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P/N 221504

OMA® Vision-PDA

Data Acquisition/Analysis Software

Instruction manual

Manual Version 1
Revision F
August 11, 1998

OMA® VISION-PDA
DATA ACQUISITION/ANALYSIS
SOFTWARE INSTRUCTION MANUAL

221504-A-MNL-F

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Table of Contents

Chapter 1, Introduction 1
1.1 OVERVIEW 1
1.2 DISKS SUPPLIED 1
1.3 KEY CONCEPTS 1
1.3A Program Structure 1
1.3B Data Acquisition 1
1.3C Data Analysis 2
1.3D System Configuration 2
1.3E Utilities 2
1.3F System Parameters 2
1.4 WHERE TO FIND INFORMATION YOU NEED 2
1.5 HOW TO USE THIS MANUAL 2

Chapter 2, Installing OMA Vision/OMA Desk 3
2.1 OVERVIEW 3
2.2 HOST COMPUTER REQUIREMENTS 3
2.3 INSTALLATION RECORD 3
2.4 DISKS SUPPLIED 3
2.4A Files Included on the OMA Vision Program Diskette 3
2.4B Files Included on the Install Diskette 4
2.5 RUNNING INSTALL 4
2.6 AFTER RUNNING INSTALL 4
2.6A CONFIG.PAR 5
2.6B AUTOEXEC.PAR 5
2.6C CGI.CFG 5
2.6D Renaming Files 6
2.7 SYSTEM DEFAULT PARAMETERS 6
2.8 GPIB CONFIGURATION 6
2.9 ADDITIONAL PRINTER AND PLOTTER DRIVERS 6

Chapter 3, Getting Started 7
3.1 OVERVIEW 7
3.2 DEFINITIONS OF TERMS 7
3.3 KEY CONCEPTS AND FUNDAMENTAL PROCEDURES 7
3.3A Menu and Function Structure 7
3.3B System Default Parameters 7
3.4 NOTATION CONVENTIONS 7
3.5 STARTING THE OMA VISION PROGRAM 9
3.6 STARTING THE OMA DESK PROGRAM 10
3.7 SCREEN ELEMENTS 11
3.8 MOVING AROUND IN THE PROGRAM 12
3.8A Entering the Program 12
3.8B Operator Interface 12
3.8C Accessing a Menu 12
3.8D Selecting Menu Items or a File 12
3.8E Expanding/Contracting about the Cursor 12
3.8F Exiting a Menu, Submenu, or Load/Store Screen 13
3.8G Exiting the Zoom Mode 13
3.8H Using DOS Functions 13
3.8I Exiting the Program 13
3.9 ENTERING PARAMETERS, EQUATIONS, AND FILENAMES 13
3.9A Editing Capabilities 13
3.9B Entering Information 13
3.9C Loading or Storing a Curve Set 14
3.9D File Selection Function Keys 14
3.10 MOVING THE CURSOR 15
3.10A In Text Screens 15

3.10B In Graphics Screens 15
3.10C In Equation Plot Screens 15
3.10D File Selection Screens 15
3.11 MOVING A THRESHOLD 16
3.12 ZOOMING IN AND OUT 16
3.13 PLOTTING/PRINTING SPECTRAL DISPLAYS 16
3.13A <Shift><PrtScn> 16
3.13B <F7> Plot 16
3.14 DATA FILE VERSIONS 16

Chapter 4, Data Acquisition 17
4.1 INTRODUCTION 17
4.2 FUNCTION AND ESC KEYS 18
4.3 SET TIMES 20
4.3A Run Time 20
4.3B Sample Time 20
4.3C Number of Samples 21
4.3D PreDelay Time 21
4.3E Exposure Time 21
4.3F Background Subtract 21
4.3G Reset Background 21
4.3H Shutter 22
4.3I Lamp 22
4.4 SETUP DATA ACQUISITION MODE MENU 23
4.4A I, J, and K Parameters 23
4.4B Exposure Time 24
4.4C Background Subtract 24
4.4D Reset Background 24
4.4E Load DAD Program 24
4.5 TOGGLE F1, F2 KEYS 26
4.6 SETTING UP THE DISPLAY 26
4.6A Spectrum Only 26
4.6B Equations Only 26
4.6C Spectrum and Equations 27
4.6D Strip Charts 27
4.6E Equation Display Time 27
4.6F Area/Equation Menu 28
4.7 ACQUIRING DATA 33
4.7A Live Data Acquisition 33
4.7B Accumulate Data Acquisition 34
4.8 CALIBRATING THE X AXIS 35
4.8A New Calibration 35
4.8B Recalibration of the X Axis 38
4.8C Model 1235 Spectrograph Control 39
4.9 INTENSITY CALIBRATION 41
4.9A Introduction 41
4.9B Calibration Units 41
4.9C Fixing the Collection Geometry 41
4.9D Fixing the Spectrograph 42
4.9E Calibrating the System: An Overview 42
4.9F The Intensity Calibration Menus 42
4.9G Creating a Correction Curve 43
4.10 RESETTING PARAMETERS TO A FILE 44
4.10A M1470.PRM Setup Parameters File 44
4.10B Reset to File 44
4.11 LABELING A CURVE SET 45
4.12 STORING DATA TO DISK 46
4.12A Automatic Data Storage 46

4.12B Manual Data Storage 46
4.13 SENDING DATA TO A PLOTTER OR PRINTER 48
4.14 GRAPHICS 48
4.15 MEASUREMENT MODE 49
4.15A Introduction 49
4.15B Reset Background 49
4.15C Reference Spectrum 49
4.15D Transmission 50
4.15E Absorbance 50
4.15F Reflection 50
4.15G Uncorrected 50
4.15H Exp. Time MANUAL/AUTO 50

Chapter 5, Data Analysis 51
5.1 INTRODUCTION 51
5.2 DATA ANALYSIS SCREEN 51
5.2A Function and Esc Keys 51
5.2B Loading Data 52
5.2C Storing Data 54
5.2D Information about the Data 56
5.2E Deleting Data 57
5.2F Making a Curve Set "External" 57
5.2G Tagging and Untagging Curve Sets 57
5.3 GRAPHICS FUNCTIONS 58
5.3A Plot Screen 58
5.3B 3-D Plot Screen 60
5.3C Channel Profile Screen 62
5.3D 2-D Plot Screen 64
5.3E Y:T Analysis Screen 66
5.3F Recalibrating the X Axis 68
5.3G Labeling the Curve Set 70
5.4 CURVE CALCULATIONS 71
5.4A Rules and Syntax 71
5.4B Valid Operators 73
5.4C Valid Lefthand Operands 73
5.4D Valid RightHand Operands 73
5.4E Types of Calculations 74
5.4F Sample Calculations 74
5.4G Viewing the Result of a Calculation 76
5.5 SMOOTHING AND DIFFERENTIATION 77
5.5A Smoothing 77
5.5B Derivative 77
5.6 Y:T ANALYSIS 78
5.6A Y:T Analysis Screen 78
5.6B Defining and Deleting Areas 80
5.6C Entering and Editing Equations 82
5.6D Loading and Storing Areas and Equations 82
5.6E Valid Operators 83
5.6F Valid Conditions 83
5.6G Variables 83
5.6H Valid Operations 84
5.6I Sample Equations 85
5.6J Plotting Equations 85
5.6K Strip Charts 89
5.7 CONCATENATION 89
5.7A Introduction 89
5.7B Concatenation Procedure 90

Chapter 6, System Configuration 91

6.1 INTRODUCTION 91
6.2 DATA DIRECTORY 91
6.3 PROGRAM CONTROLLER MENU 92
6.3A Same ET 92
6.3B Line Frequency 92
6.3C Sync Mode 92
6.3D Detector Temperature 92
6.4 SYSTEM INFORMATION MENU 93
6.4A Interface 93
6.4B Controller 93
6.4C Detector 93
6.4D Spectrograph and Grating Selection 94
6.4E Shutter Present 94
6.4F Bad Pixels 94
6.5 SAVE CURRENT PARAMETERS 94
6.6 RESTORE DISK PARAMETERS 94
6.7 SOFTWARE REV. 94

Chapter 7, Utilities 95
7.1 INTRODUCTION 95
7.2 STATIC INTERFACE COMMUNICATION 95
7.2A Command Entry and Editing 96
7.2B Responses 96
7.3 1470 to 1460 FILE CONVERSION 97
7.4 1460 to 1470 FILE CONVERSION 98
7.5 1470 to ASCII FILE 99
7.6 1470 to EQD FILE 100
7.7 REPORT GENERATOR 101
7.8 FILE CONVERSION ERROR MESSAGES 101

Chapter 8, System Parameters 103
8.1 INTRODUCTION 103
8.2 FUNCTION KEYS 103

Appendix A, Glossary 105

Appendix B, Calibration Lines 107

Appendix C, Data Acquisition Modes 109
C.1 INTRODUCTION 109
C.2 STORING AND ADDING MODES 110
C.3 SUBTRACTION MODES 117

Appendix D, Data Acquisition Design 121
D.1 INTRODUCTION 121
D.2 DATA ACQUISITION DESIGN DEFINED 121
D.3 WRITING DAD PROGRAMS 121
D.4 FILE STRUCTURE 122
D.5 PROGRAMMING CONSTRAINTS 122
D.6 TIMING CONSIDERATIONS 122
D.6A Definitions 122
D.6B Overhead Time 123
D.7 LOADING AND OPERATING DAD PROGRAMS 123
D.8 DAD PROGRAMMING RULES 124
D.8A "DO-LOOP" Construction 124
D.8B Memory Assignments 124
D.8C PIA Control 124
D.8D Program Execution 124
D.9 COMMAND FORMAT AND PROTOCOL 124

D.9A Introduction 124
D.9B Compound Commands 125
D.9C Command Errors 125
D.9D Summary 125
D.10 DAD COMMANDS 125
D.10A Command Categories 125
D.10B Interactive Commands 125
D.10C Control Commands 126
D.10D Conditional Commands 127
D.10E PIA Commands 128
D.10F Detector Scanning Commands 128
D.10G The Error Report 129
D.10H The Status Report 130
D.10I The ON.TRIG Command - Special Timing Considerations 130
D.11 SAMPLE PROGRAMS 132
D.12 SCAN RESYNCHRONIZATION 139

Appendix E, Report Generation 141
E.1 INTRODUCTION 141
E.2 TEMPLATE REPORT: Creating/Editing 141
E.2A Introduction 141
E.2B Special Characters 141
E.2C Commands supported by % 141
E.2D Commands supported by # 141
E.2E Use of @ for Comments 142
E.2F Use of \ for Inserting Special Characters 142
E.2G Error Messages 142

Index 145

Warranty 151

Figures

Figure 2-1. CONFIG.PAR 5
Figure 2-2. AUTOEXEC.PAR 5
Figure 2-3. MODIFIED AUTOEXEC.PAR 5
Figure 2-4. MODIFIED AUTOEXEC.PAR 5
Figure 2-5. CGI.CFG: Laserjet installed 6
Figure 2-6. CGI.CFG: HP plotter installed 6

Figure 3-1. OMA VISION/DESK MENU STRUCTURE 8
Figure 3-2. OMA VISION: OPENING SCREENS 9
Figure 3-3. OMA DESK: OPENING SCREENS 10
Figure 3-4. SCREEN ELEMENTS 11
Figure 3-5. WAVELENGTH CALIBRATED X-AXIS 12

Figure 4-1. DATA ACQUISITION SCREEN AND MENU 17
Figure 4-2. SET TIMES MENU 20
Figure 4-3. SETUP DATA ACQUISITION MODE MENU 23
Figure 4-4. LOAD DAD PROGRAM SCREEN 25
Figure 4-5. SET DISPLAY MENU 26
Figure 4-6. AREA/EQUATION MENU 28
Figure 4-7. LOAD AREAS/EQUATIONS SCREEN 29
Figure 4-8. AREA/EQUATION TABLE 29

Figure 4-9. STORE AREAS/EQUATIONS SCREEN 32
Figure 4-10. LIVE DATA ACQUISITION SCREEN 33
Figure 4-11. ACCUMULATE DATA ACQUISITION SCREEN 34
Figure 4-12. CALIBRATE MENU 35
Figure 4-13. X-AXIS CALIBRATION SCREEN 36
Figure 4-14. CALIBRATION POINT SELECTION 37
Figure 4-15. RESET WAVELENGTH CAL. SCREEN FOR RECALIBRATION TO A FILE 38
Figure 4-16. M1235 CONTROL MENU (SPECTROGRAPH COMMUNICATING) 39
Figure 4-17. M1235 CONTROL MENU (SPECTROGRAPH NOT COMMUNICATING) 39
Figure 4-18. CALIBRATING THE M1235 OFFSET 40
Figure 4-19. CALIBRATE INTENSITY MENU 41
Figure 4-20. INTENSITY CALIBRATION DIAGRAM 42
Figure 4-21. CREATE CORRECTION CURVE MENU 43
Figure 4-22. LAMP CURVE MENU 43
Figure 4-23. LAMP DATA MENU 43
Figure 4-24. LAMP TABLE 44
Figure 4-25. RESET TO FILE SCREEN 45
Figure 4-26. STORE CURVESET DATA SCREEN 46
Figure 4-27. DIRECTORY INFORMATION SCREEN 47
Figure 4-28. MEASUREMENT MODE MENU 49
Figure 4-29. TRANSMISSION MODE MENU 49

Figure 5-1. DATA ANALYSIS SCREEN AND MENU 51
Figure 5-2. FILE SELECTION SCREEN Load Curveset Data 52
Figure 5-3. FILE SELECTION SCREEN Store Curveset Data 54
Figure 5-4. CURVESET INFO SCREEN 56
Figure 5-5. FILE INFO SCREEN 56
Figure 5-6. CURVE SET 1 BEING MADE EXTERNAL Curve Sets 3 & 4 Tagged 57
Figure 5-7. GRAPHICS PLOT SCREEN 58
Figure 5-8. 3D PLOT SCREEN 60
Figure 5-9. SCALE MENU 60
Figure 5-10. 2D OVERLAY HELP MENU 61
Figure 5-11. CHANNEL PROFILE SCREEN 62
Figure 5-12. 2-D OVERLAY EXAMPLE 64
Figure 5-13. 2D OVERLAY HELP MENU 64
Figure 5-14. 2-D OVERLAY WITH NEW Z AXIS 65
Figure 5-15. Y:T ANALYSIS SCREEN 66
Figure 5-16. NEW CALIBRATION SCREEN 68
Figure 5-17. RESET WAVELENGTH CAL. SCREEN 70
Figure 5-18. SUMMARY OF CURVE SET CALCULATIONS 71
Figure 5-19. CALCULATIONS HELP MESSAGE 72
Figure 5-20. CALCULATIONS ENTRY BOX 72
Figure 5-21. CURVE CALCULATION EXAMPLE 76
Figure 5-22. SCREEN PLOT OF THE CURVE CALCULATION 76
Figure 5-23. Y:T ANALYSIS SCREEN 78
Figure 5-24. AREA/EQUATION TABLE 80
Figure 5-25. BASELINE CORRECTED AREA 81
Figure 5-26. AREA CORRECTED AREA 82
Figure 5-27. FILE SELECTION SCREEN Load Areas/Equations 82
Figure 5-28. 3-D PLOT OF 10230001.BIN 86
Figure 5-29. Y:T PLOT SCREEN 86
Figure 5-30. AREA/EQUATION TABLE WITH DATA FROM 10230001.BIN 87
Figure 5-31. Y:T EQUATION PLOT FROM 10230001.BIN DATA 87
Figure 5-32. STRIP CHART MODE 89

Figure 6-1. SYSTEM CONFIGURATION MENU: Data Directory Selected 91
Figure 6-2. PROGRAM CONTROLLER MENU 92
Figure 6-3. SYSTEM INFORMATION MENU 93

Figure 7-1. UTILITIES MENU: Static Interface Selected 95

Figure 7-2. UTILITIES MENU: 1470 to 1460 Selected 97
Figure 7-3. UTILITIES MENU: 1460 to 1470 Selected 98
Figure 7-4. UTILITIES MENU: 1470 to ASCII Selected 99
Figure 7-5. UTILITIES MENU: 1470 to EQD Selected 100
Figure 7-6. CONTENTS OF SAMPLE EQD FILE 100

Figure 8-1. SYSTEM PARAMETERS SCREEN 103

Figure B-1. WAVELENGTH CALIBRATION SPECTRUM 108

Figure C-1. SETUP DA MODE SCREEN 109

Figure D-1. LOAD DAD PROGRAM SCREEN 123
Figure D-2. TIMING DIAGRAM ILLUSTRATING THE ON.TRIG COMMAND 131
Figure D-3. TIMING DIAGRAM FOR STOPPED FLOW EXPERIMENT 132
Figure D-4. TIMING DIAGRAM FOR THE MERCURY LAMP EXPERIMENT 133
Figure D-5. TIMING DIAGRAM FOR A 200-1000 NM SOURCE 134
Figure D-6. TIMING DIAGRAM FOR A VARYING SIGNAL 136
Figure D-7. PULSED LASER CIRCUIT BLOCK DIAGRAM 138
Figure D-8. TIMING DIAGRAM FOR PULSED LASER EXPERIMENT 139
Figure D-9. SCAN RESYNCHRONIZATION NON-TRIGGERED & TRIGGERED MODES 140

Figure E-1. SAMPLE TEMPLATE 143
Figure E-2. REPORT GENERATED FROM FILE 09121006.BIN AND TEMPLATE 144

Tables

Table B-1. WAVELENGTH CALIBRATION LINES (in nanometers) 107
Table D-1. OVERHEAD TIMES - NORMAL SYNC 123
Table D-2. OVERHEAD TIMES - LINE SYNC 123
Table E-1. "P" VARIABLE INSTRUCTIONS 142

Chapter 1
Introduction

1.1 OVERVIEW

The OMA Vision data acquisition and analysis software captures the optical emission spectra from your experiment and allows you to:

- graph multiple spectra acquisitions in three- or two-dimensional display;
- view live display of absorbance, reflection, transmission, or raw spectral data;
- control EG&G PARC Model 1235, 1236, 1237, and 1240 spectrographs;
- analyze data using arithmetic and mathematical equations;
- perform Y:T analysis;
- utilize standard data acquisition modes and Data Acquisition Design for performing complex triggered experiments;
- translate data from 1470 format to ASCII, EQD, or 1460 format and translate 1460 data so that it can be viewed via the OMA Vision program;
- send static interface commands over the GPIB to the attached 1471A or 1461.

Its straightforward menu architecture makes it easy to learn and easy to run.

This software runs on an EG&G PARC Model 1470A or on any IBM PC/AT, PS/2, or 100% compatible computer connected to an EG&G PARC Model 1471A or 1461 Detector Interface. The computer must support EGA graphics and be equipped with an IEEE-488 General Purpose Instrument Bus (GPIB) for communication with the detector interface.

Circuitry in the detector interface controls the experiment as directed by the software. Data plots and equation results can be viewed on the computer monitor and sent to a plotter or printer for hardcopy documentation.

Installation of the OMA Vision software on an IBM PC/AT or compatible is covered in Chapter 2. Technical details of the hardware requirements are also provided in Chapter 2. Specific information about installation of the detector interface, detector, spectrograph, and related equipment can be found in their respective manuals.

Supplied with the OMA Vision software is OMA Desk, a post-data acquisition analysis program. Because it is not designed to acquire data, it may be run without an attached detector interface. OMA Desk can be installed separately or at the same time that OMA Vision is installed. Unless otherwise noted in this manual, all of the functions described for OMA Vision are available in OMA Desk.

1.2 DISKS SUPPLIED

The software is provided on two sets of diskettes to accommodate a wide range of hardware configurations. One set consists of 5¼" disks, the other of 3½" disks. Of the disks in each set, one is the Install disk, and the other is the OMA Vision program disk.

Note that these disks are not self-booting; that is, they do not come complete with DOS. The operating system software (MS-DOS or PC-DOS, Version 3.3 or later) must be furnished by the customer. See Chapter 2 for detailed installation instructions.

Before continuing, take a moment to fill out the Software License Agreement and Warranty Registration card provided. By returning this card, you are assured of being informed of software updates and enhancements as they become available.

1.3 KEY CONCEPTS

The OMA Vision and OMA Desk programs differ in that OMA Desk is not designed to acquire data. However, OMA Desk does simulate data acquisition by using the spectra contained in the DEMO.BIN data file to display data in the data acquisition modes.

1.3A Program Structure

The software is functionally divided into five sections: Data Acquisition, Data Analysis, System Configuration, Utilities, and System Parameters. The following paragraphs outline the important features of each functional section.

1.3B Data Acquisition

The Data Acquisition function supports both live and accumulated data acquisition. When the program is carrying out a multi-memory data acquisition run, the parameters chosen by the operator are expressed as sample time, run time, exposure time, and predelay time. These parameters are set from a simple menu. The software checks for inconsistencies as it translates the parameters.

The screen normally is updated after each memory accumulation. A Fast Mode, implemented from the Set Display menu as described in Section 4.6B (Chapter 4), allows data acquisition without screen update.

In Live Mode, the user chooses exposure time from a simple menu. He or she can load an area/equation file, and can choose from another menu how the data is to be displayed. The spectrum can be displayed with or without the equations, or the equations can be displayed without the spectrum. Data acquisition can be stopped or started by pressing a single key. Data Acquisition is explained in more detail in Chapter 4.

Note: Live and Accumulated acquisition are simulated by the OMA Desk program.

1.3C Data Analysis
When the operator chooses the Data Analysis mode from the Main menu, the Data Analysis screen appears. The upper screen half displays information about curve sets that have been loaded into memory for analysis. They are selected from a disk directory screen by using the cursor keys to highlight the files that contain them.

Curve calculations are shown in the bottom half of the screen. The program can perform various mathematical functions on loaded curve sets, including repeated smoothing and derivative functions. It can also perform AND, OR, and XOR logical operations.

Spectra can be plotted on the screen in either two-dimensional or three-dimensional displays. Two spectral displays can be plotted together with one overlaying the other.

The OMA Vision program also can perform Y:T Analysis. In this mode the program guides the operator through the procedure with prompts. As many as 12 areas can be selected. From the menu the operator can recall a previously stored area/equation file, store a newly created or modified one, or plot the results of the equations. More details of Data Analysis are given in Chapter 5.

1.3D System Configuration
The System Configuration section allows you to customize the program to suit your particular application. Usually there is no need to change the initial settings.

The following settings can be entered or changed:

- The data directory that holds your spectral data on the hard disk.
- All the necessary detector controller settings, such as exposure time, number of scans, accumulation time, detector temperature, and others.

You can control the EG&G PARC Model 1235, 1236, or 1237 spectrograph and Model 1240 Spectral Camera from within the program. You can change gratings in the Model 1235, 1236, or 1237 and can control the shutter and calibration lamp in the Model 1240. Chapter 6 explains how to set up the software to control these units.

You can also request various other information about the data acquisition system from the System Configuration menu. More details are given in Chapter 6.

