TNC–G13 Three Axis Motion Controller

THIS MANUAL CONTAINS INFORMATION FOR INSTALLING AND OPERATING THE FOLLOWING PRODUCT:

● TNC-G13 Three Axis General Purpose Motion Controller

GENERAL DESCRIPTION

The Three Axes Motion Controller (G13) is a powerful and versatile step pulse generator capable of generating step pulse and direction signal output for stepper drives. It is a standalone motion controller that accepts standard G/M codes for programming along with custom codes for specific functions.

It can drive 3 motors with low jitter pulse train of frequency up to 200 KHz for each axis simultaneously. The pulse train is smooth with linear ramps, preventing the motor stalling at high speeds. Programs are loaded through in USB drive port provided at the front of controller for easy access.

All motor outputs are differential and all inputs are opto-isolated.

PHYSICAL AND ELECTRICAL CHARACTERISTICS

Contents	Specifications
Processor	32 bit processor
Ports	USB Pen Drive Port
Axes	Three
Max Frequency of Step signal	200 KHz
Open collector outputs	4
Opto Isolated Inputs	6
Supply voltage	220Vac
Max Power Consumption	5 W
Ambient temperature range	0˚-55˚ Celsius
Relative Humidity	< 90% (without condensation)
Dimensions LxHxD mm	164x102x75 (in mm)
Dimensions LxH mm	154x92 (in mm)
Weight	200g

FEATURES:

- Supply Voltage:90V to 250V AC 50Hz/60Hz.
- Max 200Khz pulse on each axis.
- Overall Size: 165mm x 102mm x 76mm.
- Mounting: Panel Mount: 155mm x 92mm.
- MAX G-code File Size 100KB.
- 3 Axes Differential Step Pulse and Direction Pulse OUTPUTs.
- 6 Isolated INPUTs.
- 4 Open Collector OUTPUTs (Can be used for connecting 24v relays).
- Linear Interpolation Only.
- Jogging with Inbuilt Keypad(Step, Continuous and Fast Mode).
- Feed Hold(Pause), Cycle Start and Cycle Stop(Abort).
- BLOCK Execution & BLOCK Repeat mode can be control by external input.
- Common INPUT for Home and Limit for all three axis.
- Custom M code for input and output control (M62 and M66).
- Custom M code for block repeat(M98 and M99).
- G-code check option(Dry Run) and Program limit check.
- Diagnosis option in menu for INPUTs and OUTPUTs manual testing .
- Dedicated Emergency Input pin for external emergency switch.

INPUTS ASSIGNMENT

IN6   //Emergency   (High Speed)
IN5   //BLOCK MODE /GENERAL PURPOSE   (High Speed)
IN4   //START / STOP
IN3   //LIMIT /GENERAL PURPOSE
IN2   //HOME /GENERAL PURPOSE
IN1   // GENERAL PURPOSE

OUTPUTS :

Mini CNC has differential 5V output signal for 3-Axes Named X, Y and Z respectively. These Outputs can be Enabled or Disabled by Drive : Enable/Disable parameter in Axis Settings whichever is not required in operation.

General Purpose OC outputs (OUT1 to OUT4):

Out1 to Out 4 can be made ON of OFF from G-code file. These are open collector 24v outputs.

M62 Pn	*//ACTUATE_PIN n*	*(where n is pin number= 1, 2,3,4)*
M63 Pn	*//DEACTUATE_PIN n*	*(where n is pin number= 1, 2,3,4)*

CONNECTING INPUTS:

Emergency INPUT(IN6):

External switch is connected to this pin for instantly stopping the machine from continuous work if a large problem arises. When this switch is pressed, the motion stops however it does not cut down the power supply to CNC controller. On pressing the button, the machine instantly stops since all thesignal from the controller board get disabled.

START / PAUSE(IN5):

An external input is given to IN5 pin to start the g-code program for Execution and Hold. G-code program will only execute if G-code file is selected.

