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MODEL 86MM-2

USER'S GUIDE
Two Motor
STEPPING MOTOR CONTROLLER/DRIVER

11-17-86 Rev 1-19-87
Reformatted 1-16-98

Contents

Introduction

The 86MM is a programmable stepping motor control for running two motors, one-at-a-time. The Control incorporates a one-chip microcomputer that has on-chip RAM and ROM. The RAM is available for storage of a user-entered program and motion parameters. Commands and data are entered either through the front panel keypad or over the RS-232C interface from any host computer, terminal, or programmable controller having an RS-232C port. Specialized Commands provide simple and efficient entry of complex, yet compact, programs. Short programs are automatically retained in the portion of RAM which is battery-backed.

FEATURES

A complete microcomputer-based Control with nonvolatile user memory and motor drives for two axes in one package.

Motor Resolution can be set to 200 or 400 steps per revolution.

JOG/SLEW mode allows motors to be jogged one step or slewed from 16 to 2850 steps/second from the front panel (joystick emulation).

A Digitizing function can be utilized with a host terminal connected as a readout of motor position.

Menu LEDs provide command-selection from the front panel.

Keypad with audible and tactile feedback provides data-entry at the front panel.

RS-232C Port connected to a host allows Command and Data entry, Polling for status, and Absolute Position.

Acceleration/Deceleration settable from 8000 to 56000 steps/sec^2 in 8000 step/sec^2 increments.

Speed settable from 16 to 3000 steps/sec in 1 step/sec increments.

Incremental Index distance is programmable from $\pm$1 to $\pm$1,048,575 steps.

Programmable Return-to-Zero position.

Six powerful Loop Commands provide from one to continuous repeat operations, performing simple functions like auto-reverse to raster scans and other complex X,Y matrix patterns.

Pauses 100 milliseconds to 13.65 minutes.

A User Output can be programed to turn ON and OFF an external solid state or reed relay.

A User Input can be utilized in a program as a WAIT for external switch or relay closure.

Backlash Compensation can be set to automatically finish every index approaching from the positive direction.

Run, Reset, Output, Input, and RS-232C connections are accessible at a removable terminal block on the front panel.

Limit Switches for CW and CCW directions are provided with plug-in connection to UniSlide "J"

assemblies. Limits can be used for "homing."

Automatic Power Down reduces power consumption by de-energizing the motors when at a standstill.

Single Step mode is provided for debugging programs or as a controlled interrupt.

The Control can be polled for its status at any time; additionally a prompt ("^") is automatically sent to the host when a program has finished.

Capable of running large motors, up to 10 amps total (5 amps/phase).

Twelve month Limited Warranty.

SETUP

*** * CAUTION * ***

* HAZARDOUS VOLTAGE, DO NOT REMOVE CONTROL PANELS OR COVER
* DO NOT CONNECT OR DISCONNECT MOTORS WHEN POWER IS "ON"
* HIGH TEMPERATURE, CONTROL SHOULD BE KEPT AT LEAST 6 INCHES FROM ANY OBJECTS
* AIR MUST CIRCULATE THROUGH AND AROUND CONTROL, DO NOT BLOCK AIR VENT IN BOTTOM OF CONTROL
* NEVER USE IN AN EXPLOSIVE ENVIRONMENT
* IN INDUSTRIAL ENVIRONMENTS, THE CONTROL MUST BE PROTECTED TO PREVENT METAL CHIPS FROM FALLING INTO IT
* SEVERE ELECTRICAL DAMAGE MAY RESULT IF OBJECTS FALL INTO THE CONTROLS HEAT SINK

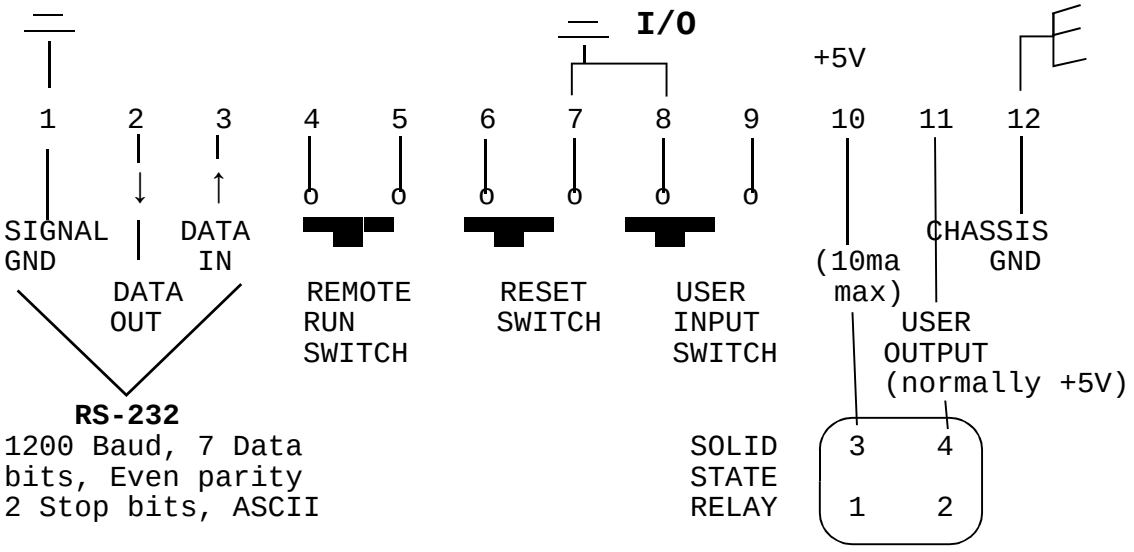
1. Connect cables to motors and limit switches.

