CYB-500

Kit for Stepper Motor Prototyping Applications

CYB500MN.001 26 MAY 92 EK KTM KDG MA PRINTED IN U.S.A.

This manual contains advance product information of which certain details are subject to change.

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CYB-500

Stepper Motor Control Prototyping Board for the CY500, CY512, and CY525

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The CYB-500
Stepper Motor Control
Prototyping Board for
the CY500, CY512, and CY525

Overview

The CYB-500 prototyping board is designed to provide a variety of interface options for the CY500, CY512, and CY525 Stepper Motor Controllers. These highly integrated devices make it very easy to control a stepper motor, using simple, high-level commands and internal program storage.

In the basic configuration, the CYB-500 will support motor control signals, jump, loop, and wait program features, parallel I/O, power connections, and power drive circuitry.

By adding the CY233 Local Intelligent Network Controller (LINC), the CYB500 can be addressed over a simple serial interface, which is not available on the CY5xx chips directly. Using CYB500s with the CY233, up to 255 CYB-500s can be linked on one serial RS-232 line (IBM-PC COM1 or equivalent). This allows up to 255 Motors to be controlled by one PC.

The board also provides a parallel TTL interface to the CY500/512/525 socket. This allows you to use a parallel host, such as an 8051 or EPROM 8751, to control the CY5xx, or you may control it from the parallel port of an IBM PC. (Example driver software is provided in Basic for the IBM-PC LPT1 port.) There is an additional wire wrap area available for power drivers, A/Ds, D/As, op amps, etc.

Basic Kit	Without CYxxx Chip (Requires Assembly) @ 6 MHz
CY500	Stored Program Stepper Motor Controller @ 6 MHz
or **CY512**	Intelligent Positioning Stepper Motor Controller @ 11 MHz
or **CY525**	Intelligent Ramping Stepper Controller @ 11 MHz

Options:

CY233	CY233	Network Controller Chip
Power-4	WM063	Elpac Power Supply
Serial Cable	4RJ-DB25F	4-conductor modular cable with DB25

Stepper Motor Controller Selection Guide

CY 500	CY 512	CY 525	Function
2K	5K	10K	Max Usable Step/Sec
64K	64K	64K	Max Number of Steps
21	25	26	Number of Instructions
18	48	60	Program Storage (bytes)
Exp	Exp	Lin	Accel (Exponent/Linear)

			Motor Support
	●	●	Pulse & Direction Output
●	●	●	4-phase Output
●	●	●	2-phase Compatible
	o	o	3-phase Compatible
●	●	●	4 phase Compatible
	o	o	5-phase Compatible
●	●	●	Full Step
●	●	o	Half Step
		o	Quad Step
●	o	o	Single Step (Jog Mode)
o	o	●	Continuous Stepping
●	●	●	Constant Rate stepping
●	●	●	Ramped Stepping
o	o	o	Limit Detection

			Command Interface
●	●	●	Parallel Interface
●	●	●	Binary Data Structure
●	●	●	ASCII Data Structure
●	●	●	Internal Stored Program
●	●	●	Direct Command Mode
	o		Stand Alone Operation

CY 500	CY 512	CY 525	Function
			Program Features
	●	●	List Prog Buffer Contents
	●	●	Display # of Steps Param
	●	●	Display Accel Parameter
	●	●	Display Step Rate
	●	●	Display Current Position
●	●	●	Stored Prog Execution
●	●	●	Conditional Prog Structure
●	●	●	Programmable Time Delay
	256	256	Program Repetition Count
	●	●	Unconditional Branch
1	1	1	Programmable I/O Lines
		●	Program Labels
●	●	●	Multi-controller Sync
		●	Live Cmds During Prog Exec

			Motion Features
o	o	●	Programmable Start Rate
●	●	●	Programmable Slew Rate
o	o	●	Program. Accel/decel Slope
●	●	●	Software Direction Control
	●	●	Automatic Direction Finding
●	●	●	Program. Num of Steps
●	●	●	Absolute Position Stepping
●	●	●	Relative Num of Steps
●	●	●	Emergency Stop/Abort
	●	●	Decelerating Stop/Abort
●	●	●	Step Inhibit Input
	●	o	Closed Loop Rate Control
●			External Direction Control
●	●	●	Motion Complete Indicator
	●	●	Slew Indicator
●	●	●	Prog Complete Indicator
●			External Jog Mode
		●	On-the-Fly Rate Change
		●	On-the-Fly Position Output

● Yes

o To a Degree or with Additional Work

CYB-500 Specifications

- The CYB-500 board may communicate with a host computer over a standard parallel interface, or over a three-wire RS-232 interface when using the CY233, or it may be used in a stand-alone configuration with an on-board parallel host.
- Supports CY500, CY512, and CY525 Stepper Motor Controllers.
- The board can operate at standard baud rates between 300 and 19,200 baud.
- LEDs on the 5 volt power supply and on eight output signals.
- Switches on seven input signals.
- On-board Power Driver IC provides up to 1.5 amps per phase @ 35 V max
- Compact size 100mm x 160mm (approximately 4" x 6.3") single height Eurocard format. Wire wrap area included for customization.
- Power requirements:

  Board voltage: +5V (200 mA max) for all options except motor driver.

  Optional + and – voltage connections are provided for custom circuits.
  Separate power supply required for Motor/Driver circuit.
  RS-232 voltages are generated internally.

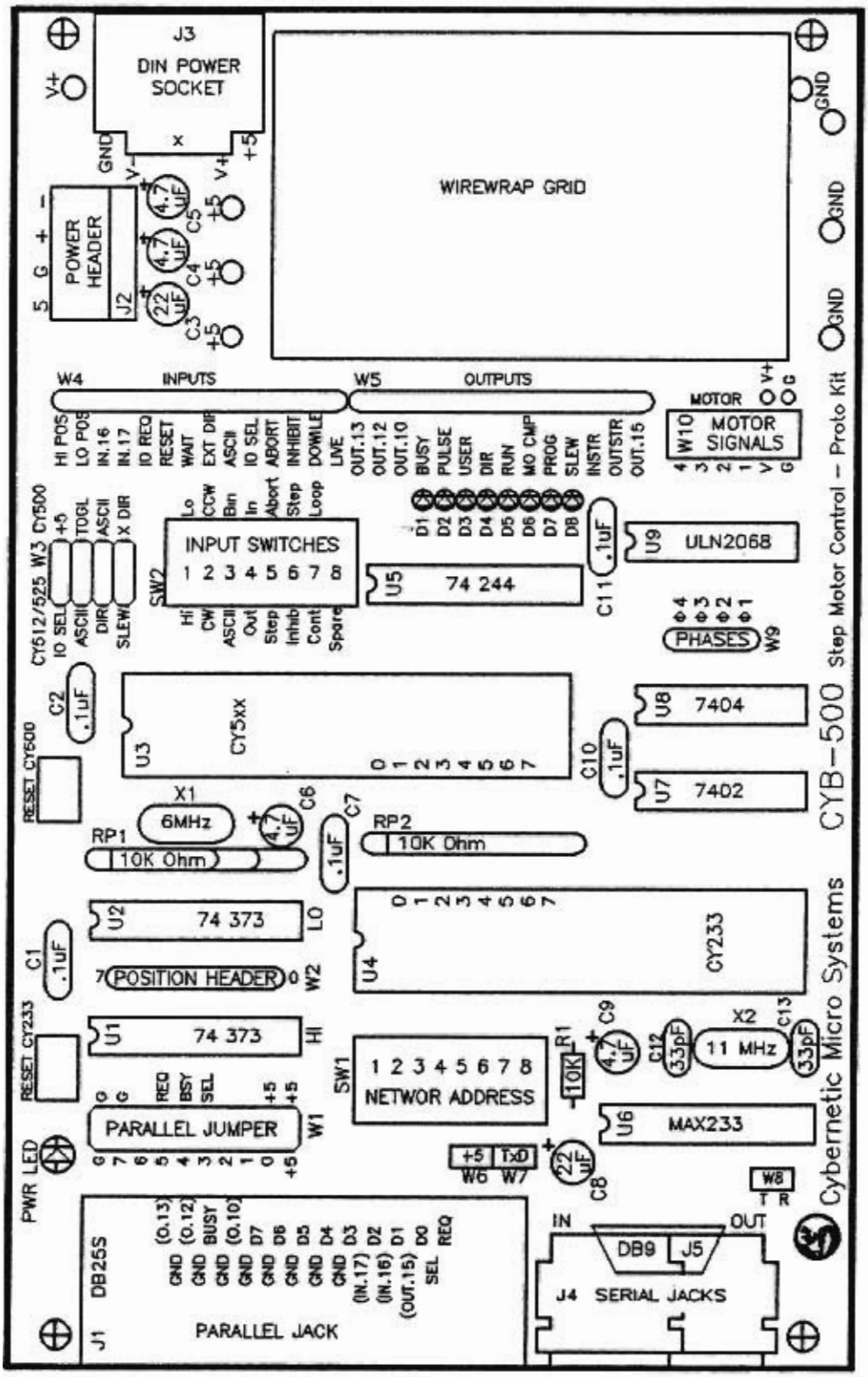
Tools Required

Assembly of the CYB-500 may require the following tools:

- ☐ A pair of needle-nose pliers
- ☐ A pair of small diagonal cutters
- ☐ A soldering iron
- ☐ Some rosin core solder
- ☐ A Volt-Ohm-Milliamp meter for testing

NOTE: Before assembling this board, you may wish to read the sections following Theory of Operation in order to decide if you will want to modify any of the board configurations. It may NOT be necessary to install some of the components, depending on your application.

CYB-500 Component Locations and Values

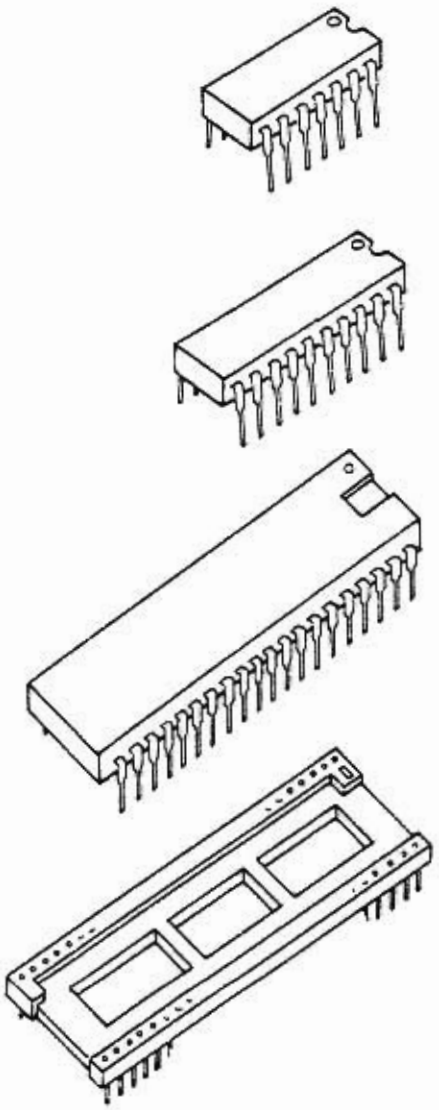


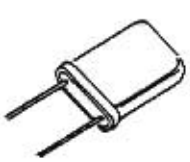
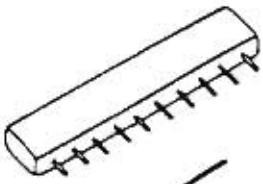
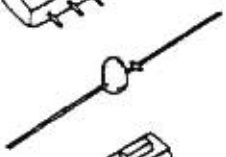
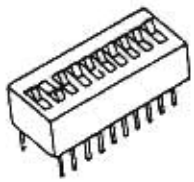
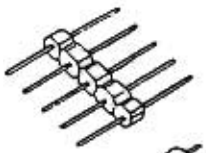
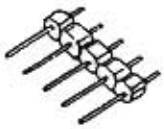
Parts List

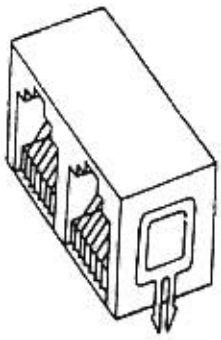
The following parts list describes the parts included with the CYB-500. Check the kit to be sure it is complete. The novice assembler may also use this opportunity to become more familiar with the various types of components supplied. NOTE: DO NOT REMOVE INTEGRATED CIRCUITS FROM THE CONDUCTIVE FOAM UNTIL READY TO USE.

CYB-500 Basic Board

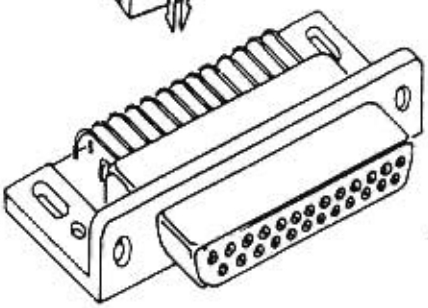
QTY	PART #	DESCRIPTION
☐ 1	CYB500PWB	Printed Wiring Board
☐ 1	CYB500Man	Assembly Manual
☐ 1	7402	Quad 2 input NOR gate
☐ 1	7404	Hex inverter
☐ 1	ULN2068B	Power Driver
☐ 1	MAX233	RS-232 driver/receiver
☐ 1	74LS244	Octal Tristate Buffer
☐ 2	74LS373	Octal Latch
☐ 1	CY500 or CY512 or CY525	Stepper Motor Controller
☐ 2	C89-40-01	40 pin low profile IC socket



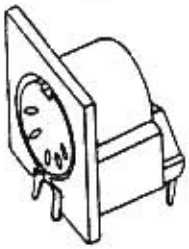
	QTY	PART #	DESCRIPTION (cont)
	☐ 1	MP06	6 MHz Crystal
	☐ 1	MP110	11 MHz Crystal
	☐ 5	TCD104M	0.1uF (or 0.01uF) 50V ceramic disc capacitor
	☐ 2	CCD330	33pF ceramic disc capacitor
	☐ 4	513D475M063JA4	4.7uF 63V single-ended electrolytic capacitor
	☐ 2	513D226M025JA4	22uF 25V single-ended electrolytic capacitor
	☐ 1	R10K	BRN-BLK-ORG-gld 10K ohm 1/4 Watt Resistor
	☐ 2	CSC10A-01-10K	10K ohm Resistor Pak 10 pin SIP
	☐ 9	HLMP-6600	Red LED w/internal Resistor
	☐ 2	Alco-FSM	Push Button Reset Switch
	☐ 2	76SB08	8 position DIP Switch
	☐ 1	CA-S36 SP100-230-930	36 headers, wire-wrap (strips)
	☐ 1	CA-S36 SP100-230-430	36 headers, solder tail (strips)
	☐ 4	Shunts	Shorting Plugs



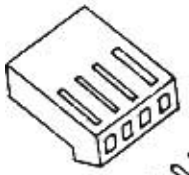
QTY	PART #	DESCRIPTION (cont)
☐ 1	TM2REA-1212	Double RJ11 Jack for RS-232



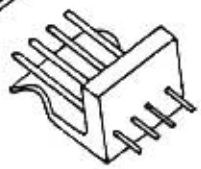
☐ 1	DBP-25SCA	25 pin sub-D connector



☐ 1	WMPCBA	180° 5-pin DIN power socket

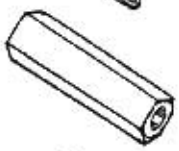


☐ 1	09-50-3041	4 pin housing, .156 centers, with locking ramp



☐ 1	09-65-1041	4 pin polarized Header, .156 centers, .045 round post

☐ 4	08-50-0106	Crimp pins for above housing



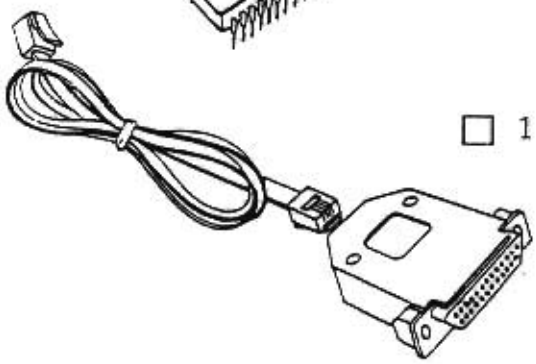
☐ 4	4309	Hex Nylon threaded spacer, 4-40 x 3/4"

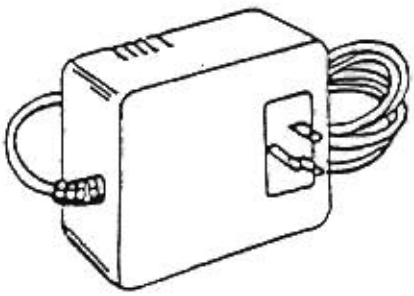
☐ 4	2501	Nylon Screw, binding head, 4-40 x 3/8"

NOTE: Certain items may have other values or part numbers substituted for those indicated. These will not affect performance of your kit.

