HB Inverter

Technical Reference Manual

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Computer Dynamics, Inc.

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ECO History:

ECO	Date	Description
TBD		Initial Release
	6/26/00	Update Warranty

FCC Testing

This subassembly is marketed to be sold to equipment manufacturers for incorporation into systems. As such this equipment is not FCC tested. FCC testing is the responsibility of the final equipment manufacturer.

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1 Introduction

1.1 Description

The HB Inverter product is intended to light (or drive) Cold Cathode Flourescent Tube (CCFL) backlights for LCD panels. It does this through the use of a single DC-to-AC inverter. The factory-installed inverter used will vary depending on panel/backlight manufacturer specifications (such as the number of bulbs to drive, ionizing voltage, operating current/voltage, etc.).

1.2 HB Inverter Power Supply Requirements

The HB Inverter runs on +12VDC, current depends on the wattage of the bulbs being lit: one CCFL usually takes 3 to 4 watts of power at full brightness, less when dimmed. The inverter is approx. 80% efficient. Multiply the # of bulbs burning by 4 watts and divide by 0.8 then divide by 12 to get input current. If input voltage drops, then current must increase to keep constant brightness. Estimate current and power draw conservatively.

The HB Inverter has been tested over an 8.5 to 16 VDC range (automotive 12 volt range), wider ranges must be tested and/or designed for.

The HB Inverter has low input pulse current draw, but still must be bypassed so that other voltage sensitive circuits and boards do not fail to operate. Avoid powering an HB Inverter indirectly – connect it to a DPPOWDIS or power supply rather than the output of a board.

All wiring to and from the HB Inverter should be as short and direct as possible, avoiding all other circuits if possible by at least 1inch. The CCFL bulb wire is conservatively rated for running voltages; as long as the insulation is intact, no shock hazard should exist.

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1.3 Board Layout

The heatsinks are all at ground potential and normally run warm to slightly hot. The transformers run warm and could deliver a startling/painful but not lethal shock. Hands clear unless power is OFF. The donut shaped component is part of the power supply; it or the transformers may 'sing' under certain conditions. If this is annoying, a touch of clear nail polish can be applied and allowed to dry and will fix wires in place that were loose to vibrate.

The Figure below illustrates the HB Inverter major components and locates the input, output, and power supply connectors.

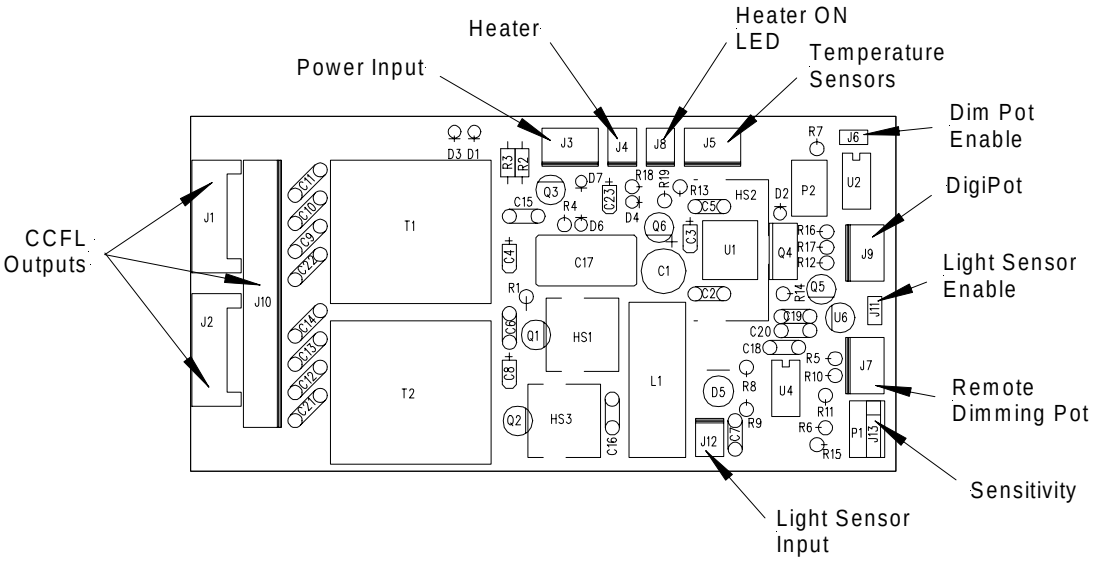

Figure 1-1 HB Inverter Layout and Connectors

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2 Hardware Configuration

All connector and strapping field orientations in this manual are relative to the board orientation as pictured in the Layout and Connections figure above.

