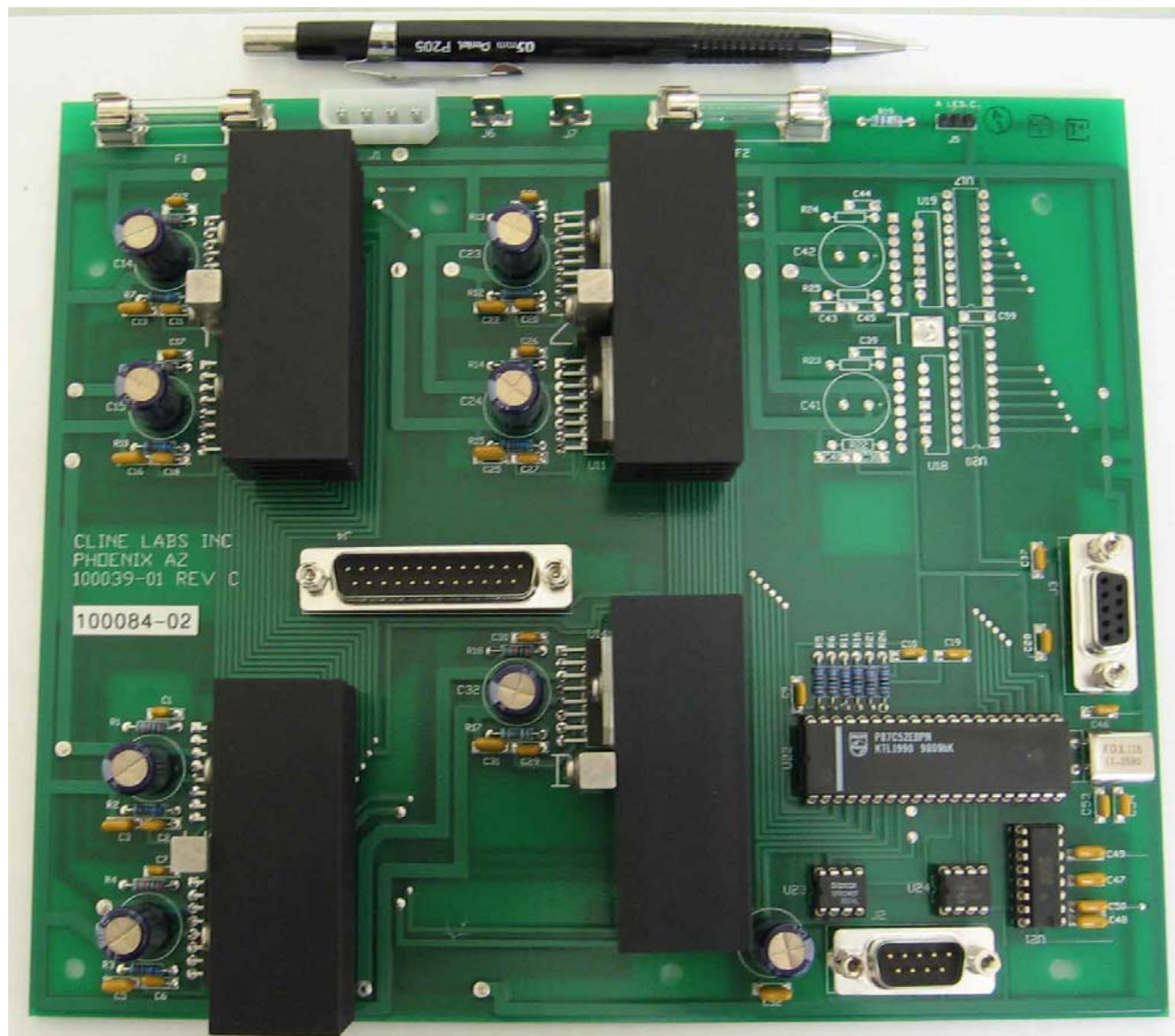




Subject: Motor Driver

Version: C

Firmware: C5308



The basic motor driver is pictured below. It has a SUB-D 9 Pin RS232, SUB-D 9 Pin from 6 home switches, SUB-D 25 Pin to three stepper motors and one dc clamp motor, 4 Pin Power connector connects with a 250Watt PC power supply having 12Vdc and 5Vdc inputs.

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Section 1 Command Overview:

The motor driver is a command oriented communication. The driver will receive characters from the RS232 communication until a ";" is received. The ";" is the command delimiter. It causes all characters sent from the last ";" to be processed as a command. The motor driver buffers a maximum of 70 command characters before it asks the host to shut up by setting the CTS line. It processes the commands and then asks the host to continue transmitting by clearing the CTS line. There are a few exceptions. A "CR" decimal 13, EOL decimal 10, and decimal 128 character are also command delimiters similar to ";". The one difference is two character commands must have a ";" to end the command or it is considered an error. Examples: PG; SP; HX; /Q; /T; etc.