LIMIT INPUT(IN4):

CNC machine can or can't have limit switch. However, usually each axis of CNC machine have two limit switches, one mounted in +ve direction and other in –ve direction of axis. limit input terminal shares the inputs from all switches of axes. The limit switch canbe set disabled if not required in limit settings function of IO Settings. Disable the limit switch function in Limit settings menu for the axes which don't have the limit switch.

BLOCK MODE INPUT(IN3):

An external input is given to the block mode input pin of the control board to execute the one line of G-code. In this mode, the motion stops at the execution of one programmed line and executes the next line on the trigger of an external input on this pin.
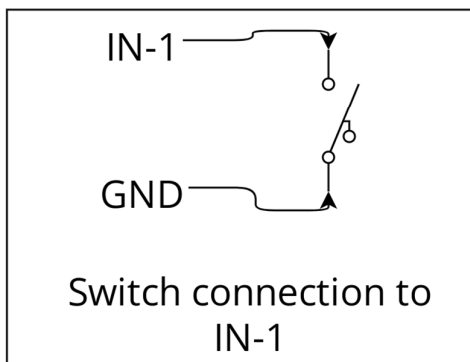
HOME INPUT(IN2):

Homing inputs are input to "IN-2" terminals of CNC controller board from home switches of CNC machine of all axes. This input canbe set as active high or active low. Usually all the axes of CNC machine consists the Home switch. Disable the home switch function in Home Switch Settings menu for the axes which don't have Home switch or for the axes for which home switches aren't required.

G-code WAIT INPUT(IN1):
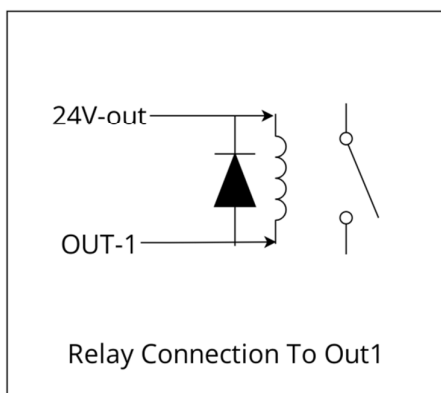
This is dedicated general purpose input button which can be use in G-code with M66 command.

INPUT TERMINAL:

IN-1

GND

Switch connection to
IN-1

OUTPUT TERMINAL:

24V-out

OUT-1

Relay Connection To Out1

X, Y Z AXEX TERMINAL:

OPERATING THE CNC CONTROLLER

JOG MODE:

KEY	IDLE MODE	HOLD MODE	RUN MODE
1	X-ZERO	-	-
2	Y-ZERO	-	-
3	Z-ZERO	-	-
4	GO TO ZERO	-	-
5	GO TO HOME	-	-
6	FILE START	FILE START	-
7	FILE RESTART	FILE START	-
8	-	-	HOLD
9	FILE SELECT	-	-
9 LONG PRESS	FILE CHECK	-	-
0	-	-	-
SHIFT	ACT ALT FUN	-	-
OVRIDE	OVRIDE SCR	OVRIDE SCR	OVRIDE SCR
OK	MENU	EXIT OVRIDE SCR	EXIT OVRIDE SCR
ESC	ABOUT	STOP	STOP
X+	JOG X+DIR	-	-
X-	JOG X+DIR	-	-
Y+	JOG Y+DIR	-	-
Y-	JOG Y+DIR	-	-
Z+	JOG Z+DIR	-	-
Z-	JOG Z+DIR	-	-
ALT FUNCTION MODE (SHIFT SELECTED)			
X+	JOG S/C/F	JOG S/C/F	-
X+ LONG PRESS	JOG OFFLINE	JOG OFFLINE	-
Y+	JOG FACTOR++	JOG FACTOR++	-
Y-	JOG FACTOR--	JOG FACTOR--	-

