DD1790

DIGITAL DRIVE UNIT

INSTRUCTION MANUAL

FOR USE WITH PRA DYE LASERS AND FREQUENCY DOUBLER UNIT

PRA®

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PREFACE

The following conventions are used in this manual:

- [] are used to signify the keys on the DD1790, example:

  [0] is the numeric zero key
  [JOG] is the JOG command key

- Except for the numbers 0 through 9, the decimal point and the [DEL] key, all keys and I/O control characters are referred to as commands.

Do not place the DD1790 close to or (especially) on top of the LN1000 nitrogen laser. The LN1000 is well shielded against the generation of RFI (Radio Frequency Interference) however, even modest levels of RFI will inhibit proper operation of the DD1790.

SECTION 1

1.0 WARRANTY

1.1 General Information

All PRA manufactured instruments are warranted against defective materials and workmanship for one year from date of shipment provided that the equipment has been used in the proper manner as detailed in the Instruction Manuals.

During the warranty period, repairs or replacement will be made at PRA's option. No instrument should be returned without informing PRA, either in writing or by telephone, of the nature of the fault, model number and serial number of the unit.

If PRA gives authorization for a return please REFER TO SHIPPING INSTRUCTIONS AT THE REAR OF THE MANUAL. These instructions are for a warranty return from the USA. An identical procedure must be followed when the return is made from any country, with the exception that notation for "US CUSTOMS CLEARANCE..." is deleted. An example with instructions of a CUSTOMS INVOICE is included as well as a blank invoice that can be used in the event of a warranty return. Follow the simple directions carefully in order to avoid delay and extra charges.

Instruments that are returned should be packed so they will withstand normal transit handling, and must be shipped PREPAID to PRA or a qualified distributor. Instruments that are damaged in transit due to inadequate packing will be repaired at the Sender's expense and it will be the Sender's responsibility to make claim with the shipper.

1.2 Expired Warranty

Instruments not under warranty shall be repaired at the standard charge. Customer Service will send a quotation for all non-warranty repairs. A Purchase Order must accompany the item to be returned.

1.3 Warranty on Equipment not Manufactured by PRA

PRA's basic one year warranty applies only to equipment manufactured by PRA. Although PRA may frequently supply, as part of a system, equipment manufactured by other companies, the only warranty that shall apply to such non-PRA equipment is that warranty offered by the original manufacturer.

1.4 On-Site Repair

The basic PRA warranty applies only to equipment manufactured by PRA which is returned to the factory. If equipment must be repaired at the customer's site, the actual repair labour and parts will be provided at no charge during the warranty period. However, travel expenses to and from the site as well as living expenses while on-site will be paid by the customer.

1.5 Damage in Transit

Shipments should be carefully examined when received for evidence of damage caused by shipping. If damage is found, notify PRA and the carrier immediately. Preserve all packages, cartons and documents. PRA will provide all possible assistance in damage claims.

SECTION 2

INTRODUCTION TO THE DD1790

2.1 Basic overview

The DD1790 digital drive is a micro-processor based stepper motor controller. It has been designed to be able to separately control up to 5 motors. The DD1790 is a stand alone unit but can be controlled by an external source via an IEEE-488 or SERIAL RS232-C interface (optional) using simple one letter ASCII commands.

2.2 Configurations

The DD1790/1 can control one PRA dye laser and the DD1790/2 can control one PRA dye laser and the L-2X frequency doubler. They can be controlled either separately or synchronously. In the synchronous mode (S.M.), both units will scan such that optimal output energy (as a function of wavelength) of the L-2X will be maintained.

2.3 Rear panel

The rear panel consists of 2 pairs of connectors, one pair for each motor, an optional power expansion connector and optional I/O connector. Their location is shown in figure 01.

Provision has been made for the inclusion of more motor connectors should the user decide to more fully utilize the multimotor control capability of the DD1790 in his particular application.

2.4 Front panel

The front panel consists of a 12 digit alpha-numeric display, 20 keys, and a power switch. Their location is shown in figure 02.

For use with more that 3 motors, the optional power expansion connector is used to connect the DD1790 to an external power supply.