CAUTION: Never connect or disconnect motors with power ON, this may result in severe damage to motor drives.

2. Plug Control into 120VAC outlet.

Input/Output (**I/O**) connections other than motor, AC power, and limit switches are located at a removable terminal block on the front panel. These Input/Output connections can satisfy various applications:

PIN #	DESCRIPTION	PURPOSE
1,2,3,12	RS-232C Interface (Signal Gnd, Tx, Rx, Chassis Gnd). 1200 Baud, 7 Data bits, Even parity, 2 Stop bits, ASCII	Allows constant program and parameter changes from a computer or P.C. Provides visual feed-back when attached to a terminal.
4,5	Remote Run	Allows program-Run from an external switch or relay.
6,7	Reset	Can be used as a emergency stop, or to synchronize the Control with other equipment.
8,9	User Input	Used as a "Go" signal from external equipment. Pin 9 is internally held "HIGH" by 1K ohm resistor connected to +5V.
10,11	User Output	Signals or actuates external equipment between moves. Capable of powering a Solid State or Reed Relay.



3. Turn ON the Control by pushing the POWER switch to the right. The JOG/SLEW light will come ON.

NOTE: Data in memory is retained when the Control is "OFF" by rechargeable batteries within the Control, that are charged when the Control is "ON". A loss of data retention due to low battery voltage is indicated by a flashing of the LEDs and beeping for 2 seconds after turn-on. This may be the situation with a new Control that has not been operated long enough to fully charge the batteries, or if four or more weeks of non-use have elapsed. See the section on MEMORY/BATTERY RETENTION for more information.

FRONT PANEL INPUT

JOG/SLEW MODE: * **JOG/SLEW**

1. With the Control in the JOG/SLEW mode, the motors can be jogged one step, or slewed from 16 to the STEPS/SEC value entered (SLEW will not exceed 2850 steps/sec) in either direction.

2. To JOG motor 1 positive, press the "1" key momentarily; the motor will move one step CW. To JOG negative hold the "-" key down and press the "1" key. Use the "2" key for Motor 2.

3. To SLEW motor 1 hold down the "1" key, the motor will run at 16 steps/sec. To increase speed press the " | " key until the desired speed is reached. Use the " | " to decrease speed. The motor accelerates and decelerates at 8000 steps/sec^2. Use the "2" key for Motor 2.

DIGITIZING

The 86MM stores its absolute position (relative to the position when power was applied or when registers were zeroed) in memory until the Control is turned-off. The absolute registers reflect the accumulated distance from operating the motors in the JOG/SLEW mode and/or under program control. These registers can hold from -8388608 to +8388608 steps.

With a host terminal or computer connected via the RS-232C interface, the Control can be used as a digitizer. In the JOG/SLEW mode the 86MM will send motor position to the host when it receives any character other than "E" or "Z".
Here is an example of what the host would receive when Motor 1 is at absolute 201 and when Motor 2 is at absolute -1294010:

X+0000201
Y-1294010

A linefeed, carriage return follows the above values.
The host can "zero" the registers by sending a "Z" to the Control.

MENU SELECTION

The " | " and " | " keys are used to make selections on the front panel menu.
Pressing keys other than the "RUN", " | ", " | " results in an audible feed-back from a buzzer within the 86MM.

Refer to the next section on COMMANDS with VARIABLES for proper values to enter.

If the Control contained a program the last time the POWER was turned OFF, the Control will prevent any menu selection past STEPS/SEC. This feature limits editing to speed and acceleration/deceleration.
To "CLEAR" a program from memory press the recessed **CLEAR button** on the front panel using a pen or pencil.

COMMANDS with VARIABLES

Front Panel Menu	Front Panel & RS-232C Input	Function
	First character applies only to RS-232C input	

Settable (one-time entry in a program)

*** ACCEL/DECEL**	**A**	**Acceleration** and **Deceleration Motor 1.** SET RANGE: 1 to 7 or 9 to 15 **1 to 7** sets motor to **200 steps/rev** (1 being 8000 steps/sec^2, 2 being 16000 steps/sec^2, 3 being 24000 steps/sec^2, etc.) **9 to 15** sets motor to **400 steps/rev** (9 being 8000 steps/sec^2, 10 being 16000 steps/sec^2, 11 being 24000 steps/sec^2, etc.) NOTE: Acceleration and Deceleration only occurs above 236 steps/sec.
*** ACCEL/DECEL**	**AM**	**Acceleration** and **Deceleration Motor 2.**
*** STEPS/SEC**	**S**	**Steps**/sec for **Motor 1.** SET RANGE: 16 to 3000 in 1 step/sec increments
*** STEPS/SEC**	**SM**	**Steps**/sec for **Motor 2.**
*** STEPS/SEC**	**S-1**	Turns **on backlash compensation.** Whenever a Motor makes a negative Index, 16 steps will be added. The Motor will then reverse, moving positive 16 steps (every Index will finish approaching positive).
*** STEPS/SEC**	**S-0**	Turns **off backlash compensation.** RANGE: 0 to 8191 (0 = 20 usec, 1 = 0.1 sec, 2 = 0.2, 10 = 1.0, 8191 = 819.1 sec = 13.65 min) If "Pause control" enabled (see U2 and U4 commands) the USER OUTPUT will go "LOW" for the duration of the Pause. When a "P0" follows an Index the Motor will slow down to 236 steps/sec before moving again. If STEPS/SEC is set to 236 or less the Motor will not change speed.
*** USER I/O**	**U0**	**Wait** for "LOW" on User **Input** (pin 9 of I/O).