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MAIN MENU

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GENERAL SETTING
STEP PULSE
BLOCK MODE
AXIS SETTING
X-AXIS
DRIVE
STEP PIN
DIR PIN
FLIPKEY
STEPS/MM
MM/SEC
MM/SEC^2
Y-AXIS
DRIVE
STEP PIN
DIR PIN
FLIPKEY
STEPS/MM
MM/SEC
MM/SEC^2
Z-AXIS
DRIVE
STEP PIN
DIR PIN
STEPS/MM
MM/SEC
MM/SEC^2

IOSETTING
HOMING SETTING
SEEK
FEED
PULLOFF
SAFE Z
DEBAUNCE
HOME SWITCH SETTING
X-AXIS EN/HIGH/LOW/DISABLE
Y-AXIS EN/HIGH/LOW/DISABLE
Z-AXIS EN/HIGH/LOW/DISABLE
LIMIT SETTING
X-AXIS LIMIT

                                           > HARD LIMIT EN/DIS
                                           > SWITCH HIGH/LOW

Y-AXIS LIMIT

                                           > HARD LIMIT EN/DIS
                                           > SWITCH HIGH/LOW

Z-AXIS LIMIT

                                           > HARD LIMIT EN/DIS
                                           > SWITCH HIGH/LOW

INPUT SETTING
INPUT0 HIGH/LOW
INPUT1 HIGH/LOW
INPUT2 HIGH/LOW
INPUT3 HIGH/LOW
DIGNOSIS

GENERAL SETTINGS

IN the GENERAL SETTINGS sub menu STEP PULSE width and BLOCK MODE can be set.

STEP PULSE: This option adjust the width of step pulse for stepper drives of stepper motor. Step drives for all axes operate with same step pulse width. The unit for step pulse width is uS. The maximum Step pulse width is:

Step pulse width max = (4*2, 00, 000*60)/*((Steps/mm)*velocity)

Where, ((Steps/mm)*velocity) max is the product of steps/mm and velocity of an axis for which this product value is maximum in contrast to rest three axes.

BLOCK MODE : This option Enables or Disables the BLOCK MODE. In the BLOCK MODE, the motion stops at the execution of one programmed line and executes the next line on the trigger of an external input at pin "BLOCK INPUT (IN3)". In the BLOCK MODE, the control stops motion at the end of one programmed move exactly after the completing the execution of G-code line. The control begins motion at the trigger of external input and again stops after executing subsequent G-code line. The process continues until the G-code ends. The stop is preceded by deceleration so that motion is kept at the feed rate for as long as possible.

AXIS SETTINGs

AXIS SETTINGS menu functions make the user to modify settings of the axes parameters. CNC controller controls an independent mechanism of machine which produces relative linear motion of tool and work piece in three mutually orthogonal directions called X, Y and Z axes.

For AXIS SETTINGS, make changes in the parameters discussed in this section

FOR X-AXIS, Y-AXIS, Z- AXIS : The functioning of 3 linear axes depends on the following parameters. Make the following settings for all required axes, one by one. These settings are:

DRIVE: ENABLE/DISABLE: ENABLE/DISABLE is for enabling or disabling the axis drive. The drive mechanics of CNC machines convert torque provided by the electric motors into linear motion of the tool head. Step and Diroutputs are disabled for the axis whose drive has been disabled.

STEP PIN: LOW/HIGH: The STEP PIN selects the state of the step pulse given to drive of stepper motor (connected to axes). All axes have their dedicated Step output pins on the control board; however step pulse width is same for all the axes. When this pin is active high, an active high step pulse is driven to respective axis drive. When the pin is active low, an active low step pulse is driven to the axis drive.

DIR PIN: LOW/HIGH: This DIR PIN selects the state of direction signal given to the drive of motor attached to axis. All axes have their dedicated Direction output pins on the control board and axes can have different direction settings according to the job to be performed. When this pin is active high, the machine/tool head moves in positive or negative direction according to the commands given in G-code file or by jog keys. And when the pin is active low, machine/tool head moves in the opposite direction to the one in active high state. The direction for X axis on the work bed of the machine can be either left or right, for Y axis is Back or Front whereas for Z axis is either up or down. However for rotary axis, it is either clockwise or anticlockwise.