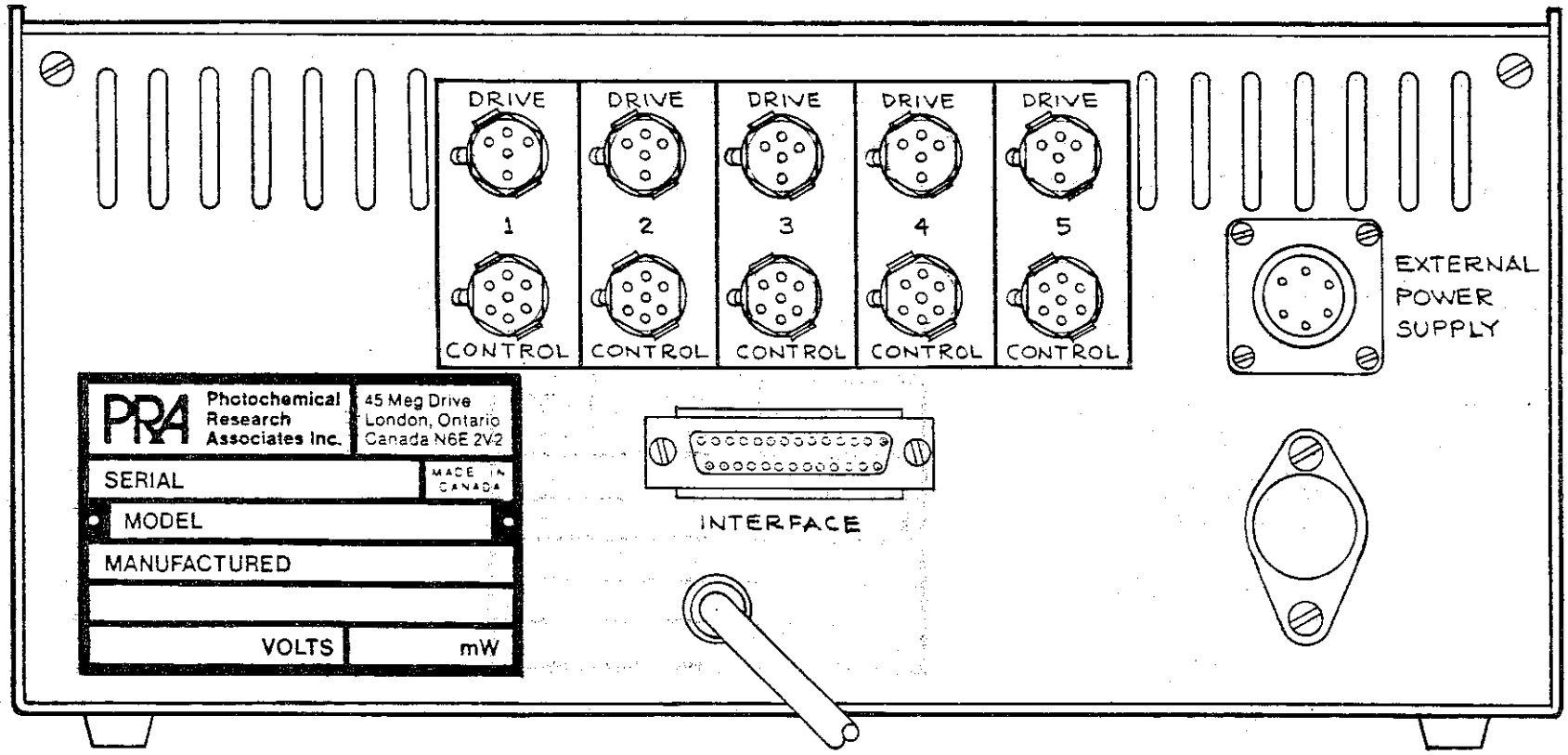


Figure 1 Rear Panel Layout

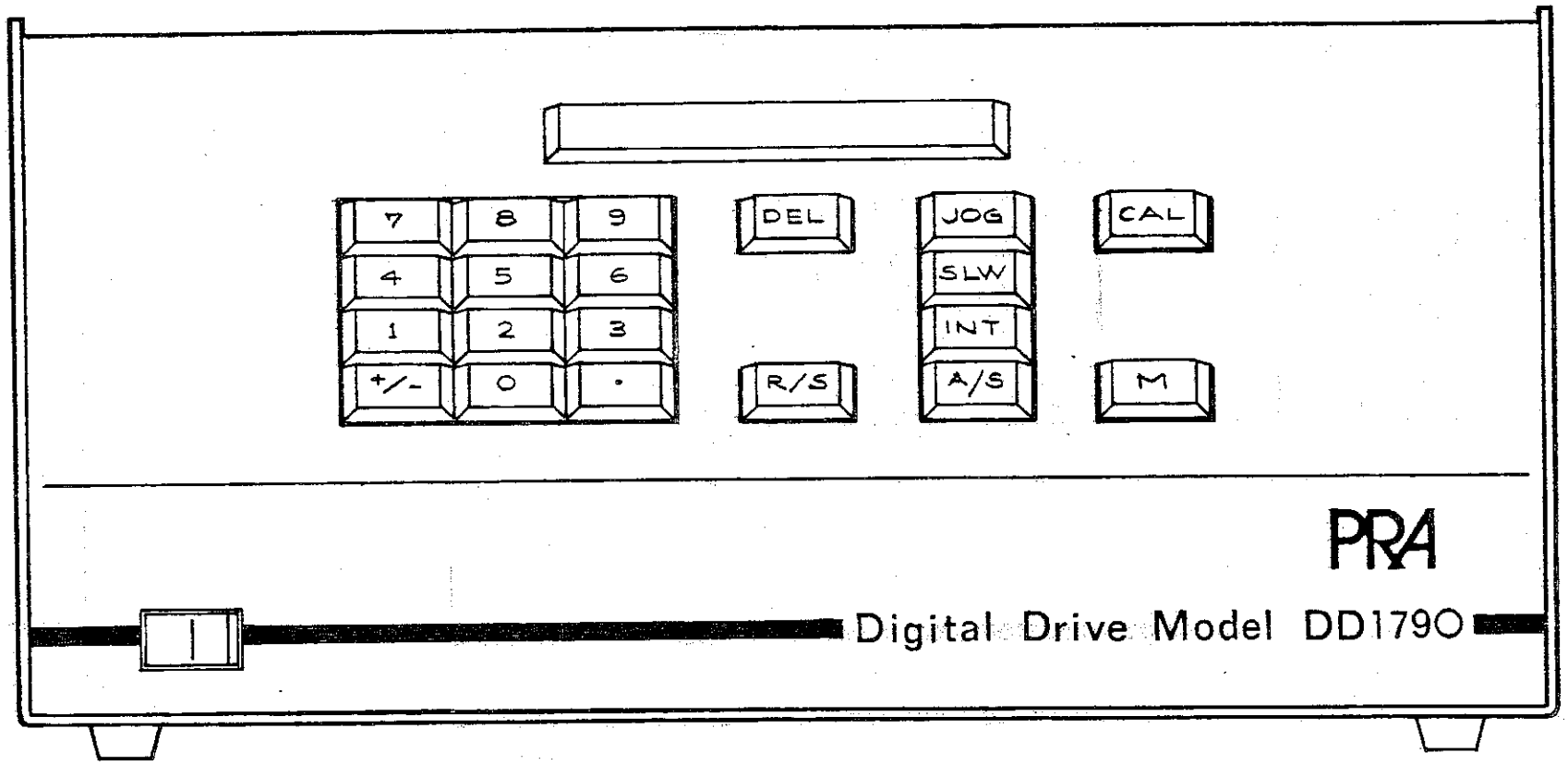


Figure 2 Front Panel Layout

SECTION 3

CONNECTING MOTORS TO THE DD1790

3.1 Motor Driver Cards

The DD1790 has 6 card slots inside on the main printed circuit board. Any 5 of these slots can be used for motors, and 1 is used for the optional I/O interface.

The possible motors that the DD1790 can drive are each assigned a number. Each of these numbers have an assigned function which is shown in TABLE 1 below.

TABLE 1: FUNCTION OF MOTOR NUMBERS

Motor Number	Function
1	LN107, LN102
2	L-2X

NOTE: Each of the above numbers can only be used once, i.e. there cannot be two or more of number 1 or two or more of number 2 etc.

The function that each motor performs is selected on the motor driver cards as shown in figure 03.

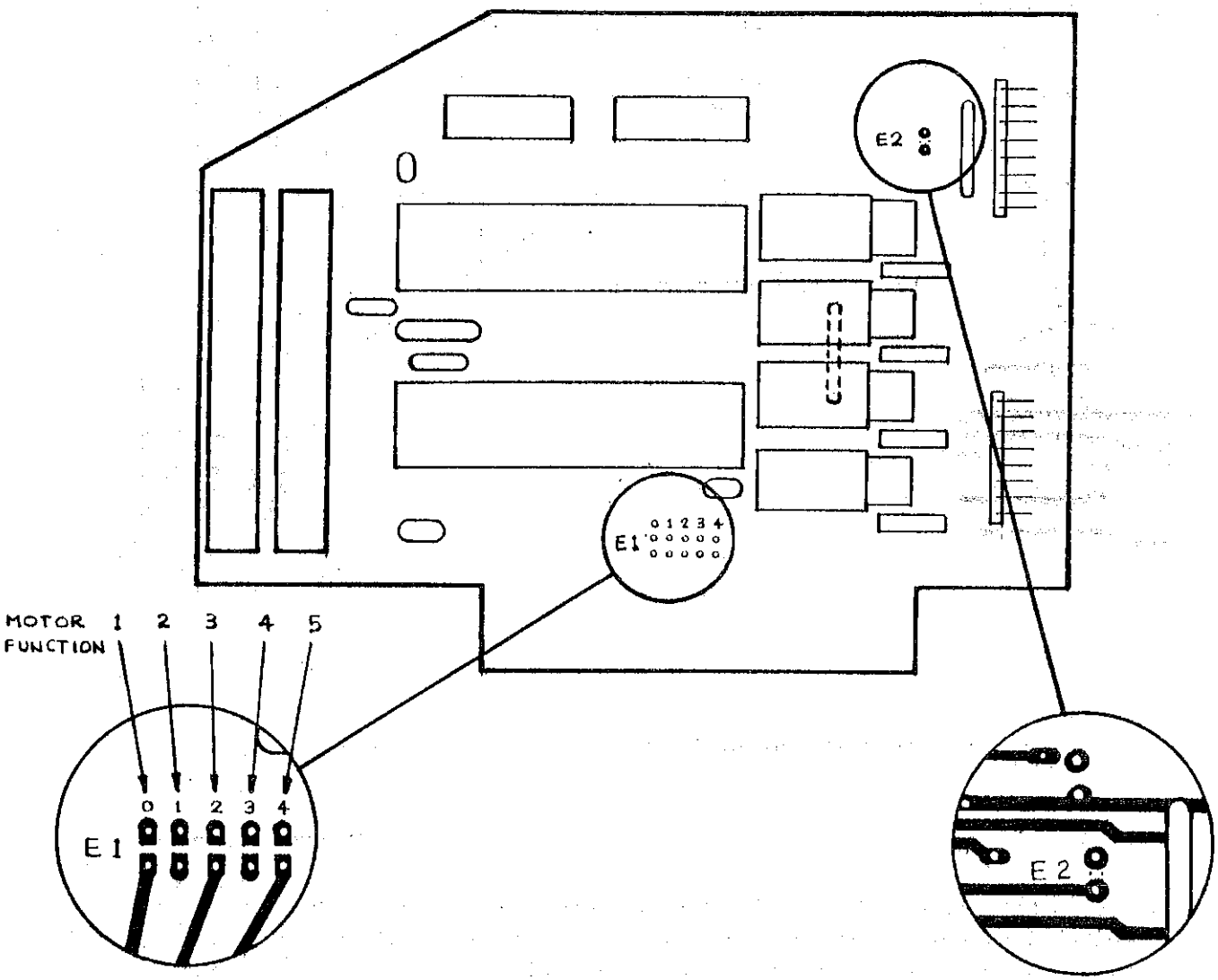


Figure 03 The motor function select position on the motor driver card.

3.2 Connecting the Motors

For each motor there is a 5 pin connector and a 7 pin connector on the rear panel. To operate with the dye laser and frequency doubler only the 5 pin connector is used. The 7 pin connector has been included as part of the standard "connector-pair" assembly. It is required in certain specialized applications other than those related to dye laser and frequency doubler operations.

SECTION 4

TURNING ON THE DD1790

4.1 First time power up

When powering up for the first time, the DD1790 needs to be setup and told about your system specifications. Read the description for the Calibration command (C command [CAL], section 7.4) for setting up the DD1790. After the DD1790 is setup, the setup information will not be lost when power is turned off.

4.2 Normal power up

When the DD1790 is turned on, the following will occur:

1/ The display will be blank until calibration is complete.

2/ The motor(s) will be inactive and the display will show the position(s) previous to power off.

On power up, the motor is "off" until the first step is taken. When power is initially applied to the motor, it may tend to step irratically, causing the display to differ from the "dial setting" of either the laser or the L-2X. It is therefore necessary to recalibrate. This is done by first turning on the motor by performing any of the motor motion commands such as Jog or Slew and then recalibrating the DD1790.