*** USER I/O**	**U1**	**Wait** for "LOW" on User **Input,** holding User **Output "LOW"** while waiting.
*** USER I/O**	**U2**	**Disables** "Pause control" of **Output**.
*** USER I/O**	**U4**	**Enables** "Pause control" of **Output** (reset state).
*** USER I/O**	**U8**	**Output "HIGH"** (pin 11 of I/O)
*** USER I/O**	**U16**	**Output "LOW"**
*** INDEX**	**I**	**Index** steps for **Motor 1** to move **Positive**. (Motor rotates CW, Slider moves away from motor on UniSlides, Rotary Tables rotate CCW) RANGE: 1 to 1,048,575 steps
*** INDEX**	**I-**	**Index** steps for **Motor 1** to move **Negative**. (Motor rotates CCW, Slider moves toward motor on UniSlides, Rotary Tables rotate CW) RANGE: 1 to 1,048,575 steps
*** INDEX**	**I0**	**Index Motor 1** to **"Absolute Zero"**. "Absolute Zero" is established when the Control is turned "on", a "Z" command, RESET, or CLEAR button is used. NOTE: Operating the motors in the JOG/SLEW mode does not change the location of "Absolute Zero"
*** INDEX**	**IM**	**Index** steps for **Motor 2** to move **Positive**. (Motor rotate CW, Slider moves away from motor on UniSlides, Rotary Tables rotate CCW) RANGE: 1 to 1,048,575
*** INDEX**	**IM-**	**Index** steps for **Motor 2** to move **Negative**. (Motor rotates CCW, Slider moves toward motor on UniSlides, Rotary Tables rotate CW) RANGE: 1 to 1,048,575
*** INDEX**	**IM0**	**Index Motor 2** to **"Absolute Zero"**. "Absolute Zero" is established when the Control is turned "on", a "Z" command, RESET, or CLEAR button is used. NOTE: Operating the motors in the JOG/SLEW mode does not change the location of "Absolute Zero".

Here is a table showing advance per step for UniSlides Assemblies and UniSlide Rotary Tables:

UniSlide Lead Screw	Adv/rev	Adv/step 200/rev Mode	Adv/step 400/rev Mode	Speed at 1000 steps/sec (200/rev Mode)
P40,C	0.025"	0.000125"	0.0000625"	0.0125 ips
P20,B	0.050"	0.00025"	0.000125"	0.2500 ips
P10,W1	0.100"	0.0005"	0.00025"	0.5000 ips
P5,W2	0.200"	0.001"	0.0005"	1.0000 ips
WF	1.000"	0.005"	0.0025"	5.0000 ips
K1,Q1	1.00 mm	0.005 mm	0.0025 mm	5.00 mm/sec
K2,Q2	2.00 mm	0.010 mm	0.005 mm	10.00 mm/sec
K4,Q4	4.00 mm	0.020 mm	0.010 mm	20.00 mm/sec

UniSlide Rotary Table	GEAR RATIO	Adv/step 200/rev Mode	Adv/step 400/rev Mode	Speed at 1000 steps/sec (200/rev Mode)
B4872TS	72:1	0.025°	0.0125°	25°/sec
B4836TS	36:1	0.050°	0.025°	50°/sec
B4818TS	18:1	0.100°	0.050°	100°/sec
B79180TS	180:1	0.010°	0.005°	10°/sec
B7990TS	90:1	0.020°	0.010°	20°/sec
B7945TS	45:1	0.040°	0.020°	40°/sec

*** LOOP** **L0** **Loop continually** from the beginning.

*** LOOP** **L-0** **Sets** the **"loop-marker"** at the current location in memory. All loops (except L0) to the right will branch to here. Loops to the left branch to the beginning. The maximum number of loops a program can hold is 10 on both sides of the loop-marker (excluding L0).
NOTE: This Command can be used only once in a program.

*** LOOP** **L** **Loop** from beginning or loop-marker.
RANGE: 2 to 255 loops
Actual number of loops is one less the value entered.
Loops can be nested. The following example loops equal 100,000 (actual loops is one less or 99,999 times):

L100 L100 L10

NOTE: When the Loop reaches its last count the non-loop command directly preceding the Loop will be ignored.

*** LOOP**	**L-**	**Loop** from beginning or loop-marker **alternating direction** of **Motor 1** Indexes. RANGE: 2 to 255 Actual number of loops is one less the value entered. Loops can be nested. The following example loops equal 100,000 (actual loops is one less or 99,999 times): **L-100 L100 L10** NOTE: When the Loop reaches its last count the non-loop command directly preceding the Loop will be ignored.
*** LOOP**	**LM-2**	**Loop** once from beginning or loop-marker **reversing direction** of **Motor 2** Indexes.
*** LOOP**	**LM-3**	**Loop** once from beginning or loop-marker **reversing direction** of **Motor 1 and Motor 2** Indexes.
	E	**Enable** RS-232C communication. (Both yellow LEDs on front panel will light.) The Control must be in the JOG/SLEW Mode to respond to this command.
	D	**Disable** RS-232C communication. Returns to JOG/SLEW Mode.
CLEAR (button)	**C**	**Clear** program from memory. STEP/SEC, ACCEL/DECEL, and backlash compensation settings are not affected. The CLEAR button zeros absolute position registers, the "C" command does not.
Keys: | or |	**DEL** **<** **<-**	**Delete** current value "keyed-in". Also the " | " and " | " are used for menu selection from the front panel.
ENT	**CR** **SP** **LF** **,**	(Carriage Return) (Space) **Enters** keyed in value. (Line Feed) (Comma)
RUN	**R**	**Run** program.
	Z	**Zero** Absolute Position registers.
	X	**Send** Absolute **Position** of **Motor 1**. Below is what the host would receive if Motor 1 is at the negative 1200. A carriage return follows the value. **-0001200**

