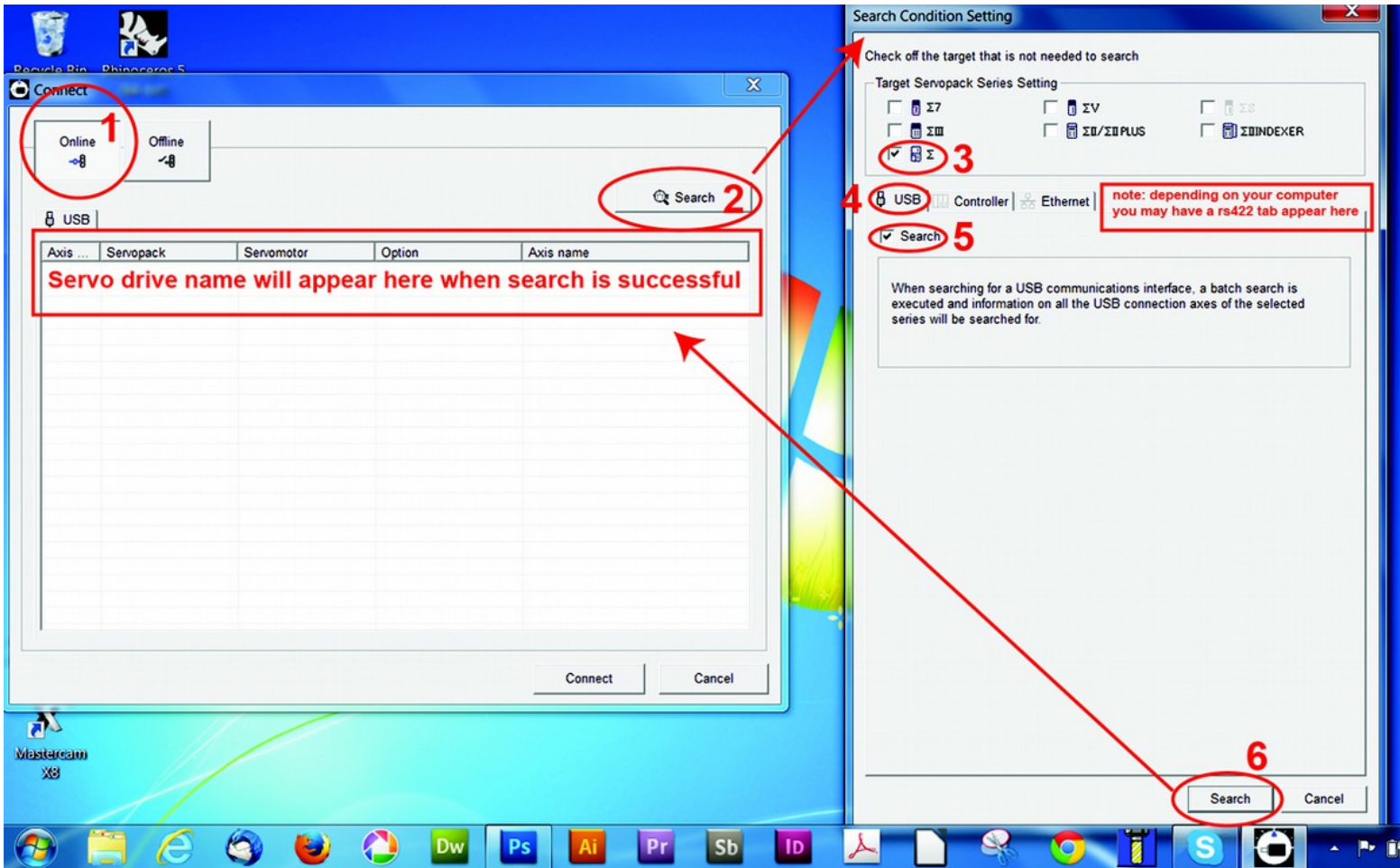
a.) Build or buy a yaskawa serial cable communication cable. Buy: Yaskawa part #YS-11(A) Build: Follow instructions in Appendix A of this Tech Bulletin to build your own cable.

b.) Buy a Serial to USB converter. We used a [Manhattan USB to Serial Converter](#) with success. Many other brands are available, reports have come in that some other brands work and some do not.

c.) Install [Yaskawa SigmaWinplus 5.70A](#) (which was the latest version as of this writing) on your laptop.

d.) Connect cable to Yaskawa and PC with drive power on and Estop depressed.