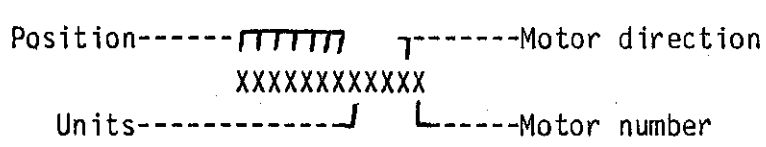
4.3 Power failure

When a power failure occurs, the results are unpredictable. When the DD1790 is turned on again, most data should have been retained, if not, repeat the "FIRST TIME POWER UP" procedure.

SECTION 5

DISPLAY FORMATS

The running mode display format is as follows:



Position: The position of the laser or frequency doubler
Units : Units used to display position
Motor direction: The direction the motor is programmed to move
Motor number : The motor number of the device (1 - laser, 2 - frequency doubler).

SECTION 6

KEYBOARD AND I/O COMMAND OVERVIEW

6.1 DD1790 control in general

Programming and commanding the DD1790, can be done via the keyboard and/or the optional I/O port. All keys, except the [SLW] and [DEL] keys have an equivalent ASCII command that is sent through the I/O port to simulate a key depression.

The keyboard keys and the I/O commands work in parallel with each other, meaning that part of a command can be entered via the keyboard and part of the command can be sent via the I/O. Both forms of controlling the DD1790 are enabled all the time.

Fractional numbers with up to two decimal places are accepted by the DD1790 for programming speed, interval, and the Angstroms per step in the system setup mode.

6.2 Keyboard control

When no key entries are made the display shows the current position of the currently selected motor to be displayed. As soon as any number is entered, the display changes to what is being entered via the keyboard, the "entry display". The delete key can be used to edit the number entered. If no entry is made for approximately 5 seconds, the display switches back to show the position of the currently selected motor to be displayed. The entry display will show again as soon as a numerical key, the delete key ([DEL]), or the decimal key ([.]) has been depressed. Entry of a command key clears the entry display and executes the command entered and returns the display back to show the position of the currently selected motor to be displayed.

6.3 I/O control

Almost all the keys on the DD1790 have an equivalent ASCII character command except for the [SLW] and [DEL] keys. There are also 3 extra commands, 2 for setting the direction of the motor and 1 to get status information of the DD1790.

When numbers are entered via the I/O port, the display does not switch to show the entry display, but remains to show the position of the currently selected motor to be displayed.

6.4 Command set summary

TABLE 2: DD1790 COMMAND SUMMARY

ASCII I/O command	KEYBOARD command	INTERPRETATION
0-9	[0] - [9]	Numeric entry
	[DEL]	Delete last character in the entry display
.	[.]	Decimal point
C	[CAL]	To calibrate 1790 display, and to setup the 1790 controlling specifications
I	[INT]	Set the scanning interval and MOVE TO position
J	[JOG]	Jog motor one step
M	[M]	Motor select
R	[R/S]	Run or Stop motor
	[SLW]	Slew motor
T	[+/-]	Toggle current direction of motor
V	[A/S]	Set the scanning rate
+		Set motor for clockwise direction
-		Set motor for counter-clockwise direction
?		DD1790 status command
.M		Enter synchronous mode Exit synchronous mode

SECTION 7

COMMAND DESCRIPTIONS

7.1 0 -> 9 [0] -> [9]

The numbers 0 through 9 are used for setting intervals and speeds etc. As the numbers are entered, they are not accepted until a command is entered. Therefore these can be deleted using the [DEL] key until then. Numbers cannot be deleted through the I/O control port.

7.2 [DEL]

The delete key ([DEL]) can be used to delete entered numbers and decimal point. This function is only available on the DD1790 keyboard and not through the I/O control port.

7.3 . [.]

The decimal point may be used to enter fractional numbers for speeds and intervals etc.

7.4 C command [CAL]

The Calibration command has two functions, one to calibrate the DD1790 display to correspond to the position of the device it is controlling and secondly, it is used to setup the controlling and running characteristics of the DD1790, (see section 7.4.1) i.e. Angstroms per step, units used to display position, etc. The calibration command works only on the currently displayed motor (motor 1 or 2).

To calibrate the DD1790 display to the actual position of the system it is controlling, enter the position using numbers 0 through 9 and the decimal point if required, followed by the C command or the entering of the [CAL] key. The units used are always Angstroms.

Example: The LN107 is positioned at 450.25 nm. Set the DD1790 display.

Enter into DD1790	4502.5C	(for I/O)
	4502.5[CAL]	(for keyboard entry)

NOTE: Remember to enter position in Angstroms.

7.4.1 System setup mode

To setup the DD1790, just enter the [CAL] command key or use the C command to enter setup mode. The DD1790 will then proceed to ask several questions, as underlined in the following explanation.

WN,A,NM Wave numbers, Angstroms or Nanometers?

The operator can select one of the above units to display the position of the LN107. To make the selection enter the number corresponding to the units requested as shown in TABLE 3 below:

TABLE 3: POSITION DISPLAY UNITS SELECTION NUMBERS

Selection number	Unit used
1	Wavenumber (WN)
2	Angstroms (A)
3	Nanometers (NM)

NOTE: The characters in the parentheses are what is used to label the position on the DD1790 display.

Slew Rate

The slew function is in effect when using the [SLW] key or when the DD1790 is repeating a scan and is returning to the start of the scanning position.

The slew rate has been set to the following values and cannot be altered:

LN107	500 (steps/second)
LN107 - L2X	100 (steps/second)

The following is an example of running through the system setup mode.

User entry	DD1790's display	Comments
[CAL] or C		- Enter system setup mode.
	WN,A,NM? A	- The units currently used are Angstroms.
[3] or 3	3	- Select Nanometers as the units used to display the position of the monochromator.
	BAUD 7	- When a RS232-C option is installed, the display shows the current Baud rate selected, 9600 Baud.

7.5*

The Interval command is used for setting the scanning interval. The number programmed is only for the currently displayed motor.

To set the wavelength scanning interval enter in the desired interval (in Angstroms) followed by the I command or the [INT] key.

Example: Setting the interval to 100 Angstroms

send	100I	For I/O
enter	[1] [0] [0] [INT]	For keyboard entry

NOTE*: Commands so indicated are valid for both units in the Asynchronous Mode (A.M.) and only the LN107 in the Synchronous Mode (S.M.).

7.6* J command [JOG]

The JOG command is used to take a single step on the currently displayed motor. The stepping rate is determined by the rate at which the JOG commands are received. The direction moved will be the currently programmed direction for the motor being jogged.

7.7 M command [M]

The motor select command will cause the DD1790 to display the current position of the selected motor and direction of travel. All commands entered at this point will correspond to the currently displayed motor.

The [M] key is a motor select "toggle" control. Repeated depression of this key will alternatively display and address either motor.

Example: If the condition of motor 2 (L-2X) is currently displayed, enter [M] (for key board entry) or send [M] (for I/O) and motor 1 (dye laser) will be selected. A single repetition of this procedure will again select motor 2.

Example: Select motor 2

send	2M	For I/O
enter	[2] [M]	For keyboard entry

Example: Select next motor

send	M	For I/O
enter	[M]	For keyboard entry

7.8* R command [R/S]

The RUN/STOP command is used to start or stop a motor or motors. When the command is used by itself, the currently displayed motor will start, or if already moving, the motor will stop. If the R command is used by a preceding motor number or numbers, those selected motors (if valid motor numbers are used) will either start or stop, depending on their present state.

Example: Assuming that all motors are not moving, start motors 1 and 2

send	12R	For I/O
enter	[1] [2] [R/S]	For keyboard entry

The R command can also be used to repeat a scan. This is done by sending the R command or entering the [R/S] key. As long as no changes are made to the interval, calibration or no slewing or jogging was done, the DD1790 will slew back to the point where the previous scan was started and then repeat the scan. If changes are made to the above mentioned parameters, the DD1790 will scan from its current position. It is allowed to change the scanning speed.

If the motor is stopped by the R command and then started again, it does not continue the scan, but starts a new scan from its current position.

7.9* [SLW]

The Slew command is used to slew in the currently set direction. This command is not available under I/O control.

NOTE: The Slew key ([SLW]) is only effective when the currently displayed motor is at standstill.

NOTE: When operating in the synchronous mode (S.M.), the L-2X is slaved to the dye laser. The system will execute the Slew command sequentially in the following manner

i. The dye laser will slew and stop.
ii. The L-2X will then slew and stop.

7.10* T command [+/-]

The Toggle command is used to change the direction of the currently displayed motor. If direction is + it is changed to - and if it is - it is changed to +.

NOTE: The T command is only accepted when the currently displayed motor is at standstill.

7.11* V command [A/S]

The Speed command is used to set the scanning speed in Angstroms per second.

The V command is accepted even while the currently displayed motor is rotating, although the command will not become effective until the motor's next scan.