1.3E Utilities
The utilities included are a static interface communication and several file conversion utilities. The static interface allows you to send 1471A or 1461 commands and command strings to the attached detector interface. The file conversion utilities can convert data to the following data formats:

- Model 1470 (OMA Vision) to Model 1460
- Model 1460 to 1470 (OMA Vision)
- Model 1470 (OMA Vision) to ASCII
- Model 1470 (OMA Vision) to EQD

Chapter 7 describes how to use the static interface and the conversion programs.

1.3F System Parameters
Allows you to read and change those parameters which are automatically saved on exiting the program. These become the startup parameters the next time the software is started.

1.4 WHERE TO FIND INFORMATION YOU NEED
The information you need to operate and maintain the complete data acquisition and analysis system can be found in the appropriate detector interface, detector controller, detector, and spectrograph manuals. Further information about your computer can be found in its hardware manual.

1.5 HOW TO USE THIS MANUAL
This manual is organized into seven chapters and three appendices. This chapter introduces you to the OMA Vision and OMA Desk programs and describes their functions and overall structure.

Chapter 2 tells you what you need to know about installing the OMA Vision and OMA Desk software.

Chapter 3 discusses starting the program, changing screens, making menu selections, moving the cursor, and entering filenames, labels, equations, and system parameters. It explains the conventions used for describing keystrokes and menus, and shows how to print or plot spectral displays. A diagram of the menu structure shows the relationships among the menus and serves as a roadmap for getting from one place in the program to another.

The remaining chapters explain how to use the major functions of the OMA Vision software:

Data Acquisition is described in Chapter 4.
Data Analysis, in Chapter 5.
System Configuration, in Chapter 6.
Utilities, in Chapter 7.

Appendix A is a glossary of technical terms used in this manual. Some chapters also have a section that defines terms used in the chapter.

Appendix B contains a table and graph of mercury, argon, and neon spectral lines for wavelength calibration.

Appendix C describes the Data Acquisition Modes.

Appendix D contains information about Data Acquisition Design (DAD®) programing.

Appendix E describes the optional Report Generator.

Chapter 2
Installing OMA Vision/OMA Desk

2.1 OVERVIEW

This chapter describes the hardware and system software requirements for installing and running the OMA Vision software on a computer connected to a separate detector interface. This chapter also describes the system default parameters, and shows how to change them by running the Install program again. Also, it lists the files included on the OMA Vision and Install distribution diskettes.

The discussions that follow assume you have a basic familiarity with DOS. If not, consult your DOS manual.

Note: You can also install the OMA Desk software using the Install program. Since OMA Desk is designed for post-acquisition analysis of data it does not require hook-up to a separate detector interface.

2.2 HOST COMPUTER REQUIREMENTS

The OMA Vision software will run on an EG&G PARC Model 1470A; or an IBM AT, PS/2, and 100% compatible computer connected to an EG&G PARC Model 1471A or 1461 Detector Interface with Version 3.05 or later EPROMs. The computer must be able to run under MS-DOS or PC-DOS, version 3.3 or greater. Although operation with other versions of DOS may be possible, it cannot be assured. Also required are a National Instruments GPIB (General Purpose Instrument Bus) card (see below) and a monitor and graphics adapter that support EGA. The computer must be equipped with a hard disk and either a 5¼" 1.2 Mbyte floppy disk drive or a 3½" floppy drive. The system will also need either a plotter or printer as an output device.

Note: Since OMA Desk is a post-acquisition analysis program, it is designed to be run without a detector interface.

The GPIB card must be one of the following:

- National Instruments GPIB-2
- National Instruments GPIB-2A
- National Instruments GPIB-3
- National Instruments MC-GPIB (for PS/2)
- National Instruments AT-GPIB

Refer to "GPIB Configuration", Section 2.8, for instructions on configuring this card and its driver.

2.3 INSTALLATION RECORD

A number of questions are asked about your computer and the peripheral equipment as you proceed through the installation. By answering the following questions, installation will proceed more quickly and give you a hardcopy record of your entries and choices. This record will also prove helpful if you ever need to reinstall the software.

Computer:

Graphics adapter card (EGA or VGA) _____

National IEEE card (GPIB-1, GPIB-2A, GPIB 3, MCGPIB, AT-GPIB or None) _____

Disk drive and directory where OMA Vision is to be installed (default: C:\OMAVIS) _____

*Plotter:

Type _____

Output port (COM1 or COM2) _____

*Printer:

Type _____

Output port (LPT1, LPT2, COM1, or COM2) _____

***Note:** Only one hardcopy device can be installed: you can install either a printer or a plotter but not both. An Epson-compatible or IBM graphics 9-pin printer connected to LPT1 for the <Shift><PrtScn> keyboard function (EGAHCOPY) does not need to be installed via the **Install** program. It is also possible to print to an HP LaserJet or HP 500C or 550C DeskJet printer by substituting HCOPY_HP or HCOPY_DJ respectively for EGAHCOPY in the AUTOEXEC.BAT file.

2.4 DISKS SUPPLIED

The OMA Vision software is provided on two sets of diskettes. One set consists of 1.2M 5¼" disks; the other of 720k 3½" disks. Of the disks in each set, one is the Install disk and the other the OMA Vision program disk.

These disks are not self-booting. That is, they do not contain the DOS files required for starting your computer from the diskette. The operating system software (MS-DOS or PC-DOS, Version 3.3 or later) must be furnished by you.

2.4A Files Included on the OMA Vision Program Diskette

OMAVIS.EXE: The OMA Vision program. Designed for the acquisition and post-acquisition analysis of spectral data. Requires the presence of a connected and turned on Model 1471A or Model 1461 if not being used on a Model 1470A.

LABEL.TXT A text file used to generate the disk label for the program disk. It is not for customer use.

OMADESK.EXE: The OMA Desk program. Permits off-line analysis of data.

EGAHCOPY.COM: The file that enables <Shift><PrtScn> to send screen information to an Epson, Epson-compatible, or IBM graphics 9-pin printer connected to LPT1.

HCOPY_HP.COM: Enables computer print-screen function to print to an HP LaserJet printer connected to LPT1.

HCOPY_DJ.COM: Enables computer print-screen function to print to an HP 500C or 550C DeskJet printer connected to LPT1.

DEMO.BIN: A sample data file for OMA Vision and OMA Desk.

FILCNVT.EXE: The conversion program file that converts OMA Vision data files to the four available formats. This conversion program is accessed from the Utilities menu of the OMA Vision software.

CAL_LINE: A text file containing tables of spectral lines of argon, mercury, and neon.

CAL.BAT: A batch file that displays the spectral tables in the CAL_LINE file.

DISK.ID: A text file used to identify the program disk.

PROGRAM.DAT: A script file used by the installation procedure.

2.4B Files Included on the Install Diskette

INSTALL.EXE: The Install program.

INSTALL.DAT: A script file used by the installation program to bring up the welcome screen.

DRIVERS.DAT: A script file used by the installation program for selecting drivers.

DRIVERS.LIB: A library file containing the required screen and plotter drivers.

DISK.ID: A text file used to identify the Install disk.

LABEL.TXT: A text file used to generate the disk label for the Install disk. It is not for customer use.

2.5 RUNNING INSTALL

You must run the **Install** program to copy the files from the program and installation diskettes to your hard disk. You can also run **Install** whenever you wish to change certain system parameters, such as the type of plotter to be connected to COM1. While installing the software, Install creates three files: CONFIG.PAR, AUTOEXEC.PAR, and CGI.CFG. These files are described in Section 2.6.

Note that the installation may be performed from any floppy diskette drive. However, once the Install program has been started it will require that the initial drive used be used each time diskettes are removed and inserted. The installation procedure below uses Drive A. If you plan to install from Drive B simply change the references to Drive A as required.

To run Install:

1. Turn on your computer.
2. Place the **Install** diskette in Drive A.
3. Type **<A:>** and press **<Enter>**.
4. Type **Install** and press **<Enter>**.

The **Install** program, which is completely self-guiding, will load and execute. Just follow the prompts and refer to the previously filled out installation record (Section 2.3). You will be asked some questions relating to your system configuration and will be directed to change the disk in the drive at the proper times.

Note: When designating the **display driver and printer drivers**, please choose EGA even if you have a VGA system. This preserves the correct character height and ensures compatibility with the EGAHCOPY program used to print the screen with the <Shift><PrtScn> keyboard function. Note that, whereas EGAHCOPY applies solely to Epson or compatible graphics printers, HCOPY_HP.COM can be substituted to extend the <Shift><PrtScn> function to the HP LaserJet and HCOPY_DJ.COM can be substituted to extend it to the HP DeskJet 500C or 550C.

Printers connected to LPT1 can also be used with the Plot function accesed from many screens with the F7 function key. To install a printer for use with the <F7 Plot> function, designate that printer as the system *printer*; do not select a plotter. (The printer is assumed to be on LPT1 even though, when you press <F7 Plot>, the software will ask if the device is connected. Answer Y for yes after checking that the device is connected and turned on.)

2.6 AFTER RUNNING INSTALL

After you have run the Install program you will have to:

- rename existing CONFIG.SYS and AUTOEXEC.BAT files in the root directory (C:\) to something such as CONFIG.OLD and AUTOEXEC.OLD by using the DOS RENAME command. This preserves the commands in your old files should you ever run software that needs them. Alternatively, you can edit these files to include the

commands used in the AUTOEXEC.PAR and CONFIG.PAR files.

- rename the AUTOEXEC.PAR and CONFIG.PAR files that have been created. (These files were given the ".PAR" extension so they would not overwrite the CONFIG.SYS and AUTOEXEC.BAT files you may already have.)

- modify the AUTOEXEC file if you plan to use the <Shift><PrtScn> capability.

The following subsections describe the contents of the AUTOEXEC.PAR, CONFIG.PAR, and CFG.CGI files that were created, show examples of modifications, and describe how to rename the files.

2.6A CONFIG.PAR

The commands written into the **CONFIG.PAR** file depend on your choice of program directory while performing the installation. CONFIG.PAR is created by the installation and is placed in C:\, the root drive of the hard drive. Before the system can use this file for configuration it will have to be renamed: see Section 2.6D for an explanation of how do this. This file contains commands that DOS checks each time the computer is "booted" (started). These commands determine the computer's default configuration settings.

A typical CONFIG file created by the Install program is shown in Figure 2-1. The commands set the files to 20 and the buffers to 10, point to the location of the GPIB.COM program. Note that the drive:\subdirectory specified during the installation was C:\OMAVIS.

More detailed information about **CONFIG.SYS** can be found in your DOS manual.

```
DEVICE=C:\OMAVIS\gpib.com
FILES=20
BUFFERS=10
```

Figure 2-1. CONFIG.PAR

Note: GPIB.COM is required for OMA Vision use only. It is not required to use OMA Desk.

2.6B AUTOEXEC.PAR

The **AUTOEXEC.PAR** file is created when the OMA Vision/Desk program is installed. The installation process writes that file based on your responses and places it in the C:\, the root directory of the hard drive. The ".PAR" extension is used so that the newly created AUTOEXEC file does not overwrite an existing AUTOEXEC.BAT file.

The example AUTOEXEC.PAR shown in Figure 2-2 was created using a Rev. 3.1 version of the Install software. The commands used set the path, turn on EGAHCOPY, and load the drivers required by the system. Note that the drive:\subdirectory used was specified during the installation as C:\OMAVIS.

Modifying the AUTOEXEC file can be done by using a DOS text editor such as the DOS EDLIN utility. Changes that you might want to make would be those such as adding a DOS PATH statement and inserting a **Prompt=PG** statement. By adding the **Prompt** statement you will know what directory you are in when you either Shell to DOS or Exit to DOS from the OMA Vision program. Figure 2-3 shows an AUTOEXEC file with these changes and additions. Note that the directory holding the OMA Vision software is included in the PATH statement.

Figure 2-4 has an additional line added at the end of the AUTOEXEC file. Because the OMAVIS subdirectory is included in the path statement, this last line will load the OMA Vision program from the hard disk when the system is turned on.

```
SET CGIPATH=C:\OMAVIS
C:\OMAVIS\EGAHCOPY
C:\OMAVIS\DRIVERS
```

Figure 2-2. AUTOEXEC.PAR

```
path=c:\;c:\omavis
prompt=$p$g
C:\OMAVIS\EGAHCOPY
SET CGIPATH=C:\OMAVIS
C:\OMAVIS\DRIVERS
```

Figure 2-3. MODIFIED AUTOEXEC.PAR

```
path=c:\;c:\omavis
prompt=$p$g
C:\OMAVIS\EGAHCOPY
SET CGIPATH=C:\OMAVIS
C:\OMAVIS\DRIVERS
OMAVIS
```

Figure 2-4. MODIFIED AUTOEXEC.PAR

2.6C CGI.CFG

The **CGI.CFG** file is created by the Install program and is required to further configure the computer. The CGI file shown in Figure 2-5 was created with the Rev 3.2 Install program. Note that the OMA Vision software was installed in a subdirectory named OMAVIS. The commands in this file set up the graphical interface, the monitor, and an HP plotter.

Another version of the CGI.CFG file is shown in Figure 2-6. In this version, an HP Laserjet has been installed. The statements in this CGI file allow data to be plotted to an HP Laserjet on LPT1 via the OMA Vision <F7> Plot function. Note that the default resolution for the printer has been set to 300. If you find that the text size on a printout is unacceptably small, you may want to edit the RESOLUTION statement and change it to RESOLUTION=150 or RESOLUTION=75. The character size varies inversely with the resolution, with the result that the lower-resolution setting will give print that is larger and more easily read. Also, at 150 or 75 dots per inch, the laser printer will require less internal memory to fully plot the data.

```
driver=C:\OMAVIS\gsscgi.sys
driver=C:\OMAVIS\ibmega.sys
/G:DISPLAY
DISPLAY=ibmega.sys
orientation=landscape
driver=C:\OMAVIS\laserjet.sys
/G:PRINTER
PRINTER=laserjet.sys
PLOTTER=laserjet.sys
RESOLUTION=300
laserjet=lpt1
```

Figure 2-5. CGI.CFG: Laserjet installed

```
driver=C:\OMAVIS\gsscgi.sys
driver=C:\OMAVIS\ibmega.sys /G:DISPLAY
DISPLAY=ibmega.sys
orientation=landscape
driver=C:\OMAVIS\hpplot.sys /G:PLOTTER
PLOTTER=hpplot.sys
hpplot=com1
com1=9600
```

Figure 2-6. CGI.CFG: HP plotter installed

2.6D Renaming Files

These instructions assume that the DOS RENAME command exists in a directory or subdirectory pointed by the path statement in the current AUTOEXEC.BAT file.

To rename the existing CONFIG.SYS and AUTOEXEC.BAT files:

1. Move to the root directory (assumed to be C:\).
2. Type **REN AUTOEXEC.BAT AUTOEXEC.OLD <Enter>**
3. Type **REN CONFIG.SYS CONFIG.OLD <Enter>**

To rename the CONFIG.PAR and AUTOEXEC.PAR:

1. Type **REN AUTOEXEC.PAR AUTOEXEC.BAT <Enter>**
2. Type **REN CONFIG.PAR CONFIG.SYS <Enter>**

The commands in these files will take effect when you press <Ctrl><Alt><Del> for a warm reboot or after you turn off and restart your computer.

2.7 SYSTEM DEFAULT PARAMETERS

When OMA Vision is started, it is loaded from the hard disk. The first time the program is exited via the <F10> Exit Program function a new file called **M1470.PRM** is created and written to the program directory. This file contains a set of the system parameters in effect at the time of exiting the program. These parameter settings are then used by the program as the program defaults the next time OMA Vision is run. Included are data acquisition parameters, area/equation parameters, and calibration coefficients. Changes to these settings that occur while using the software will become the new system default parameters when the program is exited normally (when the <F10> Exit Program function is used). On exiting, the existing M1470.PRM is renamed M1470.BAK and the parameters are stored in a new M1470.PRM file.

The communications defaults are given below:

Plotter: Determined during the initial running of the Install program.

Printer: Epson-compatible or IBM graphics 9-pin at LPT1 (supports Print Screen function). It is also possible to print to an HP LaserJet or HP 500C or 550C DeskJet printer by substituting HCOPY HP or HCOPY DJ respectively for EGAHCOPY in the AUTOEXEC.BAT file.

RS232C Parameters: 9600 baud, 8 data bits, 1 stop bit

2.8 GPIB CONFIGURATION

The National Instruments GPIB card used in your computer should have its interrupts turned off. To accomplish this, most boards require a jumper to be set to "no interrupts," and the interrupt option set to "none" in the GPIB.COM driver file. The setting in this file is changed via the IBCONF.EXE program, which is copied to the program directory during installation. If you are using the National Instruments PC2A board, the GPIB.COM that was copied to the program directory during installation can be used to replace the current GPIB.COM listed in your CONFIG.SYS file. Note that GPIB.COM is not required to run OMA Desk.

2.9 ADDITIONAL PRINTER AND PLOTTER DRIVERS

Additional printer and plotter drivers for the <F7> Plot function are available. Contact EG&G Princeton Applied Research at (609) 530-1000 for further information.

Chapter 3
Getting Started

3.1 OVERVIEW

This chapter shows you what you need to know about getting the OMA Vision or OMA Desk program started after you have installed it (Chapter 2). The information contained here tells you how to change screens, make menu selections, move the cursor, and edit items such as labels or equations. The chapters that follow address the major divisions of the OMA Vision software: Data Acquisition, Data Analysis, System Configuration, and Utilities.

3.2 DEFINITIONS OF TERMS

This section explains the meanings of three key technical terms used in this chapter.

Curve set: A set of information, stored and processed together, relating to the acquired spectra. A curve set may be the spectral data complete with data acquisition parameters, Area/Equation table, and calibration coefficients. Or, a curve set may be just the acquisition parameters or the Area/Equation table or the calibration coefficients.

Default parameters: The initial parameters (see below) used by the system at startup.

Parameter: A value used by the program to determine how the spectral data will be acquired, interpreted, and processed, such as run time, sample time, or exposure time.

3.3 KEY CONCEPTS AND FUNDAMENTAL PROCEDURES

3.3A Menu and Function Structure

To simplify the user's understanding and operation of the OMA Vision program, it is organized into a series of functions accessed from menus and submenus. These menus and functions are logically organized in a tree-like structure (see Figure 3-1) that allows you to easily branch to any part of the program and perform the desired operations. Operations are selected from the menus or started by pressing function keys whose functions are named at the bottom of the screen.

3.3B System Default Parameters

When the OMA Vision program or OMA Desk program is started, the program files are loaded from the hard disk. In addition, a set of system parameters is loaded from the file M1470.PRM on the disk. These parameters include data acquisition parameters such as measurement times, display options, area/equation parameters, and wavelength calibration coefficients.

When the program is exited normally (when the **<F10> Exit Program** function is used), any changes to these parameters while using the software causes the existing M1470.PRM file to be renamed M1470.BAK and a new M1470.PRM file to be created using the updated parameters. If the system is turned off without exiting the program first with <F10>, the current setup in M1470.PRM is not overwritten. The communications defaults are given in Chapter 2.

Before the system resets to the parameters in the M1470.PRM file, two checks are made of the hardware by the OMA Vision program. The OMA Vision program checks to see that the detector (1462 or 1463 type) is compatible with the detector type used when M1470.PRM was written. It also checks to see if the detector array lengths are the same. If the actual configuration and the file information do not agree, the actual configuration information is used in the setup. Since the OMA Desk program does not require a detector, these checks are not made when OMA Desk is booted.

3.4 NOTATION CONVENTIONS

Many of the operations require pressing specific keys or combinations of keys. Whenever a specific key or key combination is referred to, the following conventions will be used.

<key>: Indicates that you must press the named key. For example, **<F1>** indicates that you must press the "F1" key.

<key><key>: Indicates that you must press and hold the first key while pressing the second key. For example, **<Alt><x>** indicates that you must press and hold the "Alt" key while pressing the "x" key.

The conventions used when referring to menus and submenus are as follows:

Menu name: A menu or submenu is referred to by the name given for it at its top: for example, the **System Configuration** submenu.

Menu name/Submenu name: When it is necessary to make clear the path to a submenu, it may also be referred to by a combination of its name and the name of its parent submenu. For example, the **System Information** submenu may be referred to as the System Configuration/System Information submenu.

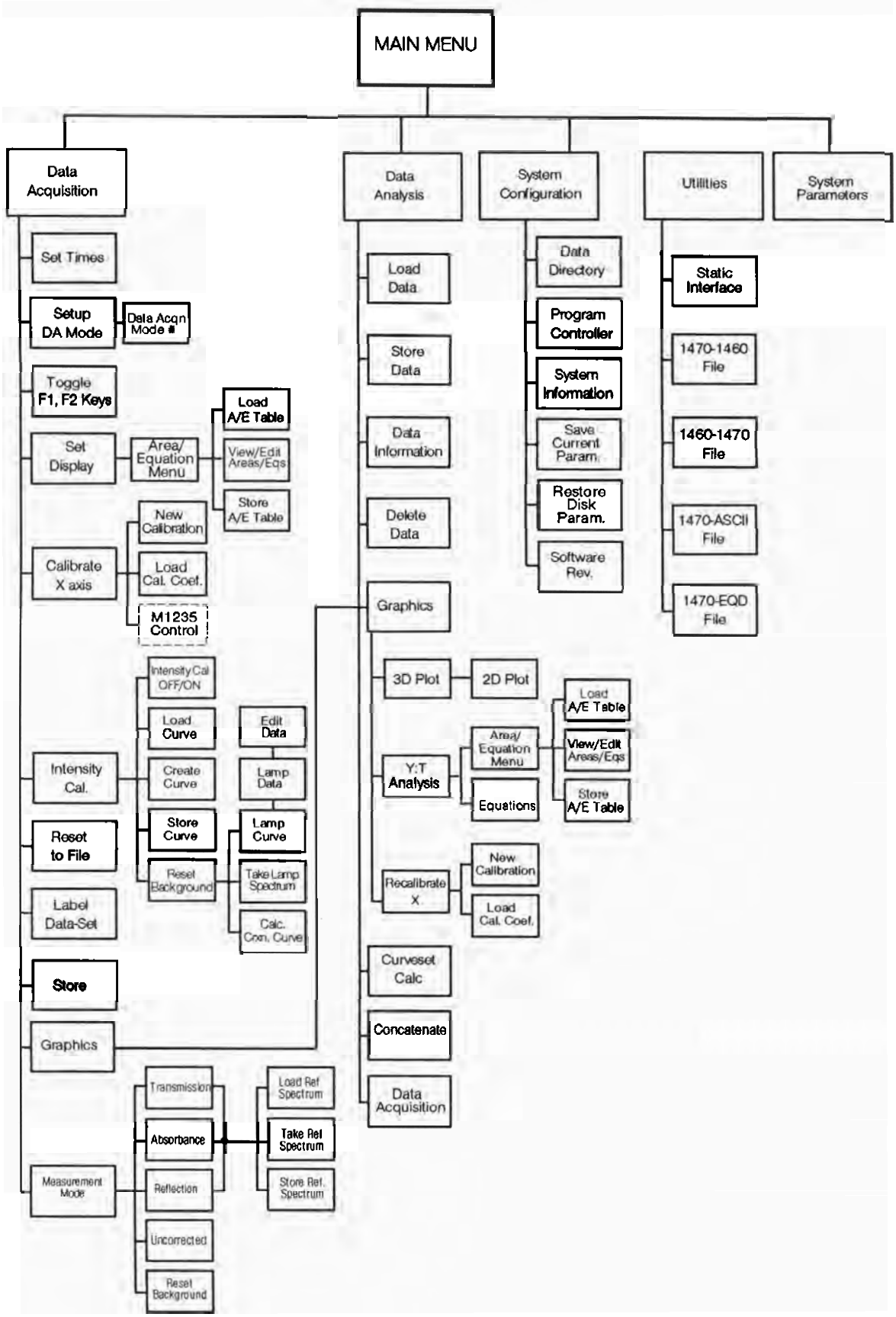


Figure 3-1. OMA VISION/DESK MENU STRUCTURE

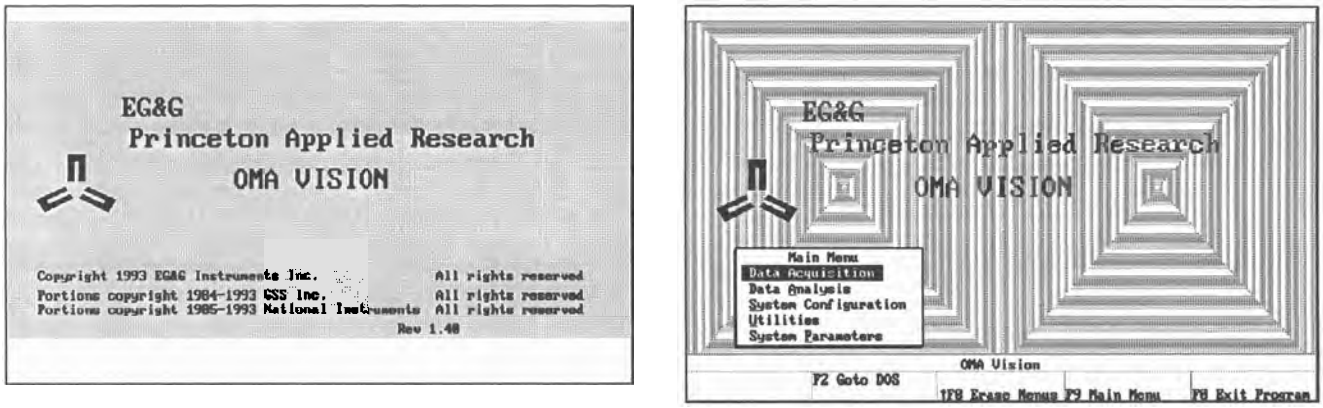


Figure 3-2. OMA VISION: OPENING SCREENS

3.5 STARTING THE OMA VISION PROGRAM

Before powering up the system, confirm that all units of the data acquisition system have been installed as described in their accompanying hardware manuals. Verify that all required cabling and tubing connections have been made.

