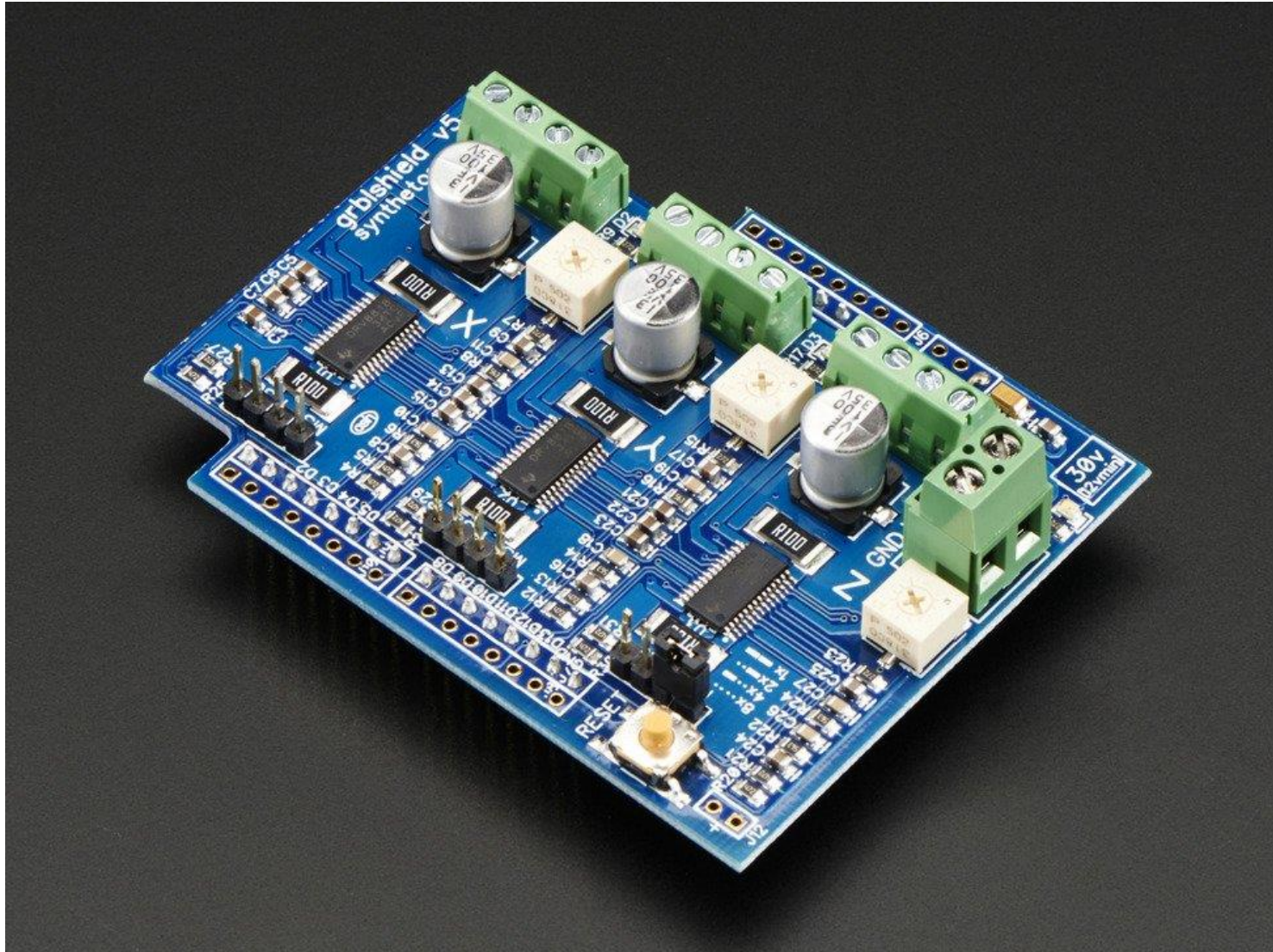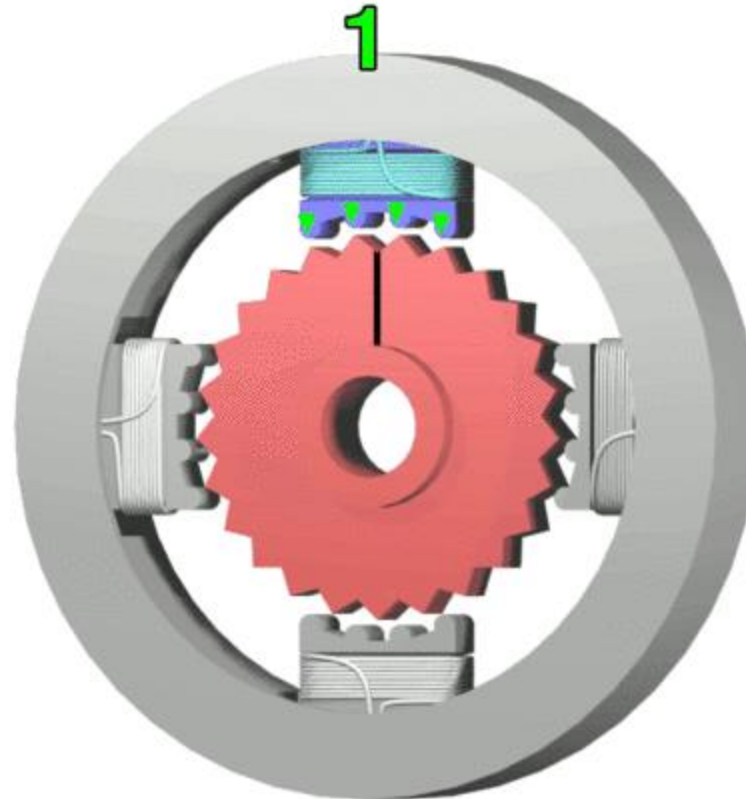# Inventables CNC Machine