FLIPKEY: ENABLE/DISABLE: This option invert the working of jogging keys.

STEP/MM: STEPS/MM shows the number of steps the motor must turn in order for the CNC machine to move 1 mm on the particular axis. This is machine dependent and remains same for a particular axis of machine. Different machines can have different values of steps/mm. The axes of the machine can have different "step/mm" number.

MM/MIN:It shows the maximum velocity of the axis. Different axes can have different velocities. The maximum achievable velocity for all axes is:

Velocity (max) = (2, 00, 000*60)/(Steps/mm)

Steps/mm remains fixed for axis. The pulse rate varies in accordance with velocity (MM/MIN) for particular axis. Maximum achievable pulse rate for all axes is 150 KHz.

MM/SEC²: It is the increment of the processing velocity from initial velocity to the highest one for the motor connected to axis. The value of the acceleration is user programmable and can vary for all axes. The range of acceleration for all axes is 1 to 99999.

Set all these parameters for all the axes, individually.

HOMING SETTING:HOMING SETTING provides settings for an advanced homing cycle with speedconfigurable options to return to home position. Homing ensures the safety of the machine. Homing can be done in the conditions where the motion got skipped for anyaxis. In such case, machine should be placed somewhere at the known place. For thispurpose, home switches should be installed for all axes on every machine.

For homing, CNC controller follows a sequence of cycles before reaching to machinezero. In first cycle, Z-axis moves upward till finding and triggering Z-axis home switch.In second cycle, rest three axis moves together in independent way and trigger theirhome switches. In both cycles, they move at set "homing seek rate". In proximity ofall home switches, machine leaves and approaches switches in two cycles to precisely"home" at the machine zero location at set "homing feed rate". In the last cyclemachine moves to a position determined by set "pull off distance" away frommachine zero location for all enabled axes in coordinated way at homing seek rate.Finally machine stops, where DRO shows the current known location.

SEEK (MM/MIN): **The rate at which an axis traverses from its current position to its** *Home switch on ressing Key 5 is called homing seek rate. It is user programmable and range for seek rate is 1 - 9999mm/min.*

FEED (MM/MIN): **The rate at which home switches are triggered and released (twice)***to precisely home at the machine zero location is called homing feed rate. It is also user programmable and maximum range for feed rate is 9999 mm/min.*

PULL OFF MM: **The machine moves to a position away from machine zero location** *for all enabled axes in coordinated way at seek rate after homing. The distance of this position from machine zero is set by "Pull off" function. Pull off function is programmable and the maximum range is size of machine.*

SAFE Z- HEIGHT: **This function ensures the safety of the machine for** *which Home switch for Z-axis either has been disabled or not installed. When key 5 is pressed,Z-axis uplifts to a height set in this function and then homing of other axes takes place. By this, the tool installed at Z-axis remains safe. The maximum height can be the height of the Z-axis of the machine.*

DEBOUNCE mS: **This is the delay settled for debouncing of the Home Switch, when** *pressed. By default, it is 100 ms. However; it is user programmable. Maximum value of debounce delay is 1 second. The units for debounce delay are ms.*

Here is the method to access HOMING SETTING:

a. Select and enter in HOMING SETTING.

b. Select SEEK mm/min and edit its value.

c. Select FEED mm/min and modify its value.

d. Select PULL OFF mm and modify its value.

e. Select SAFE Z-Height and edit its value.

f. Select DEBOUNCE us and edit its value.

g. Confirm or cancel the settings made and Exit to previous menu.

