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Molectron
DETECTOR, INCORPORATED

JD2000
TWO-CHANNEL
JOULEMETER/RATIOMETER

Operator Manual
Revised February 1, 1991

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MOLECTRON DETECTOR INCORPORATED **Memorandum**

FROM: Burt Mooney **DATE:** 9-9-92

TO: JD2000 Customers

SUBJECT: JD2000 matrix setup with J9LP, J4-05, J4-09 probes

Since the JD2000 was originally designed we have developed a few new energy probes such as J9LP, J4-05, and J4-09. These probes are not currently listed in the JD2000 probe selection matrix. In order for these to work with the JD2000 you have to set them up in the matrix as other similar probes. You should set them all up as J25's. The J9LP needs to have the 50/1Mohm switch in the back set for 1 Mohm. The J4-05 and J4-09 need to have the switch set for 50 ohms.

You can edit the default probe for any line in the matrix to a J25. For example: Flip the Meas/Cal switch in the back to Cal. The word Cal should now appear on the front display. Next press the left autorange key. This gets you into the matrix. Hold that key down until a number appears on the display. If the number 1. is not displayed, press the left Range up or down key until you see the number 1. displayed. You are now at the far left of line 1. of the matrix. The matrix can only display 4 characters at a time. Press the right Autorange key to scroll to the right. You should see 1. J, then J3, and finally J3-02. When this is displayed you can press the number 3 key, then press the Enter key. This is the code number to edit the probe selection to change to a J25. Next scroll over again to display SN (serial number). Keep scrolling until a 4 digit appears. Now you can enter your 4 digit serial number, then press the Enter key. If your probe has only 3 numbers, enter a 0 as the first digit. Next, scroll over until you see a number displayed in scientific notation and the words Volt, Joule displayed. Now press the appropriate numbers and decimal point for your probes calibration. Then press EXP and enter the correct exponent. Then press the Enter key. If you scroll over again you can enter an attenuation factor when your see 4 digits displayed. To return to beginning of the line press and hold down the left Autorange key. To set up this probe now for channel A, check to see if the green LED for channel A is lit above the Display button. If it is lit then the JD2000 is set up. If it is not lit, then press the display button once. If you want this probe set up Channel B, then press the Display button once more. Now both LED's for channel A & B are lit. You can now set up any other line of the matrix for channel A without changing B. If you have any questions, please give me or one of our Application Engineers a call.

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MOLECTRON DETECTOR MODEL JD2000
JOULEMETER RATIOMETER

TABLE OF CONTENTS

I. GENERAL INFORMATION 1

Introduction 1
Specifications 2
Description 3
Basic Features 3
Modes of Operation 3
Linear or Log Display 3
Pulse Average Standard Deviation 3
Custom Features 3

II. INSTALLATION 5

Unpacking and Inspection 5
Power Supply 5
Safety Precautions 5
Selecting Line Voltage 6

III. GUIDE TO OPERATION 7

Controls 7
Front Panel Controls 7
Power 7
Mode 7
Average 7
Keyboard 9
Trigger 9
Status 9
Display 9
LIN/LOG 9
Range 10
Autorange 10
Multi-Function Keys 10
Rear Panel Connections 10
RS-232 10
IEEE488 10
Calibrate/Measure 11
CH A/CH B Input 11
50Ω/1MΩ 11
CH A/CH B Output 11
AUX A/AUX B Input 11
AC Power Plug and Fuse 11

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Joulemeter Probes 12
Selecting a Joulemeter 12
Checking Damage Threshold 12
Connecting Joulemeter Probes 12
Calibration Mode 13
Software Calibration 13
Entering Joulemeter Calibration Data 17
Calibration a Joulemeter Probe to CH A and CH B 18
Editing Preset Calibration Matrix 18
Operating Procedure 19
Power On 19
Selecting Mode 19
Triggering 19
Display Options 19
Manual Range or Autorange 20
Linear or Log 20
Averaging 20
Running Average 20
Accumulate/Reset 20
Standard Deviation 20
Storing Setup 20
Analog Outputs 21
CHB-OUT 21
CHA-OUT 21

IV. COMPUTER INTERFACE 22

RS232 Setup 22
RS232 Pinouts 22
IEEE488 (GPIB) Setup 23
Interface Command Codes 23
Data Collection Examples 26
COntinuous Mode 26
QUery Mode 27

V. LIMITED WARRANTY 28

LIST OF TABLES

Table 1. Joulemeter Range and Sensitivity When Used With JD2000 4

Table 2. Software CAL Matrix (example) 14

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LIST OF FIGURES

Figure 1. JD2000 Front Panel..... 8

Figure 2. JD2000 Rear Panel..... 8

Figure 3. CAL MODE Indicates CAL Setup..... 15

Figure 4. CAL MODE Indicates Line 1 of CAL Matrix..... 15

Figure 5. CAL MODE Shows Joulemeter Model Number..... 15

Figure 6. CAL MODE Indicates Serial Number..... 16

Figure 7. CAL MODE Shows Voltage Responsivity..... 16

Figure 8. CAL MODE Indicates Attenuation Factor..... 16

Figure 9. CAL MODE Displays Attenuation Number..... 16

LIST OF SCHEMATICS

Schematic 1. JD2000 Display Board 0010-7590.

Schematic 2. JD2000 Analog Board 0010-7630.

Schematic 3. JD2000 System Board 0010-7550.

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I. GENERAL INFORMATION

Introduction

The model JD2000 Joulemeter Ratiometer is a precise microprocessor-based dual channel, energy meter and ratiometer. As a dual channel Joulemeter it was designed to accurately measure pulsed radiation sources (i.e., laser, flashlamps, etc.). It handles pulsewidths from milliseconds to picoseconds, single-pulse or up to 40 pulses per second. It can measure one or two-pulsed sources simultaneously. With a variety of our standard Joulemeter probes, it can measure from picojoules to Joules, from the deep UV through far IR. Our NBS traceable calibration procedure gives you the assurance of accurate optical measurements.

As a dual channel Ratiometer, it provides a precise linear or log ratio of signals present on channels A and B, accurate to better than 0.1%. It's autotrigger and autorange capabilities make ratioing easy over a wide dynamic range. Select channel A or B as the reference channel, let the other channel autorange, and display the ratio of A/B or B/A.

The JD2000 comes equipped with both RS232 and IEEE488 computer interfaces. It can transmit or receive over either computer bus and is remotely controllable by computer.