e.) Connect to the servo drive thru the SigmaWin software, make sure the “online tab” is selected and click on the “search” box, select the drive type you are connected to and the USB tab and the little Search box is checked and then click on Search at the bottom of the window.



f.) If the search was successful, the servo drive name will appear, highlight it and click the “Connect” Box. If the servo drive does not appear, you may have to try a different tab in step #4 in figure 2 above. Sometimes depending on your computer even though you are connected thru a USB port a Tab will appear in the SigmaWin software labeled RS232 or RS422, select this new tab and run the search again.

g.) Once connected it is advisable to make a backup of the servo drives existing parameters. Click "Parameters(U)" and select "Edit Parameters" from the drop down menu. Click on the Floppy disk icon and save the .USR file to your laptop. (.USR file is the extension given to the yaskawa servo drive parameter backup file) Note: Give the .USR file a name that indicates that it is the initial/original backup of that particular drive and axis.

1

Parameters(U) Alarm(A) Monitor(M) Trace & Tuning(T) Test Run(R) Help(H)

and select "edit parameters" from drop down menu

2

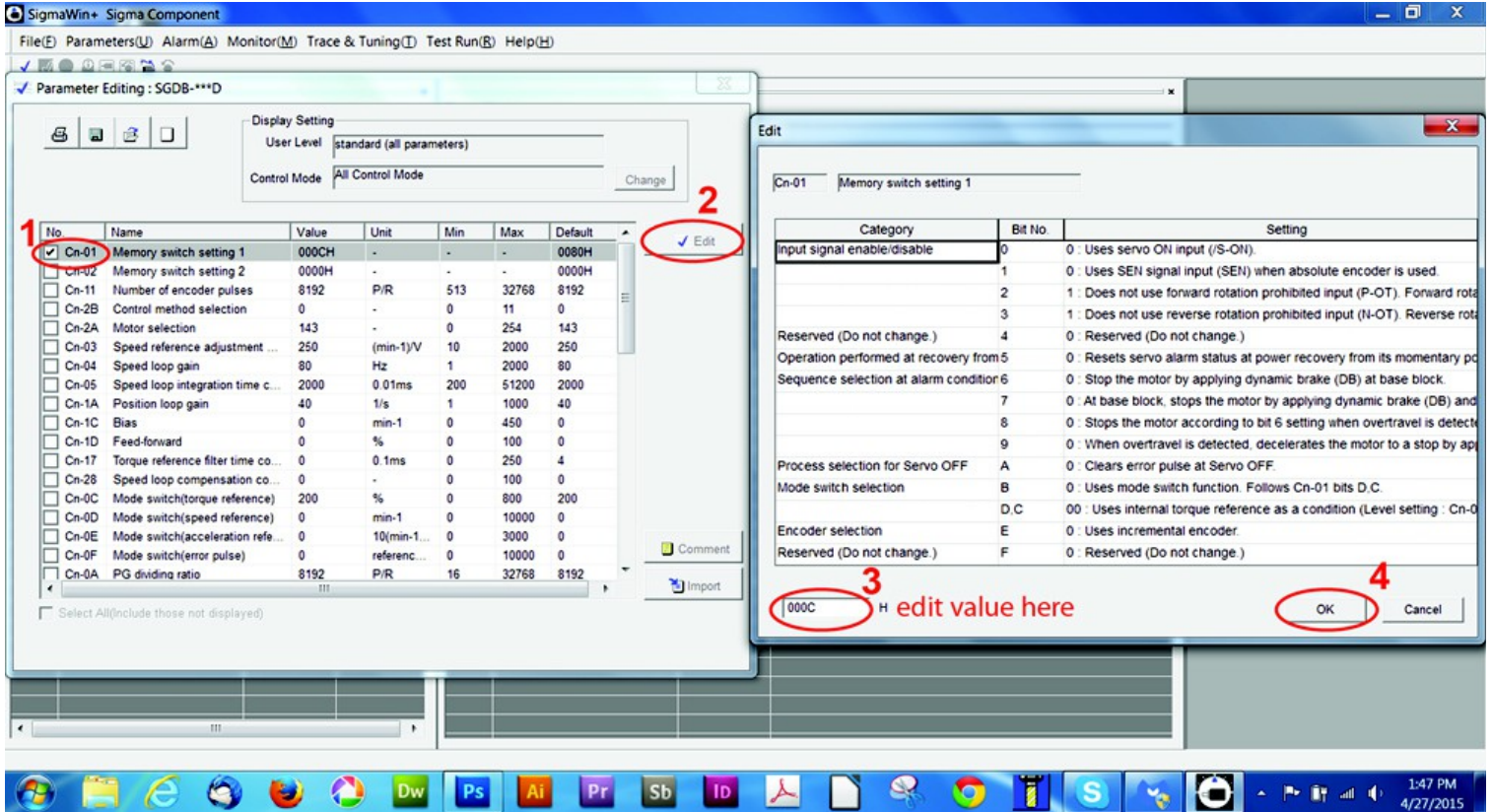
save .USR file to laptop

No.	Name	Value	Unit	Min	Max	Default	
<input type="checkbox"/>	Cn-01	Memory switch setting 1	0100H	-	-	0080H	
<input type="checkbox"/>	Cn-02	Memory switch setting 2	0000H	-	-	0000H	
<input type="checkbox"/>	Cn-11	Number of encoder pulses	8192	P/R	513	32768	8192
<input type="checkbox"/>	Cn-2B	Control method selection	2	-	0	11	0
<input type="checkbox"/>	Cn-2A	Motor selection	143	-	0	254	143
<input type="checkbox"/>	Cn-03	Speed reference adjustment ...	250	(min-1)/V	10	2000	250
<input type="checkbox"/>	Cn-04	Speed loop gain	80	Hz	1	2000	80
<input type="checkbox"/>	Cn-05	Speed loop integration time c...	2000	0.01ms	200	51200	2000
<input type="checkbox"/>	Cn-1A	Position loop gain	40	1/s	1	1000	40
<input type="checkbox"/>	Cn-1C	Bias	0	min-1	0	450	0
<input type="checkbox"/>	Cn-1D	Feed-forward	0	%	0	100	0
<input type="checkbox"/>	Cn-17	Torque reference filter time co...	0	0.1ms	0	250	4
<input type="checkbox"/>	Cn-28	Speed loop compensation co...	0	-	0	100	0