After all cabling and cooling connections have been checked, turn on your Detector Interface. This may be a Model 1470A, Model 1471A, or Model 1461. Then, turn on your computer if you are using a 1471A or 1461. Wait for the boot process to finish, change to the directory containing OMA Vision, and type "omavis" (Do not type the quotation marks.).

If the AUTOEXEC.BAT file has been modified as shown in Figure 2-4, the OMA Vision program will start automatically after you turn on your PC or 1470A and the bootup sequence finishes.

When the program starts, it displays a title screen showing the EG&G Princeton Applied Research logo, the name of the applications software, the software revision level, and copyright dates. After a moment, the screen is replaced by the OMA Vision screen. (Both screens are shown in Figure 3-2.) The **Main Menu** which is displayed on the OMA Vision screen is the starting point for any operations you wish to perform. Simply by pressing **<Enter>** on the keyboard, you can move to the procedure highlighted in yellow on the menu. The yellow bar can be moved up or down to highlight other menu items by pressing the **<↑>** or **<↓>** keys.

The same **Main Menu** will appear, without the company logo and name of the software, whenever you press **<F9>** **Main Menu** from any other screen as the program is running.



Figure 3-3. OMA DESK: OPENING SCREENS

3.6 STARTING THE OMA DESK PROGRAM

Once you have installed the OMA Desk program on your computer, starting the program is a simple matter. First, turn on your computer and wait for the boot process to finish. Then change to the directory containing OMA Desk, and type "omadesk" (Do not type the quotation marks.). The OMA Desk program will boot and load the demo data file DEMO.BIN (assuming the file is present).

If statements such as those contained in Figure 2-4 have been added to the AUTOEXEC.BAT file, the OMA Desk program will be automatically started after the initial boot sequence. Note that the statements included in Figure 2-4 are based on the OMA Vision program; a version appropriate to the OMA Desk program would include the OMADESK directory in the path statement and substitute **OMADESK** for **OMAVIS** in the last line of the AUTOEXEC file.

When the program starts, it displays a title screen showing the EG&G Princeton Applied Research logo, the name of the applications software, the software revision level, and copyright dates. After a moment, the screen is replaced by the OMA Desk screen. (Both screens are shown in Figure 3-3.) The **Main Menu** which is displayed on the OMA Desk screen is the starting point for any operations you wish to perform. Simply by pressing **<Enter>** on the keyboard, you can move to the procedure highlighted in yellow on the menu. The yellow bar can be moved up or down to highlight other menu items by pressing the **<↑>** or **<↓>** keys.

The same **Main Menu** will appear, without the company logo and name of the software, whenever you press **<F9>** **Main Menu** from any other screen as the program is running.

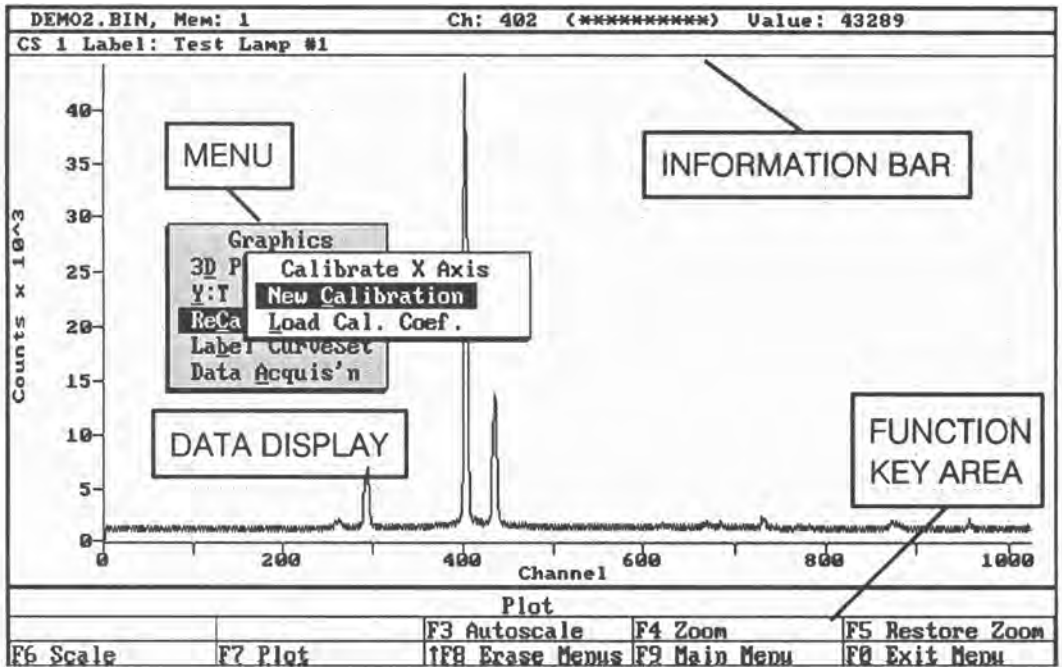


Figure 3-4. SCREEN ELEMENTS

3.7 SCREEN ELEMENTS

Figure 3-4 has been edited to indicate the major parts of a screen. These parts are the menu, the data display window, the information bar, and the function key area. Whenever there is an input box (performing calculations, for example), this box may replace the function key area.

In some cases, the **menu** has several selections which in turn have submenus. This structure can be seen in the menu shown in Figure 3-4. Some menu and submenu selections change the state of a selection back and forth (turn it on or off). Others prompt you for information.

The **data display window** allows you to view a representation of your data in Normal, 2-D overlay, or 3-D mode. Data display updating occurs in real time when Live acquisition is active.

The **information bar**, located at the top of the screen, displays information about the currently displayed data. Depending on the screen, the information bar may be empty or it may contain a set of information including one or more of the following items: the filename and memory number of the data displayed, the file label, the scan number, the cursor location (channel number and wavelength, if calibrated), the intensity at that location, the file number that will used when data is stored, and the elapsed acquisition time.

Figures 3-4 and 3-5 show uncalibrated and wavelength-calibrated data, respectively. The information bar in Figure 3-4 shows the filename (DEMO2.BIN), the memory number (1), the cursor location in terms of channels (402), and the intensity (43289 counts) at that location. Figure 3-5 shows the same data but it is now wavelength calibrated as can be seen from the information bar: the wavelength at channel 402 is 515.52 nm.

The **function key area** shows the active keyboard function keys and their current functions. The purpose and status of each function key may change from screen to screen. In some screens, only a few of the function keys are active. In others, all ten function keys have assigned functions. Whenever a key is not assigned a function, it is blacked out.

The following function keys work the same way in each graphics-oriented screen:

- F3 = AutoScale
- F4 = Zoom
- F5 = Restore Zoom
- F6 = Manual Scale
- F7 = Plot (to installed printer or plotter)
- F8 = Recall menu/s for current screen
- ↑F8 = Erase menu/s from current screen
- F9 = Return to **Main Menu**
- F10 = Exit (back up to the previous menu). If pressed from the **Main Menu**, it displays the System Parameters that will be saved in 1470.PRM and gives the option of exiting to DOS by selecting **Y** or of returning to the Main Menu by selecting **N**.

Note that F10, which is used to exit the menu or the program, is designated by F0 in the function key area to save space.

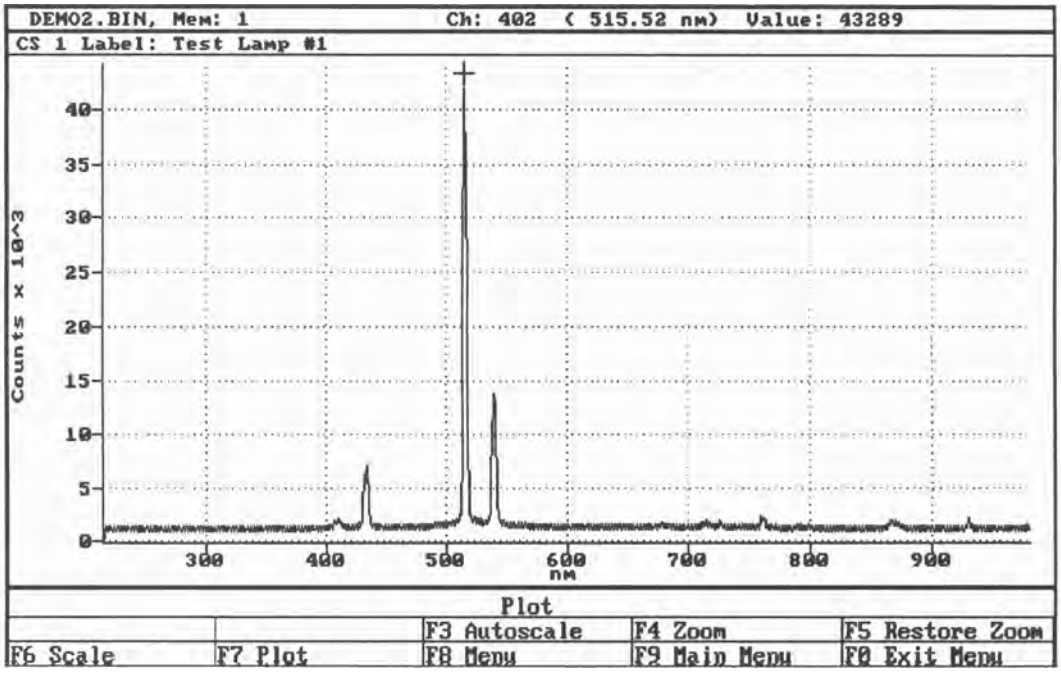


Figure 3-5. WAVELENGTH CALIBRATED X-AXIS

Keys F1 and F2 have different functions depending on the screen displayed and the operation being performed. See Chapters 4 through 7 for descriptions of screen-related function key assignments.

3.8 MOVING AROUND IN THE PROGRAM

3.8A Entering the Program

You enter the program by turning on your PC. The software may start automatically, or you may have to type "omavis" or "omadesk" (without the quotes) when in the program directory. This was explained in Sections 3.5 and 3.6.

3.8B Operator Interface

The OMA Vision software displays pop-up menus that allow you to move easily between operations and setups. You can perform standard actions such as displaying the curves, calculating the results, and returning to the **Main Menu** by pressing a single function key.

3.8C Accessing a Menu

The menu for the current screen is accessed by pressing **<F8> Menu** whenever that function is available. In most instances, the **Main Menu** (the top menu for the program) can be accessed via **<F9> Main Menu**. This provides a quick way to jump to another major section of the program.

3.8D Selecting Menu Items or a File

Menu selections bring up submenus or other screens, or permit the entry of parameter values. When a menu is displayed, an item can be selected from it by either of two ways. The easiest way is simply to type the key letter for the menu item. The key letter is highlighted and underlined for immediate recognition. Or, you can use the **<↑>** and **<↓>** cursor keys to move the highlight bar over the desired menu item, and press **<Enter>**.

Several of the numeric keypad keys can be used to find a desired file in a **Load** or **Store** screen file listing. The **<↑>** and **<↓>** keys are used for single stepping through the file list. The **<→>** and **<←>** keys move the cursor from column to column. **<Home>** moves the cursor to the first file in the list and **<End>** moves the cursor to the last file. **<PgUp>** and **<PgDn>** can also be used to page through the file list. After the desired file is highlighted, pressing the **<Enter>** key selects it.

3.8E Expanding/Contracting about the Cursor

In some instances, the **<Ins>**, **<Del>**, **<Shift><Ins>**, and **<Shift><Del>** can be used to expand or contract (after expansion) the curve about the cursor. The expansion or contraction will occur along either the X or Y axis depending on the key combination used. This function can used while Live data is being acquired and in some of the Data Analysis plot screens such as Y:T Analysis screen. The effects of these keys are described below and on the following page.

<Ins> allows you to expand around the cursor in the X direction.

<Del> allows you to contract around the cursor in the X direction.

<Shift><Ins> allows you to expand around the cursor in the Y direction.

<Shift><Del> allows you to contract around the cursor in the Y direction.

3.8F Exiting a Menu, Submenu, or Load/Store Screen
Making a menu selection or loading or storing information is one way to exit a menu, **Load CurveSet Data** screen, or **Store CurveSet Data** screen. The two ways to exit from a menu or Load/Store screen without making changes to the current settings are to use the **<F10> Exit Menu** function key or the **<Esc>** key. A menu or Load/Store screen is erased when it is exited. In several cases, pressing either **<Esc>** or **<F10> Exit Menu** exits to the next higher level screen: remember, F0 means to press the F10 key. Another way to exit a menu or set of menus is to use **<Shift><F8>** Erase Menus when it is a function choice: this function erases all menus from the screen.

Note: Function keys have precedence over menus. Pressing a function key activates the selected function and clears any menu from the screen.

3.8G Exiting the Zoom Mode
Getting out of zoom mode without creating a zoom box is accomplished by pressing **<Esc>**.

3.8H Using DOS Functions
At times you may want to leave the OMA Vision program without having to restart it afterwards. This can be done by selecting the **<F2> Goto DOS** function that is available when the **Main Menu** is displayed. When you leave or "shell out" of the program, you can perform various DOS functions and then return to the program by returning to the directory where the OMA Vision software is located and then typing **exit** at the DOS prompt, followed by **<Enter>**.

3.8I Exiting the Program
To quit the OMA Vision program, return to the **Main Menu** via **<F9> Main Menu** and press **<F10> Exit Program**. This function displays the system parameters and ends the program when you key in **Y** after the **Exit Program (Y/N)?** prompt. *(Keying **N** returns you to the Main Menu.)* The program then exits to the computer's operating system and data which has not been saved is lost. However, the current operating parameters are stored in the file M1470.PRM for use as defaults the next time the program is entered.

3.9 ENTERING PARAMETERS, EQUATIONS, AND FILENAMES

3.9A Editing Capabilities
The following editing keys can be used to edit information:

<Home> moves the cursor to the start of entry.

<End> moves the cursor to the end of entry.

<→> moves the cursor one character to the right.

<←> moves the cursor one character to the left.

<Del> deletes the character at the cursor.

<Backspace> deletes the character to the left of the cursor.

<Shift><Home> (pressing **Home** while holding down **Shift**) erases all changes and restores the original entry.

<Shift><Del> (pressing **Del** while holding down **Shift**) erases what you last typed.

<Esc> if pressed before **<Enter>**, erases your entry, restores the current setting, and takes you out of the input or editing box.

3.9B Entering Information
Setting the run time for data acquisition is an instance when input information is requested. When you select **Run Time** from the **Set Times** menu, the current parameter setting is presented in an input box. Key in the desired setting. Note that the current setting is erased if your first keystroke is a number. If you are typing in an input box that can accept letters, the current setting is also erased if your first keystroke is a letter.

You can edit the current setting or what you have just typed using the editing keys described in Section 3.9A, so long as you have not pressed **<Enter>** or **<Esc>**. If you decide not to change the current setting, you can back out of the box by pressing **<Esc>** and leave the current setting unaffected.

Word processors with which you may be familiar generally have two modes of editing: the "insert" mode and the "typeover" mode. Only the insert mode is used in the OMA Vision software. When you type a letter or number, it will be inserted between the character under the cursor and the previous character.

When you have completed your entry, press **<Enter>**. The input box closes and the setting shown in the menu changes unless the setting is outside the range of acceptable values.

Note: Up to four equations can be displayed on the **Equation Plot** screen. Selecting the equations to be displayed is accomplished by selecting Plot Equations from the **Y:T Analysis** menu. At the prompt, either accept the equation number by pressing **<Enter>** or edit the number and then press **<Enter>**. To end the selection process, press **<Esc>**.

3.9C Loading or Storing a Curve Set

A curve set may be the spectral data complete with data acquisition parameters, Area/Equation table, and calibration coefficients. Or, a curve set may be just the acquisition parameters or the Area/Equation table or the calibration coefficients. Regardless, the procedure for loading information is pretty much the same. To load information, select the **Load *.BIN Data** function from the menu. When the **File Selection** screen appears, you can move the highlight cursor to the desired filename and press **<Enter>** repeatedly until the data is loaded. You can also key in the filename and change the directory path and/or disk drive to be used when searching for the named curve set.

Note: When changing the selected disk drive, you can enter the backslash (\) after the drive designation if you are changing to the root directory. For example, to change to the root directory on Drive C, the entry required is either **C:** or **C:**. When changing to any other directory the backslash should not be entered after the subdirectory name. To change to the **Data** subdirectory on Drive C, the entry required is **C:\Data**.

The **Store *.BIN Data** function presents you with another **File Selection** screen similar to the **Load CurveSet Data** screen. (If you are using the **Store *.BIN Data** function, check to see that the correct information is pointed to in the **Data Analysis** screen.) The current information will be stored with the name and to the disk directory that you key in.

Points to keep in mind when loading or storing information:

1. A filename must be a legitimate DOS filename. It can have up to 8 alphanumeric characters. It may also have a three-character alphanumeric extension which is separated from the name by a period (.). The standard extension for OMA Vision data files is BIN.

   If a filename has no extension or uses an extension other than BIN, the file will not be listed in the Load/Store directory. However, it can be loaded by keying in the filename.

2. Data may be stored in directories other than the directory shown in the **Store CurveSet Data** screen. When changing the path, use F2 or F5 and follow DOS conventions to enter the new path.

3. As all accumulated data is automatically saved to the active data directory, it is important that this directory be specified correctly. To change it, go to the **Main Menu**, choose **System Configuration**, select **Data Directory**, edit or retype the directory name, and press **<Enter>**.

4. When storing, the prompt **New Label:** appears. The label shown at the prompt is the label that will be stored with the file when **<Enter>** is pressed. If the label shown is not correct, you can change it at this point.

Note: Before selecting **Load *.BIN Data** from the **Data Analysis** menu, verify that the cursor is pointing to the memory number where you want the data to be loaded. Otherwise, any data already stored in that memory location will be overwritten when the new data is loaded. Alternatively (with the cursor at a random location), press F1 and type in the filename, followed by **<Enter>**.

3.9D File Selection Function Keys

The functions described below are active in any of the Load or Store screens. Note that the "current curve set" depends on the operation being performed. When data is being loaded, the "current curve set" is the file that is highlighted. When data is being stored, the "current curve set" is the data in memory.

Key	Function
F1	**Filename:** Allows you to key in the filename to be used in the Load/Store operation. When **<Enter>** is pressed, the file is loaded/stored to/from the name in the highlighted box.
F2	**Change Dir:** Allows you to edit the directory path to change the directory used by the program: this, in effect, changes the Data Directory set in the System Configuration menu. The path entered must be a valid DOS path. The directory changes when **<Enter>** is pressed. If the directory name keyed in does not exist, the program allows you to make it at this time.
F3	**File Info:** Opens the **File Selection** screen. Data acquisition parameters, detector parameters, and area/equation information for the current curve set are displayed here. The screen is exited by pressing **<F3>** again or by pressing **<Enter>**.
F5	**Directories:** Displays a listing of the current directory's subdirectories. A subdirectory can then be selected by moving the highlight bar and pressing <Enter> twice. Note that a single dot (.) listing means the current directory and a double dot (..) means the parent directory. **File Menu:** Returns to the File Selection screen.
F6	**Edit Label:** Allows the user to add or change the file label associated with the current curve set.
F7	**Delete File:** Allows the user to delete the currently selected file.
F9	**Main Menu:** Accesses the **Main** menu.
F10	**Exit Menu:** Exits the currently displayed menu. In

some cases, it also exits the current screen.

3.10 MOVING THE CURSOR

A variety of cursors are used in the screens, menus, and data plots. The cursor may be an arrow or a "+" symbol. Its movement is generally controlled by the <↑>, <↓>, <←>, and <→> cursor keys. In many cases the distance the cursor moves is increased by combining these keys with <Shift> as in <Shift><→>.

3.10A In Text Screens

<↑> or <↓> moves the cursor from one line to another unless a menu is displayed.

<Shift><↑> moves the cursor from one line to
<Shift><↓> another when a menu is displayed.

<Ins> tags or untags each curve set pointed to
<Del> in the Data Analysis screen. A tagged curve is indicated by an asterisk "*" next to its entry.

3.10B In Graphics Screens: Live Data Acquisition and Data Analysis screens

<←> or <→> moves the cursor to the left or to the right one screen pixel along the equation plot or spectrum (curve).

<Shift><←> speeds up the cursor along the plot or
<Shift><→> curve.

<↑> or <↓> moves the cursor from one spectrum to the next when more than one curve is in a displayed dataset.