*HOME SWITCH SETTING:*Home Switch Setting allows the operator to enable or disable the home switches for

all axes. Disable the home switches for axes for which switches are not installed. An input signal is driven from the home switch to its axis Home-In terminal on CNC control board when it got triggered. When the machine is in Run/Jog mode and Home switch for an axis got triggered, an input is generated to the axis Home-IN pin and motion of an entire axes system ceases. A message of alarm for Hard Home/Limit is displayed on the screen. Press Ok key to continue. None of the jog key works and entire motion system stops in this condition. Press the left navigation key long to enter in manual override mode and to release the switch.

All the keys are disabled except the jog and navigation keys in manual override mode. Jog the machine reverse using jog keys to release the switch and set the machine at required position. At any situation, if the limit/ home switch got triggered, hard limit/home is not checked and user need to jog the machine reverse. Press left navigation key long again to exit from manual override mode.

For all axes, it is required to make some settings for home switches. These are:
ENABLE: **sets the home switch enabled for the axis. It makes the homing of the axis** *when key 5 is pressed.*
HIGH/ LOW: **Active high sets the home switch to generate an active low pulse to** *axis Home-In terminal on the board when the switch got triggered. Active low sets the home switch to generate an active high pulse when the switch got triggered.*
DISABLE: **sets Home switch disabled for the axis. Homing of the axis got ceased***when key 5 is pressed. However the Z-axis if set disabled, moves to Z-safe height (discussed in Homing setting function) when homing command is given.*
Access the Home switch settings as following:
a. Select and enter in Home Switch Setting function in IO Setting Menu.
b. Enable or disable the home switch for the axis as per requirement. Set the switch high or low if enabled. Make the modifications for all the axes.
c. Confirm or cancel the settings made and Exit to previous menu.

LIMIT SETTING: Limit Setting allows the operator to enable/disable the limit switches for all axes. Usually, in all the machines, each axis consists of a pair of hard limit switches installed in its negative and positive direction. Axis Limit-IN terminal at the CNC Control board shares the inputs from both switches. There is no Limit-In input terminal for Y-Slave.

When the machine is in Run/Jog mode and Limit switch for an axis got triggered, an input is generated to the axis Limit-IN pin and motion of an entire axes system ceases. An alarm message of Hard Home/Limit is displayed on the screen. Press Ok key to continue. Jog the machine reverse using jog keys to release the switch and set the machine at required position. At any situation, if the limit/ home switch got triggered, hard limit/home is not checked and user need to jog the machine reverse. Disable the Limit switches for the axes which don't have the home switches. For all the three axes, it is required to make the following settings for Limit switches.

HARD LIMIT ENABLE/DISABLE: **Hard limit if enabled generates the alarm message** when hard limit switch got triggered. Hard limit if disabled does not generate any message when limit switch got triggered however the input pulse is driven to the axis Limit-IN pin of CNC control board when the switch got triggered and the machine get blocked in the same way.

HARD LIMIT SWITCH (ACTIVE HIGH): **Active high sets the Limit switch to generate** an active low pulse to axis Limit-In terminal on the CNC control board when the switch got triggered.

HARD LIMIT SWITCH (ACTIVE LOW): Active low sets the Limit switch to generate an active high pulse to axis Limit-In terminal on the CNC control board when the switch got triggered.

Steps for Limit Setting:

a. Select and enter in the LIMIT SETTING in IO SETTING.

b. Select the required axis. Select X-axis and enter.

c. Select HARD LIMIT and enable or disable it.

d. Select the SWITCH and make it high or low.

e. Confirm or cancel the settings made and Exit to previous menu.

(KEYX+/Space) : JOG MODE MENU:

Jogging is used to travel the CNC machine carriage such as CNC machine axis movement. Jogging allows for manual operation of tool by using Jog keys. (The functions of jog keys have been discussed under jog keys panel of Hand held pendant section). Jog mode can be selected in run, idle and Hold mode. However, jogging can be done in idle and in hold mode only.