Unless otherwise specified, horizontal double row connectors and single row strapping fields have pin 1 in the top right corner or to the right of the strapping field. Horizontal single row connectors have pin 1 to the left. All single row connectors are locking type.. Pin 1 always has a square pad. All other pins have round pads.

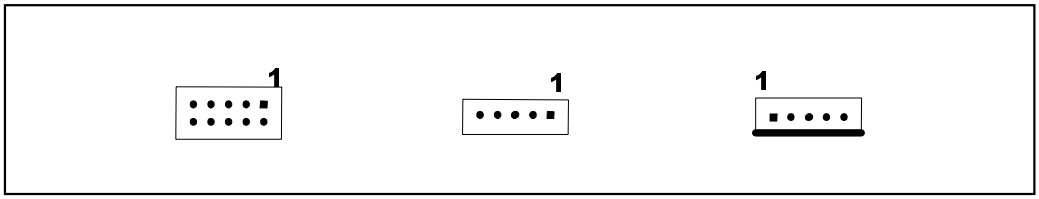

Figure 2-1. Horizontal Connectors and Strapping Fields.

Also if the connector is vertical, pin 1 is in the top left corner.

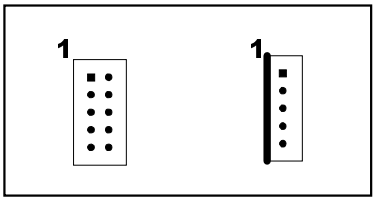

Figure 2-2. Vertical Connectors and Strapping Fields.

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2.1 CCFL Outputs (J1, J2)

CAUTION

High voltages appear throughout these circuits. Extreme care should be exercised when testing and handling this board. **Do NOT** operate HBINVERT without a load - CCFL or dummy load. Overvoltage and/or circuit damage may occur.

Cold Cathode Fluorescent Tube (CCFL) outputs are supplied via 2 surface mounted, right angle, 4 pin, 4mm connectors, the pinouts are shown in the following table:

4-Pin Connector	
1	High Voltage
2	High Voltage
3	High Voltage
4	HV Return

Figure 2-3 CCFL Connections (4 Pin)

Pin 1 of J1 and J2 are located at the top of the connector. For reference, position the HB Inverter as shown in the Layout and Connections figure above.

2.2 CCFL Output (J10)

CCFL outputs are optionally supplied via a single in-line, 19 pin connector, the pinout is shown in the following table:

19-Pin Connector	
1, 3, 5, 7	High Voltage
9	Return
11, 13, 15, 17	High Voltage
19	Return

Figure 2-4 CCFL Connections (19 Pin)

Pin 1 of J10 is located at the top of the connector. For reference, position the HB Inverter as shown in the Layout and Connections figure above.

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2.3 Power Input (J3)

Power for the HB Inverter is supplied via J3, a straight 1x4 locking header with 0.1" centers. The connector has the same pinout as the DP-POW-DIS board to provide easy power distribution to the entire system.

The heatsinks are all at ground potential and normally run warm to slightly hot. The transformers run warm and could deliver a startling and painful, but not lethal shock. Hands clear unless power is OFF.

Connections are as shown in the following table:

Power	
1	+12V (IN)
2	N/C
3	GND
4	N/C

Figure 2-5 Power Input

Pin 1 of the 1 x 4 header is located on the left-hand end of the connector.

2.4 Backlight Heater (J4)

The heater option is meant to warm up CCFL bulbs to around 10 ‘C before allowing the HB Inverter to ignite them. This is the lowest temperature where bulbs can be ignited without seriously shortening their lifetimes. The heater power needed depends upon the thermal mass of the panel/backlight combination. Nominal heater power is about 20 watts. There is a confidence LED that is lit whenever power is applied to the HB Inverter and the heater is ON – this indicates that the bulb heaters are keeping the backlight from igniting and nothing is wrong.