<Shift><↑> moves the cursor to every fifth curve of
<Shift><↓> a multiple curve set drawn in the **3D Plot** screen.

<*> on the numberpad. Valid in Plot and YT Analysis screens. Prompts you for a spectrum/memory number to switch to.

<PgUp> or <PgDn> increases the step size for <Shift><←> or <Shift><→>.

<Ins> expands or contracts the X axis (2 times)
<Del> about the cursor.

<Shift><Ins> expands or contracts around the cursor
<Shift><Del> in the Y direction.

<Home> moves the cursor to the first pixel of a curve.

<End> moves the cursor to the last pixel of a curve.

<Shift><+> move the cursor from curve set to curve
<Shift><-> set in the Graphics **Plot** screen when more than one curve set is tagged in the Data Analysis "Curve Sets Currently in Memory" box.

<C> when followed by a number, moves the cursor to that channel. Does not function if a menu is present with "C" as one of the key letters.

<X> when followed by a number, moves the cursor to that wavelength. Does not function if a menu is present with "X" as one of the key letters.

3.10C In Equation Plot Screens

<←> or <→> moves the cursor to the left or to the right one screen pixel along the equation plot.

<↑> or <↓> moves the cursor from one equation to the next when more than one equation is displayed.

<Ins> **expands or contracts the X axis (2 times)**
<Del> about the cursor.

<*> (on number pad) contracts the X axis to display its full length.

<PgUp> shifts the screen 1 width to the right if the X axis has been expanded.

<PgDn> shifts the screen 1 width to the left if the X axis has been expanded.

<Home> moves the cursor to the first pixel of a curve.

<End> moves the cursor to the last pixel of a curve.

<Shift><Home> Shifts the screen to the beginning if the X axis has been expanded.

<Shift><End> Shifts the screen to the end if the X axis has been expanded.

3.10D File Selection Screens

<←> or <→> moves highlight to the left or to the right one column.

<↑> or <↓> moves highlight up or down one row.

<Home> moves highlight to the top of the first column.

<End> moves highlight to the bottom of the last column.

<PgUp> moves highlight to previous page of filenames (if on first page, moves highlight to top of first column).

<PgDn> moves highlight to following page of filenames (if on last page, moves highlight to last name in list).

3.11 MOVING A THRESHOLD

Thresholds are used by the program in the peak finding and calibration operations for determining which peaks are of interest or can be used for calibration. A threshold is displayed as a horizontal green line. It can be moved up or down by using the <↑> or <↓> keys. When used, it appears in the same window as the cursor.

3.12 ZOOMING IN AND OUT

The **<F4> Zoom** function boxes a portion of the spectrum and magnifies it to fill the plot display. If Live acquisition is going on when **<F4> Zoom** is selected, the current spectrum is frozen and acquisition pauses until the Zoom box is defined and **<Enter>** is pressed or until the Zoom box definition is aborted via the **<Esc>** key. Acquisition resumes when either method is used to end the Zoom box definition.

There are two different methods for creating a zoom box. The first method is to use the cursor keys (→, ←, ↑, and ↓) move the cursor in very fine increments to define the two corners of the box. Combining any of these keys with **<Shift>** moves the cursor in larger jumps. The second method allows you to key in **c** or **x** and enter the appropriate channel or wavelength value to establish the two corners.

Pressing **<F5> Restore Zoom** restores the data to its original display setup.

3.13 PLOTTING/PRINTING SPECTRAL DISPLAYS

Spectral data can be sent to either a printer or a plotter and by one of two different ways. The manner in which this data is sent depends on the selections made during the software installation. Generally speaking, a plotter is installed as an RS232 device on COM1 and a printer is installed as a parallel printer device on LPT1. In addition, it depends on the type of printer installed. The information below describes when and how you can send data via the <Shift><PrtSc> function or the <F7> Plot function.

3.13A <Shift><PrtScn>

The <Shift><PrtScn> can be used to send screen data to a 9-pin Epson compatible connected to LPT1 by pressing those two keys at the same time. If you have trouble printing, check to see that the EPSONX.SYS file installed in the program directory. Also, check the AUTOEXEC.BAT file to verify that it contains the EGAHCOPY statement. Refer to Section 2.6B when checking the AUTOEXEC file. ***Note:*** *Because menus print black, users are advised to use F10 to remove them before using the print-screen function.* It is also possible to print to an HP LaserJet or HP 500C or 550C DeskJet printer by substituting HCOPY_HP or HCOPY_DJ respectively for EGAHCOPY in the AUTOEXEC.BAT file.

3.13B <F7> Plot

When **<F7> Plot** appears on a screen in the function key area, the data on that screen can be printed or plotted by pressing <F7>. When <F7> is pressed, the data is sent to the plotter *installed on COM1 or, if an HP Laserjet was installed, that printer* on LPT1.

3.14 DATA FILE VERSIONS

The filetype, version number, and label of an OMA Vision data file (FILENAME.BIN) can be checked while in DOS by using the DOS "TYPE" command. To determine this information for a file called 03222019.BIN, you would exit or shell to DOS and at the DOS prompt key in:

```
TYPE 03222019.BIN
```

The response would be something on the order of:

```
M1470BIN 00.1 Live-DataSet
```

where:

M1470BIN is the filetype,

00.1 is the version number, and

Live-Dataset is the file label that was stored with the data.

Chapter 4
Data Acquisition

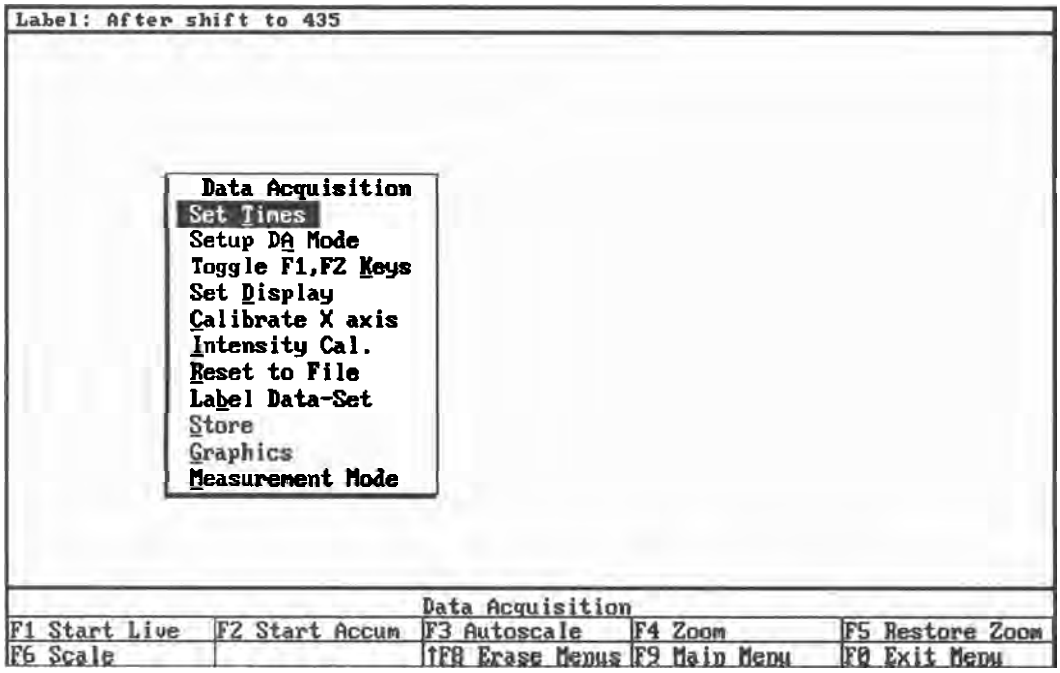


Figure 4-1. DATA ACQUISITION SCREEN AND MENU

4.1 INTRODUCTION

There are two ways in which spectral data can be entered into memory. One method, called *"live"* data acquisition, stores spectral data directly into memory, overwriting previously acquired data. The incoming data simply enters the curve memory and *replaces* the previous data for the pixel being scanned.

In the second method of data acquisition, the *"accumulate"* method, the data from each detector pixel is *added* to the previous count for that channel. After the data acquisition run is completed, the memory contains a summation of readings from each pixel.

It is important to understand that in the Live mode previously acquired data is lost when new data replaces it in memory. But in the Accumulate mode the data is retained and is automatically saved on disk under a filename that includes the date of acquisition. Besides permitting the averaging of multiple scans into one spectral sample, the Accumulate mode also allows the accumulation of multiple spectra.

In most applications, the recommended practice is to begin with the Live mode to view the spectra and see if you are getting the data you expect. This gives you a chance to take corrective action if you are seeing what you shouldn't or not seeing what you should. When the spectral data looks right, then you should switch to the Accumulate mode for your production data acquisition run.

In addition to these two basic ways of doing data acquisition, any one of seventeen different predefined Data Acquisition Modes are provided that give a variety of timing, triggering, and memory management configurations so as to allow optimum performance to be readily attained in a large number of measurement applications. The individual Data Acquisition Modes are described in Appendix C.

As a further enhancement, OMA-Vision offers full Data Acquisition Design (DAD) programming, allowing specific control programs to be written off line and executed from within the OMA-Vision environment. This capability allows OMA-Vision measurement convenience and control to be extended to almost any measurement situation.

Whether you will use the basic live or data accumulation technique, one of the defined Data Acquisition modes, or run a DAD program, the preliminary operations are much the same. Before beginning data acquisition, give the detector time to stabilize at its operating temperature. (The time required will vary according to the type of detector and the cooling method). Then, do a

"Background Subtraction" to reduce background "noise" from thermal "dark" current (see Sections 4.3F and 4.3G). Then set the data acquisition parameters. This could consist of simply using the **Set Times** menu to set the basic live and accumulate timing parameters. Alternatively, it might involve setting the values of the **I, J,** and K parameters for the selected Data Acquisition mode, or writing/loading a DAD program. **Note:** If **Exposure Time** is changed, take new background.

After you select the desired data acquisition parameters, you can begin acquisition. You can display your spectral data in several ways - spectrum only, equations only, or a combination of spectrum and equations (Section 4.4). The display setup for Accumulate acquisition and the scaling provisions are the same as those for Live acquisition.

Data will continue to be acquired and displayed until the acquisition process is stopped. Only one spectrum is stored in memory at any time. Acquisition pauses whenever a scaling or plotting function is accessed. If a portion of the data is of particular interest, you can stop acquisition, zoom in on that portion, and then rescale to view the complete curve set again.

Note: The OMA Desk program is intended for post-acquisition analysis and does not acquire data. However, upon bootup of the program, the DEMO.BIN file is loaded in and is used to simulate data acquisition. That is to say, when either Live or Accumulate acquisition is started in the OMA Desk Program, the spectra from the DEMO.BIN file are shown on the screen as if actual acquisition were occurring. This allows you to try out the features of the acquisition screens without requiring the installation of data acquisition equipment.

4.2 FUNCTION AND ESC KEYS

The function key designations described below are displayed in the Data Acquisition screen (Figure 4-1). Note that they may not all be active at the same time, depending on the type of data acquisition that has been selected and started.

Function keys have precedence over menus. Any menu or submenu displayed will be erased whenever a function key is pressed.

Key — **Function**

F1 **Start Live/Stop Live** or **Live DA Mode:** Function determined by **Toggle F1, F2 Keys** selection (See Section 4.5). Starts or stops Live acquisition.

F2 **Start Accum** or **Run DA Mode:** Function determined by the **Toggle F1, F2 Keys** selection. Starts Accumulate data acquisition or data acquisition via the selected standard Data Acquisition mode. A third possibility is Derivative data accumulation (See Section 4.5, *TOGGLE F1, F2 KEYS*).

F3 **Autoscale:** Automatically rescales the Y-axis for the best fit of the data plot to the screen. Display update stops while the autoscaling is occurring.

F4 **Zoom:** Allows you to magnify a portion of the data to fill the data display area.

F5 **Restore Zoom:** Restores the data display to its unzoomed state, where all of the active channels are displayed.

F6 **Scale:** Accesses the **Scale** menu. The choices available on this menu depend on the type of acquisition; Accumulate acquisition allows only the X/Y Autoscale and X/Y Min,Max scaling adjustments. Note that Live acquisition stops while the menu is displayed.

Y Autoscale automatically rescales the Y-axis for the best fit of the data plot to the screen.

X AutoScale automatically rescales the X-axis to show the complete curve set.

X Min, Max and **Y Min, Max** control the X- and Y-axis scaling for the spectral data display. Changing one of these values is accomplished by highlighting the parameter to be changed and pressing **<Enter>**. Then, key in the new minimum value and press **<Enter>**. Next, key in the new maximum value and press **<Enter>** again. Accept either value as unchanged simply by pressing **<Enter>**.

Eq:*x*, Y Min, Max controls the Y-axis scaling for up to 8 equations. To select an equation for Y-axis scaling, press **<E>**, type the equation number at the prompt, and press **<Enter>**. The X-axis time base is set via the **Set Times** menu.

EQ'ns Autoscale rescales the plots of the displayed equations for best fit on the screen.

Auto-Auto ON/OFF turns on and off automatic rescaling of the Equation Y-axis to fit the graphics window as data is acquired.

After the scaling parameters have been entered, **<Esc>** out of the menu. The new parameters will be used to redraw the axes.

F7 **Plot:** During **Live** data acquisition (only), plots the current curve set to the plotter or printer connected to COM1, after a **<Y>** response and **<Enter>** are keyed in at the "Hard Copy Device connected?" prompt. The message "Sending Data to Device" is displayed while the data is being sent.

Note that unless **Live** data acquisition is in progress, no function will be indicated for the **F7** key.

If you wish to change the type of output device used by F7, you must run the Install program. Refer to Chapter 2 for instructions on running Install.

F8 **Menu:** Accesses the menu associated with the current display screen.

↑F8 **Erase Menus:** <Shift><F8> erases all menus on the screen.

F9 **Main Menu:** Accesses the **Main** menu.

F10 **Exit Menu/Abort Run: Exit Menu** exits the currently displayed menu. In some cases, it also exits the current screen.

Abort Run stops Accumulate data acquisition.

The **<Esc>** key is used to cancel your last choice or to return to the screen or menu last displayed. It often has the same effect as pressing **<F10> Exit Menu**. If a single menu is showing on a curve display screen, pressing **<Esc>** will remove the menu. Pressing **<Esc>** again will return to the previous screen.

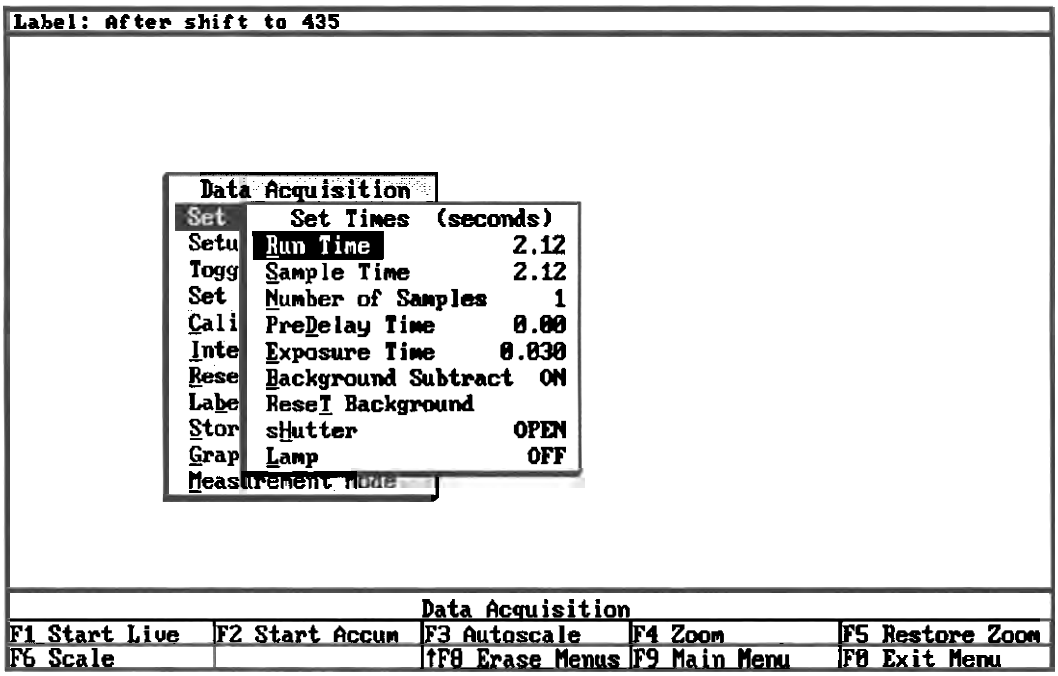


Figure 4-2. SET TIMES MENU

4.3 SET TIMES

The **Set Times** menu (Figure 4-2) allows you to set the Run, Sample, and Exposure Times required for the process. (Live acquisition uses Sample and Exposure Times only.) This menu is used to prepare for data acquisition using the basic Live and Accumulate techniques. Other than in controling the shutter and calibration lamp of a 1240 Spectrograph, this menu is not used in preparing for data acquisition using one of the standard DA modes or the DAD facility.

In addition to setting time parameters, this menu also gives you the options of turning background subtraction on or off, resetting the background to be used, and changing the state of the shutter and lamp in a detector/spectrograph such as a Model 1240 Spectral Camera. The times set via this menu and the number of samples specified determine the size of your curve set and the time intervals between samples.

Note: Some Optical Multichannel Analyzers have an External Sync mode that allows the operator to synchronize the readout scan of the photodiode array with a repetitive TTL signal from the experiment. This is particularly useful with gated experiments driven by a laser pulsing at a fixed frequency.

When the system is operating in the External Sync mode, the Run, Sample, and Exposure Times shown in the **Set Times** menu will be correct only if the External Sync signal equals a multiple of the line frequency. The Exposure Time is set by the period between External Sync pulses. The operator should determine the period of the External Sync pulse and enter it as the Exposure Time, and then adjust Sample and Run Times.

4.3A Run Time

To change the **Run Time**, select it from the menu, key in the time, and press **<Enter>**.

The total time for data acquisition is called the **Run Time**. This is the time period during which a process or set of processes is being monitored. The minimum run time is the Exposure Times + ½ second. The selected Run Time may be recalculated by the program when the **Sample Time** is entered. Run Time is in units of seconds.

4.3B Sample Time

To change the **Sample Time**, select it from the menu, key in the time, and press **<Enter>**.

The time spent in reading the detector array and acquiring a spectral sample is called the **Sample Time**. The minimum Sample Time is the specified Exposure Time + 1/2 second. Sample Time is in units of seconds. The maximum Sample Time is the specified Run Time.

Note: Run Time, Sample Time, and **Number of Samples** are tied together: setting one may result in the others being automatically calculated or adjusted by the program. When **Sample Time** is set, the **Number of Samples** to be acquired during the **Run Time** is automatically calculated. The selected Run Time may also be adjusted. When **Number of Samples** is set, the **Sample Time** is adjusted to the value required for acquiring the selected number of samples during the Run Time. Again, the **Run Time** may be affected also.

4.3C Number of Samples
To change the **Number of Samples**, select it from the menu, key in the number, and press **<Enter>**.

The **Number of Samples** determines how many spectral samples will be acquired during the specified **Run Time.** The maximum number of samples depends on the amount of memory available for storing data and must meet the criterion that the Number of Samples multiplied by the Sample Time be less than the Run Time. If the software determines that the data from the number of samples specified will exceed available memory space, the number of samples will be reset to the maximum allowable for the memory available (126 in the case of the Model 1470A and the Model 1471A) and the **Sample Time** will be recalculated.

A recommended number of samples is between 20 and 40. This conserves memory and speeds 3-D plotting of curve sets while providing reasonable time resolution over the run time.

Note: Number of Samples and **Sample Time** are tied together: setting one results in the other being automatically calculated or adjusted by the program. When the **Number of Samples** is set, the **Sample Time** is adjusted to the value required for acquiring that many samples during the **Run Time.** The Number of Samples to be acquired during the Run Time is automatically calculated when the **Sample Time** is set. To set these parameters conveniently:

1. If going to a longer **Run Time**, first select the **Run Time**. Then select the either the **Sample Time** or the **Number of Samples.**

2. If going to a shorter **Run Time**, first select the **Number of Samples**, then the **Run Time.**

4.3D PreDelay Time
To change the **PreDelay Time**, select it from the menu, key in the time, and press **<Enter>**.

The **PreDelay Time** setting lets you define a waiting period before samples are taken. The sequence is as follows. Data acquisition is started with the press of either **<F1>** or **<F2>**, the waiting period times out, and data is acquired for the period of the Run Time. For example, data acquisition with a set Run Time of 25 seconds and a PreDelay of 10 seconds would take approximately 35 seconds. The units are always in seconds.

4.3E Exposure Time
To change the **Exposure Time**, select it from the menu, key in the time, and press **<Enter>**.

The length of time during which the detector's diode array is exposed to light and read out is called the **Exposure Time**. The minimum exposure time depends on the detector connected. For a 512-element detector, the minimum exposure time is 15 ms; for a 1024-element detector, it is 30 ms. The maximum exposure time is 14400 seconds. Units are in seconds; therefore, 15 ms is entered as .015.

The ideal exposure time is one that provides Y-axis values of 80% to 90% of full scale when the system is viewing the brightest anticipated signal from the experiment, using Live data acquisition with Background Subtract off. (Full scale is 32,000 counts with the Model 1470A and the Model 1471A; 16,000 counts with older units.)

4.3F Background Subtract
Before you begin data acquisition, do a background subtraction with all light to the spectrograph and detector blocked. This will subtract from your spectral data the "noise" due to thermal dark current. Background subtraction should be done whenever the Exposure Time is changed.

To turn **Background Subtraction** on or off, simply select it from the **Set Times** menu. If it's currently on, this turns it off. If it's off, this turns it on. Note that it cannot be turned on unless a background has been previously acquired.

A background spectrum is acquired using the same data acquisition parameters required for the acquisition to be performed. When background subtraction is turned on, this background spectrum is subtracted from the raw data that is acquired during an experiment run. The resulting background-subtracted data is the spectral data that is displayed and is stored when the curve set is saved to disk. The background spectrum is acquired using the **Reset Background** function.

Even though a background has been acquired, you can turn background subtraction off if you prefer to see the raw data.

Note: Changing the **Exposure Time** after a background has been acquired automatically turns background subtraction off and prompts you to acquire a new background.

4.3G Reset Background
The **Reset Background** function is used to acquire the background data for background subtraction. To reset the background, select **Reset Background** from the **Set Times** menu and follow the prompts. Different prompts are displayed depending on the type of spectrograph being used and whether or not a shutter has been marked present. (The type of spectrograph and the shutter existence parameters are designated in the **System Information** menu, accessed from the **System Configuration** menu).

If a Model 1240 Spectral Camera or other spectrograph with a shutter is being used, the program will display the message **"Close Shutter for Background Acquisition (Y/N)?"**.

- If you wish the software to subtract only the detector

dark current, press **<Y>**, and dark current acquisition will be performed.

- If you wish the software to subtract the ambient background, press **<N>**.