DRO shows the adjacent screen during machine jogging. CNC Controller provides the three modes for jogging. These are discussed as below:

a. CONTINUOUS MODE: This mode allows continuous jogging of the axis in required direction by pressing respective jog key. A jog factor can be set in range of 1-99 which determines the rate of jogging of machine. User can change the jog factor by up-down navigation keys. Jogging velocity for each axis can be calculated by following formula.

Here is shown the calculation of jog velocity for X-axis:

Jogging velocity (Axis) = (Max Velocity for Axis / 100) x Jog Factor

The maximum velocity is the MM/MIN set for X-axis in Axis Settings menu. Calculate the jogging velocity for each axis in the same way.

b. STEP MODE: In order to precisely place the machine at required location, jog the machine in step jog mode. It allows users to select a step size out of the four preprogrammed step sizes. Select the step-size using up-down navigation keys and stepsizes available are 1mm, 0.1mm, 0.01mm and 0.001 mm.

c. FAST MODE: In order to jog the machine at required location comparatively faster than the above two modes, jog the machine in fast jog mode. The default value of jog factor for Jog fast mode is 40 and user can increase or decrease it in same manner as for the continuous jog mode.

(KEYX+/Space) LONG PRESS: JOG OFFLINE MODE:
In jog offline mode, absolute coordinates got changed and whole WCS shifts to a new position. Due to jogging, position of the machine changes and the coordinates for current position of machine got changed w.r.t. absolute coordinates. However, changed coordinates aren't reflected by screen after exiting from this mode. LCD shows same coordinated as before entering in jog offline mode for machine current position.
The absolute coordinates for WCS got updated to a position such that the coordinates appearing on screen are w.r.t. new absolute coordinates.

For example:
Press right navigation key long to enter in jog offline mode.
Jog the machine to required position and exit from jog offline mode.

(KEYY+/Dot): JOG FACTOR INCREMENT/STEP SIZE CHANGE
If Continuous/Fast jog mode is selected, press this key to increase the jog factor by 1in Idle, Hold and Run mode. Long pressing this key increases the jog factor by 10.Press this key to change the step-size if Step jog mode is selected.
(KEYY-/Minus): JOG FACTOR DECREMENT/ STEP SIZE CHANGE
If Continuous/Fast jog mode is selected, press this key to decrease the jog factor by 1 in Idle, Hold and Run mode. Long pressing this key decreases the jog factor by 10. Press this key to change the step-size if Step jog mode is selected.

COORDINATE ZERO KEYS

These keys are used to update the current coordinate and sets machine at zero position for the selected axis in current WCS. Zeroing all the axes sets new origin of current coordinate system in Idle mode. These keys do not have any effect while the machine is in run mode. For

example:

To change current working coordinates, Suppose:

KEY 1: X-COORDINATE ZERO: Press KEY 1 for X coordinate zero.

KEY 2: Y-COORDINATE ZERO: *Press KEY 2 for Y coordinate zero.*

KEY 3: Z-COORDINATE ZERO: Press KEY 3 for Z coordinate zero.

KEY 9: G-CODE FILE SELECT: Key 9 works for File select in idle mode. Upon pressing this key, it lists maximum of fifty files available on USB drive if USB device is properly mounted. Otherwise, LCD shows the message of unavailability of USB Flash drive.

It is advised to keep file name of maximum 8 lettered name and 3 lettered extension.Otherwise, it does not display full file name properly.

KEY 5 LONG PRESS: GCODE FILE CHECK:

Pressing KEY 9 long leads the controller to check G-code file selected from pen drive in idle mode for the safety of CNC machine and its proper motion. Controller reads the complete G-code file and detects the errors and shows the respective error messages. Entire G-code is checked line by line.

Press Ok to allow the controller to check the next line in G-code file if an error is found. Press Esc to exit. There can be miscellaneous errors in the Gcode lines for example Bad number format, unsupported statement, Expected command letter etc.

Press down navigation key to continue else press Esc to exit.