Status Commands from the host computer cause the driver to send information back to the host computer via the RS232 communication. The following commands are status commands. For all fatal errors and parameter errors the status will be sent immediately and unsolicited with a <CR>.

/Q; Send operational status
/S; Send all offset data (Fixed 3 digit ASCII)
CHn; Special
ID; Send driver identification string

Configuration Commands are received from the host computer via the RS232 communication. They configure the Driver's motion commands. The following commands are configuration commands.

AF; Acceleration Off
AO; Acceleration On
LF; Linear movement Off
LO; Linear movement On
OAn; Acceleration setting
ODn; Zdown setting
OEn; Special
OLn; Velocity2 setting

ONn; Special
OPn; Zup setting
OTn; Special
OUn; Special
OVn; Velocity setting
OXn; Xoffset setting
OYn; Yoffset setting
OZn; Zoffset setting

Detail motion commands are received from the host computer via the RS232 communication. They involve single motor action. An exception is MXx,y; moves the x and y axes simultaneous to obtain linear movements in the XY plane. However the host can use the MXx,y; command to move only the x-axis or only the y-axis with the appropriate x,y values. The other exceptions are ZT; , ZX; , ZY; , and ZZ; which move the corresponding single motor on to the home switch, then off the switch, then to the offset value defined by each individual offset command. This position is defined as the machine zero. The following commands are detail motion commands.

BLn; Special
CD; Clamp Down
CU; Clamp Up
D1n; Activate Dispenser 1
D2n; Activate Dispenser 2
D3n; Activate Dispenser 3
MTn; Special
MXx,y; Move X-axis and Y-axis to position x,y from machine zero. The units of 'n' are steps. There are 800 steps per motor revolution.
MZn; Move Z-axis to position 'n' from machine zero. The units of 'n' are steps. There are 800 steps per motor revolution.
ZT; Special.
ZX; Move X-axis to machine zero.
ZY; Move Y-axis to machine zero.
ZZ; Move Z-axis to machine zero.

Complex motion commands are received from the host computer via the RS232 communication. They move more than one motor, or move one motor more than one direction, or both. The /T; must be used right

after power up to insure the motors are at the machine zero position.

/T; Move engraver to machine zero position.
HX; Special.
PDx,y; Move pen down then move to x,y position.
PG; Special.
PUx,y; Move pen up then move to x,y position.
SP; Special.
UX; Special.

Section 2 Command Definitions detailed:

Status Commands

/Q; Send operational Status. One of the following ASCII characters are sent with no EOL, CR or any other character. Once sent all non-fatal status is reset to a status of "I".

- 1 Unable to make Z home switch in 10000 steps
- 2 Unable to unmake Z home switch in 1000 steps
- 3 Special
- 4 Special
- 5 Unable to make X home switch in 40000 steps
- 6 Unable to unmake X home switch in 1000 steps
- 7 Unable to make Y home switch in 10000 steps
- 8 Unable to unmake Y home switch in 1000 steps
- 9 Write error to EEPROM
- A Unable to make clamp up switch in 195000 wait states
- B Unable to make clamp down switch in 195000 wait states
- C EEPROM check sum is incorrect
- I The machine has no errors and is ready for the next command.
- X Can not recognize the Command
- Z The driver has reset and no /T; command has been issued to clear it.

Status codes 1 thru 8, A, B, and sometimes X when parameters are not numeric are fatal. /T; must be used to reset the status to "I" for these codes.

/S; Send all offset data (3 digit ASCII). The driver reads the on board EEPROM. Each offset number is from 000 to 255. It then sends to the host via the RS232 communication a fix string of ASCII numbers as follows: (Maximum numbers Shown)

OF255255255255255255255255255255255255255<CR>

Character position 1,2 is the letters O (OH) and F.
The host should use these characters to help insure character positioning and 38 as the number of characters sent.

Character position 3,4,5 is xoffset (number of steps from home switch to machine zero for the x axis).

Character position 6,7,8 is yoffset (number of steps from home switch to machine zero for the y axis).

Character position 9,10,11 is zoffset (number of steps from home switch to machine zero for the z axis).

Character position 12,13,14 is special.

Character position 15,16,17 is velocity (number of wait states, higher the number the lower the velocity).

Character position 18,19,20 is special.

Character position 21,22,23 is special.

Character position 24,25,26 is zup (a Z axis offset in number of steps of the PU, pen up, z-up position).