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Specifications

1.	Range (Full Scale):	Joules (J3-series)	µJ to 20mJ
		(J25/J50)	2mJ to 20J
		Watts (J3-series)	2µW to 5W
		(J25/J50)	2mW to 10W
		Volts (Both)	2mV to 20V
2.	N.E.J. (Typical):	(J3-series)	3nJ
		(J25)	4µJ
		(J50)	16µJ
3.	N.E.V. (Typical):		32µV
4.	Maximum Rep Rate:		40pps
5.	Linearity:		1% of full scale
6.	Digital Resolution:		1 part in 2000
7.	Ratio Accuracy:		0.1%
8.	Averaging:		1 to 100 pulses (continuous)
9.	Auto Trigger:		7% of full scale
10.	External Trigger:		0 to 4V, 1µsec
11.	Analog Output (A & B):		0 to 4V
12.	Package:		5 x 12 x 10 inches (rack mount option)
13.	Power Requirement:		120/240 VAC +/- 10%, 50/60 HZ, 25 W

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Description

Basic Features

Modes of Operation

There are three modes of operation, **VOLTS**, **ENERGY**, and **AVG PWR**. In the **VOLTS** mode, the JD2000 measures and displays the absolute peak voltage output of the attached Joulemeter probe. Its range is from a few microvolts to volts.

In the **ENERGY** mode, the JD2000 applies a calibration factor to the peak voltage measured to give a direct reading in Joules. With a variety of probes, it's range is from picojoules to Joules (see Table 1).

In the **AVG PWR** mode, the JD2000 acts like a fast averaging power meter. It calculates and displays the average power of the pulsed source being measured with subsecond response time.

Linear or Log Display

There are two options for displaying a measurement: linear or log. The linear option displays the reading in scientific notation, while the log option displays the number in logarithmic base 10 form (i.e., 100 is shown as 2.00).

Pulse Average and Standard Deviation

When operating in the **ENERGY** mode, you may select Pulse Averaging, where the average of 1 to 100 pulses will be displayed. Then by pressing the **STD DEV** button, you may calculate and display the standard deviation of pulses averaged.

Custom Features

The JD2000 has some unique custom features. The display is a large, custom designed LCD display that is backlit with a photo luminescent panel. Its large characters allow easy viewing from a distance in a dark lab.

The measurement is displayed directly in scientific notation with the appropriate units of Joules, volts, or watts. This unique display also includes a two digit count of the pulses averaged, and a fast three inch long analog bar graph for peaking a reading.

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JD2000 Joulemeter Probe Performance

Probe Model		J3-02	J3-05	J3-09	J25/J25HR	J50/J50HR
Responsivity		10 V/mJ	2.5 V/mJ	1 V/mJ	8 V/J	2 V/J
Range	Full Scale					
20	19.99	*	*	*	.01 J	.04 J
2	1.999	.001 mJ	.004 mJ	.010 mJ	.001 J	.004 J
.2	199.9	.1 μJ	.4 μJ	1.0 μJ	.1 mJ	.4 mJ
.02	19.99	.01 μJ	.04 μJ	.1 μJ	.01 μJ	.04 μJ
.002	1.999	.003 μJ	.012 μJ	.030 μJ	.004 mJ	.016 mJ

Table 1. Minimum detectable energy for standard Joulemeter probes when used with the JD2000 (assumes external trigger).

Table 1. Joulemeter Range and Sensitivity when used with JD2000.

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II. INSTALLATION

Unpacking and Inspection

The equipment described in this manual was delivered to the carrier in good condition and properly packed. When the shipment of equipment is received, it should be inspected immediately for lost or damaged components; check the case 1for cracks, loose hardware, etc. Flip switches to insure none are broken. All the boxes comprising the shipment should be opened and unpacked carefully. Contents of the boxes are listed on the packing slip.

If loss or damage is to be claimed:

1. Notify the carrier or their agent for inspection of the loss or damage claimed. File claims with the carrier.

2. Save all shipping boxes and cartons for carrier's inspection until claim is settled.

3. If you require replacement for the parts damaged in shipment, please send us your purchase order. The amount shown in the replacement part invoice may then be collected from the carrier.

Power Supply

Safety Precautions

This instrument may be damaged if operated with the LINE VOLTAGE SELECTOR set for the wrong applied AC input-source voltage or if the wrong fuse is installed.

The JD2000 has a detachable, three wire power cord with a three-contact plug for connection to both the power source and protective ground. The protective ground contact connects to the accessible metal parts of the instrument. To prevent electrical shock, always use a power source outlet that has a properly grounded protective-ground contact.

OPERATE WITH COVERS IN PLACE! To avoid injury, do not remove the product covers or panels. Do not operate the product without all covers and panels in place.

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Selecting Line Voltage

The JD2000 operates from a 100V, 120V, 220V or 240V nominal AC power source having a line frequency of 50 or 60 Hz. Before connecting the power cord to a power source, verify that the LINE VOLTAGE SELECTOR card, located in the rear panel fuse holder, is set so that the correct AC input voltage value is visible.

Conversion to other AC input voltages requires a change in the fuse holder card position and fuse value. Disconnect the power cord, open the fuse holder cover door and rotate the fuse-pull lever to remove the fuse. Remove the small printed circuit board and select the operating voltage by orienting the printed circuit board to position the desired voltage to be visible when pushed firmly into its slot. Rotate the fuse-pull lever back into its slot. Rotate the fuse-pull lever back into its normal position and insert the correct fuse into the fuse holder.

Verify that the correct line fuse is installed before connecting the line cord. For 100V and 120V, use a 1/2 Amp fuse and for 220V and 240V, use a 1/4 Amp fuse.

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III. GUIDE TO OPERATION

Controls

Front Panel Controls

Power

This is a two position switch. The **ON** position provides power to the instrument. The **OFF** position shuts power down.

Mode

There are three modes of operation. The **VOLTS** mode displays the absolute peak voltage output of the attached Joulemeter Probe. The **ENERGY** mode applies a calibration factor to the peak voltage measured to give a direct reading in Joules. Its range, depending on the probe selected, is from picojoules to Joules (see Table 1). In the **AVG PWR** mode, the JD2000 acts like a fast averaging power meter. It measures the pulse energy and time interval between pulses, then calculates the average power. You can select the average of 1 to 100 pulses.

Average

ON/OFF enables averaging. The averaging function may be selected for **VOLTS, ENERGY, and AVG PWR** modes. It allows the user to average from 1 to 100 pulses. The used selects the desired number of pulses using the numeric keyboard and then chooses the **ENT** or **ACC/RST** key. Choosing the **ENT** key results in a continuous update of the display every time the selected number of pulses is acquired. With the **ACC/RST** key, you can accumulate the number of pulses desired and display the average until you reset the JD2000 by pushing the **ACC/RST** key another time. While in this mode, you may also display the standard deviation of the accumulated pulses by depressing the **STV DEV** button.