If you answered **N**, or if you are using a separate spectrograph and detector, the program will prompt you to set up for background acquisition. Point the optical fiber at the ambient light you want subtracted or cover the entrance slit to remove the ambient light. When you are ready for the system to acquire the background data, press **<Enter>**.

While the background is being acquired, the time to completion is counted down on the screen at the same time that a progress bar provides a quick visual reference to the remaining time. The acquisition has finished when the bar reaches its righthand edge and is erased.

After the background is acquired, it is stored in memory until a new background is acquired or the monitoring equipment is turned off. **Background Subtract** is turned on automatically and the background data is subtracted from each subsequent spectrum curve set unless you turn **Background Subtract** off.

4.3H Shutter

The **Shutter** menu selection is available in the Data Acquisition menu when the Model 1240 Spectral Camera has been designated as the spectrograph used in the system or when the type of spectrograph is designated in the **System Information** menu, accessed from the **System Configuration** menu.

To open or close the shutter, simply select **Shutter** from the **Set Times** menu. Selecting **Shutter** opens or closes the Spectral Camera shutter independently of the data acquisition parameters entered. The shutter is automatically closed when the system is performing an autocalibration or when resetting the background. The shutter is set to "open" at all times when spectral data is being taken.

4.3I Lamp

The **Lamp** menu selection is available in the Data Acquisition menu only when the Model 1240 Spectral Camera has been designated as the spectrograph used in the system. (The type of spectrograph is designated in the **System Information** menu, accessed from the **System Configuration** menu).

The lamp is turned on automatically when the system is performing an autocalibration. At other times the lamp is normally off.

To turn the lamp inside the Model 1240 on or off, select **Lamp** from the **Set Times** menu. If you are turning the lamp on and the shutter is open, close it by selecting **Shutter**. (This is necessary because light from the lamp would be reflected off the back of the shutter into the spectrograph slit.)

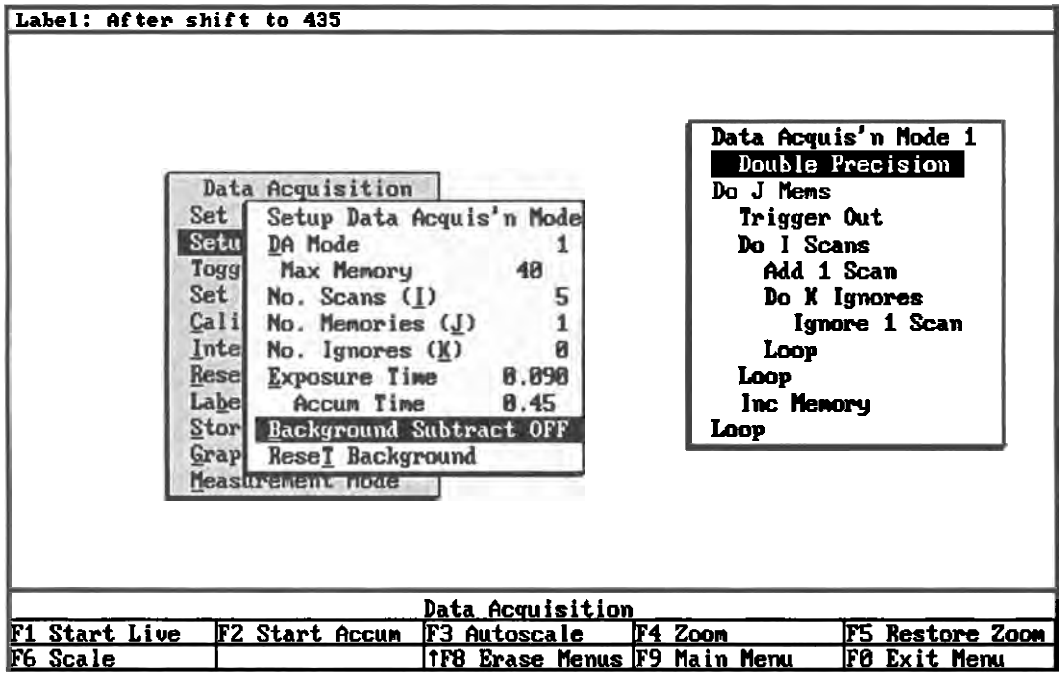


Figure 4-3. SETUP DATA ACQUISITION MODE MENU

4.4 SETUP DATA ACQUISITION MODE MENU

The **Setup Data Acquisition Mode menu** (Figure 4-3) allows you to specify any one of the seventeen standard Data Acquisition Modes. *(You can also specify DA mode 99, which provides access to the Data Acquisition Design facility.)* This menu additionally allows you to set the **Exposure Time** and the **I, J,** and **K** parameter values for the selected mode. Other actions that can be taken from this menu include resetting and taking the background.

Information displayed includes the Accumulation Time, the Maximum Memories as determined by the available memory in the 1461 or 1471A, the number of pixels in the detector, and whether the selected DA mode processes the data in single precision (16 bits) or double precision (32 bits) format. Note that a detailed flow-chart for the selected DA mode is displayed to the right of the menu. Appendix C contains a detailed description of each DA mode. DAD programming is described in Appendix D.

4.4A I, J, and K Parameters

To **I, J,** or **K,** select the parameter in question from the menu, key in the new value, and press **<Enter>**. The significance of the DA mode parameters, 'I', 'J', and 'K', is as follows.

- 'I': For modes that do not include a SUBTRACT operation, 'I' simply designates a scan whose data will be ADDED or STORED.

  For modes that do include a SUBTRACT operation, 'I' designates a scan pair. Data from the first scan of the pair is ADDED or STORED, according to the mode. Data from the second scan is SUBTRACTED from the first scan's data (allowing real time background subtraction).

  In the program listings, a scan that affects a memory occurs at the time that the ADD, STORE, or SUBTRACT operation takes place. It may be helpful to think of the ADD, STORE, and SUBTRACT operations as SCAN-ADD, SCAN-STORE, and SCAN-SUBTRACT, respectively.

- 'J': 'J' is used to denote the number of sequential memories used within an appropriate Data Acquisition mode. Each "memory" is a designated portion of the instrument's RAM dedicated to the storage of data from a complete scan. Each Model 1461 or 1471A memory is identified by an integer. The system default for the first memory to be used is Memory '1'.

  The size of a single memory depends on a number of factors, including the number of detector elements, and whether the data is being stored in single or double precision format.

- 'K': 'K' designates an IGNORED scan, which is a scan explicitly selected to be disregarded. Ignored scans differ from scans that are disregarded in non data-acquisition times in two ways:

  1. Their duration is the same as the programmed exposure time.

  2. The timing of all IGNORED scans relative to

STORE, ADD, or SUBTRACT operations is exactly defined. Note that IGNORED scans are particularly useful in measurements that have a long "dead time" between events of interest, e.g., when studying the reaction of a substance exposed to a pulsed laser.

Note that these parameters, together with the **Exposure Time**, determine the **Accumulate Time**, that is, the time to complete the Data Acquisition Mode run.

4.4B Exposure Time
To change the **Exposure Time**, select it from the menu, key in the time, and press **<Enter>**.

The length of time during which the detector's diode array is exposed to light and read out is called the **Exposure Time**. The minimum exposure time depends on the detector connected. For a 512-element detector, the minimum exposure time is 15 ms; for a 1024-element detector, it is 30 ms. The maximum exposure time is 14400 seconds. Units are in seconds; therefore, 15 ms is entered as .015.

The ideal exposure time is one that provides Y-axis values of 80% to 90% of full scale when the system is viewing the brightest anticipated signal from the experiment, using Live data acquisition with Background Subtract off. (Full scale is 32,000 counts with the Model 1470A and the Model 1471A; 16,000 counts with older units.)

4.4C Background Subtract
Before you begin data acquisition, do a background subtraction with all light to the spectrograph and detector blocked. This will subtract from your spectral data the "noise" due to thermal dark current. Background subtraction should be done whenever the Exposure Time is changed. **Note:** Background subtraction should **not** be done if using one of the ADD/SUB Data Acquisition Modes (Modes 12, 13, 14, & 15).

To turn **Background Subtraction** on or off, simply select it from the **Set Times** menu. If it's currently on, this turns it off. If it's off, this turns it on. Note that it cannot be turned on unless a background has been previously acquired.

A background spectrum is acquired using the same data acquisition parameters required for the acquisition to be performed. When background subtraction is turned on, this background spectrum is subtracted from the raw data that is acquired during an experiment run. The resulting background-subtracted data is the spectral data that is displayed and is stored when the curve set is saved to disk. The background spectrum is acquired using the **Reset Background** function.

Even though a background has been acquired, you can turn background subtraction off if you prefer to see the raw data.

Note: Changing the **Exposure Time** after a background has been acquired automatically turns background subtraction off and prompts you to acquire a new background.

4.4D Reset Background
The **Reset Background** function is used to acquire the background data for background subtraction. To reset the background, select **Reset Background** from the **Set Times** menu and follow the prompts. Different prompts are displayed depending on the type of spectrograph being used and whether or not a shutter has been marked present. (The type of spectrograph and the shutter existence parameters are designated in the **System Information** menu, accessed from the **System Configuration** menu).

If a Model 1240 Spectral Camera or other spectrograph with a shutter is being used, the program will display the message "Close Shutter for Background Acquisition (Y/N)?".

- If you wish the software to subtract only the detector dark current, press **<Y>**, and dark current acquisition will be performed.

- If you wish the software to subtract the ambient background, press **<N>**.

If you answered N, or if you are using a separate spectrograph and detector, the program will prompt you to set up for background acquisition. Point the optical fiber at the ambient light you want subtracted. When you are ready for the system to acquire the background data, press **<Enter>**.

While the background is being acquired, the time to completion is counted down on the screen at the same time that a progress bar provides a quick visual reference to the remaining time. The acquisition has finished when the bar reaches its righthand edge and is erased.

After the background is acquired, it is stored in memory until a new background is acquired or the monitoring equipment is turned off. **Background Subtract** is turned on automatically and the background data is subtracted from each subsequent spectrum curve set unless you turn **Background Subtract** off.

4.4E Load DAD Program
Specifying DA mode '99' brings up the **Load DAD Program** screen (Figure 4-4), used to select and load a Data Acquisition Program. These are user-generated programs saved as ASCII files and having the suffix **DAD**. Although the power that DAD programming brings to the system is limited only by the skill and creativity of the programmer, they must be crafted with care and due consideration for the system constraints and requirements.

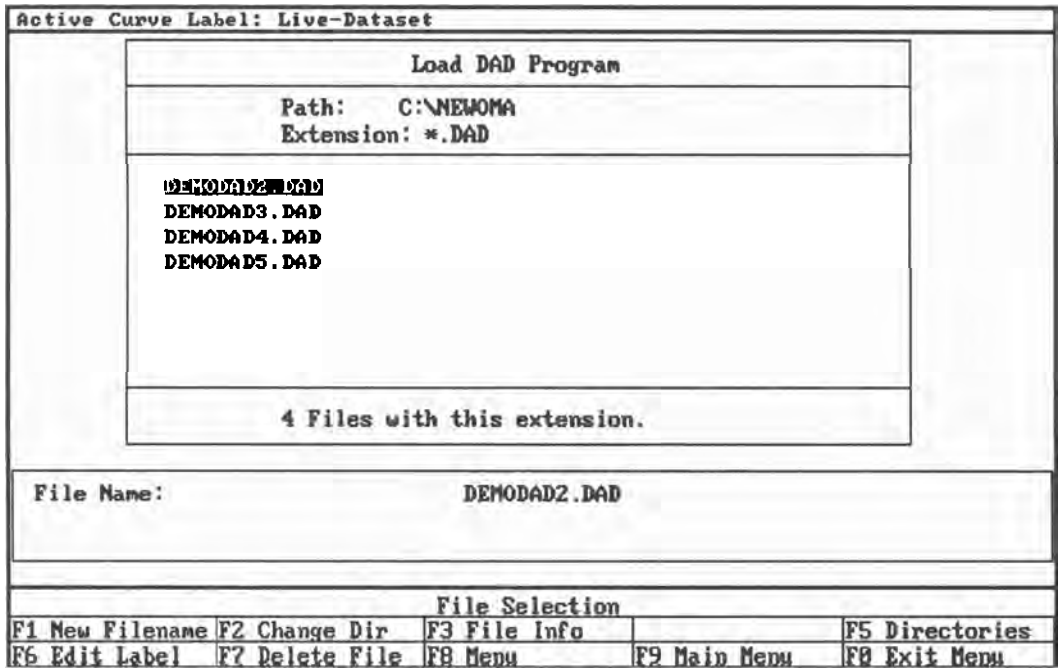


Figure 4-4. LOAD DAD PROGRAM SCREEN

New users are advised to first become thoroughly experienced with the system, the OMA-Vision software, and the capabilities provided by the seventeen standard Data Acquisition modes before attempting to write their own control programs. DAD programming is discussed in depth in Appendix D and a number of examples are provided.

To select a DAD program, move the highlight bar with the ↑ and ↓ keys until the corresponding file name is highlighted. Then press **<Enter>**. Alternatively, you can press **F1**, key in the program's file name, and press **<Enter>**. Once loaded, the DAD program can be executed by pressing the **F2** key.

Note that the function keys in the **Load DAD Program** screen are:

Key	Function
F1	**New Filename:** Allows you to type in a DAD program filename.
F2	**Change Dir:** Allows you to edit the directory path to change the directory used by the program: this, in effect, changes the Data Directory set in the System Configuration menu. The path entered must be a valid DOS path. The directory changes when **<Enter>** is pressed. If the directory name keyed in does not exist, the program allows you to make it at this time.
F3	**File Info:** Opens another window that shows detailed information about a selected file.
F5	**Directories:** Displays a listing of the current directory's subdirectories. A subdirectory can then be selected by moving the highlight bar and pressing <Enter> twice. Note that a single dot (.) listing means the current directory and a double dot (..) means the parent directory. When the **Directories** listing is displayed, two function keys have new uses as follows. **F7 Delete Directory:** Allows selected directory to be deleted. **F5 File Menu:** Returns to the File Selection screen.
F6	**Edit Label:** Allows you to assign a label to a data file or edit a previously assigned one.
F7	**Delete File:** Deletes the selected file.
F8	**Menu:** Returns you to the **Setup Data Acquisition Mode screen.**
F9	**Main Menu:** Returns to the **Main Menu.**
F10	**Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

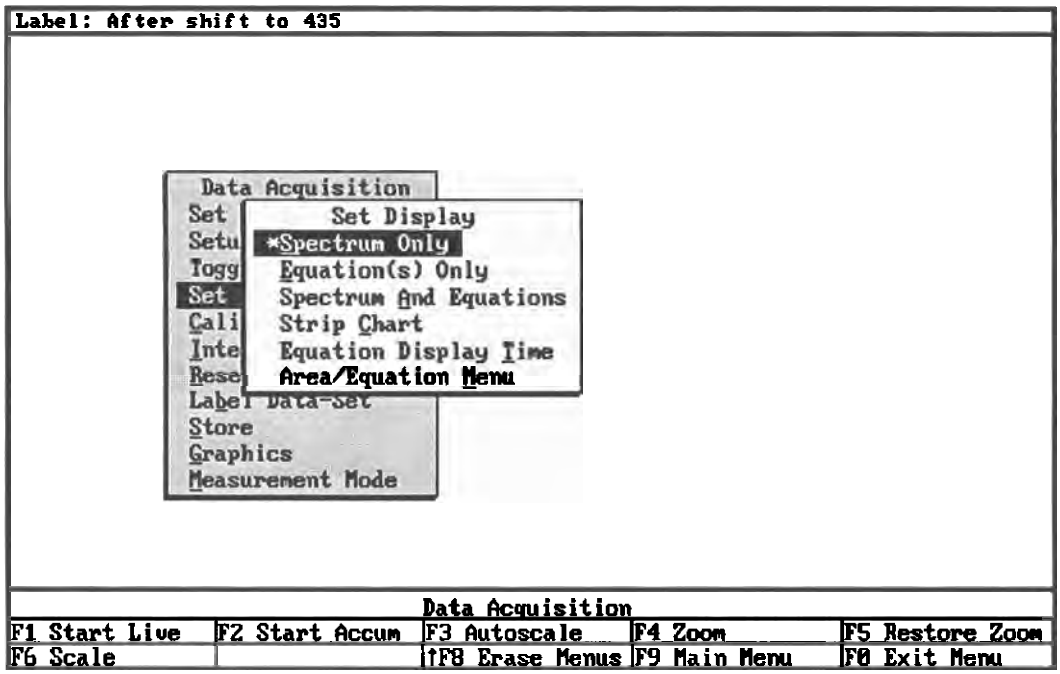


Figure 4-5. SET DISPLAY MENU

4.5 TOGGLE F1, F2 KEYS

Selecting **Toggle F1, F2 Keys** and pressing **<Enter>** toggles the label/function of the **F1** and **F2** keys. This function provides a three-state toggle, with the function changes indicated by the labels in the Function Key area of the display. In the first one state, the labels are **F1 Start Live** and **F2 Start Accum**. This state **must be** used when doing a basic live or accumulate acquisition.

In the second state, the labels are **F1 Live DA Mode** and **F2 Run DA Mode**. In this state **F2** is used to initiate a run using the selected standard DA Mode and **F1** allows live data acquisition. **F2** is also used in this state to initiate data acquisition with a DAD program.

In the third state, the labels are **F1 Live Derivative** and **F2 Accum Deriv**. This state works like the first except that it is the derivative of the data that is taken in the basic live or accumulate modes.

Note that the toggle state is important and must be correctly set for proper operation. If set incorrectly, the system may "hang" and generate an error message when the attempt to initiate data acquisition is made.

4.6 SETTING UP THE DISPLAY

The **Set Display** menu (Figure 4-5) allows you to specify a display format for the Data Accumulation and Live Data Acquisition screens. The choices for this format are spectra, equations, or a combination of spectra and equations. The current format is indicated by an asterisk (*) next to it in the **Set Display** menu. Note that the **Set Display** menu can be used to establish the *Fast* mode (Section 4.5B).

4.6A Spectrum Only

When **Spectrum Only** is selected, only the spectral data is displayed on the Data Acquisition screen. If data is acquired using data accumulation, the last legitimate spectrum is displayed at the end of data accumulation.

4.6B Equations Only

When **Equation(s) Only** is selected, the results of as many as four of eight possible equations are displayed as the data is being acquired. (All eight can be displayed in the **Strip Chart** mode; see Section 4.5D.) Before choosing Equations, either load an existing equation set using the **Data Analsyis** menu or set up your equations in the **Area/Equation Table.** *From the **Set Display** menu, you can type **M** to go directly to the **Area/Equation Menu.** From that menu you select **View/Edit Areas/Equations**, and move to the Equation Table. Refer to Sections 4.6F and 5.6 for additional information.*

After you have entered the equation to be used, or edited the existing one, return to the Set Display menu and select **Equations Only**. The software prompts you for the equation number of the equation to be used. Press **<Enter>** to accept the equation number shown, or key in the desired number and press **<Enter>**. If you wish to display a second equation, key in the equation number and press **<Enter>**. If you are selecting only one equation, you can quit the selection process by entering **0** or by pressing **<Esc>** after your selection is made.

Note that entering **0** as the equation number, or pressing **<Esc>** immediately after selecting **Equations Only** establishes the **Fast** mode, in which data acquisition takes

place without screen updates. This eliminates the dead time provided after each memory accumulation. Data is still transfered and equations calculated but not displayed.

If selecting fewer than four equations, you can quit the selection process by pressing **<Esc>** after your selections are made.

When specifying the equation numbers, the software prompts you if the equation number you enter is invalid or not defined. If this prompt is displayed, do this:

1. Press **<Esc>** to return to the **Set Display** menu.
2. Type **M** to go to the **Area/Equation Menu**.
3. Type **V** to select **View/Edit Areas/Equations**
4. Press **<F2>** to move to the Equation Table.
5. Use the **<↑>** and **<↓>** keys to point to the equation number. Type in the equation to be used, or edit the existing one, at the prompt and press **<Enter>**. Refer to Sections 4.6F and 5.6 for further information about equation entry.

Y-axis scaling for each equation is set by pressing **<F6>** to bring up the **Scale** menu, as explained in Section 4.2. The *X*-axis time base scaling is set via **Equation Display Time**, described in Section 4.6E.

4.6C Spectrum and Equations

When **Spectrum and Equations** is selected, the spectral data and as many as two selected equations are displayed as data is being acquired. In the case of accumulated data, the last valid spectrum is displayed. Equation selection is performed in the same manner as for **Equations Only**, just described, the only difference being that you cannot establish the **Fast** mode if **Spectrum and Equations** is selected. Entering **0** as the equation number when **Spectrum and Equations** is selected will have the same effect as simply selecting **Spectrum Only**.

4.6D Strip Charts

For convenient comparison, you can plot as many as eight equations on a single time axis in the Strip Chart mode. This mode is most convenient when you want to compare three or more equations.

The Strip Chart mode is selected from the **Set Display** menu. Then at the prompt, you enter the number for each equation to be displayed. If you have eight equations (up to eight can be defined), you can display all eight by keying in each equation number followed by **<Enter>**. If you have fewer than eight or you want to view a subset of the equations, key in the equation number and press **<Enter>** until you have selected all of the desired equations. At that point you can either key in a **0** followed by **<Enter>** to end the selection or press **<Esc>** for the same effect.

Note: Selected equations will be displayed on the screen in the order that they were entered. If Equation 3 was selected first, it will be drawn at the top of the plot display. If Equation 1 was then selected, it will be the next one drawn.

In addition to the actual curves, the equation number, equation, and any equation comment are shown at the lefthand side of the screen for each equation (Y:T) curve being displayed. The Y-axis value at the time reported in the information box is reported at the far right of each Y:T curve. That Y-axis value is updated for each curve whenever the time and sample number increment.

Refer to Sections 4.6F and 5.6 for information about equation entry.

4.6E Equation Display Time

The **Equation Display Time** is the time base or time window used for each equation in *live* acquisition. To reset it, type **T** to go to the **Equation Display Time** function, type the desired time window, in seconds, at the prompt, and press **<Enter>**. If you don't set a time, the default is 60 seconds.

The *Y*-axis limits for each equation are set via the **F6 Scale** function, as described in Section 4.2.

Note: When Accumulate acquisition is selected, the equation time base is set by the Run Time shown in the Set Times menu.