Example: Set motor speed to 25 Angstroms per second.

send	25V	For I/O
enter	[2][5][A/S]	For keyboard entry

7.12* + command

The Plus command is used to set the currently displayed motor's direction to clockwise (positive).

Example: send + For I/O

7.13* - command

The negative command is used to set the currently displayed motor's direction to counter-clockwise (negative).

Example: send - For I/O

7.14 ? command

The Status command is used by the external controlling device to get the status of the motors of the DD1790. The command has two forms, one is to get the display content and the other is to inform the external controller of what motors are installed and, what motors are in motion.

The display content command is the "?". When this command is received the DD1790 sends the content of the 12 digit display to the I/O port.

Example: 0520.00NM+2

This tells us that motor 2 is currently programmed for positive (Clockwise) motion and that its current position is 520.00 nanometers.

The command to get the motor installed and motion status is ".?". This command will send 5 ASCII characters one for each motor. The order sent corresponds to the motor number, eg. the first character sent is motor 1 the second character is motor 2 and so on. Each character can be an N, I or R. Their meaning is as follows:

N --> Not installed
I --> Installed but not in motion
R --> Installed and in motion

Example: IN

This says that: motor 1 is installed
motor 2 is not installed

7.15 .M command

The Synchronization [.][M] command is used to initiate synchronous scanning of the dye laser and L-2X.

After both units have been calibrated, the dye laser - doubling system is placed in Synchronous Mode (S.M.) by the "dot M" (.M) command.

S.M. operation is indicated by the presence of an "S" in the display. All operational commands will relate to the dye laser as the L-2X is slaved, through the software, to the dye laser.

SECTION 8

STEPPING TIMING INFORMATION

8.1 Scanning speed

The scanning speed selected is always in Angstroms. To calculate the actual stepping rate you divide the scanning speed by the number of Angstroms per step. This value has been pre-set to 0.05A per step (half step mode).

The slowest stepping rate selectable is 1 step every 7 seconds, with this in mind you can calculate the slowest scanning speed in Angstroms per second for your system.

Example: The Angstroms per step is equal to .05, calculate the slowest scanning rate in Angstroms per second.

(1/7 Step per Second) X (.05 Angstroms per step) = .007

Therefore the slowest scanning rate is .01, since the DD1790 will only accept 2 decimal digits.

The fastest speed the DD1790 can turn the motor is 1200 steps per second. This maximum is greatly reduced depending on the inertia and other characteristics of the mechanics that the motor is turning.

Example: The maximum scanning speed is 1200 steps per second and, there are .05 Angstroms per step, calculate the maximum scanning rate in Angstroms per second.

(1200 Steps per second) X (.05 Angstroms per step) = 60 S per second.

8.2 Ramping of speed

To move the motor at a high speed it has to be slowly accelerated to the desired speed. The DD1790 does not ramp up to speed when a low scanning rate is requested but, when the scanning rate is above 36 steps per second, it will ramp up to speed and decelerate down to a halt. This feature enables the DD1790 to move high enertia loads.

SECTION 9

OPERATING INSTRUCTIONS

9.1 Introduction

The DD1790 is a digital drive unit capable of driving as many as 5 stepper motors.

The DD1790/1 is a single drive unit appropriate for driving either a monochromator or the LN107.

The DD1790/2 is dedicated to driving the LN107 continuously tunable dye laser and the L-2X frequency doubler. These devices may be driven independently (asynchronous mode, abbreviated AM) or synchronously (synchronous mode, abbreviated SM).

The frequency doubler drive is subordinate to the LN107 dye laser drive when used in the scanning mode (SM). This is an obvious requirement since during wavelength scanning both the dye laser and the frequency doubler drives must be coordinated in order to maintain an optimized (energy) output from the frequency doubler.

Wavelength scanning of the LN107 - L2X system requires precise coordination of the crystal angle tuning of the L-2X with the wavelength tuning of the LN107. For any specific wavelength output of the LN107 a unique corresponding angle of the crystal in the L-2X must be precisely realized.

This procedure is affected by the DD1790 which has crystal angle/wavelength tuning characteristics stored in memory.

NOTE: Prior to operating the DD1790 in conjunction with the laser system ensure that the laser system is operating satisfactory. (Refer to the appropriate laser manuals).

NOTE: Place the DD1790 as far from the LN1000 as possible to minimize the effect of RFI. (Radio Frequency Interference). Although the RF generation characteristics of the LN1000 are exemplary, reliable operation of the DD1790 requires that RF levels be minimized as fully as possible.

9.2 The Dye Laser - DD1790 - Asynchronous Mode (AM)

When using the DD1790 to drive only the dye laser connect the multi-pin cable to the pin socket at the rear of the dye laser and to the connector "Motor 1" at the rear of the DD1790.

Connect the power cord of the DD1790 to the "mains".
Position the DD1790 as fas as possible from the LN1000.
Turn on the DD1790.
Examine the display. The display will indicate, for example,
06239.0A - 1

Depress [JOG] to "enable" the drive (essentially this "starts" the stepper motor as explained in Section 4.2). This activity should be accompanied by the sound of the motor "stepping" as well as a change in the display indicating that stepping is taking place.

Examine the wavelength indicator of the laser and compare that to the wavelength displayed by the DD1790. The two readings should be the same.

If there is a difference e.g. the laser indicator reads 6240.0, enter this number into the DD1790 as [6]-[2]-[4]-[0][.] and press [CAL]. The display will now read 06240.0A-1. This indicates that the system is initially calibrated to 6240.0 A. The "-" sign indicates that when scanning is initiated, it will be in the "-" direction; the "1" indicates that "motor 1" (which is appropriate for the laser) is currently addressed.

Scanning

To scan the dye laser, the user must enter the "range", the "scanning speed" and the direction.

Example: Begin at 6240.0A, scan 50A at 1A sec^{-1}.
The laser is presently at 6240.0A (see above calibration procedure)
Set range: 50A. Enter [5][0][.][0][INT]
This display will again indicate 06240.0A-1
Set speed. Enter [1][.][0][A/S].
The display will again indicate 06240.0A-1
Set direction. Enter [+/-]
The display will now read 06240.0A+1
Depress [R/S]
The laser will scan and the display will track. The scan will stop and the display will now read 06290.0A+1.
[R/S] The laser will slew to 6240A and the scan will repeat.

The scan can be interrupted at any time by depressing [R/S].

9.3 The Dye Laser - L-2X - DD1790 - Asynchronous Mode (A.M.)

Prior to operation of the system in the synchronous mode (S.M.), each unit (dye laser and L-2X) must be calibrated and initialized.

Connect the multi-pin cables as follows:
The L-2X is connected via its rear multi-pin connector to the "Motor 2" connector at the rear of the DD1790.

As a rule of thumb, recall that the L-2X is subordinated to the dye laser, therefore, the connector priorities are as follows:

Motor #1 - dye laser,
Motor #2 - L-2X

The calibration procedure of the dye laser has been previously described.

Position the L-2X frequency doubler in front of the dye laser in such a way that the input aperture of the doubler and the output aperture of the dye laser are aligned. This is accomplished by translating the L-2X with respect to the dye laser. Do not attempt to adjust the legs of either the frequency doubler or the dye laser.

The dye laser beam should pass through the center of the optical system of the L-2X (i.e. the two lenses and the crystal) and should be visible at the exit of the crystal.

The calibration procedure of the L-2X is as follows:

At this point the DD1790 should be connected to the "mains" and switched on and the dye laser will have been calibrated.
The DD1790 display will read, for example,
06240.0A+1 (see above)
Depress [M]. The display will now read, for example,
04980.2C+2
The numerical portion of the display refers to the dial reading of the L-2X;
"C" refers to the dimensionless "Count" position indicated on the dial. Unlike the dial reading of the dye laser which indicates wavelength, the dial reading of the L-2X is dimensionless and is only used as a reference to the particular crystal angle.
+ refers (as previously described) to the direction of the motor drive when activated,
2 refers to Motor 2 i.e. the L-2X

Check the display register of the L-2X. It may indicate a different reading.
Depress [JOG] to "start" the stepper motor.
Depress [SLEW] to set the L-2X dial position to mid range e.g. 4000.
This will minimize the slew travel of the L-2X drive when it is synchronized with the dye laser.
Enter [4][0][0][0][.][0] on the key board of the key board of the DD1790 and depress [CAL].
The display will now be:
4000.0C+2

Enter Synchronous Mode (S.M.)

Enter [.][M] on the key board.

The display will be .M and the L-2X will slew to the appropriate position under the control of the DD1790 at which time the display will be, for example, "CRYSTAL #4".

At this point ensure that the appropriate crystal in the L-2X is positioned in the beam by revolving the crystal mount cylinder manually.