Y **Send** Absolute **Position** of **Motor 2**.
Below is what the host would receive if Motor 2 is at negative 1200. A carriage return follows the value.

+0091203

B **Busy** poll. Control echoes "B" if busy running a program, "^" if ready. Additionally the prompt ("^") is automatically sent to the host when a program has finished.

H **Hold** flag toggle. The program stops after each operation and sends a ":" to the host. An additional stop occurs at the beginning and end of the program and when a loop reaches its last count. When stopped, the "X" and "Y" commands can be used to read motor position, an "H" toggles the flag off and the program continues, "K" terminates the program, any other character restarts the program where it left off and a stop will again occur after the next operation. This Command allows single stepping through a program for debugging or as a program interrupt from the host.

T Character **Echo** ON/OFF **Toggle**.
Normally all characters sent to the 86MM will be echoed. Character Echo will be ON after "power-up", RESET, or a "CLEAR" by the CLEAR button. When the echo is OFF the 86MM will still send a response to the "X", "Y", and "B" commands.

K **Kill** current operation.
Interrupts running program immediately. The 86MM sends the "^" to the host.
NOTE: When a motor is running at high speed (above 700 steps/sec), command "K" interruption may cause motor overshooting, resulting in loss of position.

MEMORY/BATTERY RETENTION

The 86MM has 106 bytes of RAM memory for program storage. Data in the first 26 bytes of memory is retained when the Control is "OFF" by rechargeable batteries within the Control, that are charged when the Control is "ON". A loss of data retention due to low battery voltage is indicated by a flashing of the LEDs and beeping for 2 seconds after "turn-on". This may be the situation with a new Control that has not been operated long enough to fully charge the batteries. Data loss results in the following default settings: ACCEL/DECEL =1, STEPS/SEC =1000, and backlash compensation "off".
From fully discharged to fully charged requires 30 hours of Control "ON" time. A full charge will be maintained if the Control is "ON" for at least 45 min/day, or 5 hrs/week. The batteries have the capacity to retain data in memory for 4 weeks of non-use.

The table below shows how many bytes of memory each command will use in a program.

Command	Bytes of memory
P	2
U0	1
U1	1
U2	1
U4	1
U8	1
U16	1
I	3
I-	3
I0	3
IM	3
IM-	3
IM0	3
L0	1
L	2
L-	2
LM-2	2
LM-3	2

All other commands use allocated memory, or are "immediate" (not stored).
Each command is stored and executed in the order it is received from a host or keyed-in at the front panel. Commands cannot be added to the program if the power was "turned off" and "on", which is the same as a RESET condition. When a RESET condition has occurred the ACCEL/DECEL and STEPS/SEC are the only changes that can be made to a program. When other commands are sent from a host the existing program will be "cleared" from memory. The Control will not accept a new program when it is busy executing an existing one.

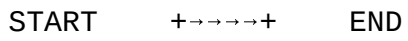
EXAMPLES

The following examples can be manually inputted from the front panel or sent by a host computer or terminal over the RS-232C. For entries made from the front panel, the first letter refers to the Command selected from the menu (LEDs) using the arrow keys. The space between commands is the "ENT" key on the front panel; the "R" is the "RUN" key.

EXAMPLE #1, One Axis, 3 bytes RAM:
Index 200 Steps

I200 R

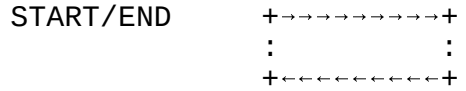
I200 INDEX 200 steps
R RUN



EXAMPLE #2, One Axis 6 bytes RAM:
Auto-Reverse

I401 I0 R

I401 INDEX 401 steps
I0 INDEX to Zero (-401 steps in this case)
R RUN

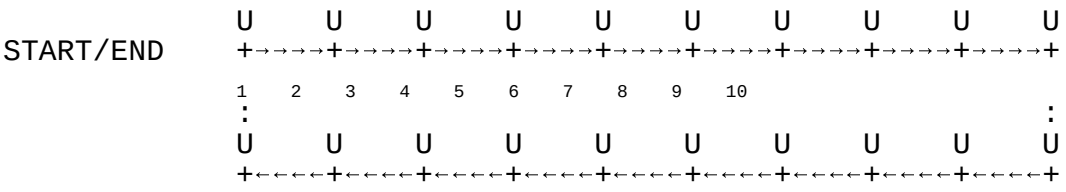


NOTE: By connecting a toggle switch to pins 4 and 5 of I/O, the above program can provide a switch controlled continuous running auto-reverse
The above example will dwell for 65 ms before reversing. By using a P0 command, this time will be reduced to 4.2 ms. The motor will still accelerate and decelerate at the set rate.
In this example the motor will dwell for only 4.2 ms before reversing direction: **I401 P0 I0 P0 R**