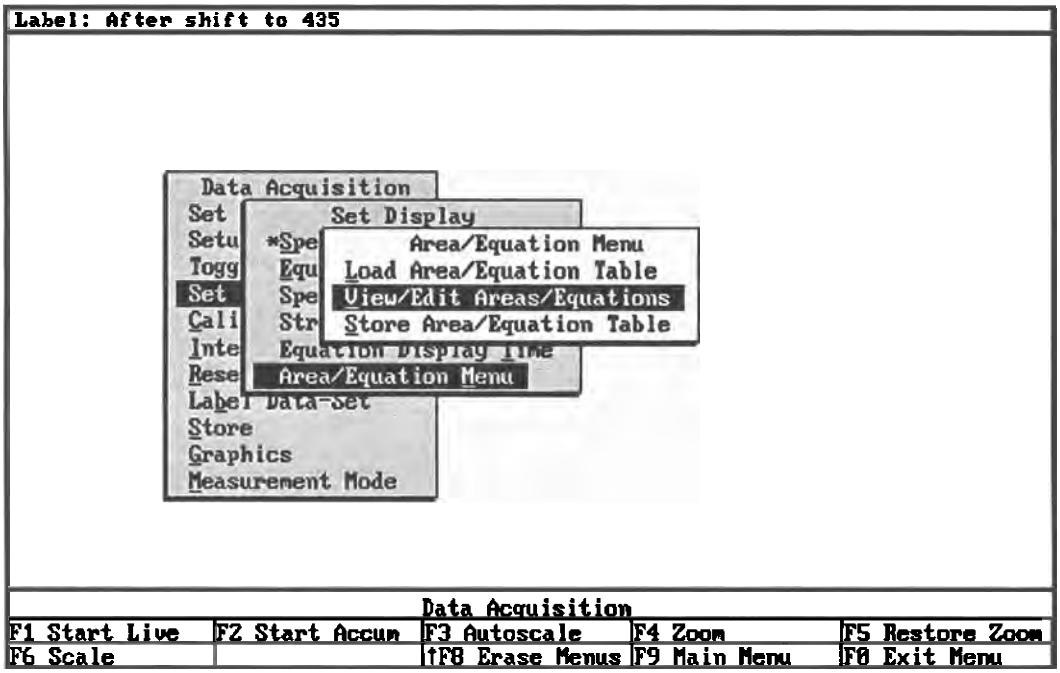


Figure 4-6. AREA/EQUATION MENU

4.6F Area/Equation Menu

The **Area/Equation** menu (Figure 4-6) is used to load, view, edit, and store an **Area/Equation Table** (Figure 4-8). It is accessed from the **Set Display** menu.

The Area/Equation Table is used to enter the wavelengths of up to 12 spectral areas and to set up to 8 equations. Areas can be used in equations to monitor change of specific spectral lines or areas as data is acquired.

The current Area/Equation Table is stored with the data when a curve set is stored to disk. It can also be stored separately as an Area/Equation file.

Note: If the effect of changing the center wavelength or system calibration excludes a previously declared area or areas from the field of view, the area/s affected and related equation/s will be erased from the Area/Equation Table.

Load Area/Equation Table: An existing Area/Equation Table can be loaded from a previously stored data file or Area/Equation file. When **Load Area/Equation Table** is selected from the **Area/Equation** Menu, the **Load Areas/Equations** screen (Figure 4-7) appears on the display.

The function keys active in the File Selection screen for the Load Areas/Equations are as follows:

Key	Function
F1	**New Filename:** Allows you to select a file to be loaded by typing its name, providing an alternative to making the selection by highlighting a listed name and pressing **<Enter>**.
F2	**Change Dir:** Allows you to edit the directory path to change the directory used by the program: this, in effect, changes the Data Directory set in the System Configuration menu. The path entered must be a valid DOS path. The directory changes when **<Enter>** is pressed. If the directory name keyed in does not exist, the program allows you to make it at this time.
F3	**File Info:** Opens another window that shows detailed information about a selected file.
F5	**Directories:** Displays a listing of the current directory's subdirectories. A subdirectory can then be selected by moving the highlight bar and pressing <Enter> twice. Note that a single dot (.) listing means the current directory and a double dot (..) means the parent directory. Note that with this selection, two function keys have new meanings as follows.
	F5 File Menu: Returns to the File Selection screen.

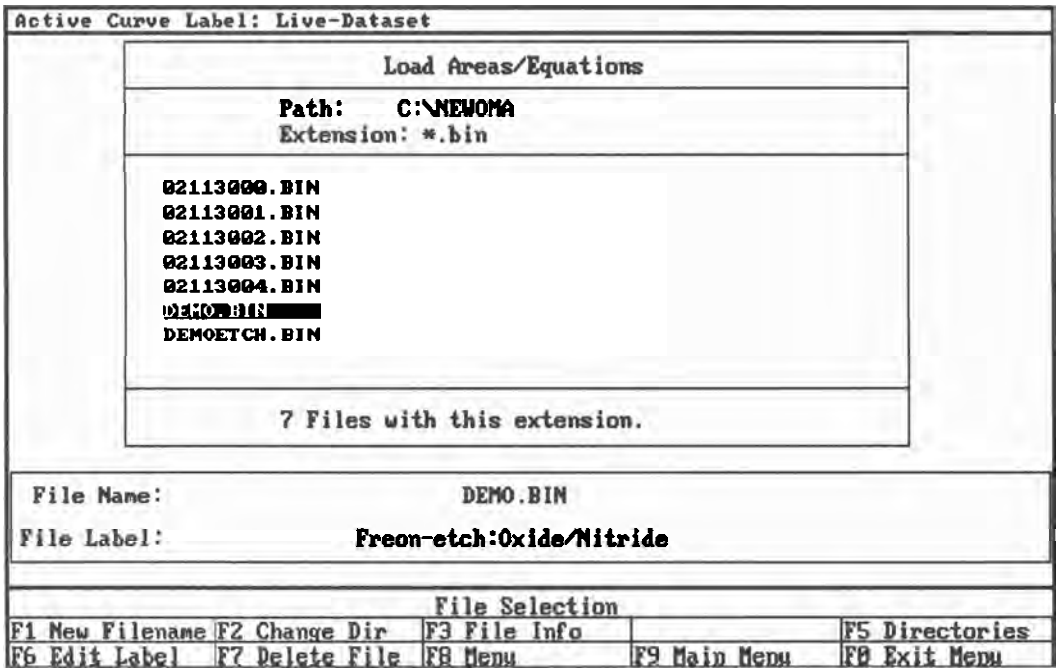


Figure 4-7. LOAD AREAS/EQUATIONS SCREEN

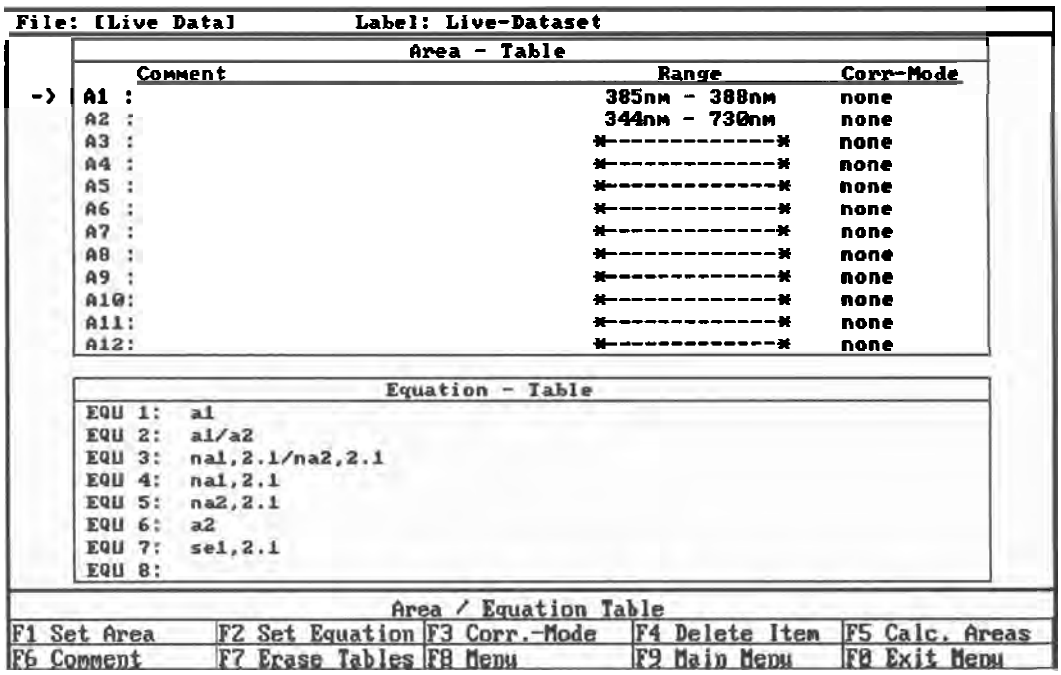


Figure 4-8. AREA/EQUATION TABLE

F7 Delete Directory: Deletes selected directory.

F6 **Edit Label:** Allows you to assign a label to a data file or edit a previously assigned one.

F7 **Delete File:** Deletes the selected file.

F8 **Menu:** Restores **Area/Equation Menu.**

F9 **Main Menu:** Returns to the **Main Menu.**

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

To select a file, move the highlight bar with the ↑ and ↓ keys until it is highlighted. You can preview the Area/Equation Table information associated with that file with the **<F3> File Info** function. Press a key such as **<Enter>** or the spacebar to leave the information screen.

If the highlighted file contains the table of interest, press **<Enter>** to load the information. Press **<Esc>** or **<F10> Exit Menu** to back out of the operation without changing the current table and return to the **Area/Equation** menu.

View/Edit Areas/Equations: When you select **View/Edit Areas/Equations** from the **Area/Equation** Menu, whatever is in the Area/Equation Table (Figure 4-8) is displayed and can be edited to change or add areas and equations.

The function keys active in the Area/Equation Table screen are:

Key	Function

F1 **Set Area:** Opens the next unused area entry line. If the table is full, it overwrites A12.

F2 **Set Equation:** Opens the next unused equation entry line. If the table is full, it overwrites EQU 8.

F3 **Corr.-Mode:** Toggles among the three possible types of baseline correction: none, background, and area.

F4 **Delete Item:** Allows you to clear the area or delete the equation pointed to in the table.

F5 **Calc. Areas:** Calculates and displays the values for the areas listed. These values are based on the wavelength boundaries and the active correction mode for each area.

F6 **Comment:** Allows you to add a comment to the area entry line. The comment may have a maximum of 29 characters. Comment entry is set up for automatic insertion at the cursor. The standard editing keys **<Home>**, **<End>**, **<→>**, **<←>**, **<Del>**, and **<Backspace>** can be used in entering and editing the comment. The comment is displayed on the Area/Equation Table. It can also be displayed on the Y:T Analysis screen when F2 Show Comments is selected and will be shown on the Equation Plot screen. In addition, a comment displayed on the Y:T screen or Equation Plot will be drawn on the hardcopy if F7 Plot is selected.

F7 **Erase Tables:** Deletes all areas and equations in the tables. For safety, the program asks you first if you really mean to do this, and requires a **<y>** or **<n>** answer to the prompt.

F8 **Menu:** Returns you to the **Area/Equation** menu.

F9 **Main Menu:** Returns to the **Main Menu.**

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The **<Esc>** key is used to cancel your last choice and return to the **Area/Equation** menu. It often has the same effect as pressing **<F10> Exit Menu.**

To define an area:

1. Press **<F1>** Set Area to open the next unused area entry line.
2. Key in the start channel, and press **<Enter>.**
3. Key in the end channel, and press **<Enter>** to complete the entry.

A graphical way to define an area is to select the **<F1> Select Area** function in the **Y:T Analysis** screen and use the cursor to mark off the areas to be used (see Section 5.6). The Y:T Analysis screen is accessed from the **Graphics** submenu in the **Data Analysis** section of the software. The advantage to entering areas via the Area/Equation Table is that you can define overlapping areas of interest.

To edit an existing area:

1. Move the cursor to the area listing and press **<Enter>.**
2. Key in the start channel and press **<Enter>.**
3. Key in the end channel and press **<Enter>.**

To define an equation, press **<F2> Set Equation** to move

the highlight to the next undefined equation number.Refer to Chapter 5, Sections 5.6E-5.6I for information regarding operators, conditions, variables, operations, and sample equations. Using this information, then type the equation definition and press **<Enter>**.

To edit a previously defined equation, use the **<↑>** and **<↓>** keys to point to the equation, press **<Enter>**, retype the equation, and press **<Enter>** again.

To delete an area or equation, move the cursor to the area or equation listing to be deleted and press **<F4> Delete Item**. At the prompt "Delete Item (Y/N)?", key in **y** to delete the area or equation.

In addition to specifying the range of the area, you can specify baseline correction via the <F3> Corr.-Mode function. Three options are available: "none" (no baseline correction), "background" (the background currently in memory), or "Area" (one of the twelve possible areas). Note that the "background" option is not the detector thermal background but the background curve from which the peaks emerge.

Note that it is permissible to specify range increments that are outside the active range as defined during the X Axis Calibration. Such increments, and equations that contain them, will be "grayed" and marked with a # sign to indicate that they are not in the active range and will not be used in area calculations. This feature allows ranges and equations to be entered that will become valid as a result of subsequent changes in the spectrograph parameters followed by a new calibration. At that time the previously grayed lines will longer be grayed and the # sign will disappear.

To designate or change a baseline correction, point with the cursor arrow to the area for which you want to apply or cancel the correction. Then, press **<F3>**. This has different effects depending on the current baseline correction in effect for that area.

- *If no correction is currently specified in the table*, pressing **<F3>** selects the "Background" correction.
- *If "background" is now specified*, pressing **<F3>** allows you to change the option to a particular background area. When the program prompts you for the number of the background area to be used, type the number. *If you want no baseline correction, type 0 and then* **<Enter>**.
- *If an area is now specified, pressing* **<F3>** *will cancel all baseline correction.*

The **<F6> Comment** function allows you to add a comment to an area. Comment entry is set up for automatic insertion at the cursor. The standard editing keys <Home>, <End>, <→>, <←>, <Del>, and <Backspace> can be used in entering and editing the comment. The comment may be as long as 29 characters. This comment will be displayed whenever the Area/Equation Table is accessed. It can also be displayed on the Y:T Analysis screen when F2 Show Comments is selected and will be shown on the Equation Plot screen. In addition, a comment displayed on the Y:T screen or Equation Plot will be drawn on the hardcopy if F7 Plot is selected.

Equations also can be commented, but in this case <F6> is not used. To comment an equation:

1. Point with the cursor arrow to the number of the equation to which you want to add a comment, and press **<Enter>**.
2. Key in the equation if it doesn't exist. If it already exists, press **<End>**.
3. Press the spacebar and type a colon (:).
4. Type the comment and press **<Enter>** when you've finished. The colon tells the software that anything that follows should be ignored when the equation is processed. The line below, for example, says that Area 1 is to be evaluated as Equation 1; the comment will be ignored during processing.

EQU 1: a1 :this is a comment

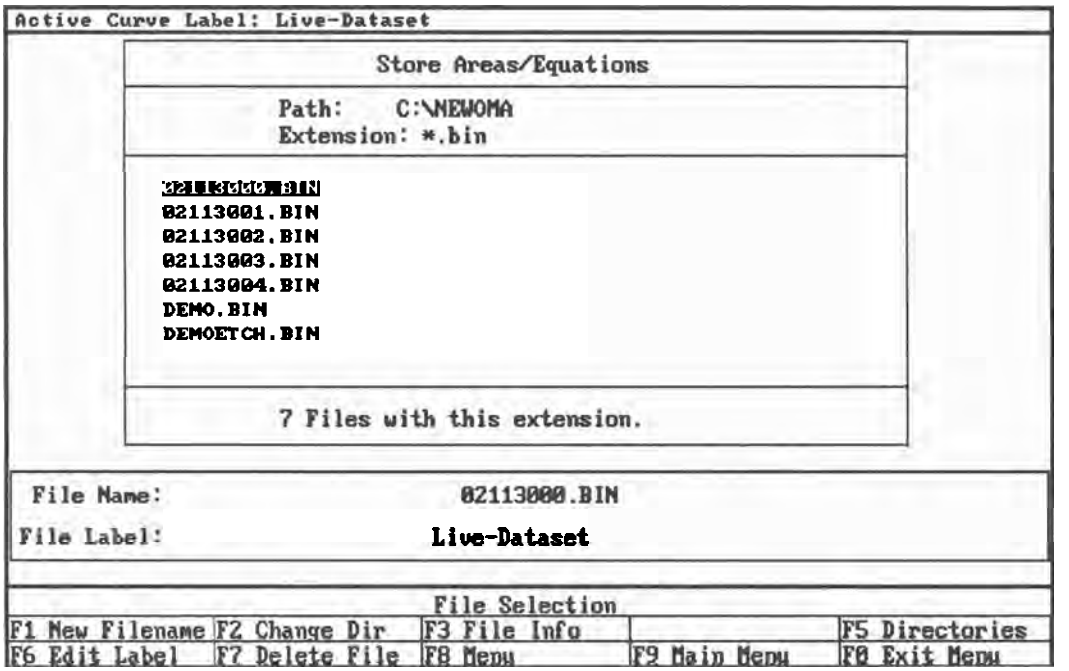


Figure 4-9. STORE AREAS/EQUATIONS SCREEN

Store Area/Equation Table: Data acquired in the Accumulate mode is automatically stored to a disk file at the end of acquisition. The current Area/Equation Table settings and equations are automatically stored at the same time in the same file. You may however want to store this information in a separate file, appropriately named and labeled. The function keys active in the File Selection screen for the Store Areas/Equations are:

Key	Function
F1	**New Filename:** Prompts you for the name of the file in which the Areas/Equations will be stored, providing an alternative to storing the Area/Equations data in an existing file by highlighting a listed name and pressing **<Enter>**. In either case you are given the opportunity to enter a new label before the file is written to disk.
F2	**Change Dir:** Allows you to edit the directory path to change the directory used by the program: this, in effect, changes the Data Directory set in the System Configuration menu. The path entered must be a valid DOS path. The directory changes when **<Enter>** is pressed. If the directory name keyed in does not exist, the program allows you to make it at this time.
F3	**File Info:** Opens another window that shows detailed information about a selected file.
F5	**Directories:** Displays a listing of the current directory's subdirectories. A subdirectory can then be selected by moving the highlight bar and pressing <Enter> twice. Note that a single dot (.) listing means the current directory and a double dot (..) means the parent directory. **File Menu:** Returns to the File Selection screen.
F6	**Edit Label:** Allows you to assign a label to a data file or edit a previously assigned one.
F7	**Delete File:** Deletes the selected file.
F8	**Menu:** Returns you to the **Area/Equation** menu.
F9	**Main Menu:** Returns to the **Main Menu.**
F10	**Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

To store the table in a separate disk file by itself, or to change the table in one of the files on disk:

1. Select **Store Area/Equation Table** from the **Area/Equation** menu. The Store Areas/Equations screen (Figure 4-9) will appear.
2. To use another directory or create a new directory for

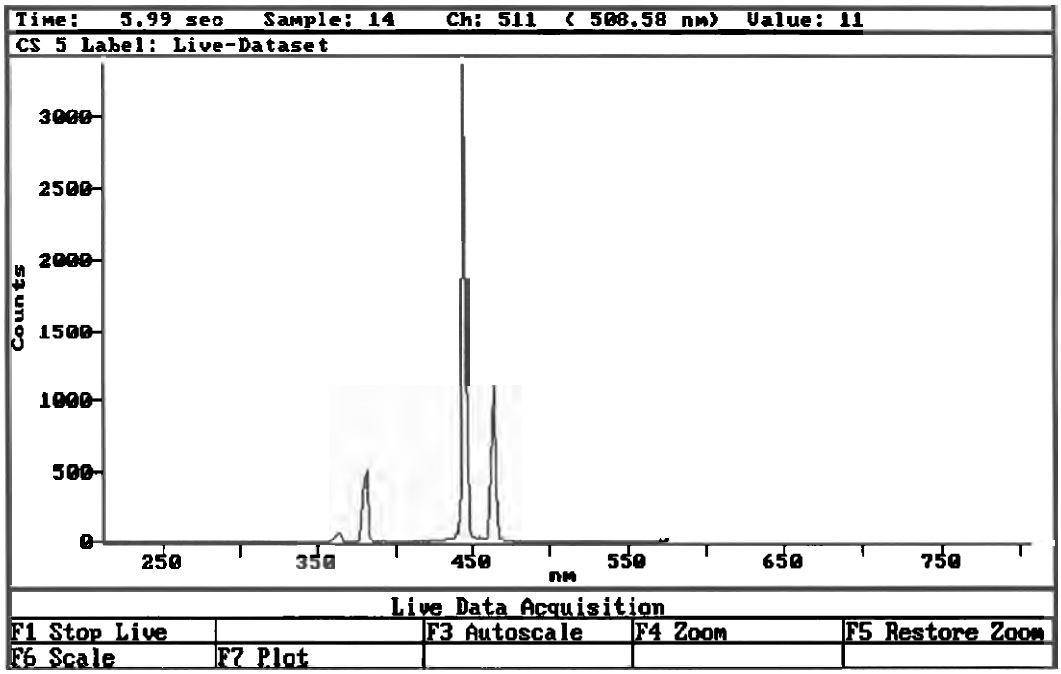


Figure 4-10. LIVE DATA ACQUISITION SCREEN

storage, press **<F2> Change Dir** and edit the directory name. Then, press **<Enter>**.

To change to a subdirectory of the current directory or view a listing of current directory's subdirectories, press **<F5> Directories.** A subdirectory can be selected by moving the highlight bar and then pressing <Enter> twice. Then press **<F5> File Menu** to return to the File Selection screen.

3. Press **<F1>** and key in the filename. Give the file a distinctive name (eight characters or less with no spaces, DOS format) to indicate that it contains only area/equation data and no spectral data. The program automatically adds the .BIN extension to the filename. Then, press **<Enter>** to store the file. Refer to your DOS manual if you are not familiar with DOS filename requirements.

4.7 ACQUIRING DATA

After the timing parameters have been set (unless the default parameters are acceptable), you can begin acquiring data by pressing either **<F1> Start Live (Live DA Mode)** or **<F2> Start Accum (Run DA Mode)**. The data being acquired is displayed according to the display format selected from the Set Display menu.

4.7A Live Data Acquisition

To begin Live data acquisition, press **<F1> Start Live (Live DA Mode)**. Live data is displayed on the **Live Data Acquisition** screen (Figure 4-10) as it is being acquired. If only spectra have been selected for display, each new spectral acquisition will be drawn over the previous one. If equations are being displayed, the equation plots while data is being acquired and the *X* axis is automatically relabeled to reflect the passage of time. When Live acquisition is stopped, the last acquired spectrum, set of equations, or set of spectrum and equations is displayed on the **Live Data Acquisition** screen.

Live acquisition is paused while an <F3> Autoscale, an <F4> Zoom, an <F5> Restore Zoom, an <F6> Scale, or a cursor positioning via X= or C= is being performed. It is immediately restarted when the operation is completed.

As live data is acquired, three items shown in the information bar are continually updated: **Time, Sample,** and **Value. Time** is the start time for the displayed curve. **Sample** is the current scan being displayed. **Value** is the current Y-axis value for the cursor. **Note:** Live data acquisition is limited to 1000 samples; then it automatically stops.

The location and value of the cursor during data acquisition (Press a cursor arrow keys to make the cursor visible.) are reported. The cursor can be moved while data is being acquired and expansion/contraction about the cursor can be accomplished as well. If cursor movement seems slow, take advantage of the step increase and X/C cursor functions described in Section 3.10B.

Live data is listed with the filename **[Live Data]** in the **Data Analysis** screen's **Currently in Memory** box. Live data is always stored in Curve Set 5 (memory location 5). Unlike Accumulate data, Live data is not automatically saved to disk, but it can be saved by using the Data Acquisition menu **Store** selection.