Depress [R/S]
The display will now be:
06240.0A+S

This indicates that the dye laser is set at 6240.0A and when actuated the system will scan in the positive direction. "S" indicates that the system is in S.M.

At this point, place a business card [or better, a business card or piece of paper coated with Rhodamine 6G (2A579 or 7A579)] a few centimeters in front of the exit of the L-2X. It is preferable to do this in a darkened room.

A fluorescent spot a few mm in diameter should be observable.

If not, enter the asynchronous mode and slew the L-2X a few hundred counts in either direction about the 'initial position'. The fluorescent spot will appear.

In order to scan properly in the synchronous mode the dial reading of the L-2X must be restored to the 'initial position' by subtly adjusting the position of the L-2X with respect to the dye laser.

A slight adjustment of the two legs of the LN107 closest to the L-2X may also be required.

Refrain from making any other adjustments if possible.

After final adjustment, the positions of the dye laser and frequency doubler should be secured by the use of bench clamps or similar devices.

Refer now to Section 4.2 of the L-2X Frequency Doubler operating manual.

The system will now operate as described previously.

Enter the scan interval to be used.
e.g. 20A by entering
[2][0][.][0]
[INT]

The display will now be:
06240.0A+S

Enter the scan speed (maximum 1A per second)
e.g. 1A per second by entering
[1][.][0]
[A/S]

The display will now be:
06240.0A+S

Enter [R/S]

The system will scan 10A at 1A per second. Recall that dye laser will scan over 20A while the frequency doubled output will scan over 10A (one half of the scan interval of the dye laser).

The display will now be:
06260.0A+S
Enter [R/S]

The system will slew back to the original position and the scan will be repeated. After scanning the display again will be:
06260.0A+S

SECTION 10

ORDER INFORMATION

TABLE 4: DD1790 MODEL NUMBERS

DYE LASER	DD1790/1
DYE LASER/L-2X	DD1790/2
RS232-C SERIAL INTERFACE OPTION	DD1790/RS
IEEE-488 PARALLEL INTERFACE OPTION	DD1790/IE

SECTION 11

RETURN AUTHORIZATION (R/A) NUMBER IS REQUIRED BEFORE RETURNING ANY ITEM TO PRA. CONTACT CUSTOMS AND TRAFFIC FOR R/A NO. AND FOLLOW THE SHIPPING INSTRUCTIONS FOR RETURN PROCEDURES AS LISTED BELOW:

SHIPPING INSTRUCTIONS

WHEN SHIPPING BY TRUCK, BUS OR COURIER:

1. Canadian Customs Invoices, in quadruplicate, must accompany the shipment. Attach Customs form to a copy of the Bill of Lading.

2. Canadian Customs Invoices and Bill of Lading SHOULD CLEARLY BE MARKED AS FOLLOWS:

   U.S. CUSTOMS CLEARANCE CONTACT: J.V. CARR, 560 Delaware Ave., Buffalo, N.Y. 14201 or J.V. CARR & SON INC., 1600 W Lafayette Detroit, MI 48232 for T.I.B. BOND.

   FOR CANADIAN CUSTOMS CLEARANCE: CONTACT PEACE BRIDGE BROKERAGE LTD.

3. Mail two extra copies of Canadian Customs Invoice, the Original Bill of Lading, and your commercial invoice or purchase order on date of shipment to PRA.

WHEN SHIPPING BY AIR FREIGHT OR AIR CARGO:

1. Canadian Customs Invoices, in quadruplicate, must accompany the shipment. Attach to the Air Way Bill and CLEARLY MARK:

   U.S. CUSTOMS CLEARANCE TO ISSUE TIB BOND, PRIOR TO DEPARTING THE U.S.

   AND ALSO:

   AIRPORT CUSTOMS CLEARANCE FOR CANADIAN CUSTOMS CONTACT: PEACE BRIDGE BROKERAGE LTD.

2. Air Way Bills must be identically marked as above.

3. Air Mail two extra copies of Canadian Customs invoice, the original Air Way Bill and you commercial invoice or purchase order to PRA the day the shipment leaves.

SHIPPING INSTRUCTIONS CONTINUED

WHEN SHIPPING BY MAIL OR PARCEL POST:

1. Canadian Customs invoice, in quadruplicate, must be mailed direct to:

PRA INTERNATIONAL INC.
45 MEG DRIVE
LONDON, ONTARIO
CANADA N6E 2V2 Phone No.: (519) 686-2950

2. Mail two extra copies of the Canadian Customs Invoice, and your commercial invoice or purchase order to PRA, on date of shipment.

PLEASE NOTE: If goods are not registered with U.S. Customs as leaving the U.S. to be going to Canada for repair or replacement, there will be lengthy delays, and it may be necessary for additional charges to be incurred for proper Customs clearance.

PRA is entitled to refuse to accept any returns that do not have proper Customs documentation, once the customer has been advised of proper procedure regarding returns.

If any questions arise concerning the foregoing procedure, please contact:

PRA INTERNATIONAL INC.
45 MEG DRIVE
LONDON, ONTARIO
CANADA N6E 2V2

Phone No.: (519) 686-2950 Attention: Traffic Department

INSTRUCTIONS ON HOW TO COMPLETE THE CANADA CUSTOMS INVOICE OR COMMERCIAL INVOICE

POUR LES INSTRUC... EN FRANÇAIS, VOIR

Parties to this transaction / *A cette transaction*

☐ Are related *Sont* ☐ Are not related *Ne sont pas*

6. Country of Transshipment / *Pays de transbordement*

7. Country of Origin of Goods *Pays d'origine des marchandises*

IF SHIPMENT INCLUDES GOODS OF DIFFERENT ORIGINS ENTER ORIGINS AGAINST ITEMS IN 12. *SI L'EXPÉDITION COMPREND DES MARCHANDISES D'ORIGINES DIFFÉRENTES, PRÉCISER LEUR PROVENANCE EN 12.*

8. Transportation: Give Mode and Place of Direct Shipment to Canada
Transport: Préciser mode et point d'expédition directe vers le Canada

9. Conditions of Sale and Terms of Payment
(i.e. Sale, Consignment Shipment, Leased Goods, etc.)
Conditions de vente et modalités de paiement
(p. ex. vente, expédition en consignation, location de marchandises, etc.)

10. Currency of Settlement / *Devises du paiement*

11. No. of Pkgs *Nbre de colis*	12. Specification of Commodities (Kind of Packages, Marks and Numbers, General Description and Characteristics, i.e. Grade, Quality) *Désignation des articles (Nature des colis, marques et numéros, description générale et caractéristiques, p. ex. classe, qualité)*	13. Quantity (State Unit) *Quantité (Préciser l'unité)*	Selling Price / *Prix de vente* 14. Unit Price *Prix unitaire*	15. Total

18. If any of fields 1 to 17 are included on an attached commercial invoice, check this box ☐
Si les renseignements des zones 1 à 17 figurent sur la facture commerciale, cocher cette boîte

Commercial Invoice No. / *Nº de la facture commerciale* _____

16. Total Weight / *Poids Total*: Net ____ Gross / *Brut* ____

17. Invoice Total *Total de la facture*

19. Exporter's Name and Address (If other than Vendor)
Nom et adresse de l'exportateur (S'il diffère du vendeur)

20. Originator (Name and Address) / *Expéditeur d'origine (Nom et adresse)*

21. Departmental Ruling (If applicable) / *Décision du Ministère (S'il y a lieu)*

22. If fields 23 to 25 are not applicable, check this box ☐
Si les zones 23 à 25 sont sans objet, cocher cette boîte

23. If included in field 17 indicate amount:
Si compris dans le total à la zone 17, préciser:

(i) Transportation charges, expenses and Insurance from the place of direct shipment to Canada
Les frais de transport, dépenses et assurances à partir du point d'expédition directe vers le Canada
$ _____

(ii) Costs for construction, erection and assembly incurred after importation into Canada
Les coûts de construction, d'érection et d'assemblage après importation au Canada
$ _____

(iii) Export packing
Le coût de l'emballage d'exportation
$

24. If not included in field 17 indicate amount:
Si non compris dans le total à la zone 17, préciser:

(i) Transportation charges, expenses and insurance to the place of direct shipment to Canada
Les frais de transport, dépenses et assurances jusqu'au point d'expédition directe vers le Canada
$ _____

(ii) Amounts for commissions other than buying commissions
Les commissions autres que celles versées pour l'achat
$ _____

(iii) Export packing
Le coût de l'emballage d'exportation
$

25. Check (If applicable):
Cocher (S'il y a lieu):

(i) Royalty payments or subsequent proceeds are paid or payable by the purchaser
Des redevances ou produits ont été ou seront versés par l'acheteur ☐

(ii) The purchaser has supplied goods or services for use in the production of these goods
L'acheteur a fourni des marchandises ou des services pour la production des marchandises ☐

DEPARTMENT OF NATIONAL REVENUE — CUSTOMS AND EXCISE
MINISTÈRE DU REVENU NATIONAL — DOUANES ET ACCISE

APPENDIX I

MOTOR DRIVE AND CONTROL SIGNAL SPECIFICATIONS

1. Motor drive connector signals

The motor driver card used in the DD1790 is setup for a 4 phase type stepper motor. The common source voltage is about 4 volts for a 5.1 Ohms per winding motor. Ratings and pin numbers are shown in Table 5 below.