Options

QTY	PART #	DESCRIPTION
☐ 1	CY233	Serial/Parallel Network Controller IC
☐ 1	4RJ-DB25F	4-conductor modular cable with DB25 connector for CY233 serial signals
☐ 1	Power-4	Elpac WM063 Power Supply +5 @380mA, +12 @180mA, -12 @180mA, and GND (Will supply adequate power for board w/all options except Driver. Power Supply can provide only 90 mA per phase to driver.)

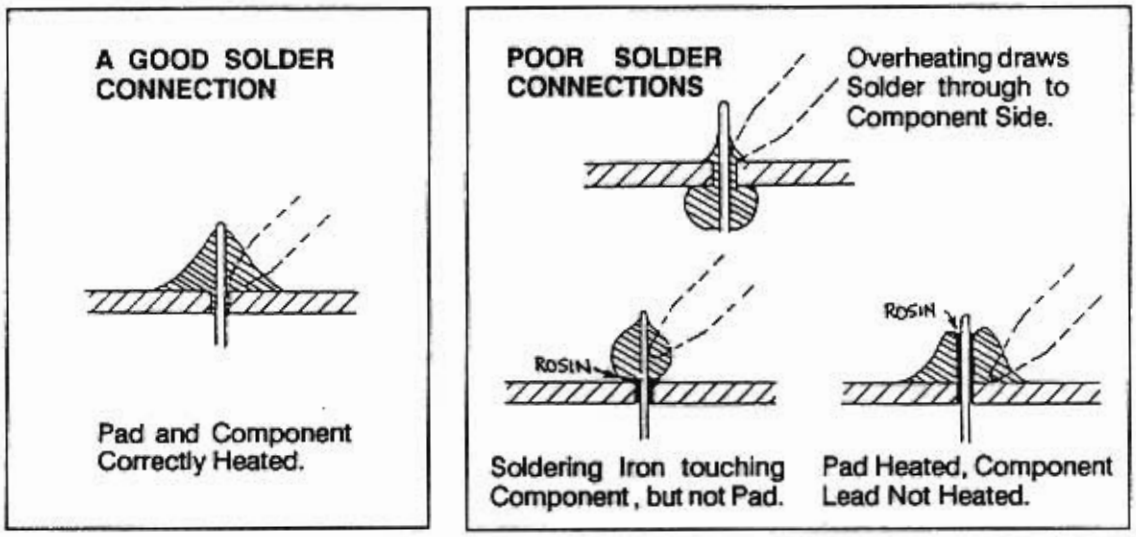




Assembly Procedure

The CYB-500 will be assembled in stages, with similar components installed at the same time. Soldering technique is very important when assembling a PC board. The soldering iron tip should be kept reasonably clean during soldering. This usually requires that it be wiped on a damp sponge after every few components. While the iron is not being used, a slight residue of solder on the tip will keep it from overheating, prolonging the tip life. Components should be installed so they rest fairly close to the board surface on the component side (front side, with silk screened printing). Components with long leads (resistors, capacitors) should have the leads cut before soldering. Leads should extend between 1/8 and 1/4 inch from the solder side (back side) of the board.

To solder a component in place, install the component at the proper location on the board. This may require bending the leads of some parts. All components are installed from the component side of the board. Be sure that all leads show through the solder side before soldering, especially when installing the integrated circuits. If required, cut the leads from the solder side of the board. The component is now ready to solder in place. Heat the component lead and the board pad to which it will be soldered for one to two seconds, from the solder side. Then, with the iron still in place, apply some solder to the area. Keep the iron in place until the solder flows around the component lead and pad, then remove. The whole procedure should take from two to five seconds, depending on the size of the component and the board area to which it is attached. When properly done, solder will flow through the hole in which the component is placed, and be visible from the component side. CAUTION: DO NOT OVERHEAT THE COMPONENT DURING SOLDERING. THIS MAY DAMAGE THE PART. Also, if the parts are not heated enough, cold solder joints and connections will result. A properly soldered component will have the solder firmly and smoothly melted around both the component lead and over the pad to which it is attached. Solder should flow through the mounting hole and be visible from the component side, but the part should not be overheated and damaged in the process.



The following pages give a step-by-step procedure for assembly of the CYB-500, including photographs of the completed Board.

RESISTORS

The resistors will be the first components installed on the CYB-500. To install each resistor, the leads must be bent and cut to fit. Resistors are installed as follows:

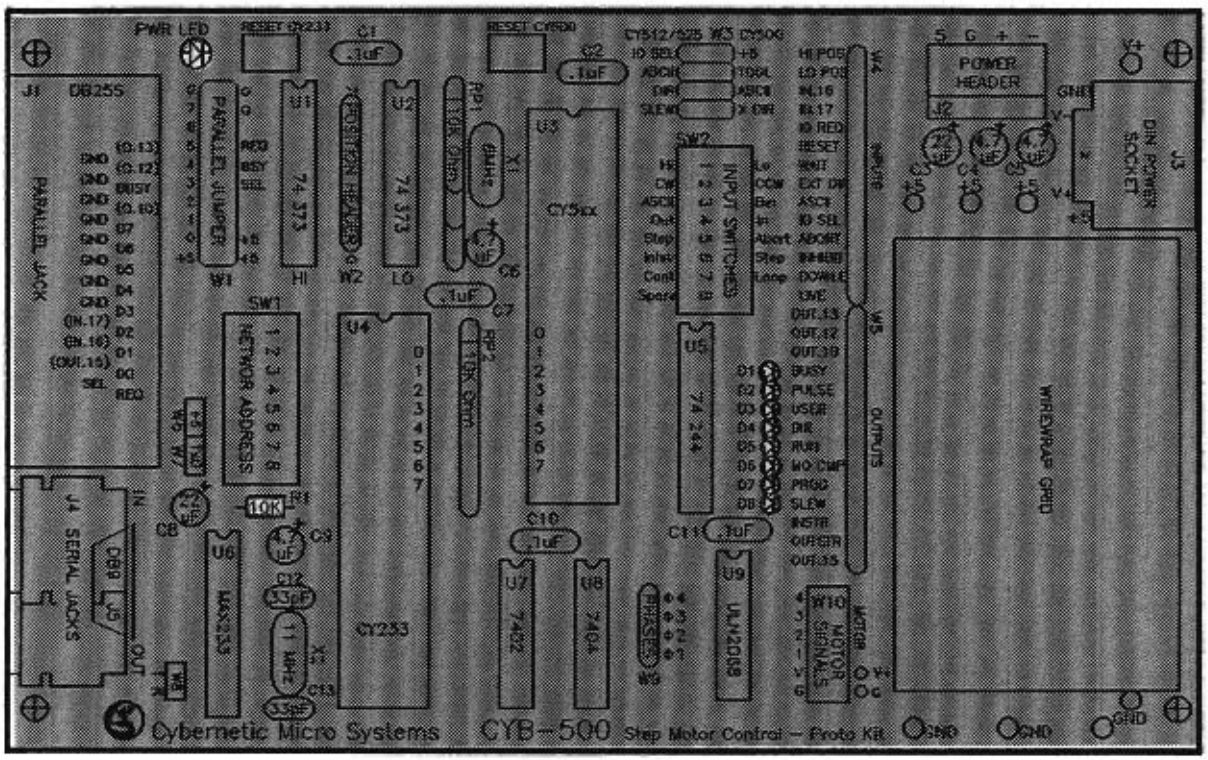
☐ Install the 10K ohm resistor (brn-blk-org-gld) in location R1.

DIODES

There is one miniature light emitting diode (LED) indicating power is applied to the CYB-500 and additional LEDs on the outputs of the CY5xx. The LEDs are polarized and must be installed properly to work. The cathode (negative) side is indicated by a bar across the lead, or by a painted bar on the body of the LED, and is shown as a bar on the silkscreen. This cathode side should face the wirewrap area. The positive or anode side of the LED is shown on the silkscreen as a triangle and is connected to +5 volts.

☐ Install the Power LED at location PWR, next to the DB25 pattern.

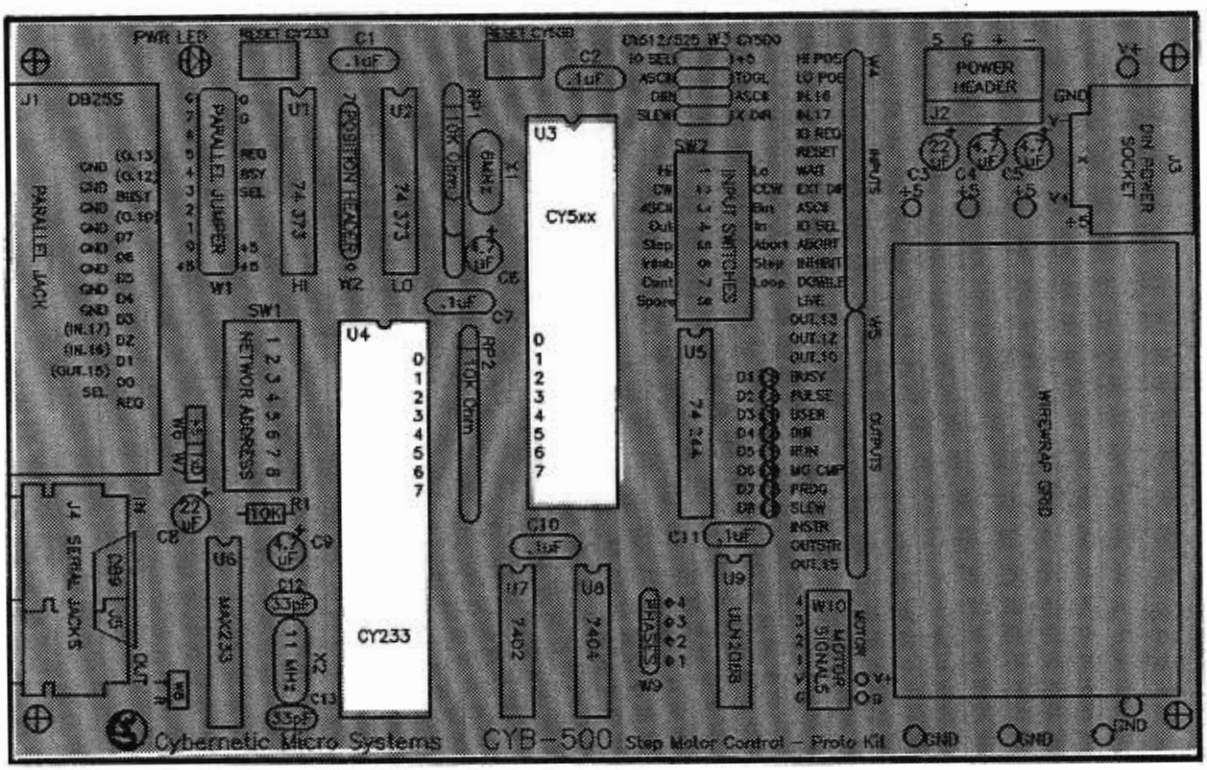
☐ Install 8 LEDs at locations D1 to D8.



INTEGRATED CIRCUIT SOCKETS

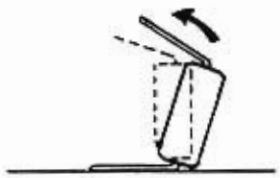
Solder tail sockets are provided for the CY5xx and CY233. The sockets have a notch or other marking to designate the pin 1 side, and should be installed to match the patterns of the CYB-500 silkscreen.

☐ Install the 40 pin solder tail sockets in locations U3 for the CY5xx, and U4 for the CY233.