When the averaging function is on, it enables the **COUNT** portion of the LCD display. It displays the number of pulses selected and/or the number of pulses acquired during measurement. Note: This two-digit portion of the display shows 100 as **EO**.

To get out of the averaging operation, you must press the **AVERAGE ON/OFF** button.

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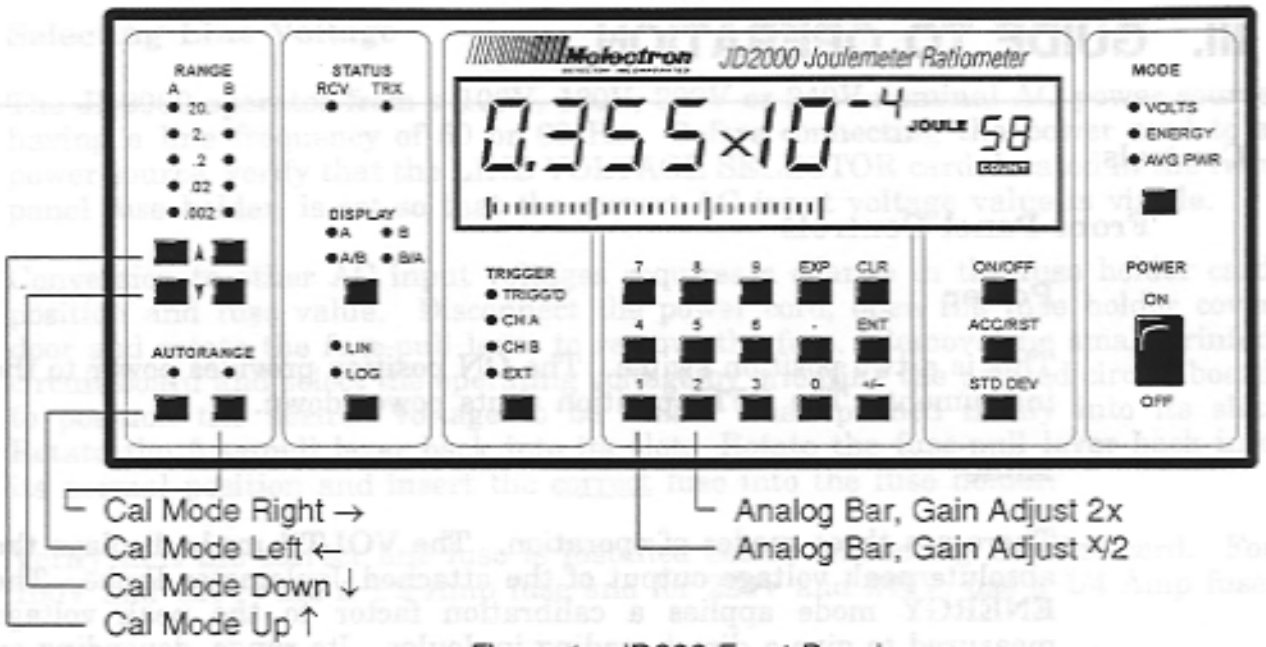


Figure 1—JD200 Front Panel

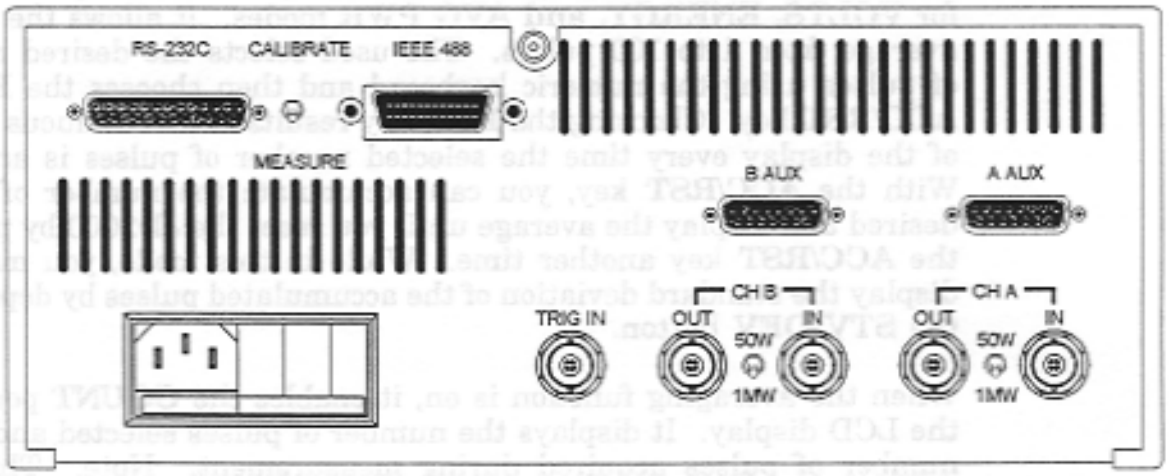


Figure 2—JD200 Rear Panel

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Keyboard

The calculator-type keyboard is used for entering Joulemeter probe calibration data and attenuation factors of accessories (see Section on Calibration Mode, page 12), and when selecting number of pulses to average (see Average under Control Section, page 7).

Trigger

The trigger button is used to select the trigger source...CH A, CH B or EXT. Trigger level for CHA or CHB is set at 7% of full scale. The channel chosen as a trigger must be manually ranged, while the other channel may be autoranged. When an external trigger is used, both channels A and B may be autoranged. The electronic requirements for EXT trigger are as follows:

Pulse Height:	0 to 4 volts or greater
Risetime:	Less than 1 microsecond
Pulse Width:	Less than 100 microseconds

A **TRIGG'D** annunciator clearly indicates proper triggering.

Status

The status indicator lets you know what is happening with the computer interface by lighting a green LED. **RCV** indicates listen mode for IEEE488 or receive for RS232. **TRX** indicates talk mode for IEEE488 or transmit for RS232.

Display

The display button selects the value to be displayed. Select **A** to see channel A. Select **B** to see channel B. Select **A/B** to see the ratio of A/B. Select **B/A** to see the ratio of B/A. A green LED lets you know what you have selected. Note that the JD2000 acquires the measurement of both channels A and B at the same time, though it only displays the one selected.

LIN/LOG

The value displayed can be in linear scientific or logarithmic notation by pressing **LIN/LOG**. A green LED lets you know what you have selected.

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Range

There are five decades of range from .002 to 20 for both channels A and B. These can be selected manually by pressing individual range buttons or automatically by pushing the **AUTORANGE** button. There are separate buttons for channels A and B. These buttons are used to increase or decrease the sensitivity of the JD2000. A green LED indicates the range you have selected.