M. Neilsen

Synthetos gShield + Arduino with grbl
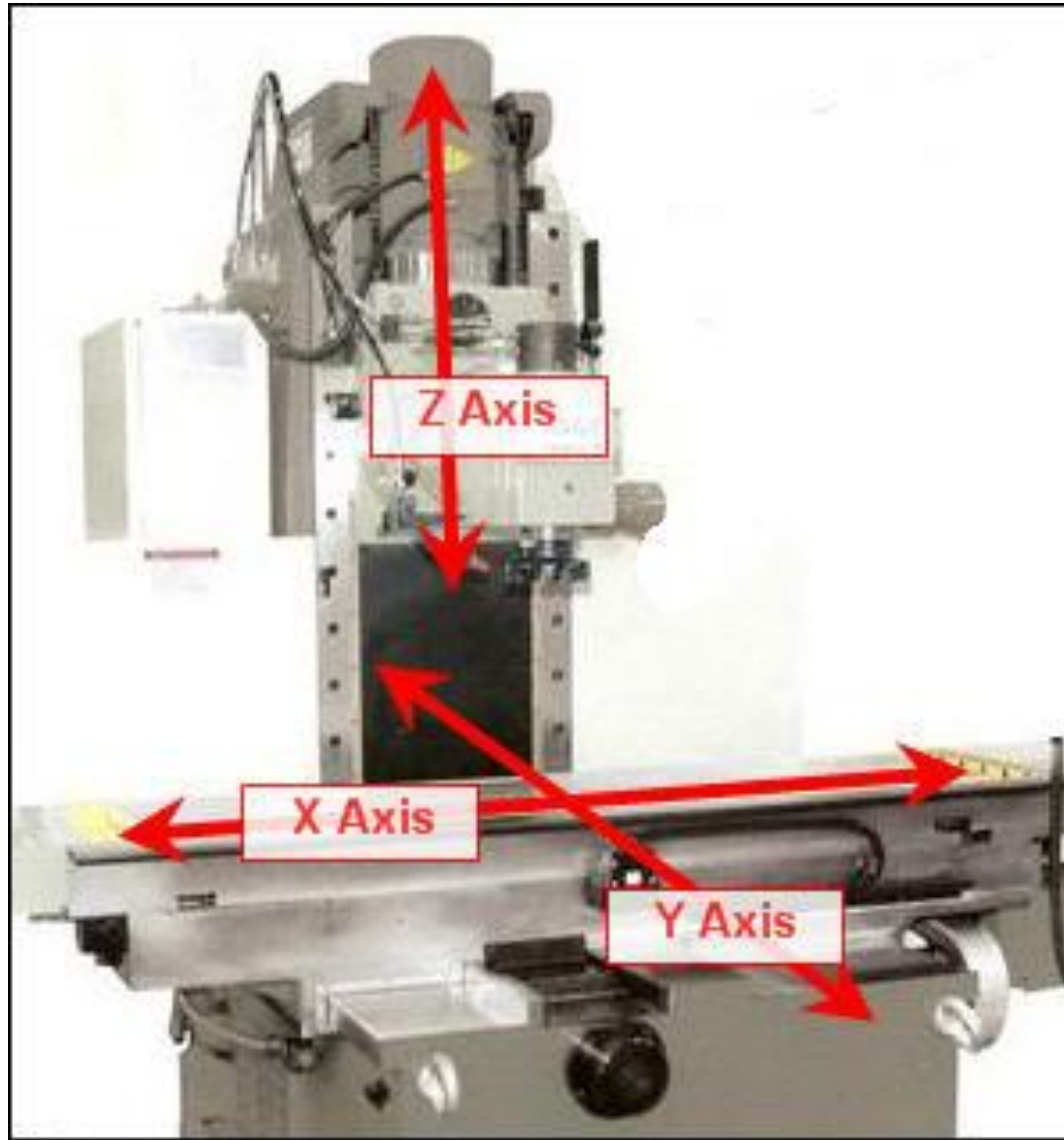
Stepper Motors