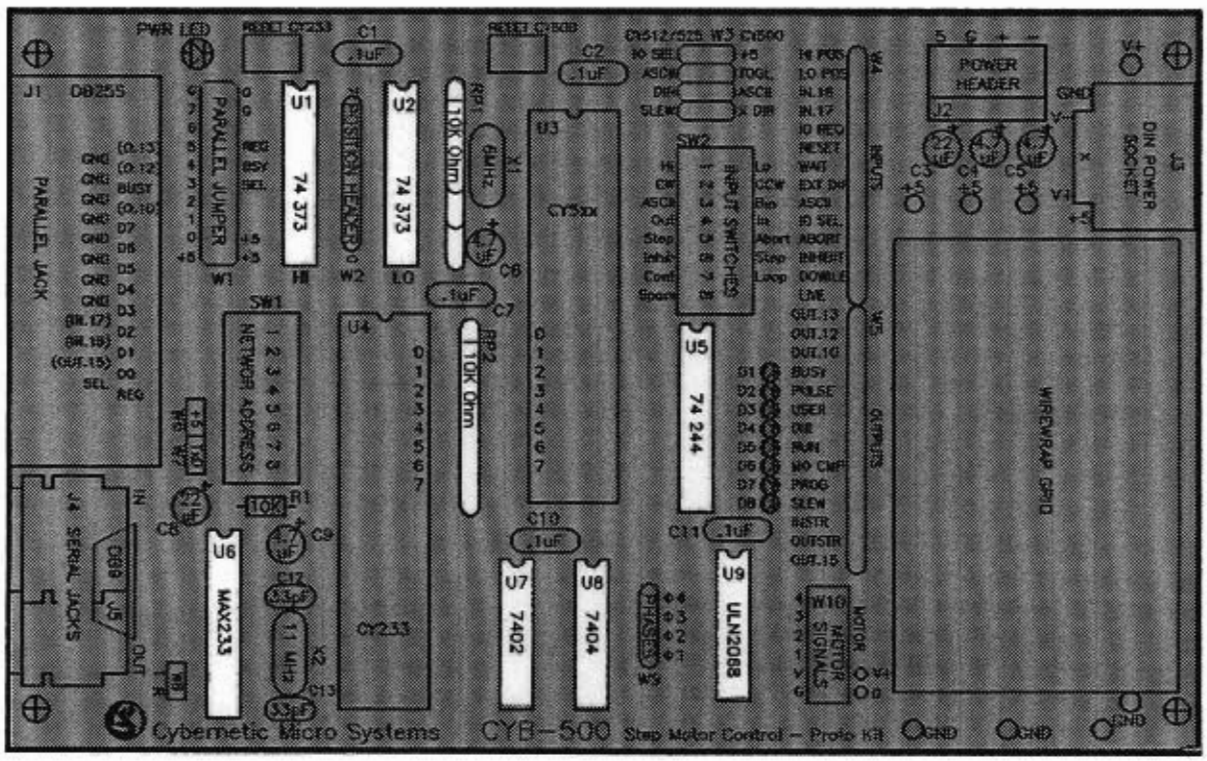
INTEGRATED CIRCUITS

The Integrated Circuits (ICs) are the next components to be installed. They are the most sensitive to damage from static electricity and overheating during soldering. When handling the ICs, touch the pins as little as possible. Keep them in the conductive foam until ready to install. In order to fit the pins into the hole patterns, it may be necessary to bend them in slightly, so they are perpendicular to the IC package. This is most easily accomplished by laying the IC on its side on the work surface and pushing on the body until the pins are straight. This procedure should be repeated for each side. The ICs must be properly oriented when installed. Any part installed backwards will be damaged when power is applied to the CYB-500. Each IC package has a notch or dot on one end, which corresponds to the pin 1 side of the IC, and should be installed to match the



notched pattern of the silk screen. Before soldering the IC in place, be sure every pin is through the proper hole in the pattern. It is very difficult to remove and correct a pin problem once the IC is soldered. Finally, during soldering, heat the pins just enough to make a good solder bond. If the ICs are overheated during soldering, they may be damaged. Be sure to solder each pin and be careful to not leave any solder bridges between the pins.

- ☐ Install two 74LS373s in locations U1, U2.
- ☐ Install the 74LS244 in location U5.
- ☐ Install the MAX233 in location U6.
- ☐ Install the 7402 in location U7.
- ☐ Install the 7404 in location U8.
- ☐ Install the ULN2068B in location U9.
- ☐ Install the 10-pin 10K ohm resistor SIPs in locations RP1 and RP2. The common pin of the resistor pak, indicated by a dot or other marking, should match the square pad on the board.



CAPACITORS

Capacitors will be installed next. Leads should be trimmed to the proper length before soldering. The ceramic disc capacitors have no polarity, while the electrolytic capacitors are polarized and must be installed with the proper orientation. All polarized capacitors are noted by a "+" on the board and a "+" or "-" on the capacitor body. The capacitors are installed as follows:

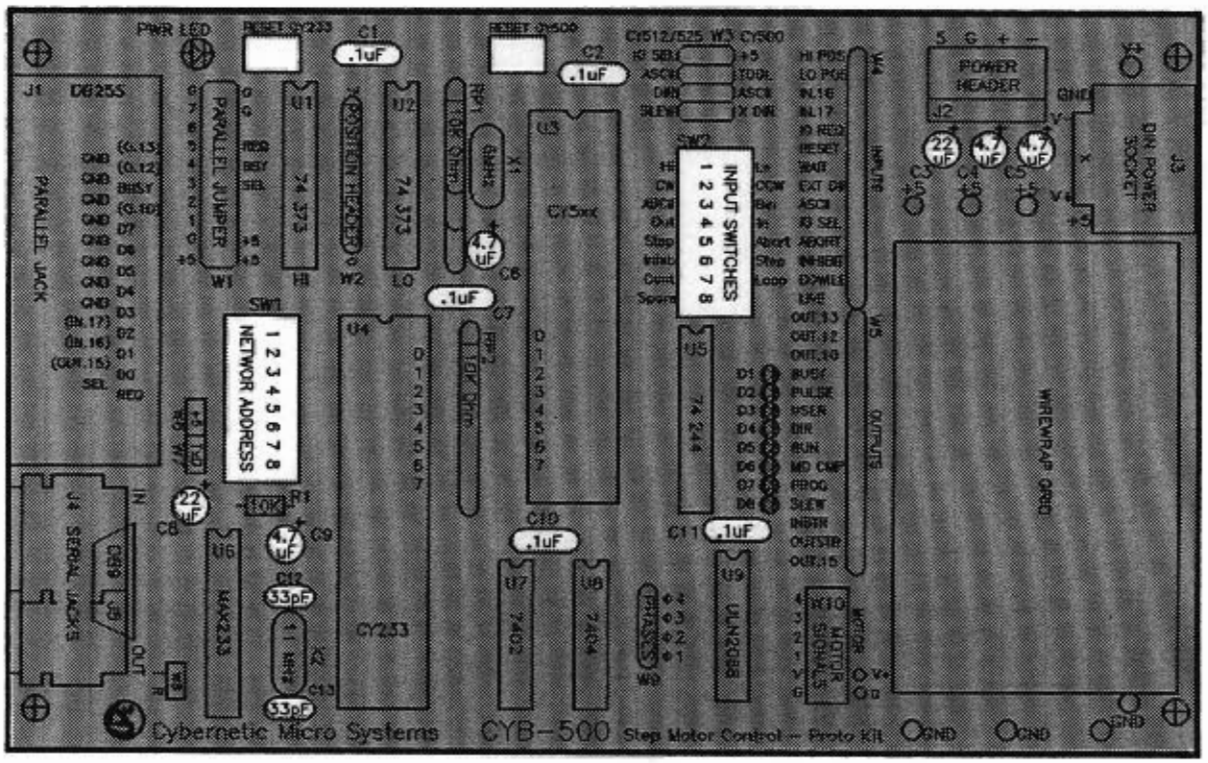
- ☐ Install two 33 pF ceramic discs in C12, C13.
- ☐ Install five 0.1 uF ceramic discs in C1, C2, C7, C10, C11.

- ☐ Install the two 22 uF electrolytic capacitors in C3, C8.
- ☐ Install the four 4.7 uF electrolytic caps in C4, C5, C6, C9.
  If running motor voltage through C5, then be sure the cap is properly sized for the voltage being used.

SWITCHES

There are four switch locations on the CYB-500. There is no electrical polarity to these switches. However, the 8 position DIP switches at SW1 and SW2 have a proper orientation, due to the numbering scheme of the 8 switches, requiring switch position number one to match the pattern on the board.

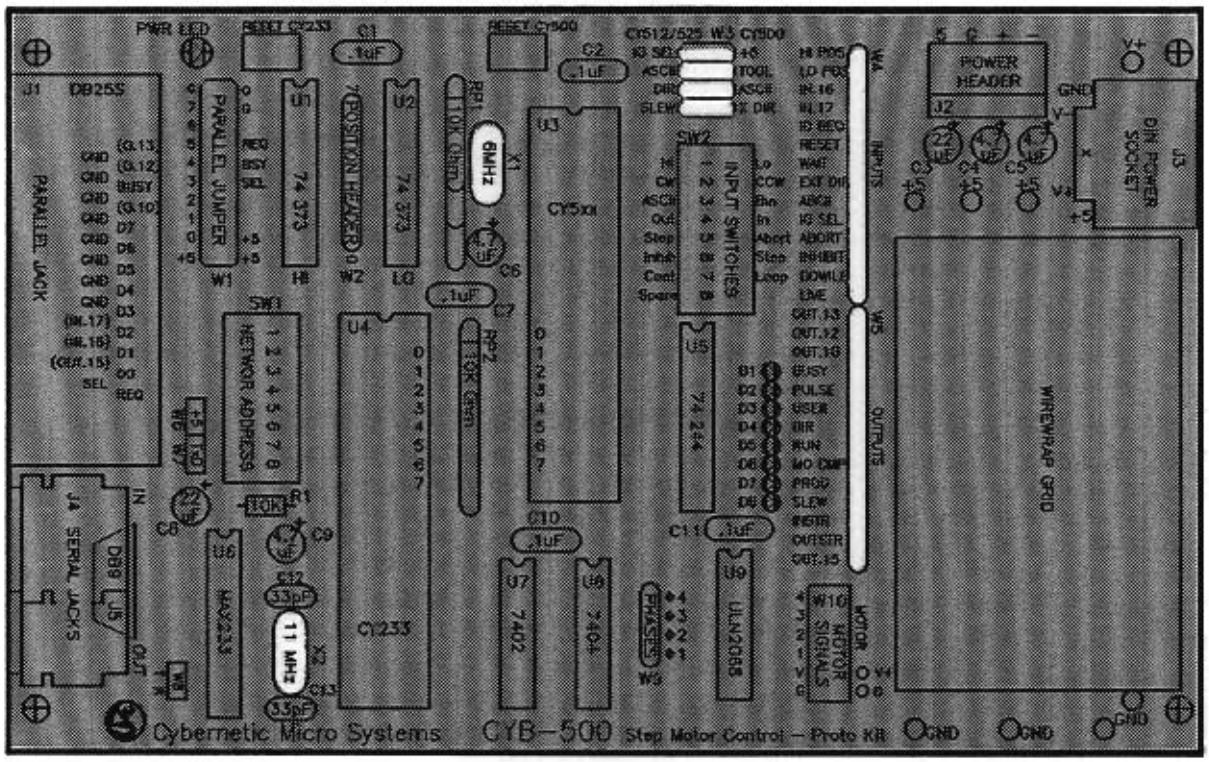
- ☐ Install the two push button reset switches at locations RESET CY233 and RESET CY500.
- ☐ Install the two 8-position DIP switches at locations SW1 and SW2.



STRIP LINE HEADERS

Wire wrap posts are provided in single-row strips which are broken into the appropriate lengths and soldered into the jumper pads. Jumpers are then wired together by wrapping a short piece of wire wrap wire between the appropriate posts or by using shorting plugs. Solder tail posts, which have one section slightly longer than the other, are also used on the board. The solder tail posts should be inserted with the short, solder tails protruding through the board to the solder side. This leaves the slightly longer section of the post available on the component side for attaching the jumper wires. Wire wrap posts, which have one section much longer than the other, should be inserted with the longer wire wrap tails protruding through the solder side of the board. Connections from these jumpers would be wired from the solder side.

- ☐ Install wire-wrap posts in jumpers W4 and W5.
- ☐ Install solder tail posts in W3.
- ☐ Locations W6, W7, and W8 do not require posts.
  Posts may optionally be installed in locations W1, W2, W9, and W10, depending on your application. See "Jumper Functions".



CRYSTALS

There are two crystals on the CYB-500, one the CY5xx and one for the CY233. The crystals are installed standing up, to minimize occupied board space.

- ☐ Install an 11 MHz crystal in location X2 for the CY233.
- ☐ Install a 6 MHz crystal in location X1 for the CY500 or install an 11 MHz crystal in location X1 for the CY512 or CY525.

CONNECTORS

The CYB-500 is supplied with a double female RJ11 telephone-style serial connector for the RS-232 interface and a DB25 female connector for the parallel interface. The receptacles should face away from the board.

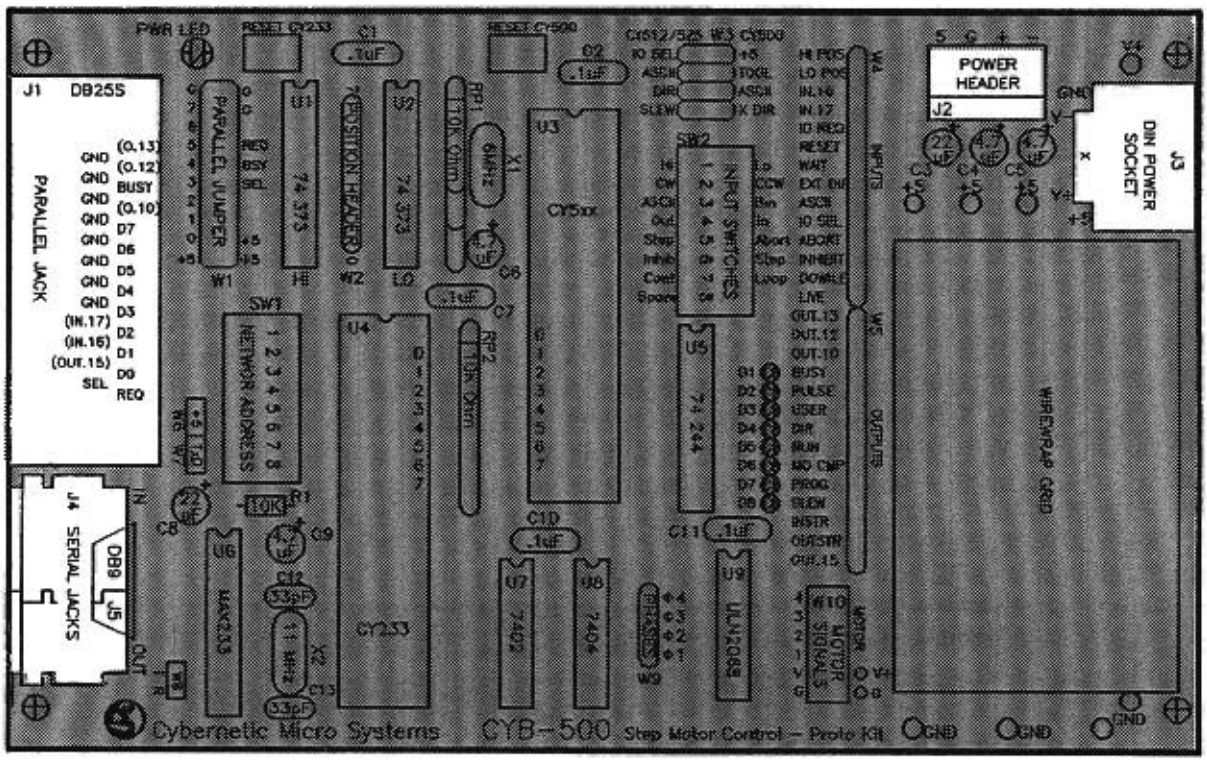
- ☐ Install the RJ11 RS232 connector in location J4. A female DB9 pattern at location J5 occupies the same space as the RJ11 pattern, and you may use your own DB9 female connector instead of the RJ11.

- ☐ Install the DB25 Parallel connector in location J1.

Two power connectors are supplied with the board: a 180° 5-pin DIN connector and a 4-pin power header. The header half of the 4-pin power connector is installed on the board, and the connector housing and crimp pins are for fabricating a connection to your power supply. The DIN connector shares the edge of the board with the VME pattern, and is optional.

- ☐ Install the 4-pin power header in location J2.
  The connection pins should face the edge of the board.

- ☐ Install the optional 5-pin DIN power connector in location J3 if not using a VME card cage connector.