EXAMPLE #3, One Axis, 9 bytes RAM:
Repeating Index two directions with wait and output

U1 I800 L10 L-2 R

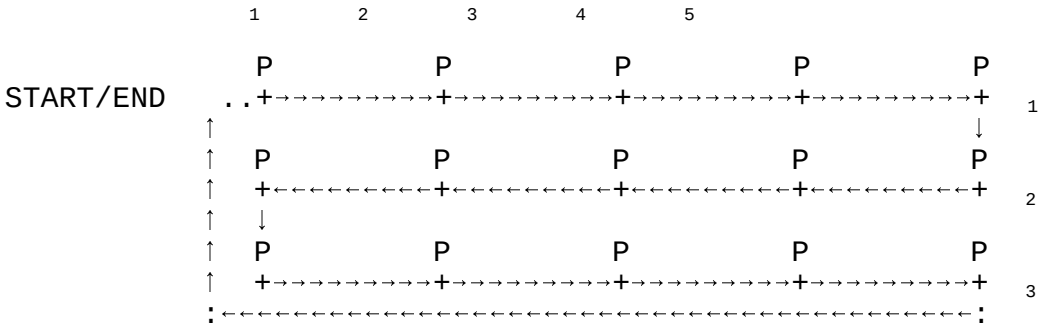
U1 Wait for LOW on User Input holding Output LOW while waiting
I800 INDEX 800 steps
L10 Do 10 times (The actual number of times the program is repeated will be one less the Loop value, and two less for any(non-Loop) command directly preceding the Loop)
L-2 LOOP from beginning with reverse direction
R RUN



EXAMPLE #4, Two Axis, 18 bytes RAM: X,Y Matrix Pausing with Output after each move.

P5 I800 L5 IM200 L-3 I0 IM0

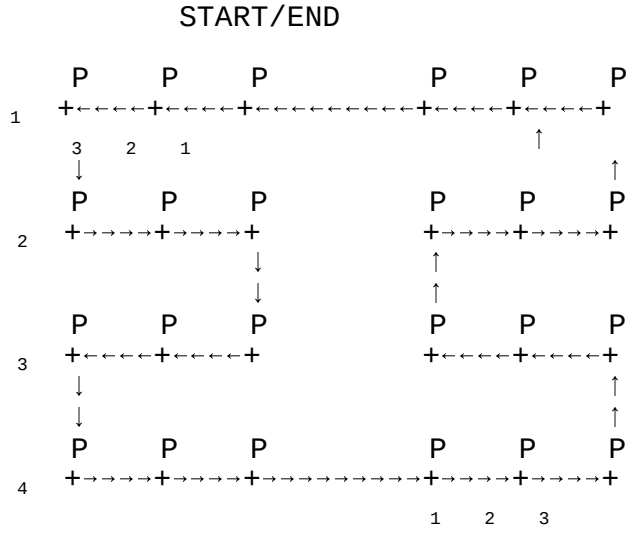
P5 PAUSE for 0.5 sec with Output LOW for duration of the pause
I800 INDEX 800 steps
L5 Do 5 times (The actual number of times the program is repeated will be one less the Loop value, and two less for any (non-Loop) command directly preceding the Loop)
IM200 INDEX Motor 2 200 steps
L-3 LOOP from beginning with alternating direction on Motor 1
I0 INDEX Motor 1 to Zero
IM0 INDEX Motor 2 to Zero



EXAMPLE #5, Two Axis, 17 bytes RAM: Mirror-image X,Y Matrix

P3 I-200 L3 IM200 L-4 I800 LM-3

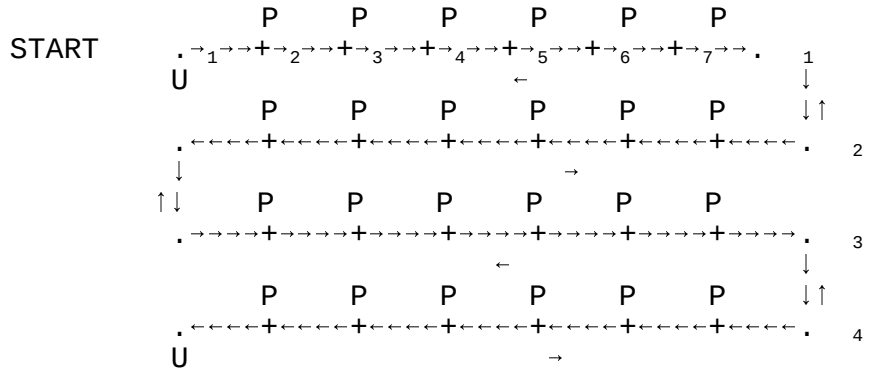
P3 PAUSE for 0.3 sec with Output LOW for duration of the pause
I-200 INDEX negative 200 steps
L3 Do 3 times (The actual number of times the program is repeated will be one less the Loop value, and two less for any (non-Loop) command directly preceding the Loop)
IM200 INDEX Motor 2 200 steps
L-4 LOOP from beginning with alternating direction on Motor 1
I800 INDEX Motor 1 800 steps
LM-3 LOOP once from beginning reversing direction of Motor 1 and Motor 2