Four Phase Unipolar Stepper:
https://learn.adafruit.com/all-about-stepper-motors
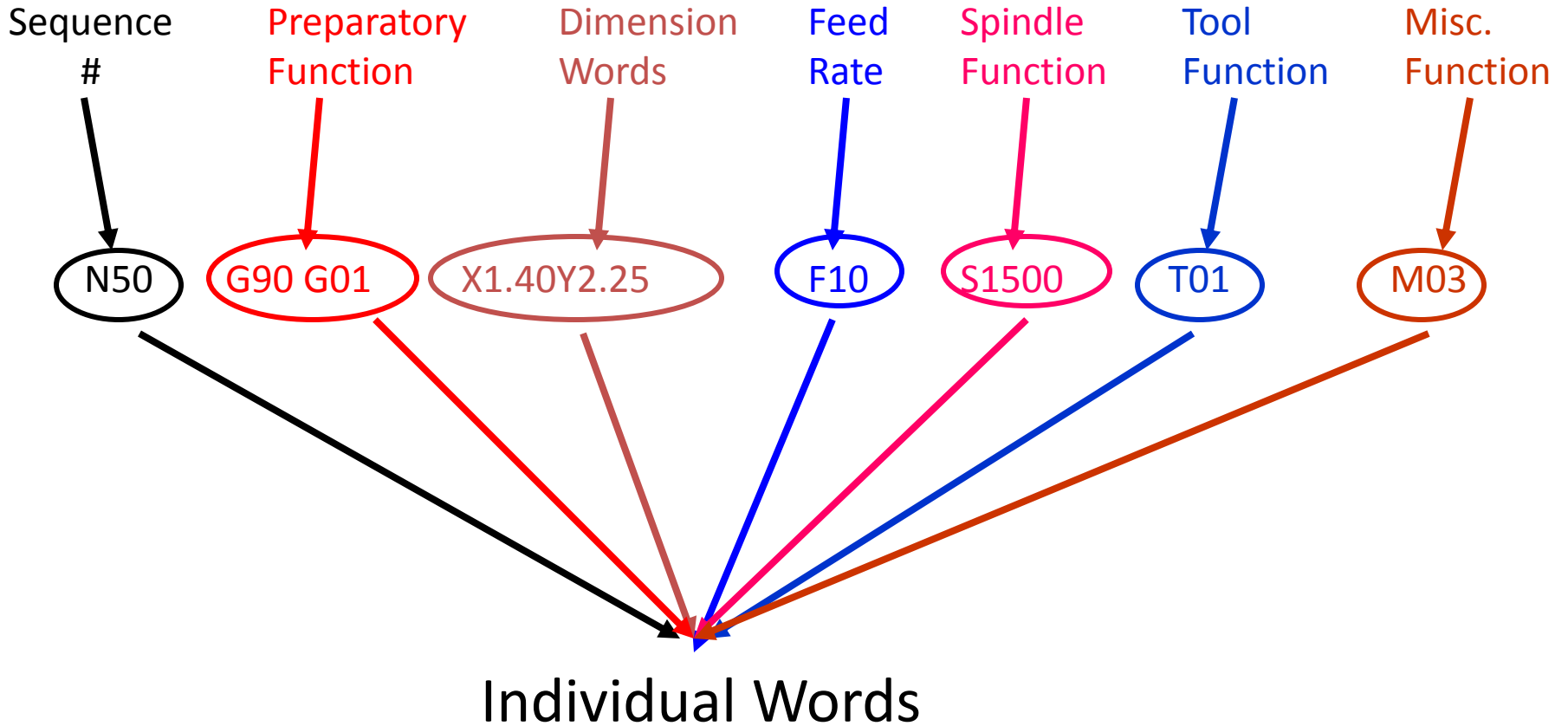
3-Axis CNC Machine