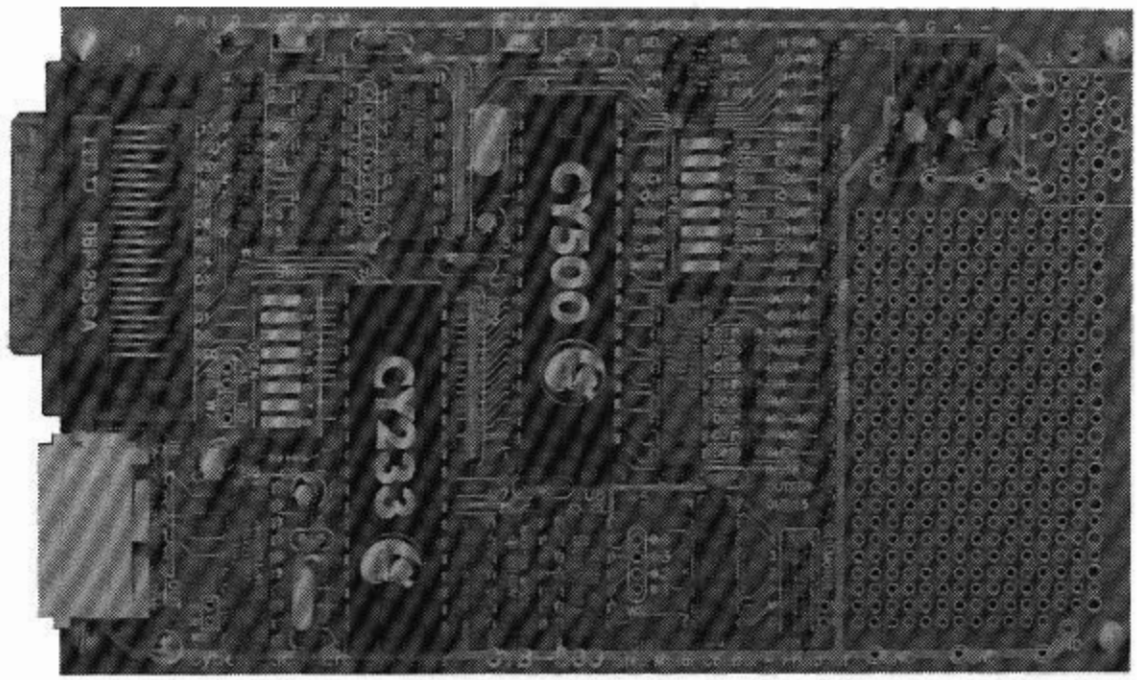
Clean the board according to the following instructions and follow the "Final Assembly and Checkout" procedures at the end of this manual before inserting the CY233 and CY5xx in the 40 pin sockets at U3 and U4. Be careful to match the notch in the chip with the silkscreen pattern on the CYB-500.
When all the parts have been installed, the board should be cleaned to remove the solder flux residue which results from the soldering operation. It is only necessary to clean the solder side of the board. The board should be cleaned with rubbing alcohol, which does not leave a residue. It is often helpful to use a toothbrush or similar device to help scrub the board. Once the flux has been removed, the solder side may be scrubbed with a mild soap and water solution, then rinsed with clean water. Do not immerse the board, as this may damage some components. Rather, rinse the solder side of the board gently under running water. The board should be reasonably clean and free of flux when this operation is complete. Dry the board gently to remove all water. Do not apply power to the board until it is completely dry.

The screws and spacers are used as feet for the four corners of the CYB-500 board.

☐ Install the 4 spacers and screws on the four corner mounting holes.

This completes the main assembly procedure. The following sections explain the theory of operation, which must be understood to determine the proper jumper connections and switch settings. Then the jumper options are explained and the connector pinouts are listed. This will allow the user to make the cables necessary to connect the board to the local computer, the power supply, motor driver, and other parts of the system, as required.

Assembled CYB-500 (with Options)

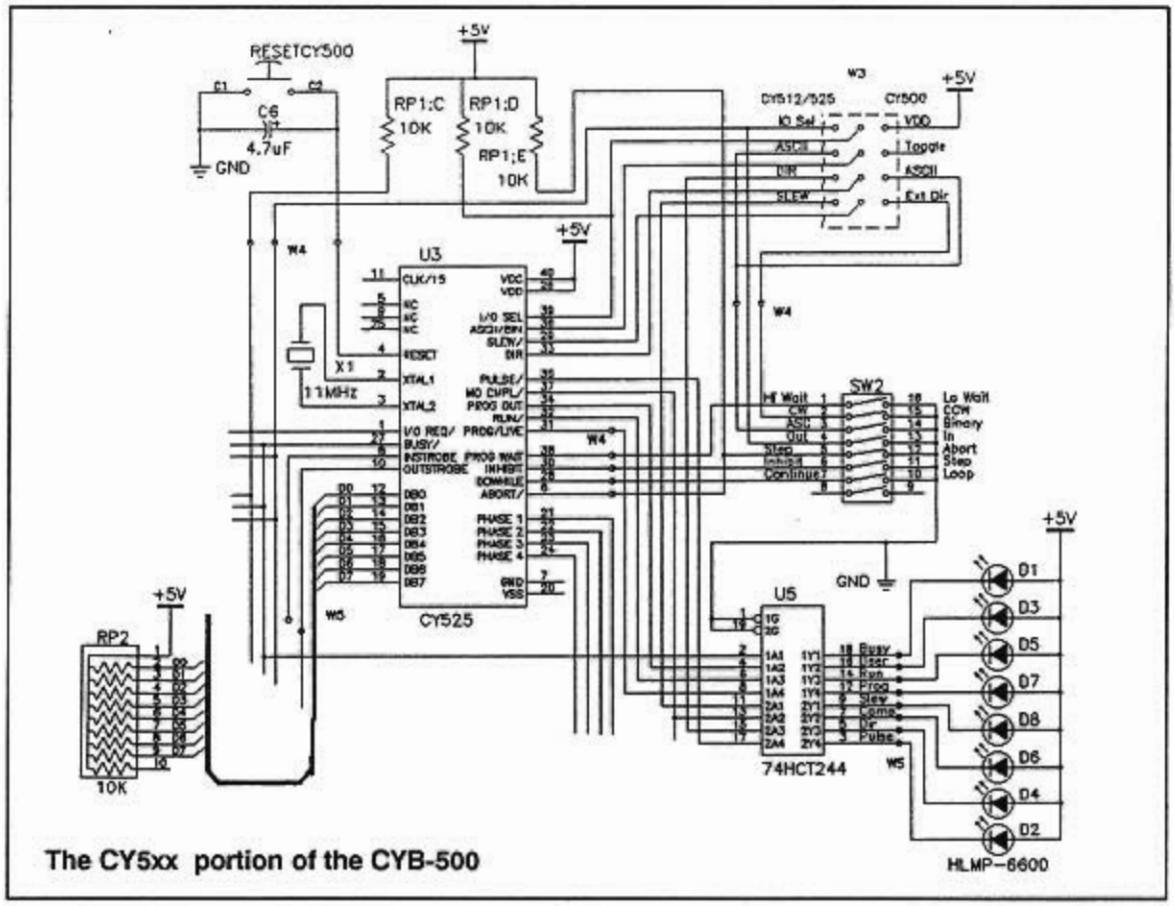


CYB-500 Theory of Operation

The CYB-500 Prototyping Board implements the basic support circuits for the CY500, CY512, or CY525 Stepper Motor Controllers. This includes the CY500/CY512/CY525 itself, passive support devices, the CY233 LINC for direct serial interface or networking of multiple CYB-500s, a direct parallel interface which is compatible with IBM PC printer ports, a simple L/xR type driver circuit, and a wire wrap prototyping area. The CYB-500 schematic is included in this section, and is the basis for this discussion.

The CY500/CY512/CY525

The motor controller device is the key component of the CYB-500 board. It supports three different Stepper Motor Controllers, the CY500, CY512, or CY525. These devices are based on similar technology and have two basic pin-outs, that of the CY500 and that of the CY512/CY525. The jumper options at jumper W3 handle the signal differences between these devices.



The CY5xx portion of the CYB-500

Each different controller is described in its own User Manual, including descriptions of all pin functions and commands. This information will not be repeated here. Refer to the specific User Manual for basic definitions and descriptions.

Support circuits for the CY500/CY512/CY525 include a crystal, which provides basic timing for the device, and is used to derive specific step rates and timing functions. The default value for the crystal is 11 MHz for the CY512 and CY525, and 6 MHz for the CY500, which does not function to 11 MHz. A separate reset circuit is also provided, with a 4.7 uF capacitor providing an automatic reset at power-on, and a push-button switch providing a manual reset.

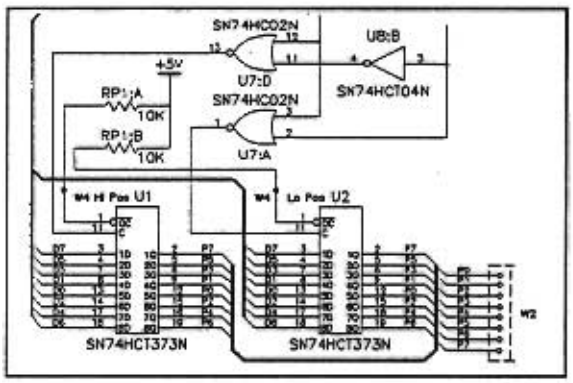
The motor controller output signals are connected to a '244 buffer, which drives indicator LEDs. Each LED lights when the associated signal is a logic low level. The signals from the buffer outputs are also available at posts on jumper W5, where they may be connected as required by the application.

Similarly, the input signals are available at posts on jumper W4, and may be driven by TTL level application signals, if desired. Optionally, the signals may be controlled manually by DIP switch SW2. When the inputs are driven by external signals, be sure the associated switch is in the "open" or "off" position, so it can be driven without interferance from the switch.

Data bus and handshake control signals are connected as required on the board, to function with the other components, such as the CY233 LINC. They are also brought to two interface points on the board. Jumper W1 is provided for custom direct parallel interfaces, and can be connected to a 2x10 ribbon cable. This connection is compatible with a similar jumper on the CYB-550 board, allowing both to be driven by a similar interface.

The signals are also brought directly to the IBM PC compatible parallel printer port interface, which will be discussed later in this section.

Finally, two '373 latches are provided in support of the CY525. They are not used or required by the CY500 or CY512. These latches hold the current position value when the CY525 on-the-fly position update function is enabled. The latch outputs are connected together, and are normally tri-state. A separate control signal enables each latch output, allowing the host system to control the reading of the latch values.



The latch outputs may be connected to a separate input port of the host, or with some care in timing, they could be connected to the board data bus. When host software reads the position values in this case, the timing must be such that it will not conflict with the CY525 use of the data bus for updating the latches.

The CY233

The CY233 option allows the CYB-500 to be used with a serial port. Since the CY233 also supports network configurations, with node addressing, multiple CYB-500 boards can be controlled from the same serial port through this device. The UART mode can be selected for direct serial communications, while the normal networking mode will work for one-to-one connections or for multiple boards in a network.

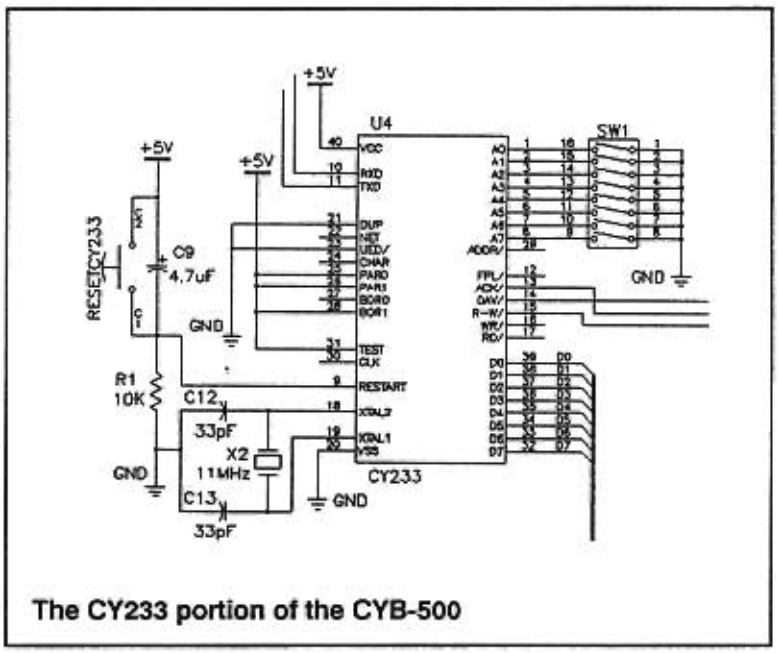
Support circuits for the CY233 include a separate crystal oscillator and a separate power-on reset circuit, with its own push-button switch. Also included are data bus pull-up resistors.

The CY233 address lines are connected to address switches, making it easy to select a decoded mode address. This allows up to eight CYB-500 boards to be controlled by one serial port. If more than eight boards must be controlled from the same port, the CY233 must be operated in encoded mode, which requires you to cut the U-E-D signal trace from ground, and add custom address decoding circuits. Details of encoded mode are discussed in the CY233 User Manual. For the default decoded mode, simply close one of the switches to select the address for that CYB-500. The other switches should be left open.