TABLE 5: MOTOR DRIVE SIGNAL RATINGS AND PIN CONFIGURATION

Pin		Signal	Ratings
A	RED	Phase 1	2 Amps
B	GREEN	Phase 3	2 Amps
D	RED/WHITE	Phase 2	2 Amps
E	GREEN/WHITE	Phase 4	2 Amps
H	BLACK & WHITE	Common source	1.5 Amps @ 4 volts

2. Control signal connector

The function of this connector is to supply the user with two types of limit sensing outputs and a motor direction and motor step pulse output. The direction and stepping pulse outputs can be used, with the proper interface to produce the right signal characteristics for a plotter. The limit sensors can be used as a protection or as a calibration feature.

The motor direction and stepping pulse outputs are open collector drive signals. The motor is programmed for a clockwise direction when Pin A output is floating, and is in a counter-clockwise direction when Pin A is at ground potential. For every step that the motor takes, Pin B is pulled to ground potential for approximately 10 micro seconds.

Limit sensor A and B inputs are "ABORT" type limits, which when activated (pulled to a ground potential) aborts the current command and stops the motor.

TABLE 6: CONTROL CONNECTOR, SIGNAL RATINGS AND PIN CONFIGURATION

Pin	Signal		Ratings
A	Motor direction	(output)	08 milliamps sinking
B	Motor stepping pulse	(output)	08 milliamps sinking
C	Limit sensor A	(input)	5 volts maximum
D	Limit sensor B	(input)	5 volts maximum
E	+5 volts		Use only for sensors
H	Ground		Common ground

APPENDIX II

I/O INTERFACE SPECIFICATIONS

1. IEEE-488 Interfacing

The IEEE-488 interface conforms to the ANSI/IEE-488-1978 specifications.

The DD1790 IEEE-488 is setup for the addressable talker listener mode. The DD1790 can be set to any of the 31 addresses, ranging from 0 through 30. Each address can be selected by setting the switches on the IEEE-488 driver card to the appropriate binary bit positions for the particular address value desired. The address selected establishes the DD1790's device address. The DD1790 IEEE-488 interface device address is factory set to 07, but can be changed by the user. Check figure 04 for setting the device address.

The DD1790 IEEE 488 functions implemented are as follows:

1. Source Handshake (SH1)
2. Acceptor Handshake (AH1)
3. Talker (T2)
4. Listener (L2)
5. Service Request (SR1)
6. No Remote Local (RL0)
7. No parallel Poll (PP0)
8. No device Clear (DC0)
9. No device Trigger (DT0)
10. No controller (C0)

The interface clear command, IFC, overrides all bus operations and returns the bus to a known quiescent state.

Figure 04 shows the address switches as they are set at the factory. The off position, as labelled on the switch, is a logic 1, and the other position is a logic 0. These logic levels correspond to the ones and zeros used in TABLE 7.

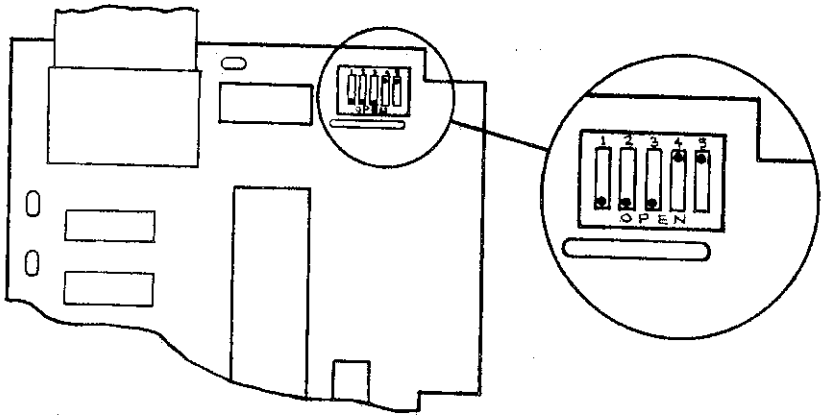


Figure 04 Factory set address of 7 on switches

TABLE 7: DD1790 IEEE-488 DEVICE ADDRESS SELECTION

	Address Switch setting (() are the switch numbers)					Address Codes	
	16(5)	8(4)	4(3)	2(2)	1(1)	Decimal	Octal
	0	0	0	0	0	0	0
	0	0	0	0	1	1	1
	0	0	0	1	0	2	2
	0	0	0	1	1	3	3
	0	0	1	0	0	4	4
	0	0	1	0	1	5	5
	0	0	1	1	0	6	6
*	0	0	1	1	1	7	7
	0	1	0	0	0	8	10
	0	1	0	0	1	9	11
	0	1	0	1	0	10	12
	0	1	0	1	1	11	13
	0	1	1	0	0	12	14
	0	1	1	0	1	13	15
	0	1	1	1	0	14	16
	0	1	1	1	1	15	17
	1	0	0	0	0	16	20
	1	0	0	0	1	17	21
	1	0	0	1	0	18	22
	1	0	0	1	1	19	23
	1	0	1	0	0	20	24
	1	0	1	0	1	21	25
	1	0	1	1	0	22	26
	1	0	1	1	1	23	27
	1	1	0	0	0	24	30
	1	1	0	0	1	25	31
	1	1	0	1	0	26	32
	1	1	0	1	1	27	33
	1	1	1	0	0	28	34
	1	1	1	0	1	29	35
	1	1	1	1	0	30	36
	1	1	1	1	1	31	37

* **NOTE:** This row shows the factory setting for device address.

2. RS232-C Interfacing

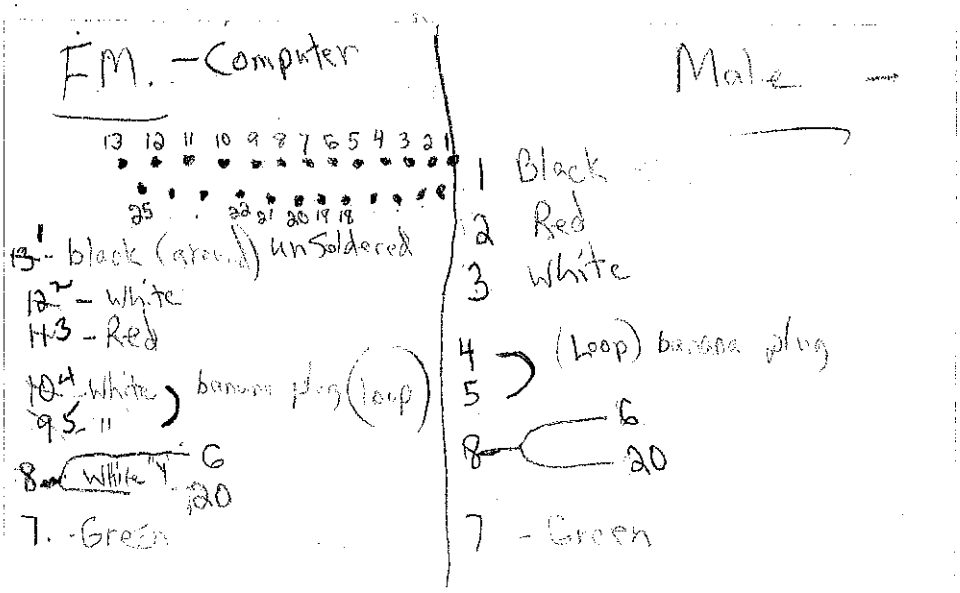
The RS232-C connector consists of a DB25 connector. There is no handshake protocol used. The signals are configured as shown in Table 8 below:

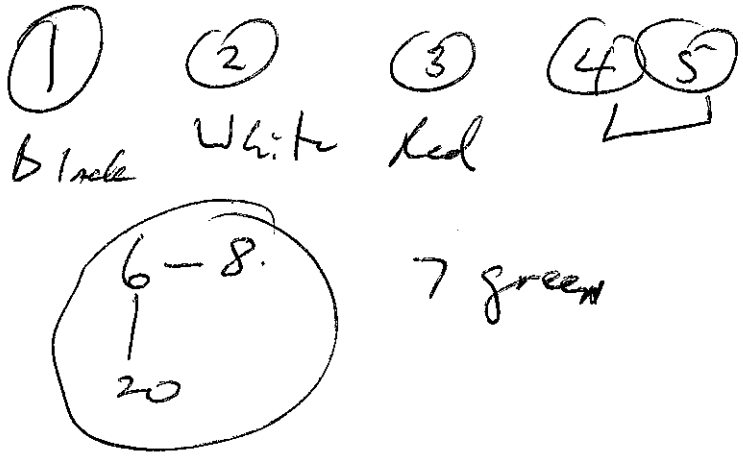
TABLE 8: RS232-C CONNECTOR PIN CONFIGURATION