Under and Over temperature conditions are sensed by thermostats. The Backlight Heater Power output connector, J4, is a 2 x 1 straight locking header with 0.1" centers. The heater element must be non-polarized and rated up to 12V @ 5A. The pinout is shown in the following table:

Serial Interface	
1	Return
2	+12 V

Figure 2-6 Serial Interface Connections

Pin 1 of the 1 x 2 header is located on the left-hand end of the connector.

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2.4.1 Temperature Sensor (J5)

The Temperature Sensor (J5) connects the optional low temp/high temp thermostat that senses temperatures too cold for bulb ignition or too hot for safe TFT operation. The connector is a 1 x 4 straight header with 0.1" centers.

There are 2 ways to sense temperatures on a highbright panel. Either use discrete thermostats or use the CDI tempsense (TMPSNS) assembly. Thermostats should be Close on Rise for both cold and hot setpoints. The tempsense assembly is a dual thermostat with nonvolatile, software programmable setpoints. It was specifically designed for the HB Inverter and edge lit hibrite panels. In an over temperature condition, the high temperature sensor will shut down the HB Inverter.

Note:

The heater/temp sensor option must be installed with an external temperature sensor; the HB Inverter will shut down if the temp sensor is not connected to J5.

The Temperature Sensor connector pinout is shown in the following table:

Temperature Sensor	
1	+5V
2	GND
3	Low Temp
4	/High Temp

Figure 2-7 Temperature Sensor Connections

Pin 1 of J5 is located on the left-hand end of the connector.

2.5 Dim Pot Enable (J6)

The On-board Dim Pot, P2, is included in the dimming circuit if J6 has a shorting jumper between pins 1 and 2. If any external control is to be used, this jumper is removed.

J6 is a 1 x 2 straight header with 0.1" centers.

J6

Dim Pot Enabled

Figure 2-8 Dim Pot Jumper

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2.6 Off-Board Dim Pot (J7)

The Off-Board Dim Pot connector, J7, is a 4 x 1 straight locking header with 0.1" centers. The pinout is shown in the following diagram:

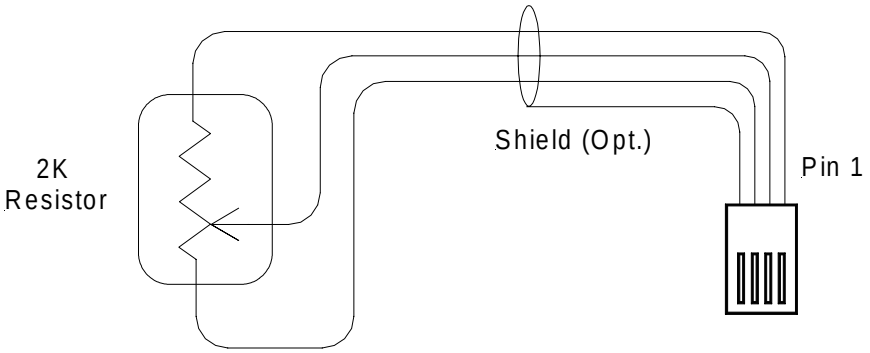

Figure 2-9 Off-Board Dim Pot Wiring

2.7 'Heater ON' LED (J8)

'Heater ON' is a confidence LED that is lit whenever power is applied to the HB Inverter and the heater is ON – this indicates that the bulb heaters are keeping the backlight from igniting and nothing is wrong. The Off-Board Heater LED connector, J8, is a 2 x 1 straight locking header with 0.1" centers. Pin 1 of J8 is located on the left-hand end of the connector. Connect the cathode of an LED to Pin 1 and the anode to Pin 2. The Heater LED connector pinout is shown in the following table:

Heater Power	
1	Heater
2	+12V

Figure 2-10 Heater LED

Heater LED "on" steady, indicates that power is being supplied to the backlight heater and is normal in cold ambient temperatures. The Heater LED blinking indicates that a stable temperature has been reached and the backlights should be illuminated.

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2.8 DigiPot Controls (J9)

A third alternative for brightness control is the implementation of a digitally controlled potentiometer (DigiPot). This device is installed to enable brightness control via a computer or digital controller. The on-board pot jumper (J6) should be removed when the DigiPot option is installed.