Character position 27,28,29 is zdown (a Z axis offset in number of steps of the PD z engrave position).

Character position 30,31,32 is special.

Character position 33,34,35 is velocity2 (starting or slowest velocity in wait states).

Character position 36,37,38 is accel1 (acceleration how fast to change from velocity2 to velocity in wait states, higher number slower change).

CHn; Special.

ID; Send driver identification string. The driver sends its release number, for example C5308<CR>.

Configuration Commands

AF; Acceleration Off. From this point on all x,y moves will only move at one velocity and will not accelerate or decelerate.

AO; Acceleration On. From this point on all x,y moves will use acceleration and deceleration.

LF; Linear movement Off. From this point on Both x and y axes move at 45 degree until one axis is solved then straight axis motion. This is the quietest motion since there is no beat frequency between axes. The driver defaults to this configuration during PU commands and then returns to the previous LF; or LO; configuration after the command is finished.

LO; Linear movement On. From this point on all x,y movements will be Linear point to point motion. The driver defaults to this configuration during PD commands and then returns to the previous LF; or LO; configuration after the command is finished.

OAn; Acceleration setting. n is any number from 1 to 255. It is placed into a variable called accell. (acceleration how fast to change from velocity2 to velocity in wait states, higher number slower change).

ODn; Zdown setting. n is any number from 1 to 255. It is placed into a variable called zdown. (a Z axis offset in number of steps of the PD, pen down, z engrave position).

OEn; Special. n is any number from 1 to 255. It is placed into a special variable.

OLn; Velocity2 setting. n is any number from 1 to 255. It is placed into a variable called velocity2. (starting or slowest velocity in wait states).

ONn; Special. n is any number from 1 to 255. It is placed into a special variable.

OPn; Zup setting. n is any number from 1 to 255. It is placed into a variable called zup. (a Z axis offset in number of steps of the PU, pen up, z-up position).

OTn; Special. n is any number from 1 to 255. It is placed into a special variable.

OUn; Special. n is any number from 1 to 255. It is placed into a special variable.

OVn; Velocity setting. n is any number from 1 to 255. It is placed into a variable called velocity. (number of wait states, higher the number the lower the velocity).

OXn; Xoffset setting. n is any number from 1 to 255. It is placed into a variable called xoffset. (number of steps from home switch to machine zero for the x axis).

OYn; Yoffset setting. n is any number from 1 to 255. It is placed into a variable called yoffset. (number of steps from home switch to machine zero for the y axis).

OZn; Zoffset setting. n is any number from 1 to 255. It is placed into a variable called zoffset. (number of steps from home switch to machine zero for the z axis).

Detail motion commands

BLn; Special.

CD; Clamp Down. Turn clamp motor until clamp down switch is made.

CU; Clamp Up. Turn clamp motor until clamp up switch is made.

D1n; Activate Dispenser 1 (right dispenser). Issue a dispense signal to the 1st dispenser, where "n" a numeric number from 0 to 9 and indicates the duration of the signal (approximately seconds).

D2n; Activate Dispenser 2 (left dispenser). Issue a dispense signal to the 2nd dispenser, where "n"

a numeric number from 0 to 9 and indicates the duration of the signal (approximately seconds).

D3n; Activate Dispenser 3 (3rd dispenser). Issue a dispense signal to the 3rd dispenser, where "n" a numeric number from 0 to 9 and indicates the duration of the signal (approximately seconds).

MTn; Special.

MXx,y; Move X-axis and Y-axis to position x,y from machine zero. The units of 'n' are steps. There are 800 steps per motor revolution. x and y must be numeric from 0 to 65535.

MZn; Move Z-axis to position 'n' from machine zero. The units of 'n' are steps. There are 800 steps per motor revolution. 'n' must be numeric from 0 to 65535.

ZT; Special.

ZX; Move X-axis to machine zero. The actual movements are. Move the X-axis on to the X-axis home switch, then off of home switch, then move XOFFSET of steps to machine zero. The speed of stepping is set to velocity2.

ZY; Move Y-axis to machine zero. The actual movements are. Move the Y-axis on to the Y-axis home switch, then off of home switch, then move YOFFSET of steps to machine zero. The speed of stepping is set to velocity2.

ZZ; Move Z-axis to machine zero. The actual movements are. Move the Z-axis on to the Z-axis home switch, then off of home switch, then move ZOFFSET of steps to machine zero.

Complex motion commands

It is not necessary to use them unless wanted. Each command has appropriate velocities, accelerations,

and offsets that should be set as necessary. A move to machine zero includes the switches. A move to zero does not. The HX; SP; and UX; commands do not move the x-axis, therefore the motion is performed where the machine is currently positioned on the x-axis.