EXAMPLE #6, Two Axis, 17 bytes RAM: Raster Scan with 20 usec output pulses

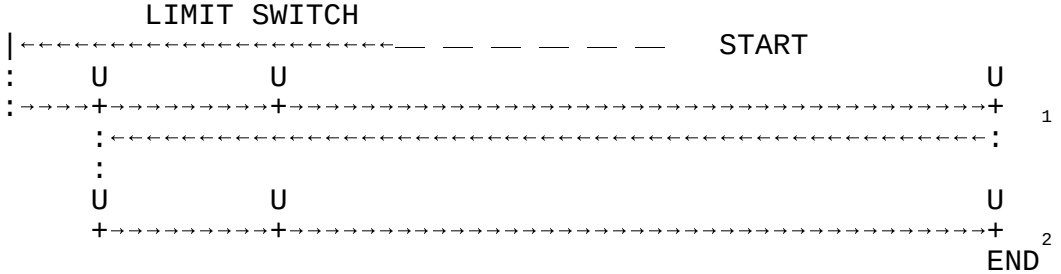
I200 P0 L7 IM400 L-4 U0 LM-2 U0 L0

I200 INDEX 200 steps
P0 PAUSE for 20 usec with Output LOW for duration of the pause
L7 Do 7 times (The actual number of times repeated will be one less the Loop value, and two less for any (non-Loop) command directly preceding the Loop)
IM400 INDEX Motor 2 400 steps
L-4 LOOP from beginning with alternating direction on Motor 1
U0 Wait for LOW on Input holding Output LOW while waiting
LM-2 LOOP once from beginning with reverse direction on Motor 2
U0 Wait for LOW on Input holding Output LOW while waiting
L0 LOOP continually from the beginning



EXAMPLE #7, One axis, 20 bytes RAM: Homing and looping using loop-marker

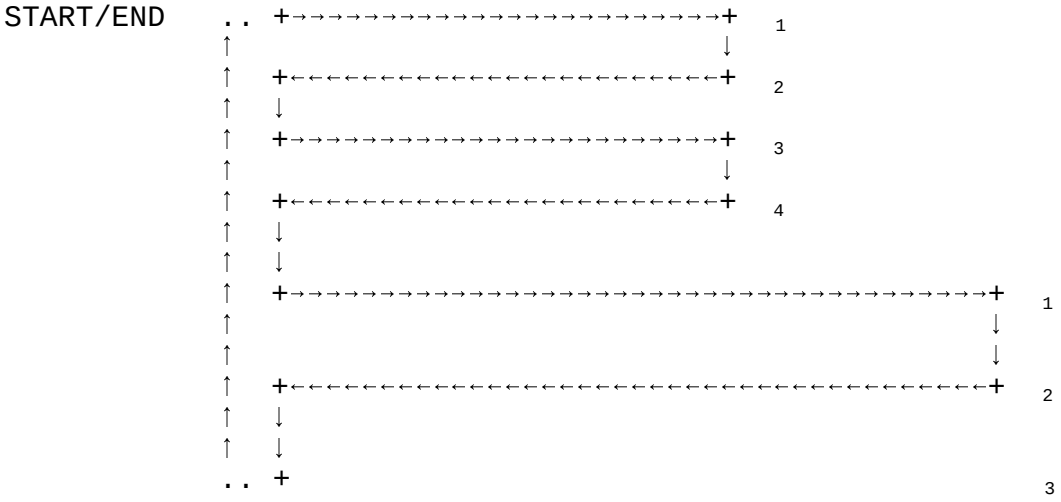
I-99999 I200 L-0 U1 I986 U1 I5002 U1 I-5988 L2
I-99999 INDEX to negative limit switch. Any number larger than available travel can be used.
I200 INDEX away from switch 200 steps
L-0 Set loop-marker to here in program. Succeeding Loops will branch to this point.
U1 Wait for LOW on User Input, Output LOW while waiting
I986 INDEX 986 steps
U1 Wait for LOW on User Input, Output LOW while waiting
I5002 INDEX 5002 steps
U1 Wait for LOW on User Input, Output LOW while waiting
I-5988 INDEX negative 5988 steps
L2 Do 2 times (The actual number of times the program is repeated will be one less the Loop value, and two less for any (non-Loop) command directly preceding the Loop)



EXAMPLE #8, Two Axis, 19 bytes RAM: Two different Raster Scans using loop-marker

I1000 IM150 L-4 L-0 IM300 I1500 L-3 IM0

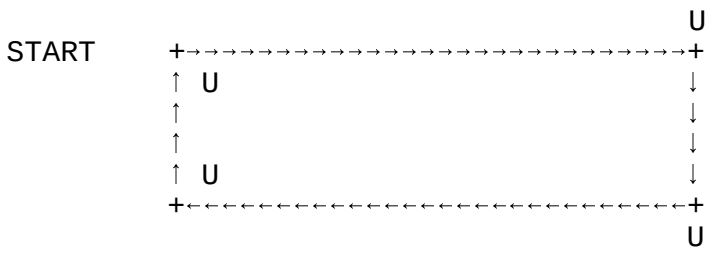
I1000 INDEX Motor 1 1000 steps
IM150 INDEX Motor 2 150 steps
L-4 LOOP from beginning with alternating direction on Motor 1
L-0 Set loop-marker to here in program. Succeeding Loops will branch to this point.
IM300 INDEX Motor 2 300 steps
I1500 INDEX Motor 1 1500 steps
L-3 LOOP from loop-marker with alternating direction on Motor 1
IM0 INDEX Motor 2 to Zero