J9 is the input connector for the DigiPot. J9 is a 4 x 1 straight locking header with 0.1" centers. Pin 1 of J9 is located on the upper end of the connector. The DigiPot connector pinout is shown in the following table:

DigiPot Interface	
1	Step
2	Up/Down
3	Chip Select
4	N/C

Figure 2-12 DigiPot Connections

The DigiPot requires three input signals to control the brightness of the backlight; STEP (Increment Count), U/D (Up Direction/Down Direction) and CS (Chip Select). When CS is TTL logic-low it enables the other two inputs. When CS is brought to a TTL logic-high while INC is high, the last value of the device is saved in non-volatile memory. The U/D input determines the direction of adjustment when the INC line is pulsed.. If U/D is TTL logic-low, the device value is decremented. If U/D is TTL logic-high, the device value is incremented. The standard device is a 100-count 10Kohm potentiometer making each step equal to 100 ohms.

2.9 Light Sensor Enable (J11)

The Off-board Ambient Light Sensor, is included in the dimming circuit if J11 has a shorting jumper between pins 1 and 2. If any external sensor is to be used, this jumper is removed.

J11 is a 1 x 2 straight header with 0.1" centers.

J11
Sensor Enable

Figure 2-13 Light Sensor Jumper

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2.10 Ambient Light Sensor (J12)

The Ambient Light Sensor, is input through J12. J12 is a 1 x 2 straight header with 0.1" centers. Pin 1 of J12 is located on the RIGHT hand end of the connector. The Light Sensor photodiode connections are shown in the following table:

Ambient Light Sensor	
1	Anode
2	Cathode

Figure 2-14 Ambient Light Sensor

Mount the light sensor so it senses the same background light that would affect the viewer, not any individual light source. The ambient light sensor is sensitive only to visible light and has an acceptance cone of about 100 degrees. The sensor is sealed, but the metal case is at 5V potential. The sensor's metal case MUST be insulated from any metal ground.

Note:

The external ambient light sensor must be connected if the AMBSNS option is installed, or jumper J11 must be opened else the panel will be dim regardless of brightness adjustment.

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2.11 Sensitivity (J13)

The Ambient Light Sensor Sensitivity, is remotely input through J13. J13 is a 1 x 4 straight header with 0.1" centers. Pin 1 of J13 is located on the top end of the connector. J13 is an option, so may not be present. If on-board sensitivity adjustment is required, P1 will be installed instead. The remote Sensor Sensitivity connections are shown in the following table:

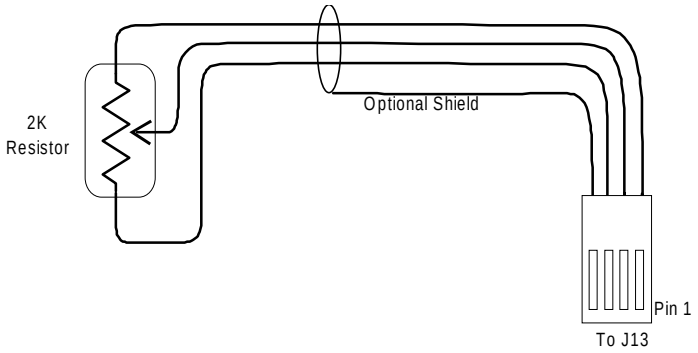

Figure 2-15 Sensor Sensitivity Pot Wiring

Sensitivity	
1	Pot End
2	Wiper
3	Pot End
4	GND

Figure 2-16 Sensor Sensitivity

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3 Setup

CAUTION

High voltages appear throughout these circuits. Extreme care should be exercised when testing and handling this board. **Do NOT** operate HBINVERT without a load - CCFL or dummy load. Overvoltage and/or circuit damage may occur.

3.1 Ambient Light Sensor

1. Allow the LCD backlight lamps to operate for at least 20 minutes to warm up.
2. Remove jumper J11. Adjust the brightness pot P2 or optional remote pot for full brightness. Back the adjustment off to the point of first detectable dimming of the display. Set the final adjustment only slightly above this point.
3. Point the sensor at a bright lamp or sunlight. Install jumper on J11 and verify that display brightness doesn't change.
4. Dim the ambient light to lowest acceptable level. Adjust pot P1 for acceptable dimmed display level.
5. Turn the lamp full UP and verify that the display intensity increases to its original high level.