Autorange

In this mode, the JD2000 automatically selects the appropriate range for the channel selected based on the signal level. To enable autoranging for a specific channel, press the appropriate **AUTORANGE** button. Note that you cannot autorange on the channel selected for triggering. This would normally be your reference channel. However, if an external trigger is selected, both channels A and B may be autoranged.

Multi-Function Keys

The function keys addressed in Figure 1 on page 8 have multiple functions.

When in the "measure" mode, the 1 and 2 keys can be used to decrease or decrease the sensitivity or the LCD's analog bar graph. 2 increases gain by 2X, while 1 decreases gain by 1/2.

RANGE A AUTORANGE

Rear Panel Connections

See Figure 2.

RS232

Serial computer interface for both "transmit" and "receive" modes of operation.

IEEE488

Parallel computer interface for both "talk" and "listen" modes of operation.

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Calibrate/Measure

This switch is used when entering probe calibration data. Flip the switch to the calibrate position and then enter probe calibration data via the numeric keyboard. You may enter the data, probe name, serial number, voltage responsitivity and attenuation factor for up to 16 different Joulemeter probes. (See Table 2.) Note: See Calibration Mode section.

CH A/CH B Input

Input BNC connectors where Joulemeter probes are attached to the JD2000 for channels A and B.

50Ω/1MΩ

There are two of these switches, one each for channels A and B. The 50Ω position selects 50 ohm impedance and the 1MΩ position selects 1M ohm impedance for the corresponding Joulemeter probe (refer to the section on Selecting a Joulemeter).

CH A/CH B Output

Analog output BNC connectors for channels A and B. Gives DC voltage output (0 to 10V) proportional to peak volts, pulse energy, or average power.

AUX A/AUX B Input

Multi-pin input connectors designed for standard Laser Precision Probes (RJP734, RJP735, and RJP736). Note: Requires special inverting connector.

AC Power Plug and Fuse

See Section on Selecting Line Voltage section on page 6.

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Joulemeter Probes

Selecting a Joulemeter

The best Joulemeter probe to use for a particular pulsed laser application will depend on the following parameters:

*pulse width
*pulse rep rate
*energy per pulse

The J3 series Joulemeters are capable of measuring from 3nJ to several mJ, picoseconds to 250 microseconds and at up to 4000 pps (limited to 40 pps with the JD2000). The J25/J50 series Joulemeters are capable of measuring from μJ to Joules, nanoseconds to milliseconds, and at up to 400 pps. (The J50 is limited to 10 pps; all other probes are limited to 40 pps with the JD2000). Please refer to our Joulemeter literature for complete technical details.

Checking Damage Threshold

The J3 and J25/J50 Series Pyroelectric Joulemeters are surface absorbing detectors and can be damaged by high energy density laser pulses. Therefore, caution should be taken when setting up the Joulemeter with the laser. Please refer to the Damage Threshold diagram in the Joulemeter data sheet or manual. Use the appropriate laser attenuator when required.

Every Joulemeter comes with a metalized and painted Damage Test Slide. This should always be used to help insure that your laser energy density is below the detector's damage threshold. The black painted slide is used for the J25 and J50 probes; the metalized slide is used for the J25HR, J50HR, and the J3-series probe.

Connecting Joulemeter Probes

Molectron manufactures two distinctly different types of Pyroelectric Joulemeters. First is the J3-series which includes a preamplifier with switch selectable voltage output and battery power. Second is the J25/J50 series which are stand alone Pyroelectric detectors with a fixed voltage response.

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Once you've decided on the type of Joulemeter probe required, connect the Joulemeter to the JD2000 as follows:

J3-Series: Connect the probe to the **INPUT** BNC connector for Channels A or B and select the **50Ω** input impedance required for J3s. Also, select the **INTERMEDIATE** switch position on the J3 probe. This determines the electrical decay time of the pulse input. It must be 500 sec or more.

J25/J50 Series: Connect the probe to the **INPUT** BNC connector for Channels A or B and select the **1MΩ** input impedance switch setting.

Calibration Mode

Software Calibration

Every JD2000 comes with a software calibration matrix table that is stored in EPROM (see Table 2 for an example). Lines 1 through 16 of the matrix include Row No., Model No., Serial No., Energy Responsitivity, and Attenuation Factor. Lines 17 and 18 are used to set up the RS232 and IEEE (GPIB) computer interface (refer to section on Guide to Operation).

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JD2000 PROBE CALIBRATION MATRIX

Number	Model	S/N	Voltage Response	Attn. Factor
1	J3-02			
2	J3-05	1062	2.5 x 10^3 V/J	Attn. 0001
3	J3-09			
4	J25	251	8.0 x 10^0 V/J	Attn. 0100
5	J50			
6	J25HR			
7	J50HR			
8	J3S-01			
9	J3S-05			
10	J3S-10			
11	RJP-734			
12	RJP-735			
13	RJP-765			
14	ED200			
15	ED500			
16	SPECIAL			

Table 2. Software CAL Matrix (example).

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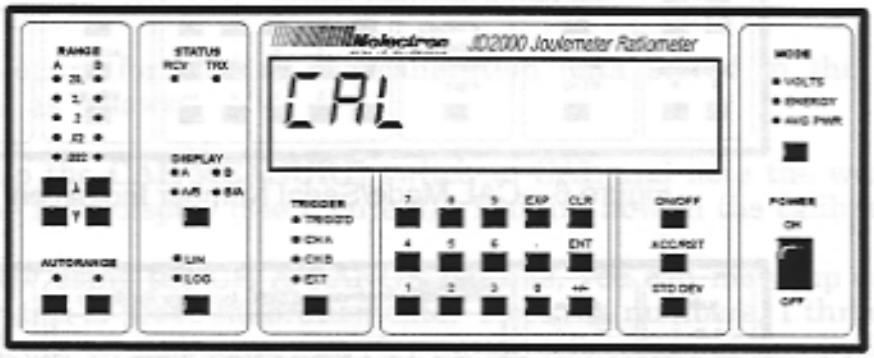


Figure 3—CAL Mode/CAL Setup Indication

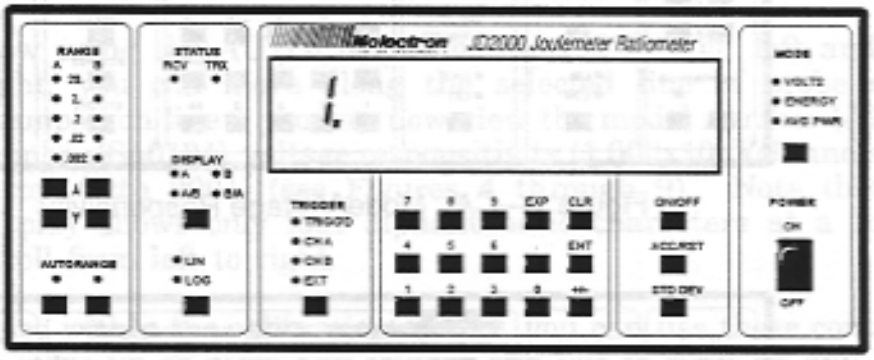


Figure 4—CAL Mode/Line 1 of CAL Matrix Indication



Figure 5—CAL Mode/Joulemeter Model Number

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Figure 6—CAL Mode/Serial Number Indication