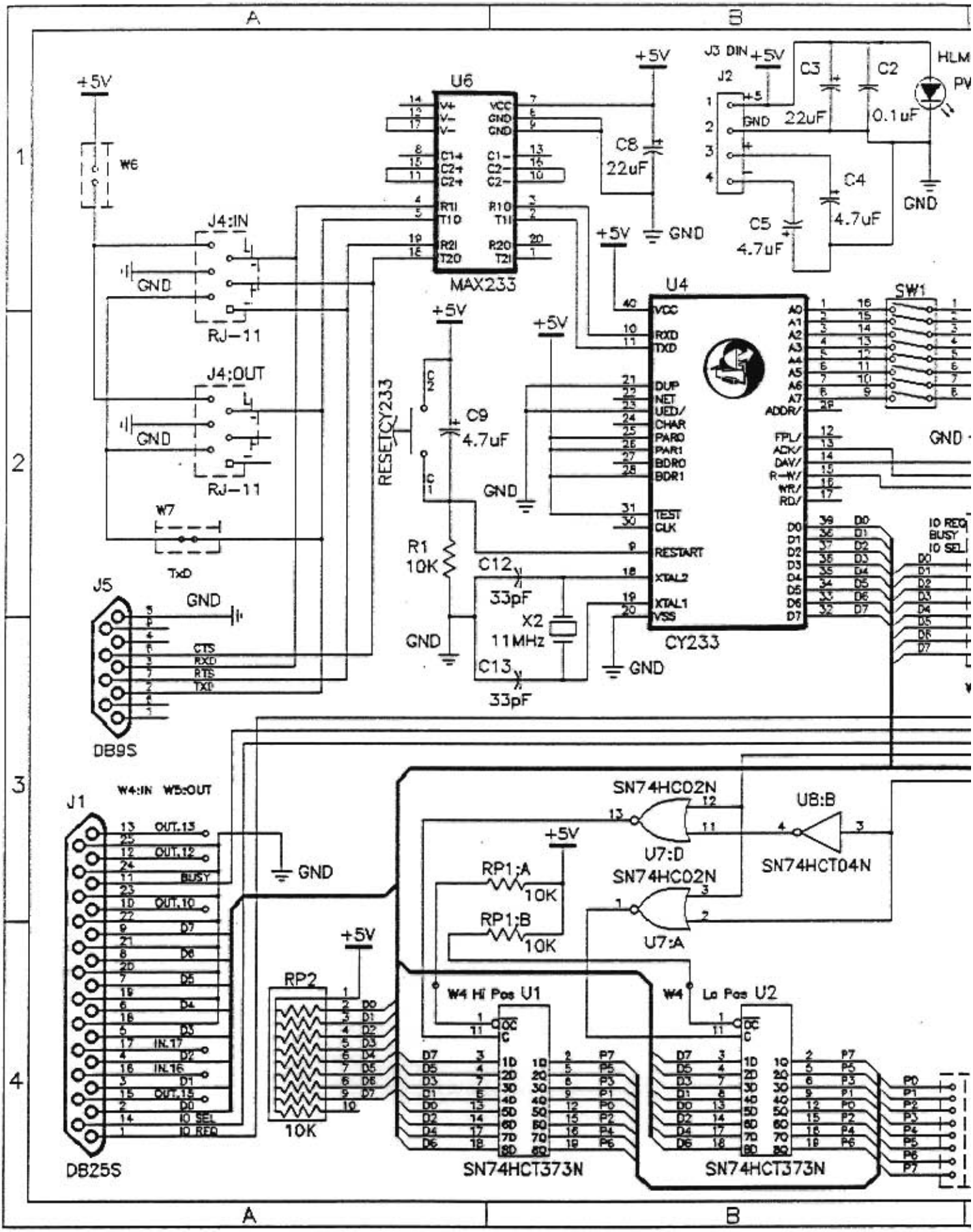
For the direct UART mode, the U-E-D signal trace must also be cut, and reconnected to +5 volts. This would allow direct serial communications with one CYB-500 board, avoiding the CY233 message prefix characters (Wxx) before the CY500/CY512/CY525 commands.

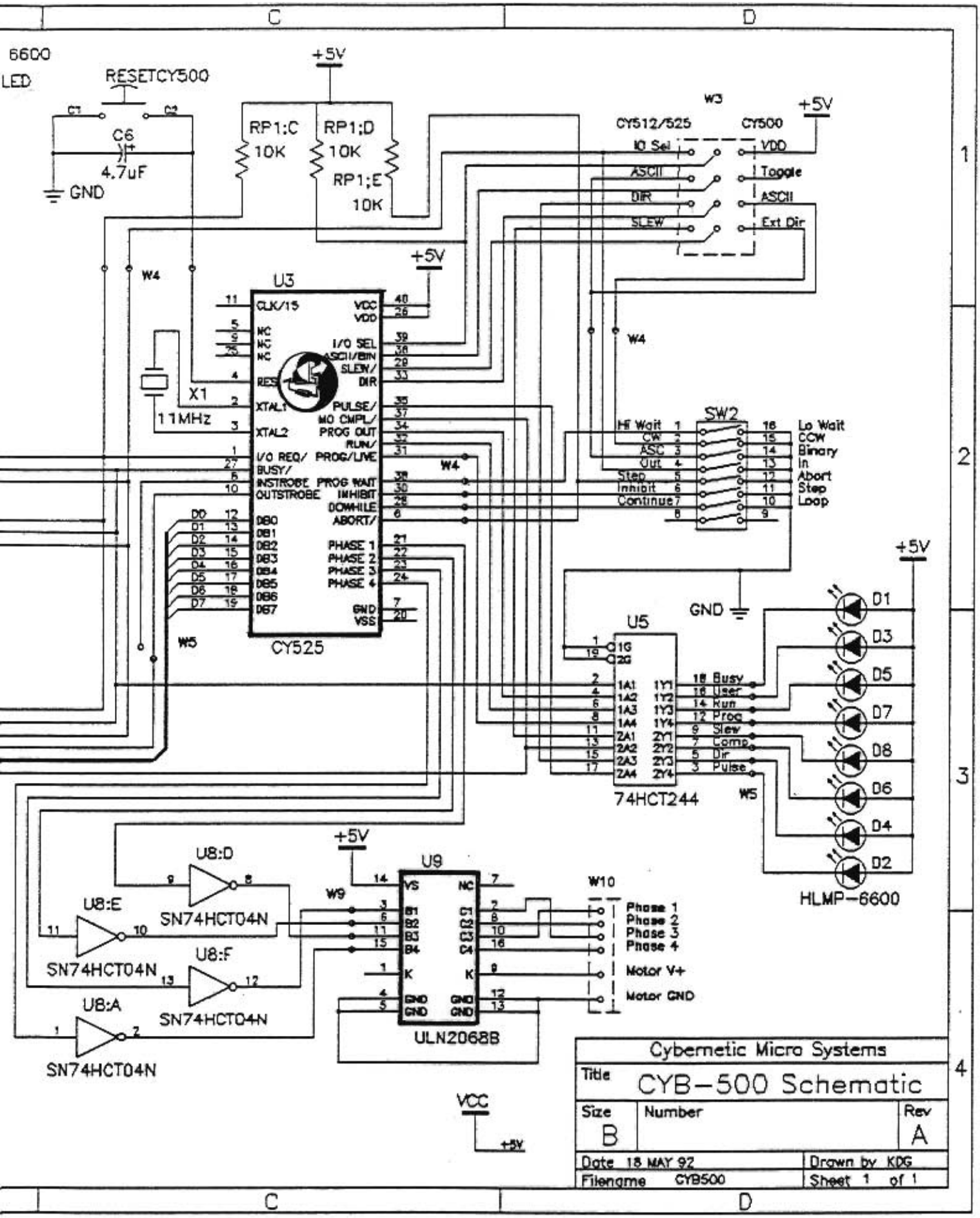
The CY233 data transfer handshake signals are connected to the appropriate CY500/CY512/CY525 signals, implementing the proper parallel interface between the CY233 and the motor controller. The data bus signals are directly connected between the CY233 and CY500/CY512/CY525.

The serial data lines are connected to the MAX233 driver/receiver chip, and through it to the RJ-11 serial jacks. For convenience in daisy chaining multiple boards together, the RJ-11 jacks are dual jacks, with an input side and an output side. The CY233 received data signal is connected to the input side, while the transmitted data



The CY233 portion of the CYB-500


A
B
1
2
3
4
+5V
W6
U6
MAX233
C8
22uF
GND
J3 DIN
J2
C3
C2
22uF
0.1uF
HLM
PW
C4
4.7uF
C5
4.7uF
J4:IN
RJ-11
J4:OUT
RJ-11
W7
TxD
RESETCY233
C9
4.7uF
U4
CY233
SW1
R1
10K
C12
33pF
X2
11MHz
C13
33pF
J5
DB9S
CTS
RXD
RTS
TXD
J1
DB25S
W4:IN W5:OUT
SN74HC02N
U7:D
U8:B
SN74HCT04N
SN74HC02N
U7:A
RP1:A
10K
RP1:B
10K
RP2
10K
W4 Hi Pos U1
W4 Lo Pos U2
SN74HCT373N
SN74HCT373N

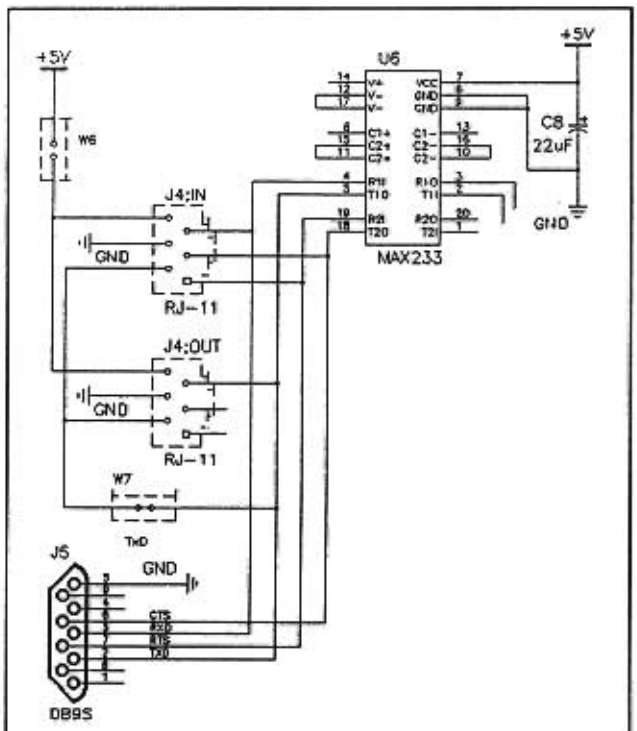

6600
LED
RESETCY500
C6
4.7uF
GND
+5V
RP1:C
10K
RP1;D
10K
RP1;E
10K
W3
CY512/525
CY500
IO Sel
VDD
ASCII
Toggle
DIR
ASCII
SLEW
Ext Dir
W4
U3
CLK/15
VCC
VDD
NC
I/O SEL
ASCII/BIN
SLEW/
DIR
RES
PULSE/
MO CMPL/
PROG OUT
RUN/
I/O REQ/
PROG/LIVE
BUSY/
INSTROBE
PROG WAIT
OUTSTROBE
INHIBIT
DONHILE
ABORT/
DB0
DB1
DB2
DB3
DB4
DB5
DB6
DB7
PHASE 1
PHASE 2
PHASE 3
PHASE 4
GND
VSS
X1
11MHz
XTAL1
XTAL2
CY525
W5
SW2
Hi Wait
CW
ASC
Out
Step
Inhibit
Continue
Lo Wait
CCW
Binary
In
Abort
Step
Loop
U5
1G
2G
1A1
1A2
1A3
1A4
2A1
2A2
2A3
2A4
1Y1
1Y2
1Y3
1Y4
2Y1
2Y2
2Y3
2Y4
Busy
User
Run
Prog
Slew
Comp
Dir
Pulse
74HCT244
D1
D3
D5
D7
D8
D6
D4
D2
HLMP-6600
U8:D
U8:E
U8:F
U8:A
SN74HCT04N
U9
W9
W10
VS
NC
B1
B2
B3
B4
C1
C2
C3
C4
K
GND
Phase 1
Phase 2
Phase 3
Phase 4
Motor V+
Motor GND
ULN2068B
VCC
Cybernetic Micro Systems
Title
CYB-500 Schematic
Size
B
Number
Rev
A
Date 18 MAY 92
Drawn by KDG
Filename CYB500
Sheet 1 of 1
C
D
1
2
3
4

signal may be connected to the input jack, for a direct connection, or to the output jack, for daisy chaining. Jumper W7 may need to be cut in the daisy chain scheme.

The CY233 mode control signals are hard wired on the CYB-500 board. The signals are floating, connected to +5 volts, or connected to ground, selecting 9600 baud, no parity, 8-bit data, ASCII characters, decoded 1-of-8 addressing, slave mode, and echo invalid. These modes may be altered by cutting traces where needed, and reconnecting the signals as required by the new modes. All traces are accessable on the solder side of the CYB- 500, with small holes available for both +5 volts and ground for each connection. Refer to the CY233 User Manual for connections and functional details of the other possible modes.

The Serial Driver/Receiver

The CYB-500 serial interface is supported by the MAX233 chip, which has internal voltage generation and two sets of drivers and receivers. With the internal RS232-level voltage generation, the MAX233 requires only a +5 volt connection, allowing all circuitry on the CYB-500 to operate off of only one +5 volt power supply.



The RS232 Drive circuit on the CYB-500

One set of drivers and receivers is connected to the CY233, while the other set is connected to jumper W8. The second set may be used as required, and can be connected to any TTL level signals, for supporting additional signals that may be required by your RS232 interface. The standard configuration uses only transmitted and received data to the CY233.

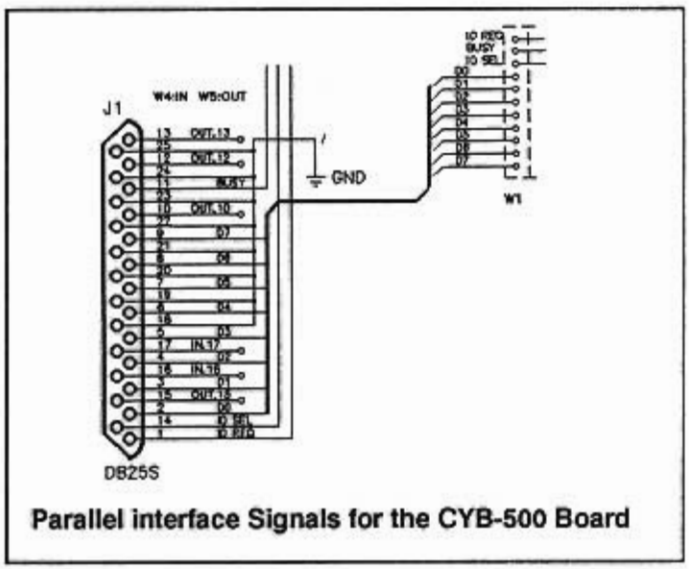
The RS232-level signals are connected directly to the RJ-11 jacks, discussed previously. As an option, the RJ-11 jacks may be replaced by a DB-9S connector, which occupies the same board area as the RJ-11 jacks, and is designated as J5.

The IBM PC Parallel Printer Interface

The CY500/CY512/CY525 parallel data bus and handshake control signals are also connected directly to a DB-25S connector, J1. The connections match those of an IBM PC parallel printer port, and allows the CYB-500 to be directly controlled from such a port.

However, the handshake protocol does not match that of a parallel printer, so custom driver software must be implemented in the PC to use this interface. The CYB-500 will not work with the standard printer routines included in the PC BIOS.

Only the 8-bit data bus, and I/O Request, I/O Select, and Busy control signals are directly connected to the printer interface. These are the minimum signals required to communicate with the stepper motor controller.



Parallel interface Signals for the CYB-500 Board

The other parallel printer port input signals are made available at jumper W4, while the other output signals are made available at jumper W5. These additional signals may be connected as required to fit the application. For example, one input might be used to monitor the Motion Complete or Run signals from the CY500/CY512/CY525, while outputs might be used for Wait signals, Aborts, or other functions.

Motor Power Driver

The CYB-500 also includes a simple L/xR unipolar power driver circuit, implemented by a ULN2068B. This is a darlington transistor array, with each transistor capable of sinking about 1 amp of current, as designed in the CYB-500 board. With additional heat sinking, the current capability could go to about 1.5 amps per phase.