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4 Troubleshooting

CAUTION

High voltages appear throughout these circuits. Extreme care should be exercised when testing and handling this board. Do NOT operate HBINVERT without a load - CCFL or dummy load. Overvoltage and/or circuit damage may occur.

4.1 No Backlight

1. Check HB Inverter cabling (CAUTION: HIGH VOLTAGE)
2. Make sure power connector is securely seated in socket (J3) on the Hi-Brite Inverter Board. Make sure backlight connectors are securely seated (J1 and J2 or J10).
3. Check for power to the HB Inverter board, +12 Vdc (J3-1) to GND (J3-3).
4. Substitute HB Inverter Board (CAUTION: HIGH VOLTAGE)
5. Substitute Flat Panel Display.

4.2 Dim Backlight

1. Check Backlight bulbs and replace Flat Panel Display if any bulbs are not functioning.
2. Check HB Inverter cabling (CAUTION: HIGH VOLTAGE)
3. Make sure power connector is securely seated in socket (J3) on the Hi-Brite Inverter Board. Make sure backlight connectors are securely seated (J1 and J2 or J10).
4. Check that power to the HB Inverter board is within tolerance.
   +12 Vdc (J3-1) between +11.50 and +12.50 Vdc to GND (J3-3).
5. Covering Sensor on front panel should cause display to dim and shining a bright light on the Sensor should brighten display. Check connections at HB Inverter (J12).
6. Adjust the brightness pot (P2) for acceptable display brightness.
7. Substitute HB Inverter Board (CAUTION: HIGH VOLTAGE)

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4.3 Backlight Too Bright

1. Check HB Inverter cabling (CAUTION: HIGH VOLTAGE)
2. Make sure power connector is securely seated in socket (J3) on the Hi-Brite Inverter Board. Make sure backlight connector is securely seated (J1 and J2 or J10).
3. Check that power to the HB Inverter board is within tolerance.
   +12 Vdc (J3-1) between +11.50 and +12.50 Vdc to GND (J3-3).
4. Covering Sensor on front panel should cause display to dim and shining a bright light on the Sensor should brighten display. Check connections at HB Inverter (J12).
5. Adjust the brightness pot (P2) for acceptable display brightness.
6. Substitute HB Inverter Board (CAUTION: HIGH VOLTAGE)

4.4 Backlight Heaters

If backlight heaters are not active during warm-up period the life of the backlight can be significantly reduced. The HB Inverter board includes a LED output specifically to monitor the heater activity. It is strongly recommended that the LED be installed and labeled in a location where it is visible. If the internal temperature within the enclosure is less than 10°C but the heaters are not activated, the tests in this section should be performed.

Note:
Make sure internal temperature conditions are met for the following tests:

1. Check for power at heater with temperature below 10° C.
2. Check that power to the HB Heater is within tolerance. At the HB Inverter board:
   +12 Vdc (J4-1) between +11.50 and +12.50 Vdc to GND (J4-2).
3. Substitute HB Heater.
4. Replace HB Inverter Board

4.5 Noises

The donut shaped component is part of the power supply; it or the transformers may ‘sing’ under certain conditions. If this is annoying, a touch of clear nail polish can be applied and allowed to dry and will fix wires in place that were loose to rattle or vibrate.