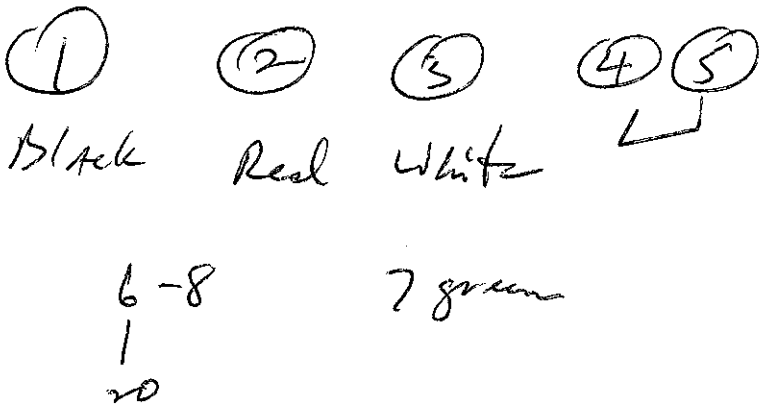
Pin number	Signal
1	Ground
2	Transmit
3	Receive
7	Ground

Baud rate is selected in the Calibration setup mode (see section 7.4.1).

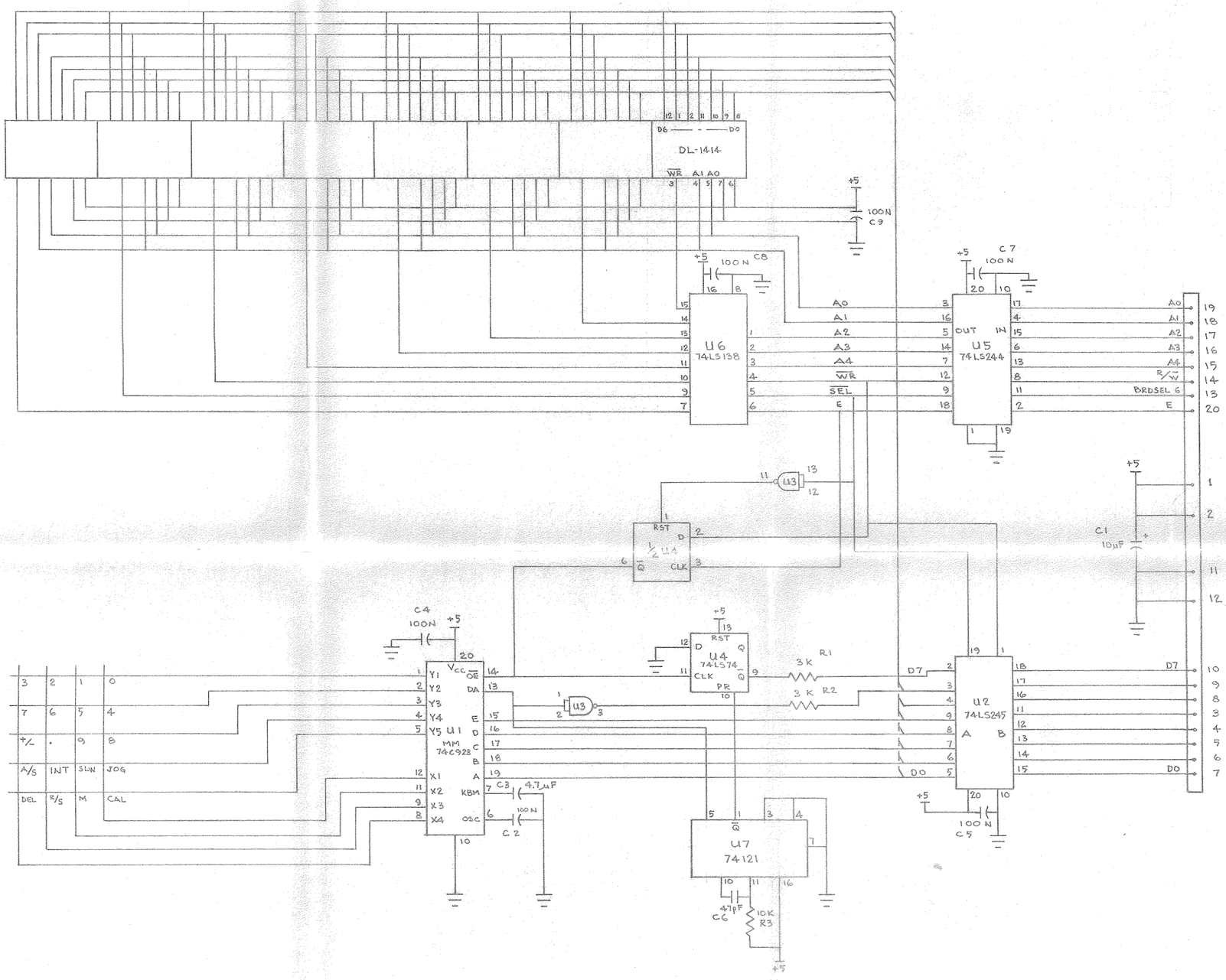
Transmitting and receiving of data follows the following format, 8 bits (7 bits plus 1 unused parity bit), 1 stop bit and no parity.




1
2
3
4
5
Black
White
Red
6 - 8.
20
7 green


1
2
3
4
5
Black
Red
White
6 - 8
20
7 green

REVISIONS				
REV	CN No.	DESCRIPTION	DATE	APPR.
——	0835	RELEASE	5 JUL 84	
A	0996	C3 WAS 1.0μF	31 JUL 84	



ITEM	QTY	DESCRIPTION	PART NO.
		PARTS LIST	

MATERIAL	FINISH
EQUIPMENT: 1790 DIGITAL DRIVE	PRA Photochemical Research Associates Inc.
TOLERANCES UNLESS OTHERWISE STATED: 3 PLACE DEC. ± .005; 2 PLACE DEC. ± .010; FRACTION ± 1/64	DRAWN R.P 18JUNE84
	CHECKED J.D 26 JUNE 84
	APPROVED J.D 26 JUNE 84
TITLE: SCHEMATIC KEY/DISPL.	
DWG SIZE: D	DWG. NO: 01052117
REV.	

REVISIONS				
REV	CN No.	DESCRIPTION	DATE	APPR
—	0685	RELEASE	3 JUL 84	
A	0796	Y1 WAS 6Mhz ; E2 ADDED	31 JULY	
B	0856	Q7, R3, R4 ADDED - Q5-8 W/HEFUS-8	17 AUG 84	

+5 C5 100 N — C4 100 N

U1 6821 — U2 CY500

D7 D6 D5 D4 D3 D2 D1 D0 — BD7 BD0

R/W — CS2 — CS1 — CS0 — E — IRQA — IRQB — RS1 — RS0 — RESET

BRDSEL 0 BRDSEL 1 BRDSEL 2 BRDSEL 3 BRDSEL 4 — E2

C2 20pF — Y1 4Mhz — C3 20pF — XTAL 1 — XTAL 2

AD7 AD0 — LS2 — ESS

TRQ — A1 — A0 — RESET

RDY/BUSY — RUN — MOTION COMP — PROG CONTROL — WAIT — TRIG — ASCII/BIN — EXT. START/STOP

ABORT — XDIR — PULSE — CONTROL — TRIG — EXT. START/STOP

TIP-122 — CR1 CR2 CR3 CR4 — Q5 Q6 Q7 Q8

RN2 1*5 — RN1 3*3

74LS05

J2: 6 Ø1, 5 Ø2, 4 Ø3, 3 Ø4, 1 GND, 2 GND

J1: 3 LIMIT SENSE 1, 5 EXT DIR, 6 STEPPING PULSE, 1 DIR OUT, 2 TRIG IN, 4 EXTERNAL START/STOP, 7 +5, 8

1,A — C1 10µF — 15,S

R4 6.2K — R3 3.9K — R2 6.8Ω — R1 6.8Ω — Q9 TIP 127 — PIN 6 U1

RN1 - 3300 Ω RESISTOR NET

RN2 - 3300 Ω RESISTOR NET

ITEM	QTY	DESCRIPTION	PART NO.

PARTS LIST

MATERIAL — FINISH

EQUIPMENT: 1790 DIGITAL DRIVE

Photochemical Research Associates Inc.