Terminology

- NC – Numerical Control
- **CNC – Computer Numerical Control**
- CAD – Computer Aided Design
- CAM – Computer Aided Manufacturing

G - Code Programming

- **G – Code Programming**
- Originally called the "word address" programming format

- Processed **sequentially**, **one line** at a time

Common Format of a Block

Sequence #

Preparatory Function

Dimension Words

Feed Rate

Spindle Function

Tool Function

Misc. Function

N50

G90 G01

X1.40Y2.25

F10

S1500

T01

M03

Individual Words

G Word

- **G words or codes** tell the machine to perform certain functions.

- Most G words are modal which means they remain in effect until replaced by another modal G code.

Common G Codes

- G00 – Rapid positioning mode - move along the shortest route to the programmed X,Y,Z position. Usually NOT used for cutting.

- G01 – Linear interpolation mode - move along a straight-line path at programmed rate of speed.

- G02 – Circular motion clockwise (cw)

- G03 – Circular motion counter clockwise (ccw)

Common G Codes ..

- G17 – XY plane
- G18 – XZ plane
- G19 – YZ plane
- G20 – Inch Mode
- G21 – Metric Mode
- G28 – Return to axis machine zero (go home)

Universal G-Code Sender

https://github.com/winder/Universal-G-Code-Sender
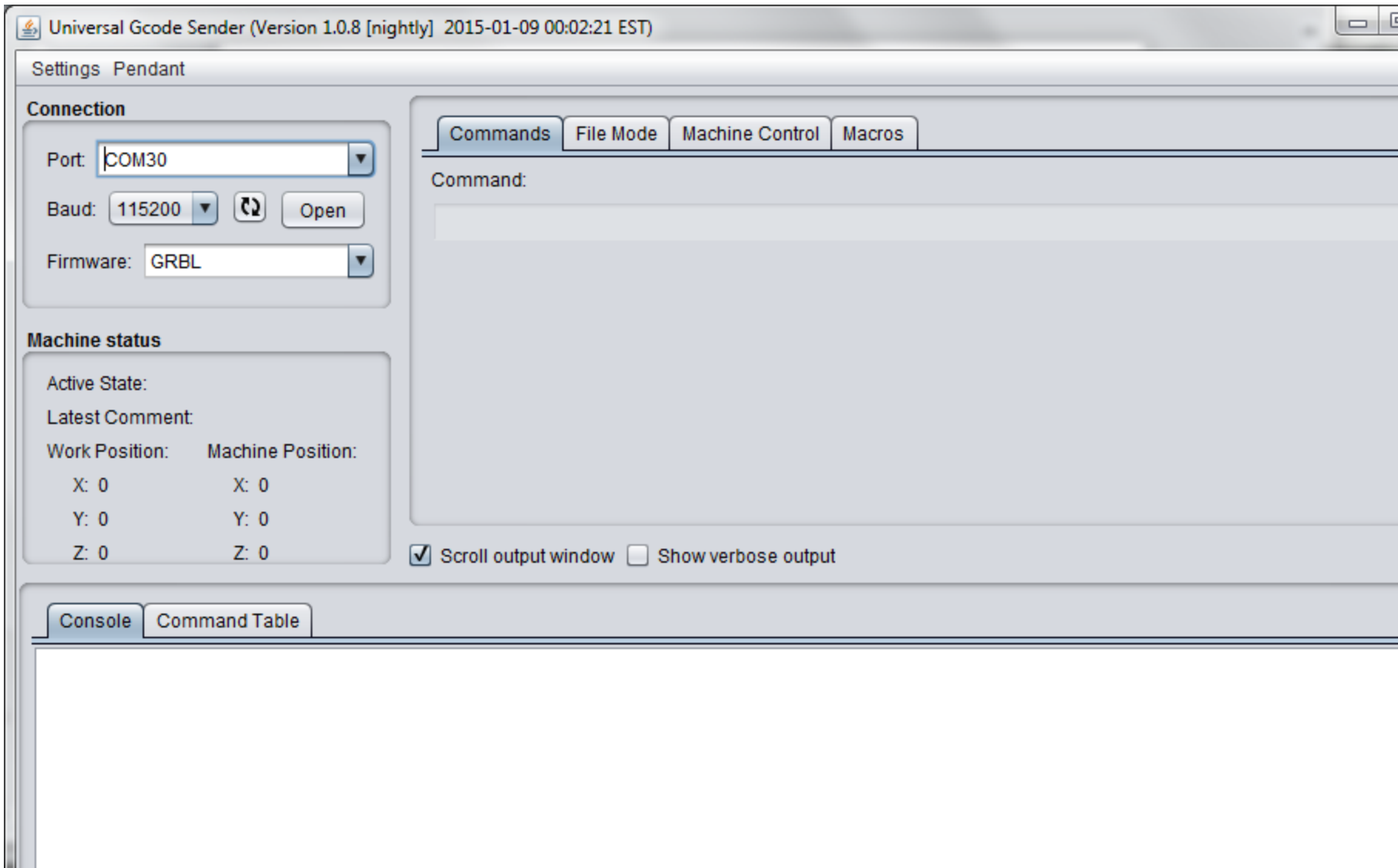
Universal GcodeSender (Version 1.0.6)

Connection

Port: /dev/tty.usbmodem621

Baud: 9600   Close

Machine status

Active State: Run

Latest Comment: Outside

Work Position:	Machine Position:
X: 7.771	X: 7.771
Y: 7.246	Y: 7.246
Z: −6.631	Z: −6.631

Commands | **File Mode** | **Machine Control**

File C/projects/OrdBot/b17049_rev_2–bot foot – 8.2 thick – 1.6 tool.nc   Browse

Send   Pause   Cancel   Visualize

☐ Override speed % 1,00

Estimated Time Remaining: 00:01:25

Duration: 00:07:43

Rows In File: 766

Sent Rows: 646

Remaining Rows: 117

☑ Scroll output window ☐ Show verbose output

Console | **Command Table**

Command	Sent	Done	Response
G0 Z−6.2	☑	☑	ok
G1 X0.5089 Y43.1691	☑	☑	ok
G1 F300.0 Z−7.0	☑	☑	ok
G1 F1000.0 X6.9429 Y9.9696	☑	☑	ok
G3 X7.7827 Y7.2438 I13.0571 J2.5304	☑	☑	ok
G0 Z−6.2	☑	☑	ok
G3 X9.6399 Y4.1598 I12.2173 J5.2562	☑	☐	
G1 F300.0 Z−7.0	☑	☐	
G3 F1000.0 X33.0571 Y9.9696 I10.3601 J8.3402	☑	☐	
G1 X34.5979 Y17.9201	☑	☐	

Easel (http://easel.inventables.com)