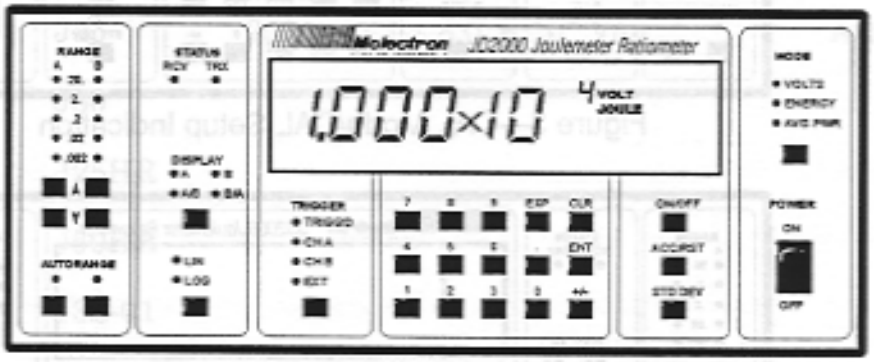


Figure 7—CAL Mode/Voltage Responsivity



Figure 8—CAL Mode/Attenuation Factor Indication

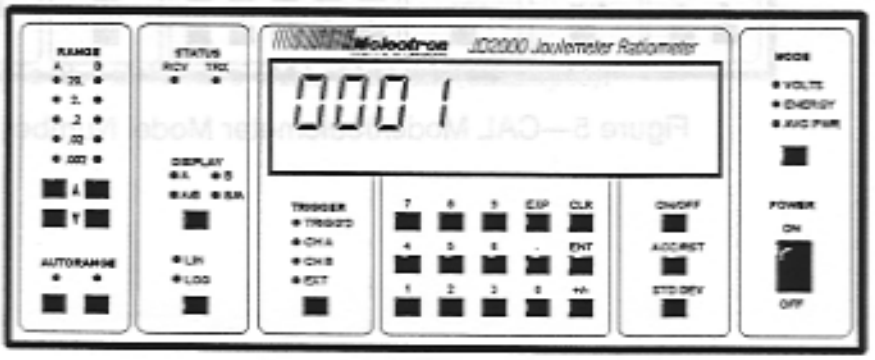


Figure 9—CAL Mode/Attenuation Number

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When Joulemeter probes are purchased with the JD2000, the calibration factors will be entered at the factory. However, should you already have the Joulemeters in your possession, there is a straight forward procedure to follow when entering the probe calibration data.

The procedure for viewing the calibration data stored in the calibration matrix is as follows:

1. Flip the **CAL/MEASURE** switch to CAL and note the word **CAL** on the LCD display (see Figure 3). You are now in the calibration mode.

2. Now using the CH A RANGE buttons, you can move up or down the matrix of probe calibration data. Note the numbers, 1 through 16 (see Figure 4), that come into view in the left corner of the display. These represent the 16 Joulemeter probes and/or lines of calibration data stored in the matrix.

3. Now using the AUTORANGE buttons, CH A for left and CH B for right, you can move along the selected line of probe data. For example, on line 1 you can now view the model number (J3-02), serial number (Sn0134), voltage responsitivity (1.000×10^4 V/J) and attenuation factor (attn 0001) (see Figures 4 through 9). Note that the LCD display shows only four alphanumeric characters at a time as you scroll from left to right.

4. Once within the calibration matrix, you can use these control buttons to move up or down any column and left to right on any line.

Entering Joulemeter Calibration Data

If you need to enter calibration data for a new probe or correct data already in the calibration matrix, use the following procedure:

1. Flip the **CAL/MEASURE** switch to CAL.

2. Once in the CAL mode, use the RANGE and AUTORANGE buttons to locate the appropriate model number (i.e., J50) or line number.

3. Scroll right to the Serial Number designation and key in the four digit serial number (i.e., 1062); use the **ENT** key to enter the number.

4. Scroll right to the Voltage Response column and key in the factory number (shown on the probe calibration label); For example the R_v for a J50 would be 2.0×10^0 V/J... use the numeric keypad and push 2.0, then **EXP 0** and the **ENT** key to enter or **CLR** to clear a mistake.

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5. Now, assuming that there is no attenuation factor to enter, you have finished adding this new calibrated probe to the JD2000. If an attenuator accessory is used (i.e., 100X ND filter), key in this attention factor...press **0100 ENT**.

Calibrating a Joulemeter Probe to CH A and CH B

When you are ready to select two of the probes from the calibration matrix and calibrate them to the JD2000, use the following procedure. Note: Both A and B annunciators stay lit.

1. While in the CAL mode, use the CAL Matrix to find the Joulemeter which you would like to calibrate to **CH B**; now push the **DISPLAY** button twice until the **B** annunciator is lit. The probe of choice is now on CH B.

2. Select another Joulemeter on the CAL Matrix you wish to calibrate to **CH A**; now push the **DISPLAY** button once to light the A annunciator. The probe of choice is now on CH A.

3. You may change channel A to any other probe number at any time without affecting channel B. To do this, flip the **CAL/MEASURE** switch to CAL and scroll to the desired probe number. Push the **DISPLAY** button once. Channel A is now set for a new probe while channel B remains on the original setting.

At the completion of this procedure, switch back to the **MEASURE** position and depress the **ENTER** key to store this probe setup. Failure to do so will result in loss of this setup when the JD2000 is turned off.

This simple procedure may be followed at any time to calibrate different probes to our JD2000.

Editing Preset Calibration Matrix

To edit a field, move the field into view with the cursor keys, then enter the data with the numeric keypad. Enter the digits as you would with a pocket calculator terminating with the **ENTER** key. The data can be entered in integer or scientific notation formats, but will be forced into predetermined formats as follows:

Row No.	1-18
Model No.	0-15
Serial No.	0-9999
Energy Responsitivity	1.000E15 to 1.000E-15
Attenuation Factor	1-1000

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To change the Joulemeter probe **Model No.**, move to that field and enter the one or two digit code shown below:

0=J3-02	8=J3S-01
1=J3-05	9=J3S-10
2=J3-09	10=RJP-734
3=J25	11=RJP-735
4=J50	12=RJP-765
5=J25HR	13=ED200
6=J50HR	14=ED500
7=J3S-01	15=Special

To move quickly to a row, window all the way to the left, then enter the row number.