FEED RATE OVERRIDE:

Feed rate override function allows the operator to adjust the feed rate of the axis during operation. The feed rate override functions as a percentage of programmed value of feed rate "F" in Gcode in the range of minimum to maximum velocity whereas the minimum value is the feed rate set in Gcode and maximum value for velocity is the minimum value of MM/MIN function among all axes set by user in Axes settings menu.

(KEY Overridw/X): OVERRIDE SCREEN
When the machine is in either of 3 modes, pressing key overide shows the override screen on the LCD. User can change the percentage of feed rate override using Y jog keys. Press 'Y+' key to increase feed rate override and 'Y-' key to decrease the feed rate override. Press Ok key to exit from override screen. However, minimum value for feed override is 10% of the programmed feed rate and maximum value is 200% of the programmed feed rate. However, maximum achievable feed rate for the tool can't reach beyond MM/MIN.

KEY 4: GO TO ZERO
Press key 4 to make the entire axes system to go to Zero position set for that working coordinate system in idle mode.

KEY 5: HOMING

Homing is the process of finding home switches and bringing machine at a known location. In some situations during machine operations when its location can't be identified accurately. For this purpose, home switches should be installed on every machine for desired axes. The homing procedure has been discussed in homing setting section of IO setting menu. Homing can be done in idle mode.
In case, if homing is not required for any particular axis, disable its home switch.

STANDARD G/M CODES SUPPORTED

G-Codes
G0: Rapid Positioning
G1: Linear Interpolation
G4: Dwell
G20: Inch System Selection
G21: Millimeter System Selection
G90: Absolute Distance Mode
G91: Incremental Distance Mode
G70: Enable Block Mode
G71: Disable Block Mode

M-Codes
M0: program stop
M1: optional program stop
M2: Program end
M30: Program end and reset
M47: Program reset and restart

CUSTOM M-CODE

M62 Pn   //ACTUATE_PIN n   (where n is pin number=0, 1, 2.. 3)
M63 Pn   //DEACTUATE_PIN n   (where n is pin number=0, 1, 2.. 3)

M66 PnLsQt   //Wait for INPUT n
(where n is pin number=0, 1, 2.. 3: where s is INPUT STATE 0=low, 1= high:
wheret is timeout in millisecond from 1 to 0xFFFFFFFF)

M98 Ri   //Block Repeat (where i is number of times to repeat block)
M99   //Block end RETURN TO M98

G4 format, where "xxxx" is the time in mSec
G4 xxxx

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G90 G0 X0Y0Z0F10000
G1 X0 Y0 F10000
M98 R10                          ( Start Of BLOCK repeat for 10 times )
G1 X100 Y100 Z100
M62 P0                           ( ACTUATE OUTPUT 1 )
G1 X0 Y0 Z0
M63 P0                           ( DEACTUATE OUTPUT 1 )
G1 X100 Y100 Z100
M62 P1                           ( ACTUATE OUTPUT 2 )
G1 X0 Y0 Z0
M63 P1                           ( DEACTUATE OUTPUT 2 )
G1 X100 Y100 Z100
M62 P2                           ( ACTUATE OUTPUT 3 )
G1 X0 Y0 Z0
M63 P2                           ( DEACTUATE OUTPUT 3 )
G1 X100 Y100 Z100
M62 P3                           ( ACTUATE OUTPUT 4 )
G1 X0 Y0 Z0
M63 P3                           ( DEACTUATE OUTPUT 4 )
G1 X50 Y50 Z50
M99                              ( End of BLOCK repeat return to M98 for 10 times )
M62 P0
M62 P1
M62 P2
M62 P3
G1 X250 Y0 Z150
M63 P0
M63 P1
M63 P2
M63 P3
M66 P0 Q60000
G1 X0 Y0 Z0
M66 P1 Q60000
G1 X100 Y100 Z100
M66 P2 Q60000
G1 X200 Y200 Z200
M66 P3 Q60000
G1 X300 Y300 Z300
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M66 P4 Q60000
G1 X400 Y400 Z400
M66 P5 Q60000