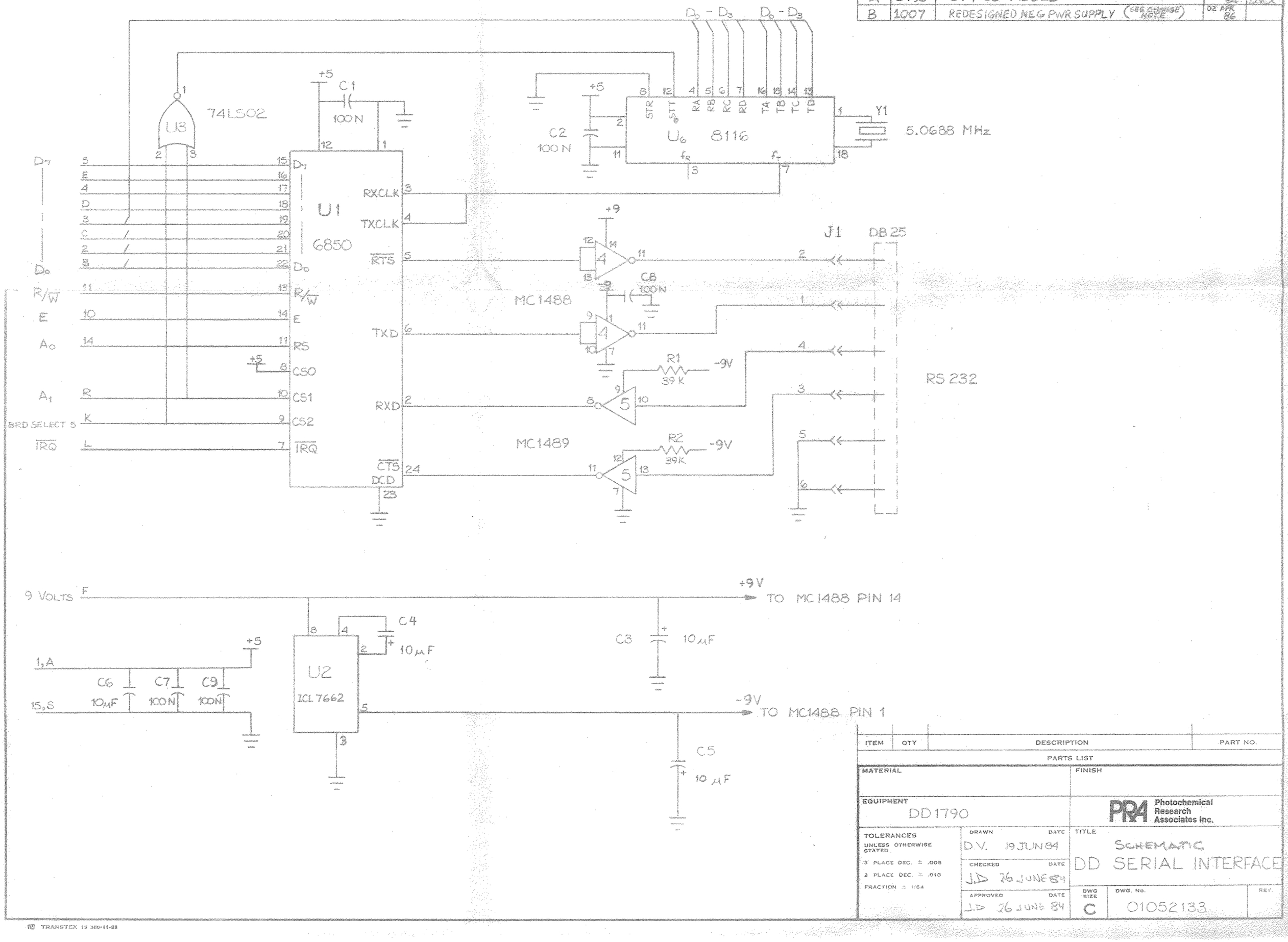
TOLERANCES UNLESS OTHERWISE STATED: 3 PLACE DEC. ± .005; 2 PLACE DEC. ± .010; FRACTION ± 1/64

DRAWN: R.P. 19 JUNE 84 — CHECKED: J.B. 26 JUNE 84 — APPROVED: J.B. 26 JUNE 84

TITLE: SCHEMATIC STEPPER DRIVER CONTROLLER

DWG SIZE: C — DWG. NO.: 010522-25 — REV.

REVISIONS				
REV	CN No.	DESCRIPTION	DATE	APPR.
—	0335	RELEASE	3 JUL 84	
A	0796	C7, C8 ADDED	31 JUL 84	
B	1007	REDESIGNED NEG PWR SUPPLY (SEE CHANGE NOTE)	02 APR 86	



ITEM	QTY	DESCRIPTION	PART NO.

PARTS LIST

MATERIAL	FINISH
EQUIPMENT: DD1790	Photochemical Research Associates Inc.
TOLERANCES UNLESS OTHERWISE STATED. 3 PLACE DEC. ± .005; 2 PLACE DEC. ± .010; FRACTION ± 1/64	DRAWN DATE: D.V. 19 JUN 84
	CHECKED DATE: J.D 26 JUNE 84
	APPROVED DATE: J.D 26 JUNE 84
TITLE: SCHEMATIC DD SERIAL INTERFACE	
DWG SIZE: C	DWG. NO.: 01052133
REV.	

REVISIONS				
REV	CN No.	DESCRIPTION	DATE	APPR.
—	0336	RELEASE	3 JUL 84	
A	0796	C1 DELETED ; C4 - C7 ADDED	31 JUL 84	

MC3448A PIN 16 +5 V_{cc}
PIN 8 GND
PIN 4, 12 GND

+5

U2 68488

D_7 D_0 V_{cc} V_{SS} T/$\overline{R}$ $\overline{EOI}$ $\overline{SRQ}$ $\overline{REN}$ $\overline{IFC}$ $\overline{ATN}$ $\overline{DAC}$ $\overline{RFD}$ $\overline{DAV}$ $\overline{TBC}$ TB1 TB2 TB3 TB4 TB5 TB6 TB7 R/$\overline{W}$ E $\overline{IRQ}$ $\overline{RESET}$ RS0 RS1 RS2 $\overline{CS}$ $\overline{ASE}$ DNA REQ DMA GRANT T/$\overline{R}$

U6 U5 U3 U4

BUS MANAGEMENT
HAND SHAKE
IEEE
DATA

N.C. N.C. N.C.

74LS04

IEEE CONN. J1

U7 74LS367

D4 D3 D2 D1 D0

RN1 3300 Ω RESISTOR NET

C4 - C7 100 N
C2 10 µF
1, A 15, S

100 N C3

5 POSITION DIP

LSB MSB

DEVICE ADDRESS

ITEM	QTY	DESCRIPTION	PART NO.

PARTS LIST

MATERIAL

FINISH

EQUIPMENT
DD 1790

PRA Photochemical Research Associates Inc.

TOLERANCES
UNLESS OTHERWISE STATED
3 PLACE DEC ± .005
2 PLACE DEC ± .010
FRACTION ± 1/64

DRAWN D.V. DATE 18JUN84
CHECKED J.D DATE 26 JUNE 84
APPROVED J.D DATE 26 JUNE 84

TITLE
SCHEMATIC
DD IEEE INTERFACE

DWG SIZE C
DWG. NO. 01052141
REV.

REV	CN NO.	DESCRIPTION	DATE	APPR.
B	0846	R7, R8 & Q3 ADDED	[illegible] JAN 85	RP
—	0355	RELEASE	3 JUL 84	[illegible]
A	0796	VR 1 ADDED	31 OCT 84	[illegible]

TO KEY BD/DISP.

J1 J2 J3 J4 J5 J6 J7

U9 6802

U1 U2 U3 U4 2732

U5 6116

U6 74LS138

U7 74LS138

U8 74LS245

U10 74LS244

78H05

MDA 980-2

DPC 12-2000

T1 T2

Q1 2N3416 OR 2N3904

Q2 2N3416 OR 2N3904

Q3 2N3906

CR1 IN4001

CR2 IN4001

CR3 IN4001

F1

VR 1

X2210

ITEM	QTY	DESCRIPTION	PART NO.

PARTS LIST

MATERIAL

FINISH

EQUIPMENT DD1790

PRA Photochemical Research Associates Inc.

TOLERANCES UNLESS OTHERWISE STATED
3 PLACE DEC. = .005
2 PLACE DEC. = .010
FRACTION = 1/64

DRAWN D.V. DATE 20JUN84
CHECKED J.D. DATE 26 JUNE 84
APPROVED J.D. DATE 26 JUNE 84

TITLE SCHEMATIC COMP/P.S.

DWG SIZE D

DWG. NO 01052109

REV.

TRANSTEX 15 30U-5-82