Operating Procedure

The following is a step by step procedure for setting up the JD2000 for operation and explains how to put your particular setup in memory. It assumes that you've already connected the Joulemeter probes (see Joulemeter Probes section).

Power On

Turn power on by pressing the "POWER" button in the lower right-hand corner. Note that "EEEEE" appears on the LCD display and all but the "STATUS" and "TRIGG'D" annunciators (green LEDs) will light. The annunciators indicate either the default function settings or those stored by the user.

Selecting Mode

Use the **MODE** button to select a Volts, Energy (Joules) or AVG PWR (watts) measurement. Note: When using the Joulemeter probes, always trigger using the fastest one (highest rep rate). For example, if using a J25 on channel A and a J3-05 on channel B, you should trigger on channel B.

Triggering

Now use the **TRIGGER** button to determine the method of triggering the JD2000. Select **A**, **B**, or **EXT**.

Display Options

The "DISPLAY" button is then used to pick the measurement data to be displayed....A, B, A/B or B/A.

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Manual Range or Autorange

Now use the **RANGE** buttons to manually select a range (.002, .02, .2, 2 or 20) for channels A and B, or push the **AUTORANGE** button for either channel. Note that the channel selected as trigger cannot be autoranged; however, if an external trigger is used, both A and B may be autoranged.

Linear or Log

Decide on whether to display the data in linear or log units and use the **LIN/LOG** button to select.

Averaging

If you wish to average the pulses being measured, push the **AVERAGE** button, this enables the averaging function. You then have several options.

Running Average

Once the average button has been pushed, you then use the numeric keyboard to enter the number of pulses to be averaged (1 to 100). Push the numbers and hit **ENT**. The JD2000 will now continually measure the pulses and display the statistical average.

Accumulate/Reset

If you want to measure a number of pulses, average them and hold the reading, then use the **ACC/RST** button to enter the number of pulses selected, instead of **ENT**. To acquire the next set of pulses, hit the **ACC/RST** button again.

Standard Deviation

Once in the **ACC/RST** mode and a measurement is taken, you can calculate and display the standard deviation of the pulses acquired by pushing the **STD DEV** button.

Storing Setup

After setting up the front panel functions as desired, you may store them by pressing the **ENT** button. This places your setup in a nonvolatile memory. Turn the JD2000 off and when you turn it on again, it restores your setup conditions.

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Analog Outputs

"CH B-OUT"

The **CH B-OUT** BNC connector gives the user a DC voltage output, from 0 to 10 volts, proportional to the Volts, Energy or AVG PWR input to channel B. This is fixed.

"CH A-OUT"

The **CH A-OUT** BNC connector is programmed to give a DC voltage output proportional to the measurement displayed on the JD2000. For example, if you select **A/B** using the **DISPLAY** button, the DC voltage output will be proportional to the ratio A/B. Note that in the **LOG** mode, the voltage out is proportional to the absolute value of the log.

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IV. COMPUTER INTERFACE

RS232 Setup

To prepare the JD2000 for use with the RS232 computer interface, select the CAL mode using the **CAL/MEASURE** switch on the back panel of the JD2000.

Now using the appropriate keys, move through the CAL Matrix to line 17. You may now enter baud rate, parity, length and stop bits as shown:

17. RS232	(Baud Rate)	(Parity)	(Length)	(Stop Bits)
	9600	E	7	1
	4800	O	8	2
	2400			
	1200			
	300			
	110			

RS232 Pinouts

The following is a list of the pinouts to the RS232 computer interface:

JD2000 (male end)	To	IBM computer (female end)
Pin 2 (TRX)	to	Pin 3 (RCV)
Pin 3 (RCV)	to	Pin 2 (TRX)
Pin 4 (RTS)	to	Pin 6 (DSR)
Pin 6 (DSR)	to	Pin 4 (RTS)
Pin 20(DTR)	to	Pin 5 (CTS)
		Pulled high when cable attached.
Pins 1 and 7 (GND)		GND Pins

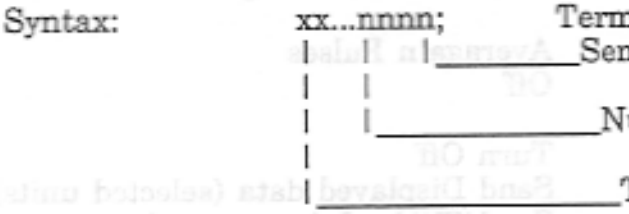
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IEEE488 (GPIB) Setup

Follow the same procedure as described for RS232, but go to line 18 of the CAL Matrix and select the BUS ADDRESS 0 to 15.

Interface Command Codes

Commands to the JD2000 consist of ASCII strings as shown below:



Notes:

1. Only the first two characters of the command message and the numeric field are important. The characters in between are ignored.

2. The numeric data can be in decimal or hex. It will be treated as hex if the last character before the terminator is an **H**. Otherwise, the data will be treated as decimal.

3. If no numeric data is present, zero will be assumed.

4. Alphabetic codes can be upper or lower case.

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The following is a list of standard commands:

Command	Parameter		Description
AUTORANGE	AU	0	Channel A autorange off
		1	Channel B autorange off
		2	Channel A autorange on
		3	Channel B autorange on
AVERAGE	AV	n	Average n Pulses
		0	Off
*CONTINUOUS	CO	0	Turn Off
		1	Send Displayed data (selected units)
		2	Send Channel A every pulse (selected units)
		3	Send Channel B every pulse (selected units)
		4	Send Channel A and B every pulse (selected units)
DISPLAY	DI	0	Channel A
		1	Channel B
		2	Channel A/B
		3	Channel B/A
LOG	LO		Log Mode
LINEAR	LI		Linear Mode
MODE	MO	0	Volts
		1	Joules
		2	Watts

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Command	Parameter	Description
PROBE SELECT	PR n	Used to select a Joulemeter probe by Row # (1 to 16) from the **CAL MATRIX** and assign it to channel A or channel B. Where n=2*(Row # - 1) for channel A and n=2*(Row # - 1) + 1 for channel B Example: To assign a J3-02 (Row #1) to channel A, send command PR 0. To assign J3-05 (Row #2) to channel B, send command PR 3.
	QU 1	Status request, to which the JD2000 responds with either **NEWTRIGGER** or **NONEWDATA**. **NEWTRIGGER** denotes that a trigger has occurred since data has been read (via a QU2, 3, or 4) (i.e., status check does not disturb the status indication).
	2	Prompts the JD2000 to transmit the last channel A datum.
	3	Prompts the JD2000 to transmit the last channel B datum.
	4	Prompts the JD2000 to transmit the last channel A and channel B data.
RANGE	RA n	Used to control range (gain setting) at channel A and channel B. Where n=2*g for channel A and n=2*g + 1 for channel B Where g=0 is .002 Range g=1 is .02 Range g=2 is .2 Range g=3 is 2.0 Range g=4 is 20 Range Example: To set channel B to 2.09 Range, send RA 7.