<input type="checkbox"/>	Cn-0C	Mode switch(torque reference)	200	%	0	800	200
<input type="checkbox"/>	Cn-0D	Mode switch(speed reference)	0	min-1	0	10000	0
<input type="checkbox"/>	Cn-0E	Mode switch(acceleration refe...	0	10(min-1...	0	3000	0
<input type="checkbox"/>	Cn-0F	Mode switch(error pulse)	0	referenc...	0	10000	0
<input type="checkbox"/>	Cn-0A	PG dividing ratio	2048	P/R	16	32768	8192

Select All(Include those not displayed)

2.) Program the Servo Drive parameters for Position Mode.

a.) In SigWin use the "Edit Parameters" menu and check the box beside the parameter you need to edit and click the Edit box. Edit the parameter value and click OK. Do this for all parameters in the chart below.



Yaskawa Sigma I	Sigma I		Yaskawa Sigma II	Sigma II	
Param #	Change value to	Sigma I parameter description	Param #	Change value to	Sigma II parameter description
Cn-01	000C	Position Mode	Pn000	0010H	Position control
Cn-02	0020	Position Mode	Pn002	0100H	Absolute encoder as incremental
Cn-11	8192	Number of encoder pulses	Pn102	80-120	Gain, adjust by trial and error. Start with 90, machine dependent
Cn-2B	1	Control Method Selection Position Mode	Pn110	0	Autotuning 1=ON, 0=OFF
Cn-1A	50 to 70 are typical values*	Gain, adjust by trial and error. Start with 60. Value is machine dependent	Pn200	0004H	Input signal A phase B phase X4
Cn-0A	8192	PG dividing ration	Pn201	8192	PG divider (Needed if Pn207 is 16 bit)
Cn-24	1	Electronic Gear Ratio Numerator	Pn202	4	Electronic gear ratio Numerator
Cn-25	1	Electronic gear ratio Denominator	Pn203	1	Electronic gear ratio Denominator
Cn-1B	7	Positioning completion range	Pn207	0100H	17 bit output (Not on Early sigma 2)
			Pn212	8192	Divider
			Pn500	7	7 Position completed width
			Pn50A	8100H	Over travel off
			Pn50B	6548H	Over travel off
			Pn50E	3200H	Servo ready

Once editing is complete click on “Write” to write the new values to the servo drive. Once written the servo drive will need to be rebooted, power off the servo drive power, wait 30 seconds and power back up. At this point its a good idea to double check the parameter values. Using SigmaWin reconnect to the servo drive and click edit parameters and review that the proper values are being displayed.