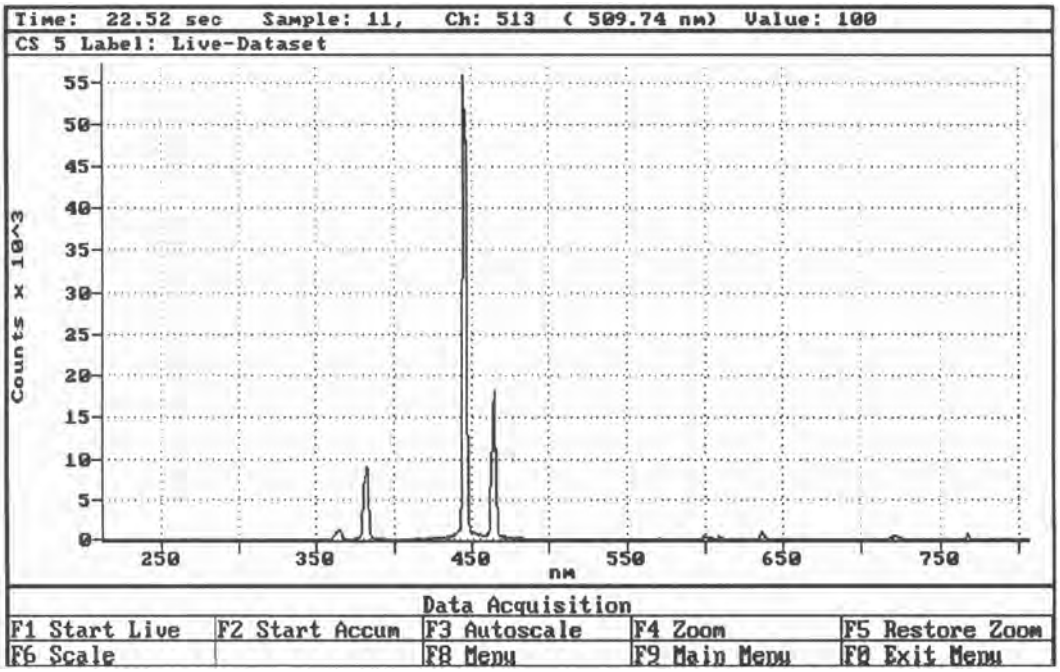


Figure 4-11. ACCUMULATE DATA ACQUISITION SCREEN

4.7B Accumulate Data Acquisition

Because Accumulated data is stored automatically, it is a good idea to create the appropriate label before starting acquisition. Select **Label Data-Set** from the **Data Acquisition** menu and key in the label information. Up to 80 characters are allowed in the file label. Press **<Enter>** to enter the label or press <Esc> to back out of labeling without entering a label. This label is used by the software with each subsequent save of data, automatic or manual, until changed. For a complete explanation of labeling, refer to Section 4.11.

To start Accumulate data acquisition, press **<F2> Start Accum**. As soon as <F2> is pressed, the message "Data Accum Active" appears. This message is displayed to indicate that acquisition has begun even though the data display has not changed. The scans are summed together and at the end of the sample time are stored in random-access memory (RAM) and displayed on the screen.

As accumulated data is acquired, two counts shown in the information bar are continually updated: **Time** and **Sample**. **Time** is the start time for the displayed curve. **Sample** is the current scan being displayed.

Accumulated data and equations are displayed on the **Data Accumulation** screen (Figure 4-11) as soon as they have been stored in RAM. The last valid acquisition and the equation plots are updated on the **Data Acquisition** screen at the end of acquisition. Accumulated data is listed with the label created via the Data Acquisition menu's **Label Data-Set** selection.

At the end of a Data Accumulation run, the data from the run is automatically saved in a file on the disk. The name assigned by the software to the data file has the form MMDDYNNN.BIN, where MM indicates the month, DD is the day, Y the last digit of the year, and NNN the sequential number of the run from 001 to 999. **This File**, displayed in the information bar, is that sequential number.

If the operator presses <F10> during the run to stop it, the partial run is automatically stored to assure that data is not lost. The currently displayed curve is the last one stored, even though the operator must wait for the completion of the last sample time.

The **Store** option on the Data Acquisition menu can be used to store the data under another name and add or edit a label, if desired.

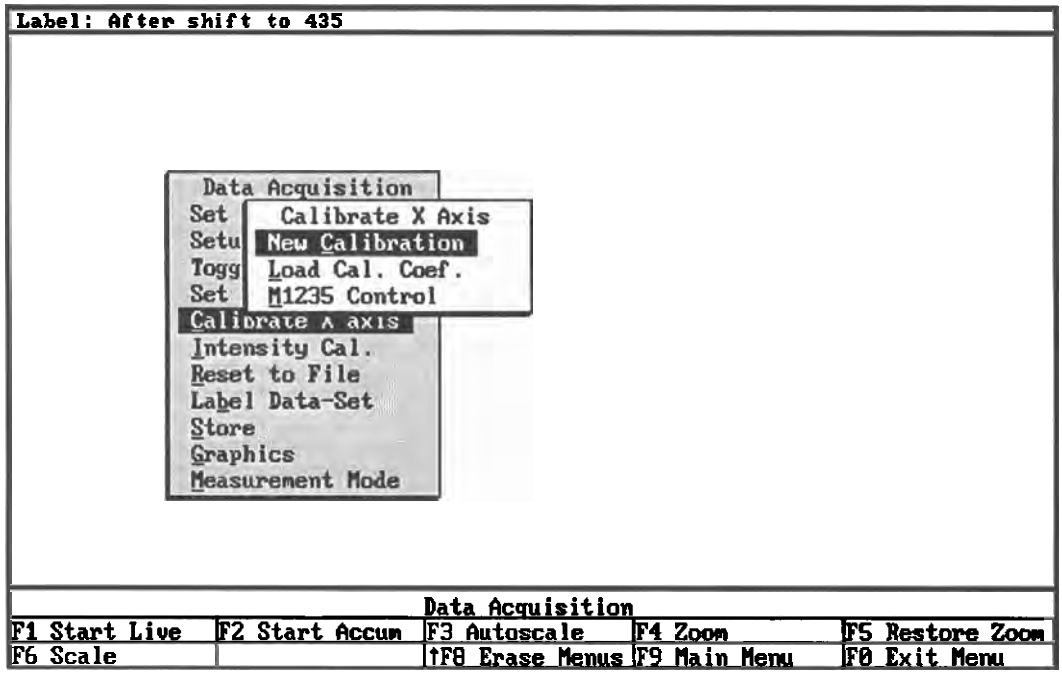


Figure 4-12. CALIBRATE MENU

4.8 CALIBRATING THE X AXIS

If the X-axis has not previously been calibrated, the units used will be in terms of Channels. Once the X-axis has been calibrated, the units displayed upon bootup will be those that were in effect the last time the program was exited normally. This is true for the photodiode array calibration and for the Model 1235, 1236 or 1237 spectrograph calibration values. Array calibration or recalibration can be accomplished by using **New Calibration** to perform a new calibration or by using **Load Cal. Coef.** to retrieve calibration coefficients from calibrated data on disk. Calibration of a Model 1235, 1236, or 1237 is performed via **M1235 Control.**

Calibration may be required after you first set up the system and aligned the detector to the spectrograph, when a grating selection has changed, when a grating position has changed, and whenever the detector/spectrograph setup has been changed or adjusted. Each time calibration is performed and the program is exited via the **<F10> Exit Program** function, the most recent calibration coefficients are stored in the M1470.PRM file. The current calibration coefficients are also stored with data whenever it is stored to disk.

Note: If the effect of changing the center wavelength or system calibration excludes a previously declared area or areas from the field of view, the area/s affected and related equation/s will be erased from the Area/Equation Table.

4.8A New Calibration

Before selecting **New Calibration,** set up a standard light source which will display spectral lines bracketing the spectral lines of interest. Acquire a spectrum of that light source. This spectrum will be displayed on the Data Acquisition screen according to the display setup and can then be used to select the calibration points.

To perform a new calibration, select **Calibrate X Axis** from the **Data Acquisition** menu. This will bring up the **Calibrate X Axis** menu (Figure 4-12). Now, select **New Calibration.** The **X Axis Calibration** screen (Figure 4-13) will now appear. A similar New Calibration function can also be accessed in the Data Analysis portion of the program via the Graphics menu, but this only works on the displayed file and won't reset the calibration for new data acquisition (except for Live data in Curve Set 5).

When the **X Axis Calibration** screen is active, the function keys have the following functions:

Key	Function
F1	**Linear Fit:** Selects Linear Fit as the calibration technique. At least two points are required. Uses a movable threshold to determine peaks of interest unless **<F5> Use Cursor** has been pressed before selection. To use Linear Fit, set the threshold to pick peaks from left to right, then follow prompts. When there are no more peaks above the threshold, the calibration will be recalculated.

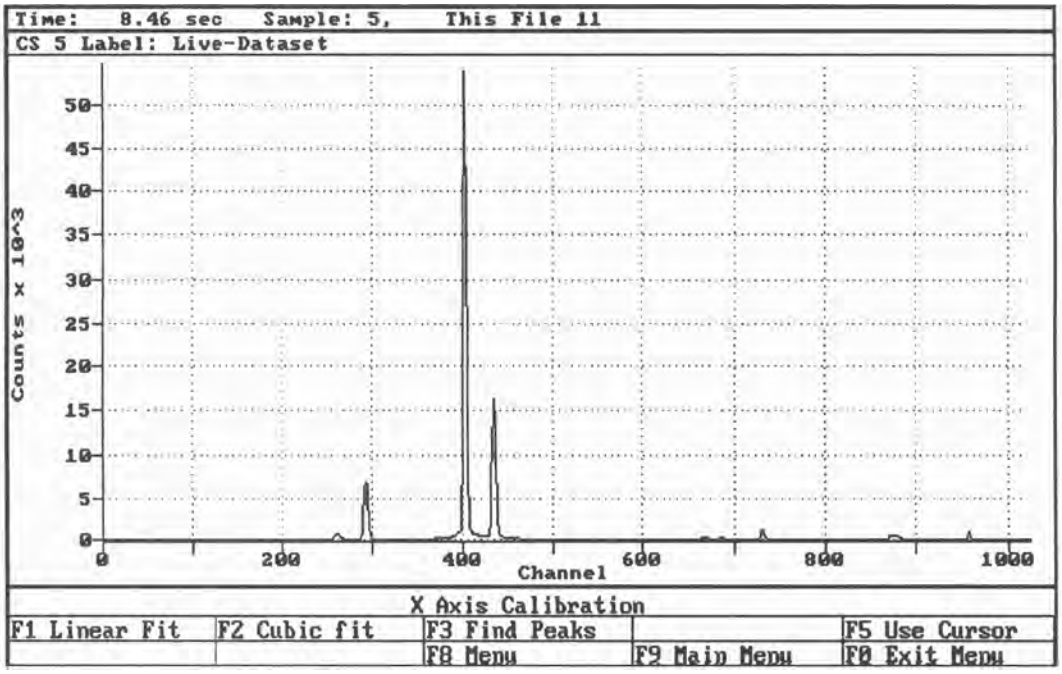


Figure 4-13. X-AXIS CALIBRATION SCREEN

F2 **Cubic Fit:** Selects Cubic Fit as the calibration technique. At least four points are required. Uses a movable threshold to determine peaks of interest unless **<F5> Use Cursor** has been pressed before selection. Recommended for coarser gratings.

To use Cubic Fit, set the threshold to pick peaks from left to right, then follow prompts. When there are no more peaks above the threshold, the calibration will be recalculated.

F3 **Find Peaks:** This process automatically labels all peaks above the threshold you set. A "peak" is the spectral energy plotted between a positive-going crossing of the threshold and the following negative-going crossing.

To set the threshold after you press **<F3>**, position it with the **<↑>** and **<↓>** cursor keys, and press **<Enter>** when it is where you want it.

The *X* value of the peak (in channels or wavelength) is the horizontal center of the area bounded by the peak above the threshold line. The center of area is the point where the number of counts on the left equals the number of counts on the right.

F4 **Flatten:** Smoothes the baseline. Only available when the data displayed is a **Live** curve. Normally the program averages a bulge in a spectral curve above the threshold into a single peak for wavelength identification. As a result, there may be peaks of interest on that bulge that are not identified by the program as separate peaks. Pressing **<F4>** applies an algorithm that generates artificial peaks above the threshold at wavelengths with sharp slopes. This process results in distortion of the data but is useful in removing broad continuous peaks, making it easier to calibrate on smaller peaks riding on top of a continuum.

F5 **Use Cursor:** Activates the cursor as the means for selecting peaks when either Linear or Cubic Fit is accessed. This function must be selected before selecting the fit. It allows you to quickly "handpick" peaks. Automatic peak finding is not desirable when the peaks are not symmetrical. Follow prompts, and press **<Esc>** to end entry of calibration peaks.

F8 **Menu:** Accesses the menu associated with the current display screen.

↑F8 **Erase Menus:** <Shift><F8> erases all menus on the screen.

F9 **Main Menu:** Returns to the **Main Menu.**

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

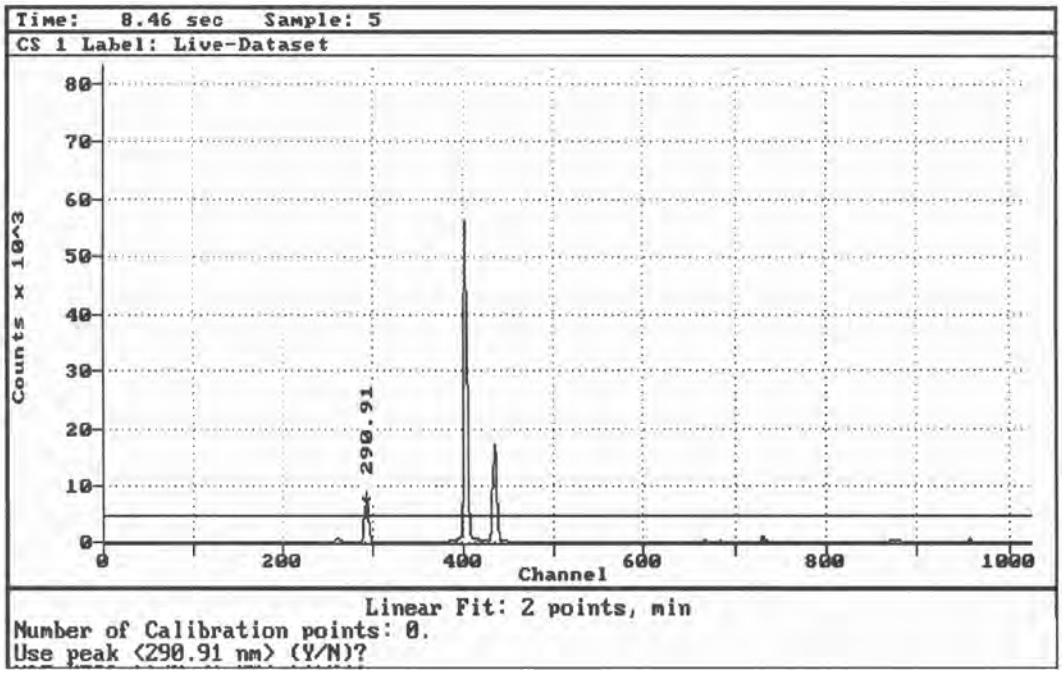


Figure 4-14. CALIBRATION POINT SELECTION

Use the **<Esc>** key to cancel your last choice or to return to the screen or menu last displayed. Pressing **<Esc>** often has the same effect as pressing **<F10> Exit Menu.**

Calibration is accomplished using either Linear Fit (requires at least two points) or Cubic Fit (requires at least four points) to change the current calibration. Peak selection may be accomplished either manually by moving the cursor (**<F5> Use Cursor** must be selected beforehand) or automatically by using a threshold bar to eliminate low-intensity peaks.

When used with single atomic peaks, the automatic method can yield superior results. The improvement in calibration is due to the assignment of a keyed-in wavelength value to the horizontal center of mass of a peak above the threshold bar. Whenever possible, the threshold should be positioned at the half-height level of the peak to be used. Since the peak of a spectrum is rarely centered on one of the diode array's channels, the automatic peak finder determines the peak's theoretical position between diodes. This permits a better match to the wavelength value obtained from a peak table.

Unfortunately, most naturally occurring peaks are not clearly isolated from their neighbors. If the separation between peaks is nearly the same as the resolution of the diode array system, the shape of the peaks will be distorted and the center of mass will be incorrect for the keyed-in wavelength. Molecular peaks are often broad and asymmetrical. You can avoid or work around these problems by being very familiar with the spectral lines used for calibration. A table of wavelength calibration lines is supplied in Appendix B.

Manual Peak Selection: In some cases it may be desirable to turn off the automatic peak find and use the cursor to input values manually. To select peaks via the cursor:

1. Press **<F5> Use Cursor.**
2. Press **<F1>** or **<F2>** to select the type of calibration fit.
3. Move the cursor to a peak of interest and press **<Enter>.**
4. Respond either **Y** or **N** to the prompt and press **<Enter>** again.

If you press **Y** you are prompted for the wavelength. After keying in the wavelength, press **<Enter>.** Repeat the process for the required number of points. Note that the cursor can be moved to the left or right of previously selected peaks for selecting additional points. Press **<Esc>** when you are through. This sets the new calibration.

To select peaks using the threshold, select the appropriate calibration function and adjust the threshold by using the **<↑>** and **<↓>** cursor keys. Then press **<Enter>** to begin entering points. Figure 4-14 shows the beginning of a linear fit calibration using the threshold for peak selection.

The program will move from left to right through the

spectral curve and find each peak above the threshold.

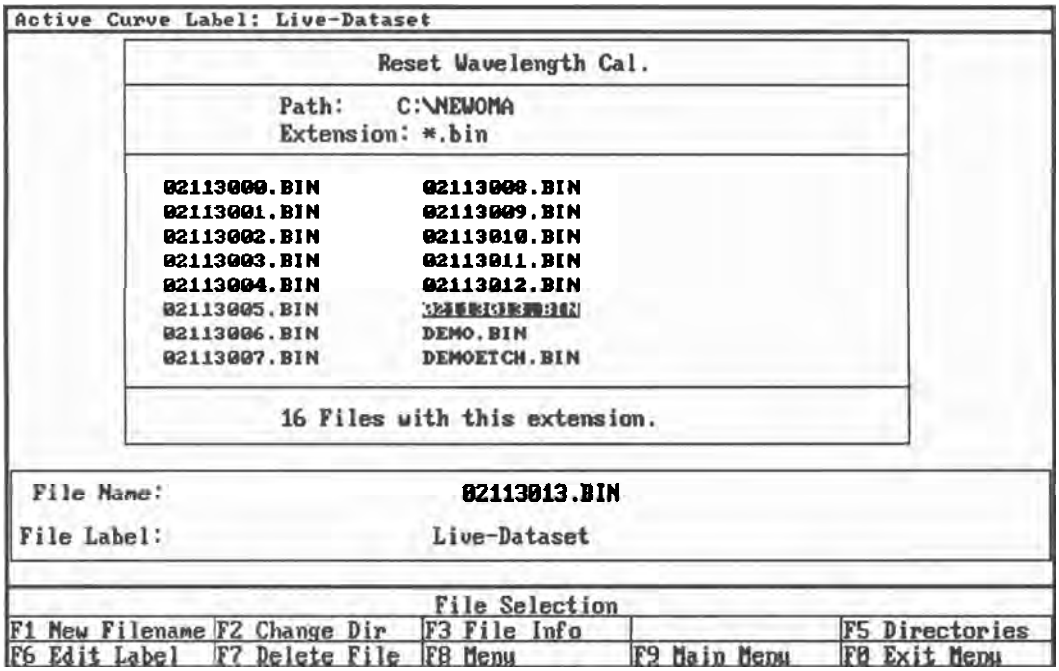


Figure 4-15. RESET WAVELENGTH CAL. SCREEN FOR RECALIBRATION TO A FILE

Each time it finds one, it asks if that peak should be used for calibration. A Y response allows you to enter the new wavelength. An N response moves the cursor to the next peak.

Continue to select peaks and enter the new wavelength values, keeping in mind the minimum number of calibration points required. If desired, you can move the threshold as you proceed through the process of selecting points. After you finish selecting a calibration point, the "Number of Calibration points:" value is updated so that you can keep track of the number of points selected. When sufficient wavelength values have been entered, press **<Esc>** to set the new calibration.

If you fail to select the minimum number of points, a prompt telling you that there are not enough points for calibration will appear. If this happens, the calibration will not be performed and you will have to start over again. Pressing **<Esc>** before selecting the minimum number of points can be used to back out of the calibration process without affecting the current calibration.

4.8B Recalibration of the X Axis

Previously calibrated, acquired, and stored data can be used to calibrate the *X* axis before acquiring new data. You may want to do this if you have just changed the grating or setting to one that has been used before.

To recall the calibration from another file, select **Load Cal. Coef.** from the **Calibrate X Axis** menu. When the **Reset Wavelength Cal.** screen appears (Figure 4-15), move the highlight bar until the correct data file is highlighted and press **<Enter>**. Press **<Enter>** again to load the calibration coefficients, or press **<Esc>** to back out of the operation and select another file. Press **<Esc>** twice to completely back out of the operation.

Generally, areas that have been selected from wavelength-calibrated data are preserved when the *X*-axis calibration is reset. Areas are not preserved when they are outside the boundaries of the new calibration.

Note: Data that has been calibrated or recalibrated must be freshly stored in a disk file for the new coefficients to be retained.

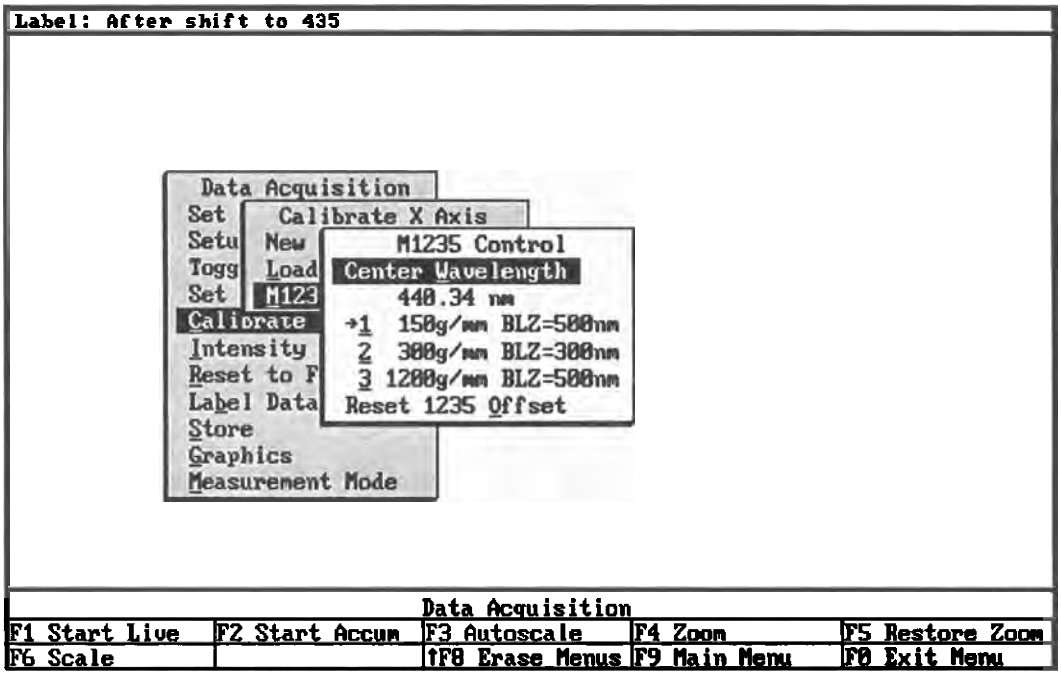


Figure 4-16. M1235 CONTROL MENU (SPECTROGRAPH COMMUNICATING)

4.8C Model 1235 Spectrograph Control

When 1235 (this choice covers the 123X series of spectrographs) has been entered for the system spectrograph in the **System Information** submenu, a third choice, **M1235 Control**, appears on the **Calibrate X Axis** menu. The purpose of the **M1235 Control** is to allow you to control the spectrograph from within the software and to have the X-axis automatically recalibrated. This calibration is the result of calculation and is noted by the use of **<nm>** as the X axis units.