/T; Move engraver to machine zero position.
Movements:
Move the z-axis, y-axis, then the x-axis.
The movement for each axis is on to the home switch, Then off of the home switch, then an additional offset specified by the appropriate offset command. This command will reset fatal errors to the "I" state. If status is not reset then the error has reoccurred.

HX; Special.

PDx,y; Move pen down then move to x,y position.
Acceleration and linearity is turned on.
The x and y values are 1000 for one motor revolution.

PG; Special.

PUx,y; Move pen up then move to x,y position.
Acceleration and linearity is turned off.
The x and y values are 1000 for one motor revolution.

SP; Special.

UX; Special.

Section 3 Definition of Terms:

For this document only:

CTS line: Clear to Send pin on the RS232 communication between devices.

Driver: The term driver is the Printed circuit card assembly that has the controller and stepper motor driver circuit together.

Home: The position of an axis when a made home switch just barely un-makes. Also called logical home not machine zero.

Host Computer: The term host computer sends the driver commands over the RS232 connection.

Logical Home: The position of an axis when a made home switch just barely un-makes. Also called Home.

Machine Zero: The position after the axis has gone home and has moved a number of offset steps.

Motor driver: The term driver and motor driver are the same.

Physical Home: the position of an axis when the home switch is just made. This is normally never used in a motion system (See Home or Logical Home).

Pen: The term pen and cutter are the same.

RTS line: Request to Send pin on the RS232 communication between devices.

Syntax: The valid format of commands and what characters are valid.

X-axis: The axis of the head that travels from the left of the machine to the right of the machine, when standing in front of the machine. Right is the positive direction. This can be redefined by the user.

Y-axis: The axis of the head that travels from the back of the machine to the front of the machine, when standing in front of the machine. Front is the positive direction. This can be redefined by the user.

Z-axis: The axis of the head that moves the cutter up and down. Down is the positive direction. This can be redefined by the user.

Zero: The position that has already been established with a /T; or PG; command. This position is moved to without using the home switches.

Section 4 Commonly asked questions:

1. What causes the motor driver to process a command? The ";" is the command delimiter. It causes all characters sent from the last delimiter to be processed as a command. A "CR" decimal 13, EOL decimal 10, and decimal 128 character are also command delimiters and perform similar to ";". The one difference is two character commands and dispenser commands must have a ";" to end the command or it is considered an error. Examples: PG; SP; HX; /Q; /T; D23; etc.

2. What is the difference between PG; and /T; commands? PG; returns to zero then machine zero. /T returns to machine zero and resets fatal errors.

3. Can the motor driver have more complex commands? Yes but these commands are normally handled by the host computer. To incorporate complex commands at the motor driver may require a PROM change in the future if any motion changed inside the complex command. It is not the intent to have the motor driver any smarter than is necessary to move the motors it drives.

4. When does the motor driver need to be configured? The motor driver has a nonvolatile EEPROM. This means that even when power is removed the configuration of the offsets remain with the driver. Therefore it is only necessary to configure the driver once in its lifetime unless for some reason one of these values needs to change. However, you may want to verify these values with a storage device on the host computer at power up or even between engraves. The acceleration and linear movement configurations are defaulted to off on power up.

5. How is velocity, velocity2, and acceleration used? You should adjust these parameters to optimize the mechanical noise of the system. When acceleration is turned on, the step velocity starts at velocity2 accelerates to a maximum velocity then decelerates back to velocity2 at the end of the

move. Velocity is used when acceleration is turned off. Note, PU and PD commands control whether acceleration and linearity is on or off and does not use the configuration commands.

Section 5 Important Items to understand:

1. Syntax: Some commands have parameters. If the parameters are present they must be numeric parameters. If the parameters and comma are not present then there is no change for those parameters. For example PU; would move the pen up and no x or y movement. The PUX,y; PDx,y; MXx,y; commands must have a "," to separate the two numeric parameters. If the comma is present and x or y is missing ten zero is assumed for the missing parameter. The D1n; thru D3n; commands must have a one character parameter and be from 0 to 9 and delimited with a ";". Commands without parameters must have a ";" as the delimiter. There is no white space permitted.

2. Motor driver error handling will stop motor movements when fatal errors occur. Status 1 thru 8, A, B, and sometimes X when parameters are not numeric are fatal errors. All new commands will be ignored except for /T; /Q; and /S;. It will require a /T; to reset the error to the "I" state. For all other errors the driver will not process the current command but it will process all new commands. The Status will be "X" if a syntax error has occurred. A /T; or /Q; will reset non-fatal errors to the "I" state.

3. For all fatal errors and parameter errors the status will be sent immediately and unsolicited with a <CR>.