3.) Configure CNC11 parameters for Yaskawa Sigma I or II position mode.

a.) Follow the CNC11 configuration instructions in its entirety using the Installation manual for the system you are using. [OAK board installation manual](#) or the [MPU11/GPIO4/Optic Direct manuals as usual](#). Then proceed...

b.) In CNC11 set the Encoder Counts per Rev to 32768.
([Review TB267](#) on the limits of encoder count maximums for MPU11 based systems)

c.) In CNC11 Set PID values as follows

Kp	Ki	Kd	Limit	Kg	Kv1	Ka	Accel
0	0	0	2560000	0	0	0	.375

c.) Set parameter 256 = 2 which enables Precision/Position Mode

d.) Release estop with machine in middle of travels, slow jog axes to test basic control of motion.

4.) Use Yaskawa Autotune to tune the axes.

Sigma I: Follow Sigma I Autotune procedure found in the [Yaskawa Sigma I users manual](#). A plug in programming module is required to Autotune a Sigma I drive. We have successfully used the Yaskawa JUSP-OP02A1-E (also known as a DAPSX3000) operator module to Autotune Sigma I drives. These are available new and used (ebay). Unlike other yaskawa drives you can not use the SigmaWin+ software to Autotune a Sigma I, the plug-in module JUSP-OP02A1-E is required for this step.

a.) Using a JUSP-OP02A1-E follow the Sigma I User's Manual section 4.2.3 and Autotune the drive.

b.) Move the machine at all the speeds and listen for noise or bad characteristics. Adjust GAIN (CN-1a) as necessary to achieve smooth sounding nice action motion and then re-Autotune once you have the gain set for satisfactory motion.

Sigma II: Follow [Yaskawa Sigma II User's Manual](#) and follow the Autotune instructions in Chapter 6 starting on page 24. You can use SigmaWin+ software to Auotune a Sigma II drive.

a.) Start the tuning process by setting the Moment of Inertia using the instructions for the Sigma I drives above.

b.) Once the Moment of Inertia has been determined use the Yaskawa Sigma II User's Manual Section 6.3. Adjust the “Rigidity” setting (Fn0001) using the keypad on the drive face. A good starting point is to set Fn0001 to 6 for a mill.

c.) Set the Autotuning Parameter Pn110 to 1 (1= Autotune ON). Move (with CNC11) the axis at rapids, typical cutting feedrates and at slow speeds to see how it responds if the axis is noisy or sluggish use Fn0001 to adjust the rigidity.

d.) After the drive is tuned set Parameter Pn110 to 0. (Pn110=0 Autotune OFF, Pn110=1 Autotune ON)

5.) Measure and Set Timing Delay Parameter Automatically with Centroid's Autotune.

Position each axis in middle of travel and run “Autotune” in the Centroid PID menu. Centroid's Autotune will automatically calculate and set the delay timing parameter for that axis. Perform the Centroid Autotune procedure on each axis, one axis at a time.

Typically Timing Delays are: Sigma I 10 – 20 milliseconds and Sigma II 5-10 milliseconds. If the Delay times are longer than these typical values then the gain is set too low, increase gain, check for good axis motion at various speeds, reautotune on servo drive and then reset the Delay Timing using the Centroid Autotune. (Note: Each time you adjust the Gain settings in the Yaskawa drive or Run Autotune in the Yaskawa, be sure to re-autotune on the Centroid side to calculate a new Timing Delay.)

f.) Once satisfied with the motion, backup good the good .USR files for each drive. Backup CNC11 parameters by making a “report” file. Email the files to support@centroidcnc.com and they will be filed with the Centroid cnc system folder for safe keeping and future reference.

Notes:

1.) Useful links

- [Oak board Installation Manual](#)

- [Yaskawa Sigma II User's Manual](#)

- [Yaskawa Sigma I User's Manual](#)

- [MPU11/GPIO4D with Opticdirect and Yaskawa User's manual](#)

- [Latest Schematics, Oak Sigma I and II, MPU11/GPIO4D/OpticDirect Sigma I and II](#)

- [Latest CNC11 Software download](#)

- [Yaskawa SigmaWinplus 5.70A download](#)

- [TB267 Yaskawa Sigma 5 setup with CNC11](#) (for reference, First and Last page applies to Sigma I and II as well)

- [Manhattan USB to Serial Converter](#)

- Example Position Mode Yaskawa “.USR” files. [Download this Zip file which contains both a sigma I and sigma II working Position Mode .USR files for your reference.](#)

Note: These can be opened in SigmaWin+ in the Offline Mode and reviewed without being connected to a servo drive.