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Command	Parameter	Description
TRIGGER	TR 0	Channel A
	1	Channel B
	2	External

*TRANSMITTED DATA FORMATS

All strings terminated with (CR)

Displayed data, Linear n.nnnE-rr
Displayed data, Log -n.nnn

CH A every pulse n.nnnE-rr
CH B every pulse n.nnnE-rr
CH A and CH B every pulse a.aaaE-xx/b.bbbE-yy

As an example, to collect the displayed data, first send the command "CO 1;" to the JD2000. Every time the JD2000 is triggered by the pulsed source, the displayed data is transmitted to the PC, unless Averaging is on, in which case it is sent only after "n" pulses.

Data Collection Examples

The user has considerable flexibility in data collection with the CO and QU commands defined in Interface Command Codes section. In general, the COntinuous mode is used for long streams of continuous data, whereas, the QUery mode is used in single-shot applications. The protocol is the same whether RS-232 or IEEE-488 is used. If using IEEE-488, EOI is used to signify the end of message.

COntinuous Mode

The continuous mode of data collection is invoked by the host transmitting a non-zero CO command to the JD2000. Beginning with the next trigger, the JD2000 transmits data each time it detects a trigger. The options and data format for the COntinuous mode are defined in Interface Command Codes section. Note that the host must be prepared to receive a continuous data stream. This data stream received by the PC may be ported to any appropriate applications program, including Molectron's own JD-APS program.

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QUery Mode

This mode is particularly useful in applications where the PC gathering data is also controlling the laser. The QUery mode can only be entered in COntinuous mode is Off. (This is the state of the JD2000 upon initial power up, or after receipt of a CO O command.) In a situation where the host is controlling the laser, the host would simply trigger the laser and then perform a QU 2, 3, or 4 to acquire the desired data. If the host is not controlling the laser and cannot deal with a continuous data stream, then the QU 1 command can be used to periodically poll the JD2000 for new data. As defined in the Interface Command Code section, the JD2000 will respond with **NEWTRIGGER** if a trigger has occurred since the last QU 2, 3, or 4. Otherwise, it will respond with **NONEWDATA**.

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V. LIMITED WARRANTY

Molectron Detector, Inc. warrants the JD2000 Joulemeter Ratiometer to be free from defects in materials and workmanship for a period of one (1) year from the date of shipment when properly installed, maintained, and used for its intended purpose. This warranty applies only to the original purchaser of the equipment, and only so long as the equipment is used in the country to which it was originally shipped by Molectron Detector, Inc.

This warranty is null and void if the user attempts to service the equipment himself (other than performing the maintenance described in the Operator Manual), or if service is performed by persons who are neither trained nor authorized to do so by Molectron Detector, Inc. If, after examination by a Molectron Service Representative, the unit is found to be defective within the period specified above, and Molectron Detector, Inc. is satisfied that the failure was due to defective materials and/or workmanship, Molectron Detector, Inc. will, at its option, repair or replace the defective parts without charge. Molectron Detector, Inc. reserves the right to make the necessary repair/replacement in its own factory, at any authorized repair station, or at the facilities of the purchaser of the instrument. Any shipping charges incurred shall be paid by the purchaser.

The Express Warranty above is the sole warranty obligation of Molectron Detector, Inc. and the remedy provided above is in lieu of any and all other remedies. There are no other agreements, guarantees or warranties--oral or written, express or implied--including, without limitation, warranty of merchantability or fitness for a particular purpose. Molectron Detector, Inc. shall have no liability whatsoever for any incidental or consequential damages arising out of any defect, improper use or unauthorized service or repair.

Prior to return of a unit, or any portion thereof, the Molectron Detector Service Department must be consulted to avoid unnecessary shipping. If return of the equipment is deemed necessary, a Return Material Authorization (RMA) number will be assigned. This number must be recorded on the outside of the shipping container.

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USERS' GUIDE FOR THE JD2000 COMPUTER INTERFACE PROGRAM

Introduction

The interface program JD2000.EXE provides real-time, two-way communication between the Molectron JD2000 Joulemeter Ratiometer instrument and an IBM PC or compatible computer. In addition, data files may be created and analyzed in a variety of ways. The communication link may be either via RS-232 using a port on the computer, or by the IEEE-488 (GPIB) by installing a National Instruments GPIB-PC card in an expansion slot. The driver software for the card (GPIB.COM) must also be obtained from National Instruments and installed in your AUTOEXEC.BAT file in order to use the GPIB link.

Running The JDSETUP Program

Choices for the communication link, the monitor adaptor being used (CGA and EGA are presently supported; VGA must run in EGA mode), and a user-selectable color scheme, are made by running the program "JDSETUP.EXE". For the RS232 link, you may select different comm ports as well as baud rates.

By pressing "ENTER" while in these menus, you select the default values. In the lowest resolution mode, 320 x 200 pixels, the graphics features of the "live" strip chart (F4) and data file analysis (F3) are not available.

The setup program MUST be ran before JD2000.EXE can operate. The resulting file, JDSETUP.DAT must reside in the same directory you are in when starting JD2000.EXE by typing "JD2000" at the DOS prompt.

When selecting colors with JDSETUP.EXE, the suggested color for each choice is given by the initial cursor position, and can be selected by pressing "ENTER". Use the arrow keys to select the "VIEW PALETTE" option to see color assignments on your monitor and/or to select any desired color.

The mode of operation for JD2000.EXE may be changed at any time by running JDSETUP.EXE again.

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The Main Display

When JD2000.EXE is invoked by typing "JD2000" at the DOS prompt, commands are sent to the JD2000 instrument to load the default front panel settings. The settings may be changed by moving the cursor to the desired indicator and pressing "ENTER". A filled circle shows the active settings. Refer to the Operator's Manual for information about the effect of the front panel settings on the JD2000 instrument.

The number appearing on the JD2000 instrument front panel is shown on your computer monitor; this display is continuously updated when the JD2000 instrument is being triggered. However, the computer monitor display will not necessarily be updated on every single trigger event of the JD2000 instrument. If the trigger rate exceeds the speed with which your computer/ monitor combination can redraw the numbers in the display, then trigger events which occur during the redraw operation will be ignored. The maximum rate varies greatly for different computers. When some shots are missing, you will see that the "TRX" light on the JD2000 instrument flashes less frequently than the "TRIGG'D" light.