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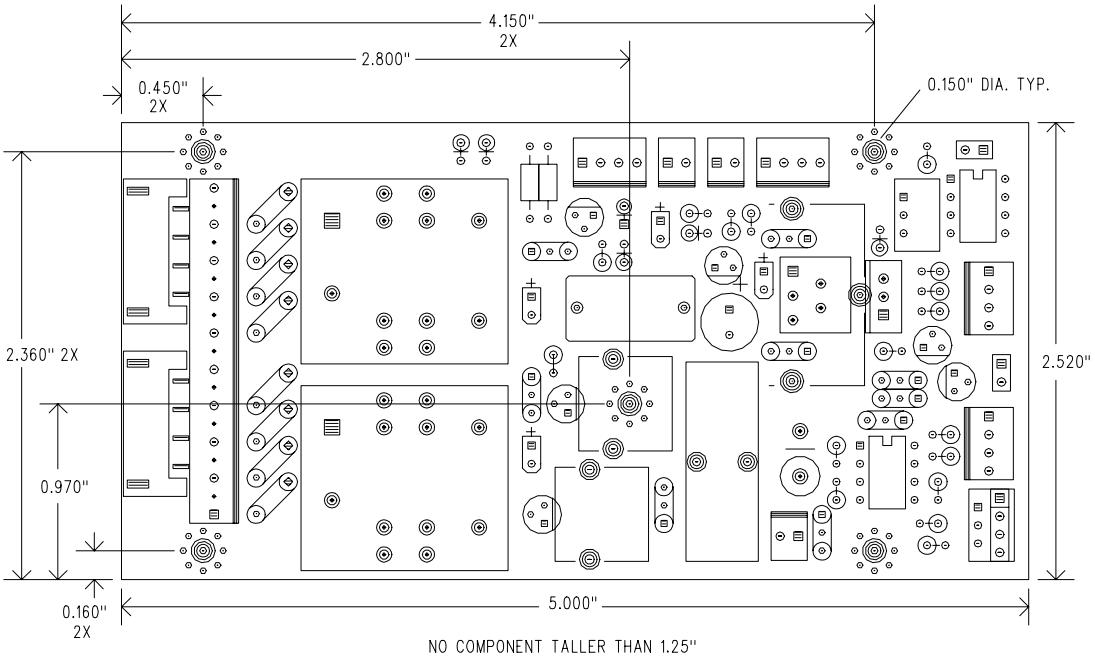
5 APPENDIX

5.1 MECHANICAL OUTLINE



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5.2 DigiPot Control Software Example

```
/*
º name   :  PotClock
º synopsis:  Toggles the counter on the pot by the value of clocks.  The
º            sign of clock indicates up or down count.  Note that the pot
º            count sticks at the extremities (i.e. it does not roll).
º entry  :  clocks is the number of steps to increment.
º globals :  NONE
*/
void        PotClock( int clocks )
            {
            UCHAR               reg;
            clock_t     done;

            #define     _CS                         0x01
            #define     _UP                         0x04
            #define     INC                         0x08
            #define     LPT1_DATA           0x0378

            /* Initialize register with everything on.    */
            reg = INC | _UP | _CS;

            /*
            ** Determine direction of count.  Negative number indicates a decrement;
            ** clr U/!D for decrement.
            */
            if( clocks < 0 )
                        {
                        reg &= ~_UP;
                        clocks = -clocks;
                        }

            /*
            ** Output initial state to LPT port, then clr !CS to enable clocking.
            ** Chip MUST see this hi - lo transition on !CS to work properly.
            */
            outportb( LPT1_DATA, reg );
            reg &= ~_CS;
            outportb( LPT1_DATA, reg );

            /* Toggle loop; switch state of !INC clocks times...  */
            do
                        {
                        reg &= ~INC;
                        outportb( LPT1_DATA, reg );

                        reg |= INC;
                        outportb( LPT1_DATA, reg );
                        }
            while( --clocks > 0 );

            /*
            ** Now set !CS to latch new pot output; done and exit.
            */
            reg |= _CS | INC;
            outportb( LPT1_DATA, reg );
            }
```


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A. WARRANTY STATEMENT

COMPUTER DYNAMICS INCORPORATED
7640 Pelham Rd., Greeville, SC 29615
Phone: (864) 627-8800

WARRANTY

CDI products are warranted for a period of one year from the date of purchase against all defects in materials and workmanship provided they are properly used and not modified by non-CDI personnel. Subassemblies and items not manufactured by CDI (power supplies, disk drives, etc.) are warranted for the period established by their original manufacturer. CDI will repair or replace the product, provided that it is returned promptly to CDI at the owner's expense. Prior to returning a component or subsystem, the purchaser must obtain a Return Material Authorization number (RMA#) from CDI. All board level products are shipped in an antistatic bag to prevent damage to the electronic components due to electrostatic discharge. Failure to use the bag in shipment will VOID the warranty. No other warranty is expressed or implied.

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We request that you inform us of any errors found, areas difficult to understand or suggestions to improve this manual. Please fill out the bottom portion (using additional sheets if necessary) with your comments and return it to CDI.

Thank you.

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COMMENTS:

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