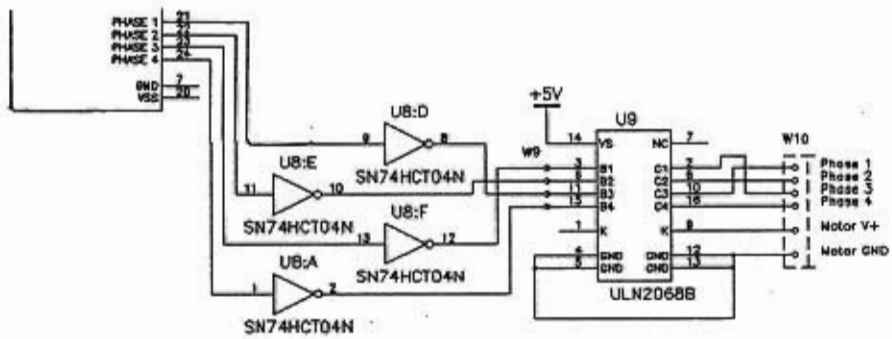
External dropping resistors and a motor power supply are used to complete the driver (along with the motor itself!). While this power driver is fairly low performance, capable of up to 2000 steps per second performance, it is very simple, and will allow you to get your motor spinning in record time!

When a high performance driver is required, the ULN2068B can be bypassed, or the outputs can be used to directly connect to the higher performance driver. The board wire wrap area provides a convenient place for other driver interfaces.

Notice that for maximum noise immunity, the ULN2068B ground signals are not connected to the CYB-500 signal ground. This is best done at the power supply used to run the motor. However, a CYB-500 signal ground jumper is provided adjacent to the motor ground signals, allowing this connection to be made on the board.

In any case, the motor ground and CYB-500 signal ground must be connected somewhere before the power driver is used. This is best done in the cables to the supplies, not on the board.

The power driver also requires a connection to the motor V+ signal, for connection of the protection diodes in the ULN2068B. The same power supply signal connects to the optional external dropping resistors, forming the L/xR function, and then to the center taps of the motor windings.



Motor Drive Signals on the CYB-500 Board

Power and I/O

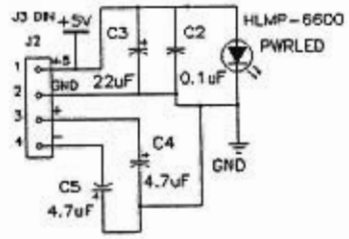
The CYB-550 circuits require only a +5 volt power supply to function. The RS232 interface, implemented by the MAX233 device, generates its own driver levels internally to the MAX233. The only other power requirement is the positive voltage for running the motor, if the on-board motor driver is used.

When +5 volts is applied to the board, the power indicator LED will light, showing that power is applied.

There are two power connectors on the CYB-500. One is a four pin, polarized header, J2, with matching connector supplied. This allows you to wire your own supplies into

the board. Note that the extra "+" and "-" voltages are not used by the CYB-500 circuitry, but are available in case you need them in your wire wrap application.

The second power supply connector is a 180 degree 5-pin DIN connector, J3, which is compatible with the Elpac WM 063 series of power supplies. These supplies also make a "+" and "-" voltage available if required by your application.



Power Signals for the CYB-500 Board

Location J4 is the dual RJ-11 jack, used for the RS232 serial interface. This location is shared with J5, an optional DB-9S connector for the same signals.

Location J1 uses the DB-25S connector for the parallel printer port interface.

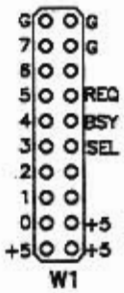
Finally, the wire wrap area may be used for any custom circuits required by your application, including a different motor power driver or other interface circuits. The CY500/CY512/CY525 control signals are available at W4 and W5, adjacent to the wire wrap area, and may be used as required.

Jumper Functions

Various options on the CYB-500 circuit design are selected by connecting the appropriate jumper pads together. Each jumper group is indicated by a "W" jumper number, with individual jumper pads in each group designated by unique labels. Small wire wrap posts are provided in a strip with the CYB-500. These posts may be broken to the appropriate length and soldered into the jumper pads. Jumpers may then be connected by shorting plugs or wire wrap wires between the pads involved.

The following sections describe each jumper and discuss the possible connection options. All jumpers and posts are also shown on the CYB-500 schematic.

W1 Parallel Port

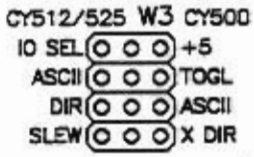


The parallel data bus is brought to W1 for use in parallel interfaces to the board. The support signals for a parallel interface, IO SELECT, BUSY, and IO REQUEST are also available on this jumper, as are +5 volts and Ground. A 2x10 or 2x8 header may be used in this location. Three spare posts are available for any use. These signals are also available at J1 if the DB25 header is preferred.

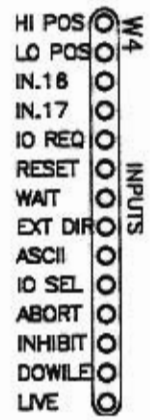
W2 Position Header

When latching the CY525 position "on-the-fly", the high byte and low byte may be read from the 74373s at location W2. This jumper is used in conjunction with the HI POS and LO POS pins on W4. See the CY525 manual "Read-out Operations" chapter for more information on latching position.

W3 Chip Select Header



The board supports the CY500, CY512, and CY525 Motor Control ICs. Since the pinouts of these chips do not match exactly, the conflicting signals are brought to this header, where the appropriate connections to the rest of the board are made using four shorting plugs. The CY512/CY525 selections are made by choosing the left pair of each header group, while the CY500 is selected by choosing the right pair on each header group.



W4 Board Inputs - Motor Support Signals

All of the CY5xx input signals are available at header W4. Those signals which provide program or motion control, based on a high or low state, are brought to a switch at SW2 so that the inputs may be manually controlled during prototyping. Additionally, spare lines from the board's parallel port, labeled IN.16 and IN.17 are brought to this header so that any two of the CY5xx inputs on W4 may be connected to the parallel port. The signals may be used as required by your circuit and application.

W5 Board Outputs - Motor Support Signals

All of the CY5xx motor support and output signals are available at header W5. The four spare lines from the board's parallel port, labeled OUT.10 to OUT.17 are brought to posts on W5 so that any four of the CY5xx outputs on W5 may be connected to the parallel port. The signals may be used as required by your circuit and application.

LED indicators (on Busy, Pulse, User Programmable Output, Direction, Run Program, Motion Complete, Programming Mode, and Slew) light up when the signals go low. Thus, you'll see lights with each step pulse, direction change, when stepping, and when slewing at the maximum step rate.

The wire wrap area is located next to jumper W4/W5, making it especially easy to add the necessary interface circuits between the CYB-500 and any external connections.

Note that the CY5xx provides limited drive current on its signals, so buffers may be required when the signals drive off-board connections. For example, buffers or opto-isolators may be required between the CY5xx and the power driver stage for the stepper motor. This would be most critical on the Pulse and Direction signals of the CY5xx.

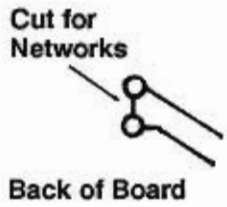
W6 Network +5 Volts

The +5 volt power supply may be networked through a series of boards via the serial cable. To take advantage of this feature, connect the W6 pads together and use a 6-wire serial cable between the boards. Do NOT bring the +5 volts back to your IBM-PC or Host. Use a four-wire cable to the Host.

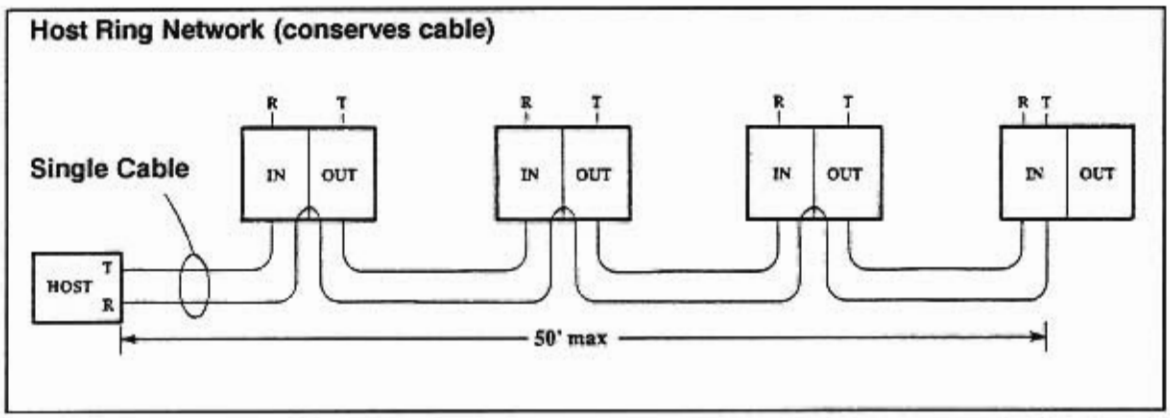
O open
O No +5 volts on RJ11

O closed
O +5 volts passed through

W7 Serial Turnaround Jumper



This jumper is hardwired closed and provides a serial turnaround of TxD when only a single RJ11 Jack is used (the IN jack). This is the case for most single board serial applications and for the terminating board of a network. For networking applications, the trace connecting the two pads should be cut, and TxD will only transmit on the OUT jack as shown below:



W8 Additional RS232 drivers

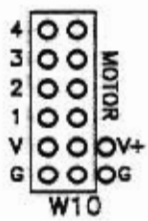
The MAX233 provides a pair RS232 level transmitters and a pair of receivers. Only one transmitter for TxD and one receiver for RxD is used by the board. The spare transmitter is accessed on the TTL side at W8 "T", while the RS232 side is available on the serial jack at the CTS position. The spare receiver is accessed on the TTL side at W8 "R", while the RS232 side is available on the serial jack at the RTS position.

W9 Motor Phase Signals

The four phase signals are available at W9. If the ULN2068B driver is not used in your application, then a header may be used at W9 and the phases may be brought to your own driver from this header. This may be done even if the ULN2068B is already soldered into the board.

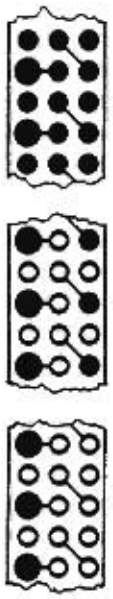
W10 Motor Drive Signals

The amplified phase signals from the ULN2068B are available on double posts at W10. The motor voltage, required by the ULN2068B driver may also be brought to the board through this header, or may be brought through the main power header and connected to W10 through a pad labeled "V+". The Motor ground should be connected to the driver ground plane. The Motor ground should also be connected to the board ground at the power supply or at the post labeled "G".

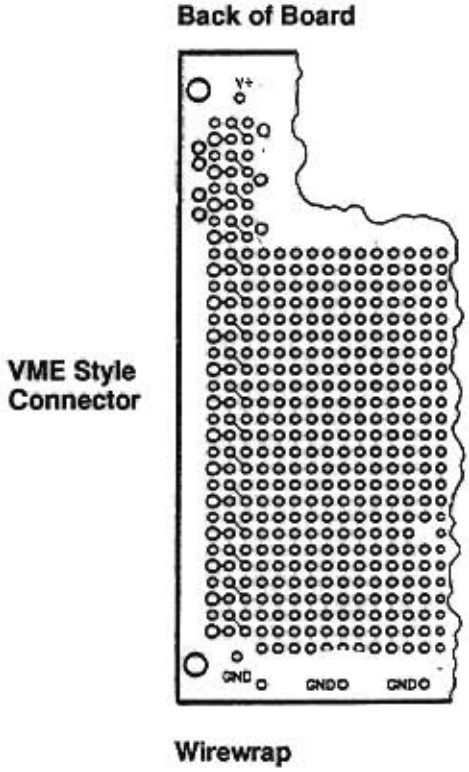


Wire Wrap Area

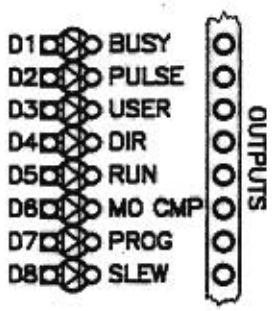
A wirewrap area is provided for custom circuitry such as a host interface or power drivers. Both +5V and GND are brought to pads at the top and bottom edges of the board, and a single V+ pad near J3 provides access to an additional power supply.



A VME connector pattern at the far edge of the board has been modified for three styles of connectors. The board accommodates a standard 96 pin VME connector (3 rows of 32 pins each), but be aware of the interconnectivity, or you may use a modified connector which contains only every other pin. In the case of a modified connector you will notice that the signals are carried to the unused center row, to allow solder connections as well as wirewrap connections. You will also note that the outermost row contains enlarged pads so that heavier-duty power connectors may be installed instead of a VME connector. The DIN power socket should not be installed if a VME connector is used.



Status LEDs and Spare Resistors



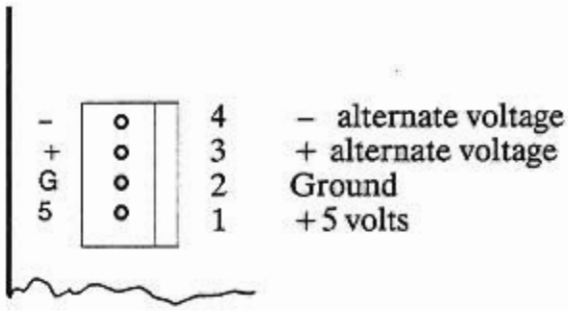
The Status LEDs at D1 to D8 are pulled high and are activated when the appropriate signal is pulled low by the CY5xx. All eight LEDs are used by the CY512/525 circuit, but two LEDs are not available to the CY500 – SLEW and DIR. (Note that the DIR LED represents a direction output and is not the same as the X DIR input of the CY500.) Since these two CY512/525 signals are left floating when the CY500 is used, you may find it desirable to connect the two signals at W3 to spare 10k ohm pullups at RP1 to prevent spurious illumination. Only the first four resistors are used in the resistor package (pin 1 = common to pin 5), so all of the remaining pins are available to the user application.

Power Connector Pinouts

J2 Power Header

Connector J2 is used to bring power to the CYB-500 circuits. It is a standard 4 pin header, with pins on 0.156" centers. The mating connector is also supplied with the CYB-500. Pin 1, the +5 volt input, is physically closest to W4, while pin 4, the negative voltage input, is closest to the VME edge of the board. The alternate + voltage is also brought to a pad near the wirewrap area if needed for motor driver voltage.

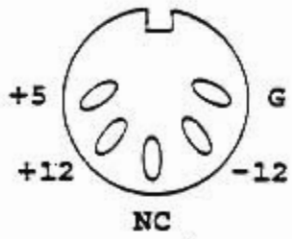
J2 Power connector



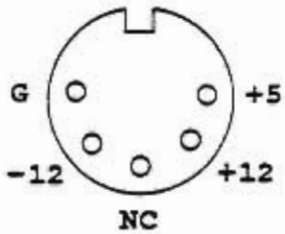
J3 DIN Power Connector

The connector at J3 is the alternate power supply connector for the board. The 5-pin 180° 1/2 inch diameter DIN receptacle is compatible with the Elpac WM 063 series of wall mount regulated power supplies. Power supplies with incompatible connectors may be used by removing the supply's output connector and replacing it with a custom wired DIN plug on the power supply output lines, using the figures below for reference.