EXAMPLE #9, Two Axis, 11 bytes RAM: Rectangle, Output and Wait at each corner

I1000 U1 IM500 U1 LM-3 L0

I1000 INDEX Motor 1 1000 steps
U1 Wait for LOW on Input with Output LOW for duration
IM500 INDEX Motor 2 500 steps
U1 Wait for LOW on Input with Output LOW for duration
LM-3 LOOP once from beginning reversing direction of Motor 1 and Motor 2
L0 LOOP continually from the beginning



TROUBLESHOOTING PROCEDURE

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION
JOG/SLEW light does not "light" when Control is switched "on".	Blown fuse.	Check fuse located on back of Control.
Motor(s) does not operate.	Limit switch(es) in closed position.	Check limit switches for proper action, or try without cables attached.
Control does not come ON-LINE when sent "E".	RS-232C may not be connected properly.	Trace Transmitted Data, Received Data, and Signal Ground wires from your computer to the 86MM Control.
	Your computer or terminal is not sending upper case letters.	Transmit only upper case letters. The Control will not respond to lower case.
	Your computer may require a high on its Data Set Ready (DSR) line. The 86MM does not implement the RS-232C control lines.	Check with the computer manufacturer to see if the DSR line must be artificially pulled high, or if it can be disabled in software.
Control does not come "ON-LINE" when sent "E" or downloaded program does not operate correctly.	The RS-232C parameters not set properly.	Match the RS-232C settings on the 86MM to those of your computer or terminal.
Your computer does not receive data from the Control.	Your computer may require a "high" on its Request To Send (RTS) line.	Check with the computer manufacturer to see if the RTS line must be artificially pulled high, or if it can be disabled in software.
Motor does not ru when sent commands to index.	STEPS/SEC or ACCEL/DECEL settings out of range.	Set STEPS/SEC and ACCEL/DECEL to specified values.
Motor stalls, it does not move at all.	Inertia in system too high, or mechanism has seized.	Hand operate the system to locate any binding. A larger motor, or a different ratio in the mechanism may be required.
Motor stalls, after rotating slightly.	Acceleration too high.	Use a lower ACCEL/DECEL. Use 400 step/rev mode.

	Motor cannot overcome friction or load.	Check mechanism for ease of movement. A larger motor may be required, or your load will have to be reduced or counterbalanced.
Motor stalls before reaching maximum velocity.	Motor torque de-creases as its velocity in-creases.	Reduce STEPS/SEC setting of motor.
With Motor remov-ed from equipment, Motor runs errat-ically at all speeds, has no torque.	Broken motor cable.	Check cables and connectors for broken wires and repair breaks.
	Faulty Motor.	Replace Motor.
	Damaged drive transistor(s.)	Ship Control back for motor drive repair to Velmex, Inc. Repair Dept. Rt. 5 & 20 E. Bloomfield, NY 14443 or replace TIP 102 transis-tors on inside back panel.
Motor or system resonates (vibrates loudly).	The motor velocity is the motor or system's natural resonant fre-quency. This is common at speeds below 230 in the 200 step/rev mode.	Use 400 step/rev mode. Increase or decrease speed to avoid resonance points. A damper or flywheel added to the motor shaft or lead screw may dampen the resonance.
Program is lost everytime Control is turned OFF (LEDs flash and buzzer beeps when Control is turned ON).	Control is not ON long enough to charge batteries.	See page 12, MEMORY/ BAT-TERY RETENTION for charge requirements.
	Batteries have reached their useful life (>1000 charge/discharge cycles, or 4-6 yrs).	Replace batteries. See page 19, BATTERIES for replace-ment procedures.
Control stops operating for no apparent reason.	Inductive surge on AC power-line.	Isolate or remove any equipment that may be putting "spikes" on the power-line.
	Inductive/Static surges coming in the I/O con-nections.	Make sure all external equipment connected is properly grounded and inductive loads are isolated from Control.

LIMIT SWITCHES

Limit switches are included on most UniSlide assemblies. The 86MM cables with the 7 pin Amphenol connectors, plug into these limit switches. The limit switch inputs are active-low (normally high by a 1K ohm resistor connected to +5V).

The Positive limit is activated by a switch closure between pin E (Signal Gnd) and D (+ Limit). When activated, motion in the positive direction (Motor rotating CW, Slider moves away from motor) is terminated and the Control will proceed to the next command in the program.
The Negative limit is activated by a switch closure between pin B (Signal Gnd) and A (- Limit).

CABLES

Caution:
It is not recommended that the motor cables be extended or altered in any other way. If motor cables must be extended the proper wire size should be used to prevent voltage drop. For motor cables to 15 feet use #16 wire. For motor cables to 30 feet use #14 wire. For motor cables to 45 feet use #12 wire.

Motor and limit switch cables should not be put in a common conduit with other wiring.

If cables must be near inductive loads (transformers, motors, etc.) or near high energy sources, shielding of the cables may be required.

RS-232 cables should be limited to a maximum of 20 feet. However, with special EIA cable 50 feet is possible.

BATTERIES

Batteries do not require servicing, they have an estimated life of greater than 1000 charge/discharge cycles or 4 to 6 years.

To replace batteries:
1. Unplug Control from AC power.
2. Remove screws (hex nuts) at each corner of the rear panel.
3. Tilt rear panel back.
4. Pull cover rearward and up to remove.
5. Slide battery retaining clips off batteries.
6. Replace batteries following polarity markings.