2.) The Yaskawa JUSP-OP02A1-E programming/operator module required for Autotuning a Sigma I drive can be purchased new from Yaskawa for around \$220 and on ebay used for around \$75-\$100. It plugs into the same 3CN connector on the drive as the serial cable.



3.) DRO Flicker and Load Meter Bounce control. Sometimes on a light load axis (like a Z axis on a knee mill) the DRO and Load Meters will flicker or bounce around since there is not a lot of mechanical damping on that axis and the servo motor is hunting around trying to hold .0001". With CNC11 Version 3.14+ the Load Meters and DRO Flicker can be dampened in the CNC11 software with Parameters 137 (load meter) and 138 (DRO). Typical value for P137 is 2 or 4, Typical value for P138 2 or 4. (Leave both set to 0 for an axis that is not flickering)

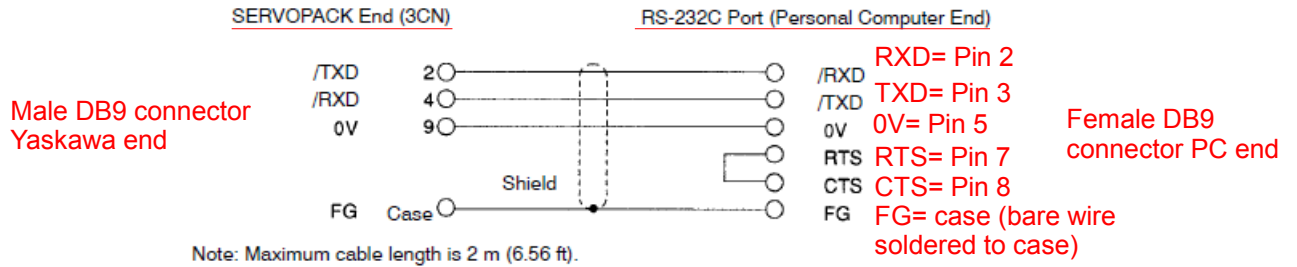
4.) Load Meters. CNC11 Load meters receive a low voltage signal feedback from the 5CN connector on the Yaskawa servo drive. The Centroid Yaskawa interface cable has a small two wire connector pig tail that comes off the Servo drive end of the Cable. Simply plug this small 4 lug (two wire) connector into the 5CN connector on the Yaskawa (see image below) and configure CNC11 for Load Meter display. Set Parameter # 143 to 1 (Load meters ON) or 3 (Load meters ON with outline) or 11 for all on with mini DRO. See [Centroid Operator Manual for details page 14-31](#)



Yaskawa Sigma I or II RS 232 to USB serial cable

Build your own Yaskawa serial communication cable.

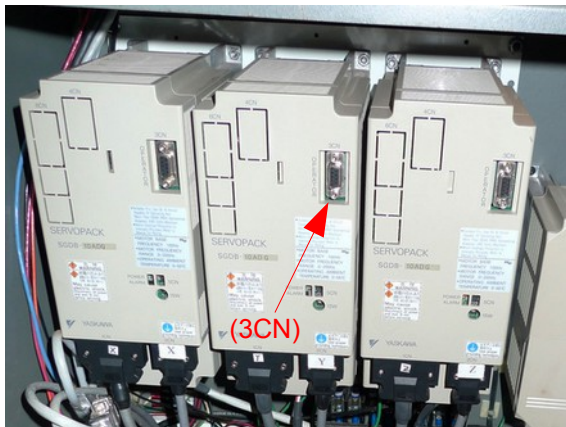
Serial Cable pin out connections from the [Yaskawa Sigma I manual](#)



Male DB9 connector Yaskawa end (3CN)



Female DB9 connector PC end



Rs 232 to [USB adapter](#)



USB port on a PC running [Yaskawa SigmaWinPlus 5.70a Software](#) (which is the latest version at the time of this writing)



Notes:

- We used a [Manhattan USB to Serial converter](#) with success. Many other brands are available, reports have come in that some others work and some do not.
- We used 22 awg shielded cable from west penn wire.
- We tested our cable and sigmawin software connection before going out to the job site with a spare sigma 1 drive on the bench. You can connect single 220 vac phase power to the sigma one and it will boot up and communicate thru the 3CN connection without a motor connected (or anything else).
- Rather than build your own, you can purchase the serial cable from Yaskawa part #YS-11(A)