When it is important to capture every event, then you should use the live strip chart mode or create a data file (see below). The panel display is intended to provide the user with an easily legible readout, and for this purpose a high repetition rate display is too difficult to follow by eye anyway. If you desire to slow down the display redrawing rate, then set "AVERAGING" to 2 or more shots as needed.

When averaging is activated with between 2 and 100 shots, the "ACC/RES" function will accumulate the selected number of shots and then display average and average deviation values for A, B, A/B, and B/A. This operation is performed by the PC processor to allow more flexibility than the "ACC/RES" function provided by the JD2000 instrument software. As a result, the event counter on the JD2000 instrument front panel will not be related to the starting and stopping point for an "ACC/RES" operation by the PC. Additional facilities are provided using the function keys of the PC, as discussed below.

F5 - ENTER

If both the "NUM LOCK" and "CAPS LOCK" are activated on the PC keyboard, the "ENTER" key will not register. The F5 utility provides a fail-safe in case the "ENTER" key will not respond.

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F10 - EXIT

Use this key to terminate the program at any time. A command to stop sending data is sent to the JD2000 instrument when program execution is terminated with F10.

F9 - Dual Display

The dual display mode shows both channel A and channel B simultaneously, effectively providing two independent joulemeters. This mode cannot be invoked while the display is in "LOG" mode, because the JD2000 instrument is not designed to send dual channel data in log mode. The dual display is single shot data, even if averaging has been activated. The maximum redrawing rate is about half as fast as the regular single channel display since there is twice as much graphics information to draw on the screen. When the dual display is redrawn, the A and B values are always taken from the same shot, and shots which occur during the redraw are ignored.

When in Dual Display mode, A/B or B/A may also be read on the JD2000 instrument front panel. When doing this, the ratio may averaged. Only the use of the "LOG" mode is prohibited. If "LOG" mode is selected using the JD2000 instrument front panel buttons while in Dual Display, the Dual Display will become gibberish.

F4 - Live Strip Chart

This option provides a rolling strip chart display of the quantity (A, B, A/B, B/A) selected for the readout. This is most useful for tweaking laser output or monitoring stability over a period of time. The top and bottom Y-axis limits are user selectable, which allow you to "zoom in" and easily observe small variations in the energy.

Rescaling is easily done by typing "R" while in the live strip chart mode. For low trigger rates, the sweep speed can be increased up to 15 times in incremental steps by typing "F"; typing "S" will slow the speed back to 64 shots/div. The sweep speed can be further decreased by activating averaging. The live strip chart display shows averaged values whenever averaging is activated. There is also a pause, "P", feature to freeze the display if desired. This would allow you to do screen dump to printer using software such as PIZZAZ, made by Application Techniques (800-433-5201). There are no print drivers built into
JD-APS-1.

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F1 - Store/Recall Setup

This key allows you to save the current front panel settings to a file for later reloading, or to load settings from a previously saved file. This can be helpful for your most frequently used setups. The setup files may be written to and loaded from any drive and/or directory, and the use of an extension is optional.

F2 - Collect Data File

When F2 is entered, you will be prompted for the name of the file to write data to. Any valid drive and directory may be optionally specified along with the chosen file name; however, if you are using a pulse repetition of 10 Hz or higher, a floppy drive may be too slow for this purpose.

You may select any desired number of shots up to 32,767 to go into the file. If 0 is entered, data collection continues until any key is pressed up to the limit of 32,767 shots. While data collection is in progress, the data received from the JD2000 instrument is output both to the monitor and the data file. During this time, the monitor screen is set to its text mode for enhanced typing speed. Any irregularity which may occur during data collection will usually be evident from the monitor display.

After data collection is completed, the monitor returns to the main display, and filename is shown as a reminder for entry in a log book or to proceed with data file analysis. If you wish to use the data file for some other application software, the program "JDTOASC.EXE" included on your disc will convert the file created by JD2000.EXE into a form with spaces and/or commas between the data columns as desired.

F3 - Analyze Data File

When F3 is entered, you will be prompted for the name of the file you wish to analyze. Until you type "Q" to exit data analysis mode, this data file will be used repeatedly for any analysis option you select. This facilitates looking at a variety of aspects of the selected file. The three options are histogram, strip chart, and scatter plot; each of these is covered in the following subsections.

(A) Histogram Display

The histogram display may be used to evaluate statistical properties of a data set and/or easily visualize the distribution of energies. You may select A, B, A/B, or B/A for the display. The X-axis limits are always determined by the lowest and highest values in the group and the Y-axis is scaled so that the tallest bar reaches the top of the display. The default value for the number of cells is 50; however, this may be changed

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to any other desired value. Values in excess of 550 cannot give any higher resolution due to limitations of the monitor. The average and average deviation are specified at the side of the plot. If you desire to average more than the 100 shots allowed by the ACC/RES function, this is possible by creating a data file and analyzing it with the histogram option. For some types of statistical analysis, a best fit to a Gaussian distribution is more appropriate than the average and average deviation.

A nonlinear least-squares fit may be invoked by typing "2" while in the histogram display. This fit is affected by the choice of cell number, because the fit attempts to make a Gaussian cure go through the center top of each nonzero histogram cell. Iteration will increase significantly for larger numbers of cells. Also, if the distribution is very far from being Gaussian, the fitting routine may diverge and cause your computer to hang.

(B) Strip Chart Display

This option will plot the selected quantity as a function of time, or more precisely, in the sequence in which the data was recorded. You may plot A, B, A/B, B/A or else both A and B. The X-axis and Y-axis will automatically be scaled so that the data will fill the screen as much as possible. You may then rescale the axis limits to any desired values. For example, it might be useful to set the minimum axis limits to zero to observe the signal to noise ratio, or it is possible to zoom in on a significant region to get higher resolution.

(C) Scatter Plot Option

This utility allows you to use any of the four quantities A, B, A/B, or B/A for the X-axis and Y-axis of a plot. The data is plotted as points which are not connected. The points are plotted on the screen in the same order in which the data was recorded, which can give some indication of the implicit time dependance. The axes are initially scaled so that the data fills the screen as much as possible. The limits can be changed to any desired values. A least-squares linear fit may be plotted by typing "2" or "3". Only the data points shown in the display area used for the fit, which permits masking out unwanted parts of the data by changing the axis limits. Typing "2" fits a general y=mx+b line. If the form of the data is such that the y intercept is theoretically zero, then type "3" to obtain a least-squares fit to y=mx.

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