Board Receptacle



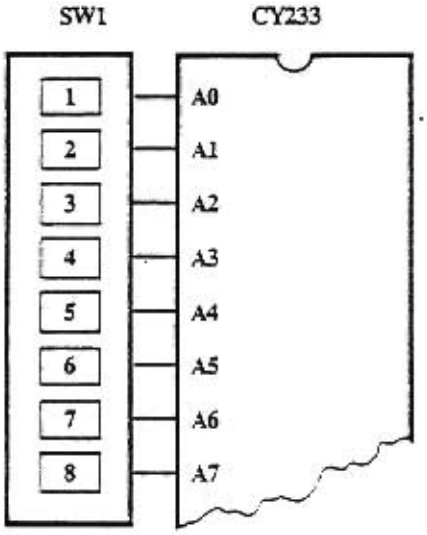
Power Supply Plug



Note that the CYB-500 board only requires the +5 volt supply (the RS-232 voltage levels are generated on the board by the Max233), so the + and – voltages on J2 and J3 may be unused. These additional supply inputs are provided to support custom circuits, as required by the application.

SW1 Network Address Switch

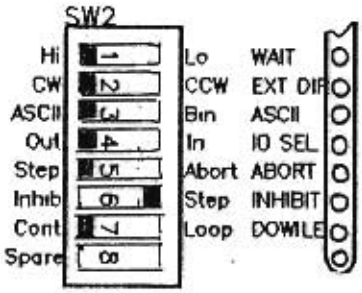
The Address Switch (SW1) is an 8 position DIP Switch (SPST Make-or-Break) package. The eight positions are connected to the CY233 address lines A0 - A7, and provide one-of-eight addressing for use in network configurations. Closing only one switch selects the address for the board by connecting that address line to ground. If the address mode is not used, the eight switches are ignored and become available to the user for any purpose.



More than eight boards may be networked using encoded addressing in the wirewrap area. See the CY233 manual for details.

If the CY233 is not used, it may be desirable to omit the DIP switch and use wirewrap posts for custom applications.

SW2 User Input Switch



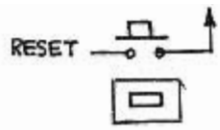
The User Input Switch (SW2) is an 8 position DIP Switch (SPST, Make-or-Break) package. The eight positions are connected to various CY5xx input signals, and provide a connection to ground when the switch is closed (the signals are internally held high when the switches are open). The first 7 switch positions are dedicated to user controllable inputs, while the last switch is unused and is available to the user for any application.

All seven signals are also brought to posts at W4 to allow interfacing to external circuitry. If these lines are driven by this other circuitry, then the switches should be set in the open position, or else the DIP Switch may be entirely omitted from the board.

To start up the board, all switches on SW2 sould be open or high, with the exception of position #6, which should be closed or low to allow stepping.

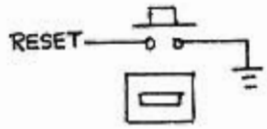
Note: The EXT DIR switch only works with the CY500 and has no connection to the CY512/525 circuit. The IO SEL switch bypasses the CY500 circuit and only works with the CY512/525.

Reset CY233 Reset Switch (Push Button)



The CY233 Reset switch is a normally-open push button switch. Pressing the button pulls the CY233 Reset lines high, providing a hardware reset of U4.

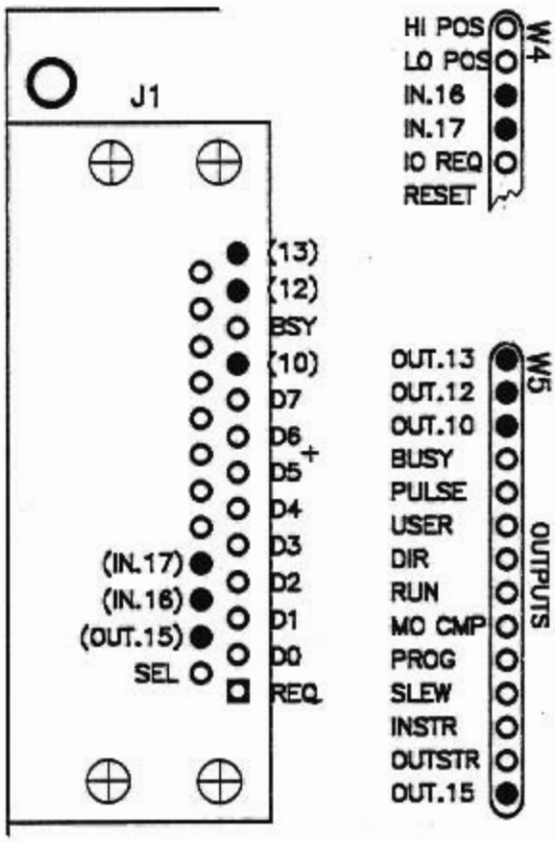
Reset CY500 Reset Switch (Push Button)



The CY500 Reset switch is a normally-open push button switch. Pressing the button pulls the CY5xx Reset lines low, providing a hardware reset of U3. This Reset signal is also available at W4 so that it may be accessed from external circuitry. You will notice that the CY233 and CY5xx resets have opposite states. A combined CY233/CY5xx reset may be accomplished by running one of the reset signals through a spare inverter on the 7404 at U8 [3 $\longrightarrow$ 4], [5 $\longrightarrow$ 6], and then tying the signal to the other's reset.

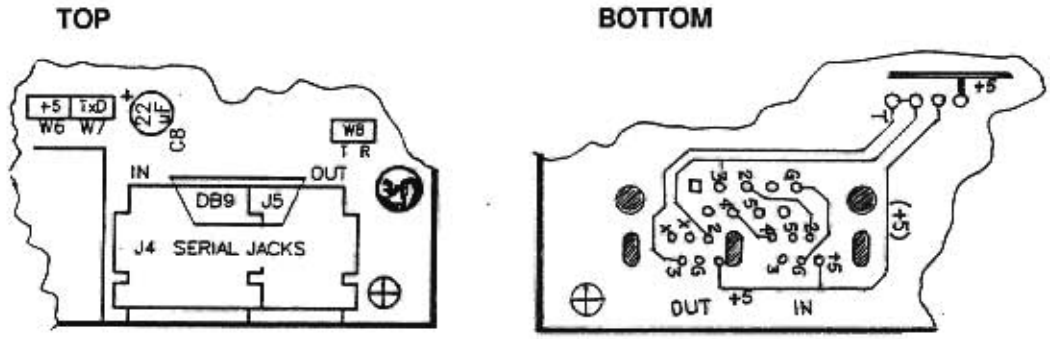
J1 IBM Parallel Port

An IBM PC compatible DB25 pattern provides a parallel interface to a host computer. The ground signals, data bus, and protocol signals are hardwired. The Uncommitted signals are brought to posts at W4 and W5 so that appropriate CY5xx signals may be connected to the parallel port, as needed by the application circuitry.



J4 Double Serial Jack

The RJ11 telephone style jack accepts a four- to six-wire telephone cable. The pin numbers on the RJ11 serial Jack1 (IN) and Jack2 (OUT) at location J4 are labeled to correspond with the pin numbers of an IBM PC compatible DB25 connector. The signals TxD, RxD, CTS, RTS, and GND are available at J4 IN and J4 OUT. A +5 volt signal is also available at J4 IN and J4 OUT for use in a multi-board network by connecting the pads at jumper W6. The +5v signal should not be connected to the host computer.



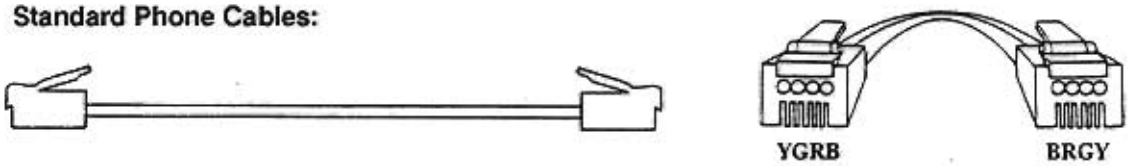
J5 Optional DB9 Serial Connector

A DB9 pattern is provided at location J5 with pads labeled to correspond with the pin numbers of an IBM PC compatible DB25 connector, consistent with the RJ11 labels above. The pattern is wired for a female DB9S connector for an IBM-AT computer, and the only signals connected are Gnd, TxD, RxD, CTS, and RTS. You may install your own DB9 connector instead of the RJ11 jacks.

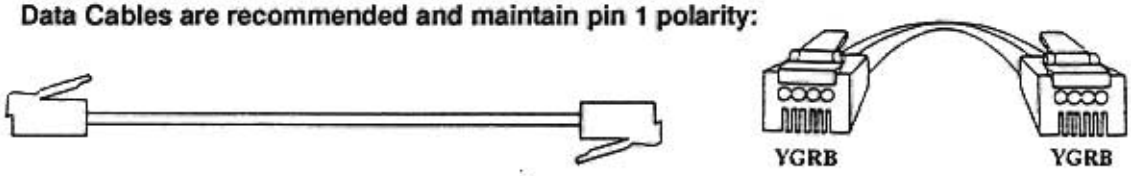
The Serial Cable

The double RJ11 is designed for use with data-type cables, where pin 1 polarity is maintained. Cybernetic Micro Systems provides this style of cable with its products. When using the single RJ11, the data-type cable is recommended, but a standard phone cable will work as long as the proper adjustments are made within the DB25 connector. When using both serial jacks in a network, only data type cables should be used.

Standard Phone Cables:

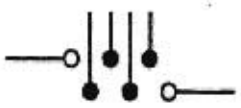


Data Cables are recommended and maintain pin 1 polarity:

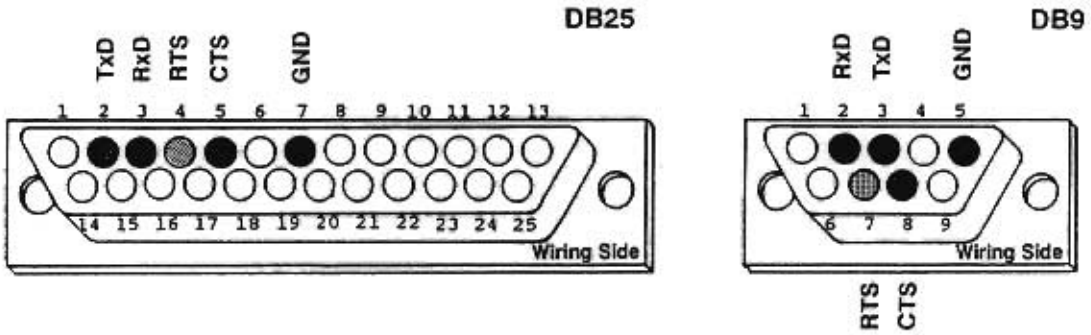


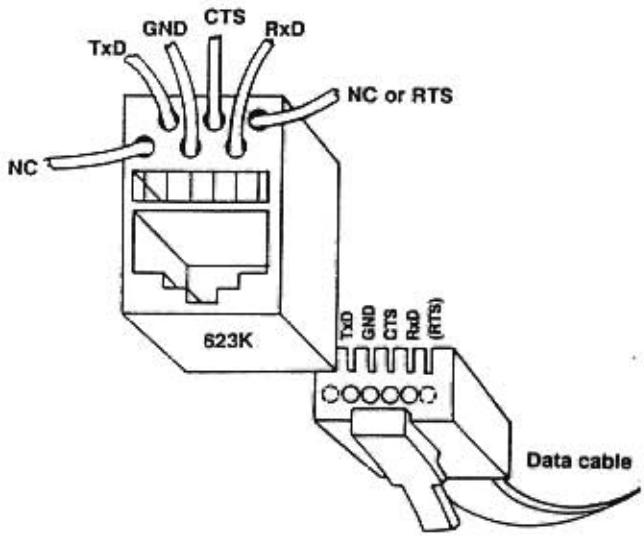
DB25 to RJ11 Connector

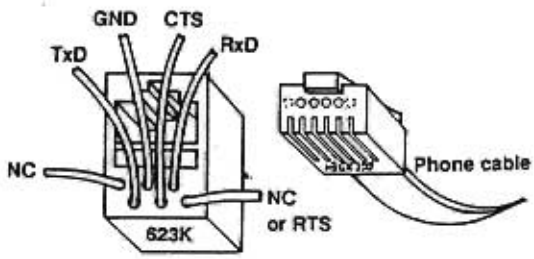
Making your own connector: The RJ11 insert on the RJ11-to-DB25 connector is often designated 623K. Looking at the side of the 623 with the wires, you will see that there are two rows of wires offset from each other. The wire colors and the direction of the offset vary with brands. In making a 4-wire connection, select the inner four wires and line them up left to right as follows:

either  or 

Lay out the components to be connected, as shown below. When using a data-type cable, the 623 should be positioned so that the locking key for the cable is toward you and facing down. The wires should be facing up and should be on the end away from you. The wiring side of the DB connector should be facing up, with the computer side of the DB facing down. Connect the 4 signals as shown in the figure. If using the 2 extra outside lines for custom circuitry, connect them last. Note that the pin labels refer to the signals as seen from the IBM-PC.

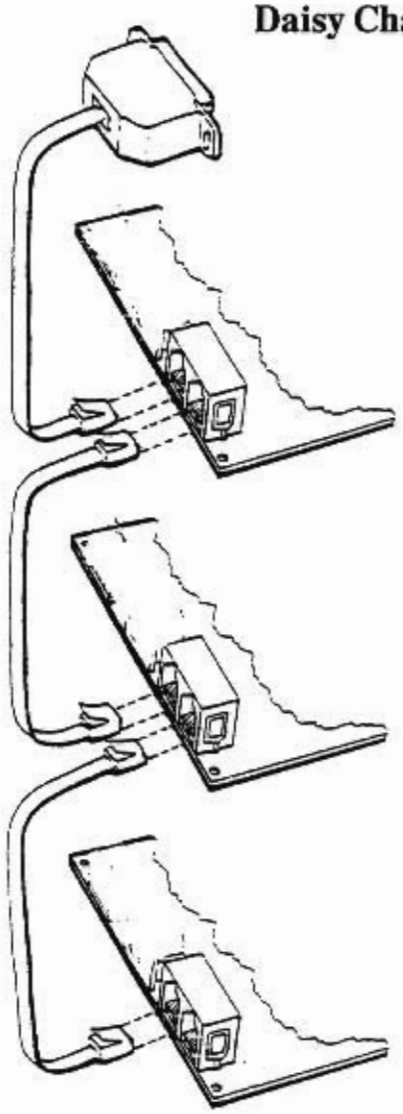






If using a standard phone cable instead of a data-type cable, then turn the 623K 180° so that the wires are toward you and the locking key is away from you. This reverses the phone cable wires, while the left to right 623 wires will still be labeled TxD, GND, CTS, and RxD.

Daisy Chaining CYB-500s - Networks



The CYB-500 can be used in a serial network. Connections between boards can be made via 4-wire cables or 6-wire cables with telephone type jacks. The 6-wire cables can carry both data signals and power as shown in the figure.

The RJ11 jack on the board is capable of delivering up to 6 signals. The 4 inner signals (4-wire cable) transmit TxD, RxD, CTS, and Gnd. The 2 outer signals (6-wire cable) transmit +5v and RTS. When connecting several boards in a serial network, it may be advantageous to transmit the power signals through the network, with power originating on the terminating board, using W6.

Remember not to connect any power transmission signals to the host computer.