Caution:
Replacement batteries should have the following characteristics:

Three 1800 mAH, High Temperature Nickel Cadmium "C" Size, 180 mA charge rating (SANYO Model No. KR-CH, or SAFT Model No. 2.0PT).
The following batteries can be substituted, but not being high- temperature type, useful life may be reduced.
Radio Shack Cat. No. 23-141, or Cat. No. 23-124.
The No. 23-124 batteries have 1100 mAH capacity, reducing program retention to 2 weeks.

SPECIFICATIONS

FUNCTIONAL

Packaged Controller/Driver, using Microcomputer control of stepping motors. Operates one to two motors, one-at-a-time.

Interactive limit switch inputs (TTL), (CW and CCW for each axis).

One User Input (TTL), and one User Output (0 or +5V, 10 ma sinking capability).

Programing through full-duplex RS-232C (1200 Baud, 7 Data bits, Even parity, 2 Stop bits, ASCII, special configurations to 4800 Baud available) or by 16 key front panel keyboard.

User available RAM for program storage is 106 bytes, 26 bytes with battery back-up

Manual control at front panel.

JOG/SLEW, ACCEL/DECEL, STEPS/SEC, PAUSE/OUTPUT, USER I/O, INDEX, LOOP Menu LEDs for input selection.

CLEAR, Run, M, -, | , | , Ent, 0 to **9** buttons at front panel.

Remote Run and Reset Inputs (TTL).

Six foot motor and limit switch cables with connectors

MOTOR COMPATIBILITY

1.8^{o} PM stepper motors, 5 amp/phase max., stepping motors.
Factory adjusted for a particular motor current, motors on each axis to be the same amp/phase value.

PHYSICAL

Weight: 19.5 lbs.

Height: 8.5 inches

Width: 11.2 inches

Depth: 14.0 inches

ELECTRICAL REQUIREMENTS

120VAC 60Hz, 350 watts

ENVIRONMENTAL

32^{o} to 120^{o} F
Convection cooling

PROGRAMMING FROM BASIC ON A IBM TYPE COMPUTER

The procedure for programming the 86MM from BASIC is:

1. Make the 3 wire RS-232 connection from the host computer to the 86MM.

Computer SERIAL 25 pin Connector		86MM I/O Connector
2	——→——	3
3	——←——	2
7	————	1

If a shielded cable is used, connect the shield to connection 12 on the 86MM I/O.

2. Turn ON the Control and the host computer.
   NOTE: A framing error may occur on the host's receiver when the 86MM is turned ON or reset while the host is ON. The host will display the "Device I/O error" message when the BASIC program is started. To prevent this error, turn ON the host after the 86MM or only connect the RS232 cable after the host and the Control have been turned ON.

3. Boot BASIC on the computer. (PC users can also use: "Terminal" program located in Accessories in Windows 3.1 or "HyperTerminal" with Windows 95, set baud to 1200, Even parity, 7 data bits, 2 stop bits, and set flow control to None).

4. Create a BASIC program that incorporates the following:
   a. Open the RS-232 port on the computer with an OPEN COM statement.

   b. Print "EZT" to the 86MM Control to get the Control ON-LINE, Zero the Absolute Position Register and to Toggle echo off. The "Z" Zeros the Absolute Position Register that would have accumulated steps if the motor had been run in the JOG/SLEW mode. The echo off ("T") will prevent the computer's receive buffer from filling with unwanted characters.

   c. Print the 86MM program to the Control.

   d. Wait for the ready ("^") prompt, indicating the 86MM program has finished running.

   e. Perform data acquisition or control function for this motor position.

   f. If desired, request motor position from the 86MM.

   g. Print another program to the 86MM.
      NOTE: To prevent the new program from being added to the last program in the 86MM, send the Clear ("C") command prior to the new program.

The following example demonstrates a method for programming the 86MM over the RS-232 by sending commands from BASIC.

```
90 REM 86MM-2 BASIC Example Program
95 REM Open RS-232 (COM1:), 1200 Baud, control lines disabled, ASCII
100 OPEN "COM1:1200,E,7,2,CS0,DS0,ASC" AS #1
105 REM Enable, Zero position register, Toggle echo off
110 PRINT#1,"EZT"
115 REM Clear any existing program, Motor one  1000 Steps/Sec, Motor two 2000 Steps/sec, Index Motor one  1500 steps, Index Motor two 5000 steps.
120 PRINT#1,"C S1000,SM2000,I1500,IM5000,R"
130 GOSUB 500
135 REM Clear existing program, Index Motor one  900 steps, Index Motor two  320 steps.
140 PRINT#1,"C I900,IM320,R"
150 GOSUB 500
155 REM Clear existing program, Index Motor one  1000 steps, Index Motor two  -1200 steps.
160 PRINT#1,"C I1000,IM-1200,R"
170 GOSUB 500
175 REM Clear existing program, Both Motors 3000 Steps/Sec, Both Index to zero.
180 PRINT#1,"C S3000,SM3000,I0,IM0,R"
190 GOSUB 500
390 PRINT "DONE RUNNING 86MM CONTROL"
400 END
499 REM Wait until ready ("^") prompt appears in receive buffer
500 C$=INPUT$(1,#1)
510 IF C$ <> "^" THEN 500
515 REM Request motor position from 86MM and print on your computer
520 PRINT#1,"X"
530 INPUT#1,P
540 PRINT "Motor one POSITION="; P; "STEPS"
542 PRINT#1,"Y"
544 INPUT#1,P
546 PRINT "Motor two POSITION="; P; "STEPS"
550 REM Your routine for end of Index would go here
600 RETURN
```