CY233 Network Communications

The CY233 serial communications parameters are hardwired on the CYB-500 to select 9600 baud, no parity, one stop bit, 8-bit data, ASCII characters, decoded 1-of-8 addressing, slave mode, and echo invalid. If any other baud rate or protocols are needed for the system, these signals may be altered on the back of the CYB-500. Refer to the CY233 manual for details on different parameters.

Final Assembly and Checkout

This section will discuss the completion of the CYB-500 board and initial operation. The remaining tasks are concerned mainly with connections between the board and the rest of the system, whether it be a terminal or computer. The user must decide, based on the specific requirements, which jumpers will be used. The appropriate jumper pads for the various options must then be connected together.

☐ Install jumpers as required.

Next, cables must be made for any applications circuits, connecting the data interface, and the power supplies. See the listing of connector pinouts for the appropriate signal, those lines which are not used may be left disconnected. They do not require any special terminations.

☐ Construct connection cables as required.

Before the board is connected to the power supply, perform a careful visual inspection to insure that all parts have been placed in the right locations and that LEDs, electrolytic capacitors, and ICs observe the proper polarities. This is very important for proper operation of the board.

☐ Perform visual inspection for correct part placement.

☐ Install board standoffs at the four corners.

☐ Connect the +5 volt logic supply and turn it on.

Now, use a VOM to see that +5 volts can be measured at various points on the board. In particular, +5 volts should be across C3, and at the power supply pins of all the ICs. No part on the board should be hot from applications of power.

☐ Check for +5 volts to various components on board.

☐ Turn off power supply.

NOTE: NEVER LEAVE THE POWER SUPPLIES ON WHEN CHANGING CONNECTIONS OR ADDING PARTS TO THE BOARD.

When the board checks out satisfactorily, the CY500, CY512, or CY525 may be installed into the 40 pin socket at location U3 and the CY233 may be installed at location U4. Be sure to observe proper polarity when installing these parts. The notch on the pin 1 side should face the top of the board. Install the part by starting the pins on one side into the socket, without pushing them completely into the socket. Then do the same on the other side. Once all the pins have been started, gently push the entire part into the socket until the pins are well seated. Be sure that none of the pins are bent or go under the part. They should all fit smoothly into the socket.

- ☐ Insert a CY500, CY512, or CY525 into the socket at location U3.
- ☐ Insert the optional CY233 into the socket at location U4.
- ☐ Connect the optional serial cable to J4 or a parallel cable to J1.
- ☐ Set all SW2 switches to the open position, except switch position 6 should be closed.
- ☐ Turn on power.

The capacitors on the Reset lines of the CY500/512/525 should provide an automatic reset on power up.

CYB-500 Debugging

The following section explains a check-out procedure for the CYB-500 board.

Parallel Interface Tests

- ☐ Connect your host system to the CY500/512/525 parallel interface at J1 or W1.
- ☐ Place the "C" command on the data bus, ASCII value 2Bh. (Use only uppercase characters.)

  D0 = 1
  D1 = 1
  D2 = 0
  D3 = 0
  D4 = 0
  D5 = 0
  D6 = 1
  D7 = 0

- ☐ Lower the IO_REQUEST line.
- ☐ Wait for the BUSY line to go low, then bring IO_REQUEST high again.
- ☐ When IO_REQUEST is brought high, BUSY will return high.
- ☐ Wait for BUSY to return high, then place the carriage return code on the data bus, value 0Dh. In all cases, the carriage return must not include a linefeed.

D0 = 1
D1 = 0
D2 = 1
D3 = 1
D4 = 0
D5 = 0
D6 = 0
D7 = 0

- ☐ Generate the IO_REQUEST handshake strobe again, interacting with the BUSY signal.

- ☐ Upon completion of the above sequence, the User Programmable Output line will go low, lighting the USER LED.

- ☐ Repeat the above sequence, with the "**B < cr >**" command. The ASCII code for "B" is 42h. The User Programmable Output signal will return high and the USER LED will turn off when this command is sent.

If the above sequence works successfully, you are commanding the CY500/512/525 through the parallel port. Continue with additional commands shown below.

Additional CY500/512/525 Commands

- ☐ Try changing direction with "**+ < cr >**" and "**– < cr >**" The DIR LED will toggle on and off.

- ☐ Try to step 200 steps with:
  R 100 < cr >
  S 50 < cr >
  F 1 < cr >
  N 200 < cr >
  G < cr >

Remember to use uppercase command letters and to add a single space character between the command letter and the argument value.

At this point, the major CYB-500 components are working. Other command sequences are shown in the appropriate CY5xx User Manual and may be tried to exercise additional features.

CY233 Tests

This check-out of the CYB-500 board will require at least a serial terminal. A computer with a terminal emulator program will also work well. The only requirements are the ability to control transmitted characters and the ability to display received characters. (A BASIC language driver that performs this function on an IBM-PC class computer is provided in the CY233 Users Manual.)

We will assume this CYB-500 board is set for address 01 in describing the following tests. If you use a different address, substitute your selected address for that shown. When an invalid address is needed, be sure to use an address different from the one(s) selected for your board.

- ☐ Set the board for address 01 by closing the second switch (position 2) on SW1.

- ☐ Set the CY233 for ASCII Character mode and Echo Invalid. Choose parity, baud rate, and other functions to match those of your serial test system.

- ☐ The default settings of the CYB-500 board provide 9600 baud, 8 data bits, no parity, ASCII Character mode, decoded addressing, and Echo Invalid. Try to set your system to match these selections. Otherwise, you must cut some of the traces on the CY233 mode selection signals.

- ☐ Connect your test terminal to J4 (or J5), the serial input connector.

- ☐ Reset the CY233 by pressing the Reset Button or by cycling the power supply.

- ☐ Send a message with an invalid address to the CY233:
  W03Test <cr>
  where "<cr>" is the carriage return character. There are no spaces between the CY233 command and the message.

- ☐ The CY233 should echo back:
  W03Test <cr>

  The echo will start after the W command and 03 address have been received. If the echo is correct, the CY233 is functioning, with baud rates, parity, etc. matching those selected for your terminal.

  If no echo occurs, be sure to verify your operating mode selections, connections to J4 (or J5), etc.

- ☐ Now send to the CY233:
  W01C<cr>
  W01B<cr>
  using uppercase characters in the command.

- ☐ Since each is a valid message, the CY233 will not echo it, but after the W and 01 are received, each character in the data portion of the message will be passed in parallel to the CY500/512/525. The commands will toggle the User Programmable Output line.

- ☐ When the above sequence is successful, you may send any message to the CY500/512/525, commanding it to change its parameters, execute a motion, etc.

This completes the test of the CYB-500 board. The CY500/512/525 and CY233 have been checked, and messages have been passed between the CY233 and the CY5xx. If the above tests failed, be sure to carefully check the assembly of the board, all jumper connections, and all switch settings. Try to verify that serial data is getting to the RxD signal at J4 (or J5) when your terminal is transmitting, and that the data reaches the CY233 at its RxD pin, pin 10. You can also check if the CY233 is alive, by seeing that the Restart line, pin 9, is low during normal operation, and that a 1.8 MHz clock is being generated from the CLK line, pin 30.

If the above tests do not resolve the problem, contact Cybernetic Micro Systems.

Basic Program for Parallel Printer Port

```
100 '=============================================================================
110 '      PARALLEL.BAS    05-14-92        Communicate over printer port
120 '=============================================================================
130 '      program to send parallel command strings to the CYB-500 and
140 '      receive data from it if the Query command is issued
150 '=============================================================================
160         '     IBM-PC DB25F Parallel Printer Port Connector
170         '  13  12  11  10  9   8   7   6   5   4   3   2   1
180         '    25  24  23  22  21  20  19  18  17  16  15  14
190         '
200         '
210         ' IBM-PC Printer LPT1
220         ' parallel connector        CY525 pins
230         ' pin  1    Strobe/          1    IO-Req/
240         ' pin 11    Busy            27    Busy/
250         ' pin 14    Auto Feed       39    I/-O-Sel
260         ' pin  2-9  data0-data7    12-19  data0-data7
270         '
280         '                              IBM                CYxxx
290         ' IBM PS2 Register &H378          = Data Bus    = Data Bus
300         ' IBM PS2 Register &H379, bit 7 = Busy        = Busy Line
310         ' IBM PS2 Register &H37A, bit 0 = Strobe      = IO_Request Line
320         ' IBM PS2 Register &H37A, bit 1 = Auto Feed   = IO_Sel Line
330         ' IBM PS2 Register &H37A, bit 2 = Initialize = unused
340         ' IBM PS2 Register &H37A, bit 3 = Select     = unused
350         ' IBM PS2 Register &H37A, bit 4 = IRQ Enable = Enabled
360         ' IBM PS2 Port &H65  = Parallel Printer Port Output Control
370         '
380         ' The "high" and "low" BUSY and IO_REQUEST signals described in
390         ' the comments below are measured at the CY chip.  The commands
400         ' used to control the BUSY and IO_REQ register values may
410         ' need inversion, as is the case in this program.
420         '
500 '---set up size of command fields
510         DIM CmdString$(4)       'define the (number of commands) to be sent
520         '
600 '---list your own commands here that will be sent to the chip
610         CmdString$(0) = "C" + CHR$(13)          'Clear CY5xx User Bit
620         CmdString$(1) = "X 1000" + CHR$(13)     'Delay 1 sec, CY500, CY512
'620        'CmdString$(1) = "D 1000" + CHR$(13)     'Delay 1 sec, CY525
630         CmdString$(2) = "B" + CHR$(13)          'Set CY5xx User Bit
640         '
900 '---initialize the parallel port
910         IOCtrl = INP(&H65)
920         IOCtrl = IOCtrl AND &H7F                'disable parallel
930         OUT &H65, IOCtrl                        'port output
940         '
950         OUT &H378, &HFF                         'remove any data from bus
960         OUT &H37A, &HEE                         'raise IO_Request
970         '
```

```
'---send a command string out parallel printer port to CY5xx
      'the value in the "i" loop below should be set to the number
      'of commands that you will actually be sending
      '
   FOR i = 0 TO 2                              'CmdString$(0) - CmdString$(2)
      FOR j = 1 TO LEN(CmdString$(i))             'length of each cmd string
      'send one character of the command string to CY5xx
      '
      Char = ASC(MID$(CmdString$(i), j, 1))
      'extract characters from command string
      '
      GOSUB 2000                                  'send Char to CY5xx
      '
      NEXT j
   NEXT i
   '
   IOCtrl = INP(&H65)
   IOCtrl = IOCtrl AND &H7F                       'disable parallel
   OUT &H65, IOCtrl                               'port output
   '
   '
   'a computer without a bidirectional port should stop here.
   END
'---receive data from parallel printer port only if port is bidirectional.
   'many older computers do not have bidirectional printer ports.
   'This section is only used if a query command was sent to the chip.
   'and will only work with the CY512 or CY525.
   '
   byte$ = ""                                     'initialize variable
   FOR i = 1 to 5                                 'loop receives specific
                                                  'number of chars from CY5xx
      '
      GOSUB 2500                                  'read a byte back from CY5xx
      '
      byte$ = byte$ + CHR$(Byte)                  'build string of bytes
      '
   NEXT i                                         'loop for specified count
   '
   PRINT byte$
   '
END
'================================================================================
'================================================================================
    ' Subroutine to send one character, in variable "Char"
    ' to the CY5xx on the parallel printer port.
      '
      WHILE ((Status AND &H80) <> 0)              'check for busy high
          Status = INP(&H379)                     'ready when high
          WEND
      '
      IOCtrl = INP(&H65)
      IOCtrl = IOCtrl OR &H80                     'enable parallel
      OUT &H65, IOCtrl                            'port output
      '
      OUT &H378, Char                             'put data on bus
      OUT &H37A, &HEF                             'lower IO_Request
      'OUT &H37A, &HEF                            'and also lower
                                                  'IO_Sel if CY525
      '
```

```
2170        WHILE ((Status AND &H80) <> &H80)
2180            Status = INP(&H379)                     'check for busy low
2190            WEND                                    'because busy went low
2200        '
2210        IOCtrl = INP(&H65)
2220        IOCtrl = IOCtrl AND &H7F                    'disable parallel
2230        OUT &H65, IOCtrl                            'port output
2240        '
2250        OUT &H378, &HFF                             'remove data from bus
2260        OUT &H37A, &HEE                             'raise IO_Request
2270        '
2280        RETURN
2290 '
2500 '=============================================================================
2510     ' Subroutine to read one character from the CY5xx, and
2520     ' return it in variable "Byte".
2530        '
2540        WHILE ((Status AND &H80) <> 0)              'check for busy high
2550            Status = INP(&H379)                     'ready when high
2560            WEND
2570        '
2580        OUT &H37A, &HEF                         'lower IO_Request
2590        'OUT &H37A, &HED                        'lower IO_Request & raise
2600                                                'IO_Sel if CY512 or CY525
2610        '
2620        WHILE ((Status AND &H80) <> &H80)       'check for Busy line low
2630            Status = INP(&H379)                 'at the CY chip
2640            WEND
2650        '
2660        Byte = INP(&H378)                       'receive one character
2670        OUT &H37A, &HEE                         'raise IO_Request
2680        '
2690        RETURN
```

Basic Language Driver for CY233 Serial Interface

The following BASIC program was written for the IBM-PC family of computers. It turns the PC into a terminal emulator, allowing you to directly communicate with the CY233 through the computer keyboard and display.

```
100 '
110 '   CRT EMULATOR FOR CY233
120 '   Cybernetic Micro Systems, Inc.
130 '
140 ' This program waits for keyboard input, then
150 ' displays the keys on the screen and sends them
160 ' out the COM1 port.  It also reads any received
170 ' data from COM1 and displays it on the screen.
180 '
190 CLS
200 LF$=CHR$(10) : NL$=CHR$(0) : ES$=CHR$(27)
210 '
220 ' Open COM1 serial port with baud rate and parity.
230 ' NOTE: settings MUST match CY233 selections.
240 '
250 OPEN "COM1:9600,N,8,1,CS0,DS0,CD0" AS #1
260 LOCATE 5,5,1
270 PRINT "Ready to Go!"
280 '
290 ' Open the screen for displays
300 '
310 OPEN "SCRN:" FOR OUTPUT AS #2
400 '
410 ' Check for keyboard input.  Display and send
420 ' any keys to COM port.  Stop when Escape key input.
430 '
440 A$=INKEY$ : IF A$=ES$ GOTO 630
450 IF A$<>"" THEN PRINT #1,A$; : PRINT #2,A$;
460 '
470 ' Check for any received data from COM port, and
480 ' display it, then loop back to check keyboard.
490 '
500 WHILE NOT EOF(1)
510  J%=LOC(1) : B$=INPUT$(J%,#1) : LF%=0
520  LF%=INSTR(LF%+1,B$,LF$)
530  IF LF%>0 THEN MID$(B$,LF%,1)=NL$ : GOTO 520
540  PRINT #2,B$;
550 WEND
560 GOTO 440
600 '
610 ' Exit program when Escape key pressed.
620 '
630 CLOSE #1 : CLOSE #2
640 STOP
```

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