Note: Since this is a calculated calibration there may be an error of about two diode positions near the center of the array and three-four near the ends of the array. This accuracy is usually good enough for survey work. When higher accuracy is required, you will want to calibrate the X axis manually using a known light source.

The contents of the **M1235 Control** menu depend on whether or not the spectrograph is connected and communicating. If it is, the version shown in Figure 4-16 allows you to change gratings and designate a new center wavelength. If it is not connected or communicating, the version shown in Figure 4-17 will appear and prompt you to turn on the spectrograph and restore the correct parameters.

To reset the spectrograph if it is not communicating or connected:

1. Make sure the spectrograph and control unit are connected and the cable connectors are tight.

2. Turn on the spectrograph control unit.

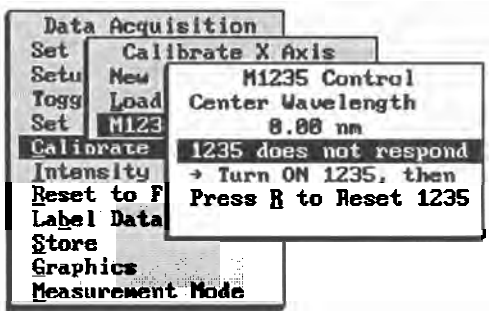


Figure 4-17. M1235 CONTROL MENU (SPECTROGRAPH NOT COMMUNICATING)

3. Press **<r>** to reset the M1235 and answer **Y** to the reset question.

4. The menu shown in Figure 4-16 will reappear, and you may proceed to reset the center wavelength, change gratings, or reset the M1235 offset as described in the following paragraphs.

Resetting the M1235 Offset: While the Model 1235, 1236, or 1237 has its own self-calibration program, the alignment of detector to spectrograph is likely to introduce an offset which will vary from grating to grating. Because this offset is likely to change whenever there is any physical movement between the detector and spectrograph, it is important to set the offset value for each grating every time the detector and spectrograph installation is adjusted or changed; this includes the initial

installation of the detector and spectrograph. The three correction values entered via The Reset M1235 Offset selection are saved in the M1470.PRM file when the program is exited normally (<F10> Exit).

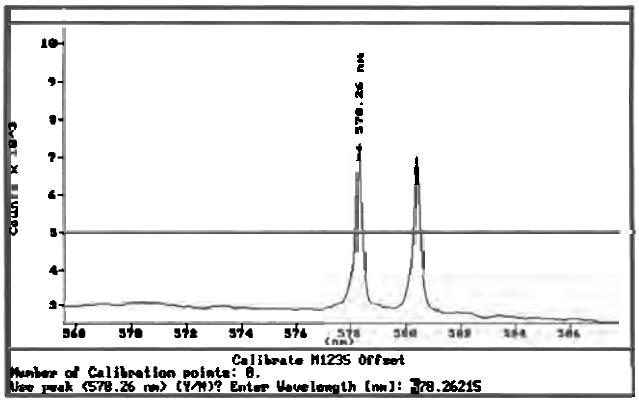


Figure 4-18. CALIBRATING THE M1235 OFFSET

To Set/Reset the M1235 Offset after detector/spectrograph adjustment:

1. Install the detector and spectrograph.
2. Make all required cabling and coolant connections.
3. Place a known spectral light source in front of the slit. Office fluorescent lights can be used.
4. Turn on the spectrograph control unit.
5. Turn on the Model 1470A or host computer and boot the OMA Vision software.
6. From the **System Configuration/System Information** menu, select **Spectrograph** and key in 1235: 1235 indicates a Model 123X series spectrograph. Enter a default grating number, as well.
7. From the **Data Acquisition** menu, select **Calibrate X Axis**, and then select **M1235 Control.**
8. Select grating 1.
9. Set the center wavelength. If you are using fluorescent lights as the light source, 546.073 nm would be a suitable center wavelength.
10. Using Live Data Acquisition with background subtraction on, acquire a spectrum.
11. Return to the **M1235 Control** menu.
12. Select **Reset M1235 Offset**.
13. Move the threshold with the <↑> and <↓> keys so that it is at approximately half-height of the 546 line.
14. Press <Enter> and answer **Y** or **N** until the 546 line selected.
15. Key in the wavelength in nm -- 546.073 and press <Enter>.
16. Repeat the procedure for the other two gratings, changing the center wavelengths appropriately.

Changing Gratings: Simply key in the number to the left of the desired grating selection on the menu. A message will appear saying that the change is in progress. Wait until the software signals that the change has been completed before you proceed further.

Changing the Center Wavelength: Press **<W>**. A prompt will appear: **Enter Center Wavelength (nm):** followed by the default setting. Type in the desired center wavelength in nanometers and press **<Enter>**.

> **Note:** If the effect of changing the center wavelength or system calibration excludes a previously declared area or areas from the field of view, the area/s affected and related equation/s will be erased from the Area/Equation Table.

X-axis Units: Until the X axis is calibrated using the OMA Vision software, the X-axis label will be displayed as <nm>. The "<" and ">" bracketing the "nm" indicates that the axis is calibrated according to the Model 1235's autocalibration routine. These will be removed when the axis is calibrated via the OMA Vision software.

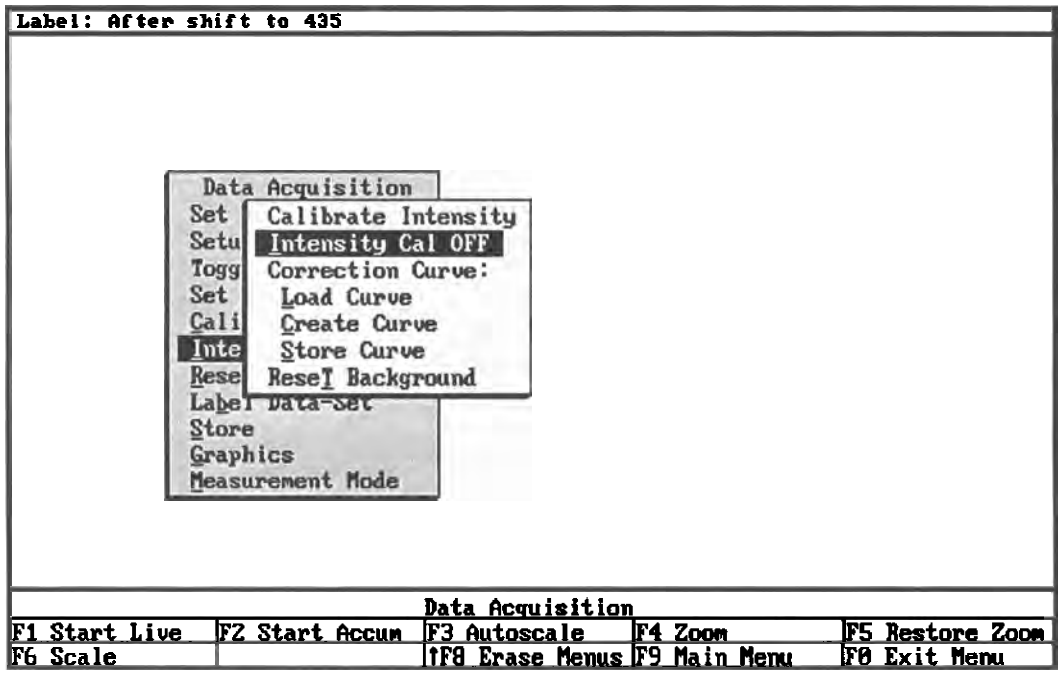


Figure 4-19. CALIBRATE INTENSITY MENU

4.9 INTENSITY CALIBRATION

4.9A Introduction

Data is most commonly calibrated in the "X" direction and a wavelength is assigned to each pixel. However, the intensity is often left uncalibrated and may be expressed in terms of 'counts', 'counts per second', 'arbitrary units', or similar units.

Intensity calibration is complicated by several factors: the wavelength dependence of the sensitivity of the detector, the geometry and optical throughput of the collection optics, and the optical throughput of the spectrograph. For a given spectrograph, the optical throughput depends on the choice and orientation of the grating.

To calibrate the total system, it is necessary to fix the measurement conditions, measure a calibration source with a known output, then create a "correction curve." The correction curve is the ratio of the known output to the raw data of the calibration source. The correction curve is stored and used to calibrate subsequent raw data.

The Intensity Calibration feature allows you to create a library of correction curves that can be conveniently loaded so that all data is presented in intensity calibrated (radiometric) units. When used with the Model 1235, 1236, or 1237 Triple Grating Spectrograph, it is possible to calibrate the system at a variety of grating/grating position settings then load in the appropriate correction curve. The repeatability of a 1235 is better than 1/2 pixel; with a 150g/mm grating, the dispersion is 0.6 nm per pixel. As lamp calibration data is often provided in 5 nm steps, this repeatability may be adequate for routine measurements. When more precision is required, recalibration is a simple procedure.

4.9B Calibration Units

Spectral intensity is given as power per area per wavelength band. When an integrating sphere is used to collect all the emitted light, the intensity is expressed as power per wavelength band.

In the OMA Vision software, the wavelength band is always nanometers. The power units may be microwatts, watts, or photons per second. The four radiometric units supported are:

W/nm-cm2
W/nm-cm2
W/nm
Photons/sec-nm-cm2

4.9C Fixing the Collection Geometry

The key to the accuracy of the measurement is fixing the collection geometry. The most convenient method is to place the source and unknown samples at the same physical location and orientation. The radiometric correction is then done by direct comparison. An ideal source will emit uniformly in all directions. An accurate calibration will require knowing the distance from the source and the solid angle of light collected. A "telescope" with known aperture on the input of the spectrograph is a convenient collection device.

Many sources, such a LEDs, Diode Lasers, fluorescent lamps, etc. do not emit uniformly. In these cases, a measurement is often carried out with an "integrating

sphere" to collect all light emitted.

4.9D Fixing the Spectrograph
The optical throughput of a spectrograph depends on the choice and orientation of the grating. Every time the grating is changed or rotated, the system must be recalibrated. As the detector exhibits nonuniform sensitivity, the same holds true when the detector is remounted, refocused, or jostled.

4.9E Calibrating the System: An Overview
The intensity calibration of the system takes place in 4 steps:

1. entering the data of the calibration lamp,
2. creating a "lamp curve" from the calibration data,
3. measuring the calibration lamp, and
4. calculating the correction curve; the ratio of the lamp curve to the measured curve.

Once correction curve/s have been created, it is only necessary to reset the background and load the desired correction curve to place the system in the Intensity Calibrated mode. The next time you enter the program, it will boot in the same mode having remembered the correction curve. The file must be in the default data directory.

The software will warn you to reset the background. If you choose to ignore the warning, the last stored background will be used. If you change the exposure time, you will be forced to reset the background.

To create correction curves, follow the procedure below:

1. The calibration data provided with the lamp is given as a table of intensities at several different wavelengths. The software provides a convenient means for entering and storing these data. This need only be done once.

2. The lamp curve is created by carrying out a spline fit on the lamp data and creating a calibration curve with a data point for each pixel. The software will automatically take into account the wavelength calibration coefficients and the number of pixels being used in the measurement. For different gratings or grating positions, new lamp curves must be created from the same lamp data.

3. The calibration lamp must be measured. The software will automatically accommodate different exposure times by expressing the results in counts per second. Again, a new lamp measurement must be made for each position of each grating.

4. In the normal flow of the software, the proper lamp curve and lamp measurement will be matched to calculate the correction curve for that grating position.

5. The correction curve should be stored so the system can recall it the next time the program is re-entered.

4.9F The Intensity Calibration Menus
Radiometric correction is found under Data Acquisition by choosing **Intensity Cal.**. After intensity calibration is selected, you can choose from several branches as shown in the diagram shown in Figure 4-20.

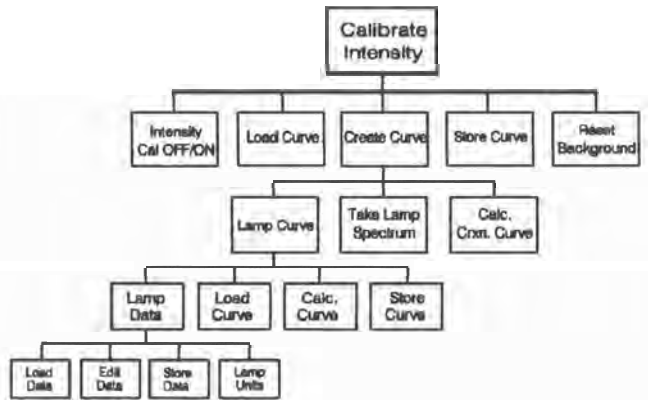


Figure 4-20. INTENSITY CALIBRATION DIAGRAM

As you can see from the diagram, the flow of the software is the inverse of the procedure given in Section 4.9E. If the system already has stored correction curves, it is only necessary to go one level deep to the **Calibrate Intensity** menu (Figure 4-19) to load the desired curve. The more basic the system calibration, the deeper you will get into the menu tree but the less often you will have to do it.

Since intensity calibration requires detector background in order to be of any use, you will be warned (blue box): "No Background! (Press any Key)" if the background has not been set or it has been set and background subtraction has been turned off. After pressing a key you will see the **Calibrate Intensity** menu with the choice "Reset Background" highlighted. It is advisable that you select this option and then follow the prompts to acquire a "no light" spectrum. If you change the exposure time under the Set Times menu, you will be prompted to reset the background then.

> **Note:** The active background is stored in the M1470.PRM file upon leaving the program or when **Save Current Parameters** (System Configuration menu). It is then loaded the next time the program is booted. This preserves the value of experiments performed by an operator who forgets to take a fresh background. You should, however, take a fresh background curve after waiting 20 minutes after turn-on to minimize the effects of system warmup.

Intensity Cal toggles Y-axis calibration ON and OFF. When OFF, raw data is acquired, displayed, and stored as counts per second. When toggled ON, the data is corrected as it is read and displayed and stored in the appropriate units.

Load Curve allows a previously created correction curve

to be loaded. At this point Live or Accumulated data acquisition can be initiated with <F1> or <F2>.

Store Curve allows a newly created correction curve to be stored for future use.

Create Curve brings up **Create Crxn Curve** menu (Figure 4-21), the top menu for all of the operations required to create a correction curve.

4.9G Creating a Correction Curve

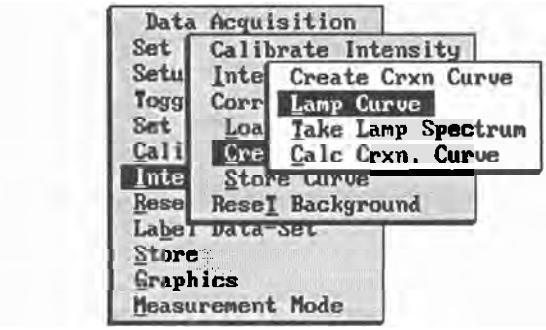


Figure 4-21. CREATE CORRECTION CURVE MENU

A correction curve is based on a set of calibrated lamp data, the resulting calculated lamp curve, and a spectrum taken of the calibration lamp. **Lamp Curve** is used to identify which lamp curve to use. **Take Lamp Spectrum** prompts you to prepare to take a spectrum of the calibration lamp. The actual measurement parameters (Exposure Time, Run Time, etc.) will have been set up under the Set Times menu.

Once the Lamp Curve is identified and the lamp is measured, **Calc Crxn. Curve** carries out the calculation. By backing up to the previous menu, it can be stored and/or used immediately. **Note:** it should be stored to a disk file before being used, since all files carry the name of the correction file used (if any).

When **Lamp Curve** is chosen to identify the lamp curve to be used, the menu shown in Figure 4-22 appears.

If there is an existing Lamp Curve for the current spectrograph, it may be loaded using **Load Curve.** If not, the appropriate **Lamp Data** must be identified and loaded, the Lamp Curve can now be calculated and then stored.

The **Lamp Data** menu is shown in Fig 4-23.

If you have already entered the Lamp Data, you simply have to load it here, and then back up the menu tree to complete the calibration process.

Edit Data allows you to edit previously entered data or to enter new data. If you have loaded data, Edit Data will display the Lamp Table (Figure 4-24) and allow you to enter corrections. If you haven't loaded data, select the **Lamp Units** from the four available before selecting **Edit Data** and beginning to fill in the empty table displayed: if you don't follow this sequence, the data will be incorrectly scaled.

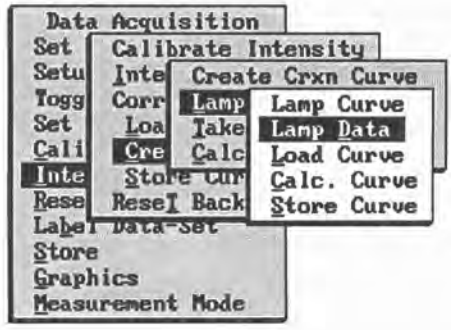


Figure 4-22. LAMP CURVE MENU

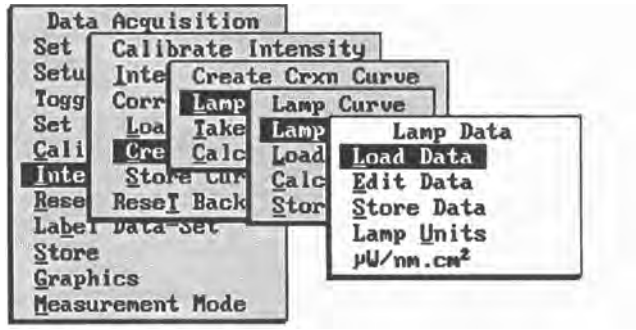


Figure 4-23. LAMP DATA MENU

The Lamp Table screen supports normal editing tools. The <↑> and <↓> cursor keys move you up and down the table one line at a time. <Home> moves the cursor to the first set of data in the table; <End> moves the cursor to the last set. Typing at the start of an entry causes the entry to disappear to allow you to make a new entry. Moving into an entry puts you in insert mode with the delete and backspace keys active.

The following function keys are active when the lamp table screen is displayed:

Key	Function
F1	**Enter Point:** Moves the cursor to the next empty data line and prompts you for a wavelength value and the intensity at that wavelength. If the wavelength value falls between previously entered values, the intensity data is inserted at the appropriate line. Otherwise, the data is placed on the next empty line.
F4	**Delete Item:** Deletes the wavelength and intensity values on the line pointed to by the cursor. The subsequent lines of data move up one line.

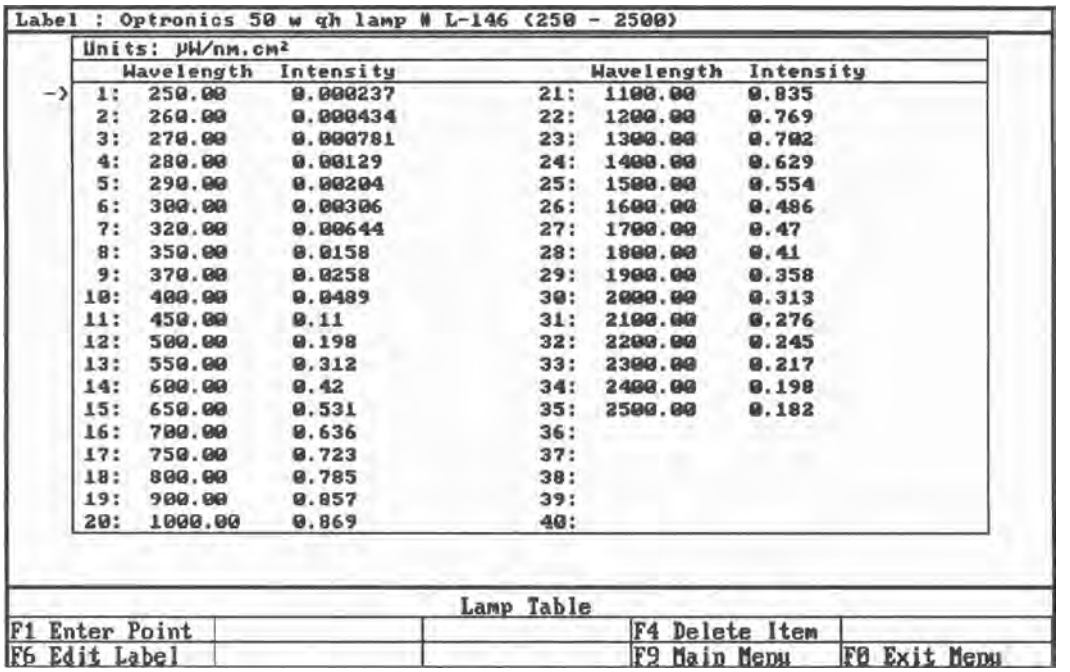


Figure 4-24. LAMP TABLE

F6 **Edit Label**: Allows you to assign a label to a data file or edit a previously assigned one.

F9 **Main Menu**: Returns to the **Main** menu.

F10 **Exit Menu:** Exits the currently displayed screen.

At this point, the data can be stored, and by backing up the menu tree, a lamp curve can be calculated and stored, the lamp can be measured, and a correction curve calculated and stored.

4.10 RESETTING PARAMETERS TO A FILE

Each time the OMA Vision program is started, the initial setup information it needs is taken from the M1470.PRM default parameter file. This file stores the setup information from the last time the software was run or the last time parameters were saved to it. The startup settings can be changed to those contained in another file by the use of the **Reset to File** feature. Both the M1470.PRM file and the **Reset to File** feature are described in the following paragraphs.

4.10A M1470.PRM Setup Parameters File

The initial setup information taken from the M1470.PRM file was placed in it either when the program was last exited normally (that is, by pressing **<F10>**) or when the **System Configuration/Save Current Parameters** selection was made. At the time the information was saved, the existing M1470.PRM (if there was one) was renamed M1470.BAK and a new M1470.PRM file was created.

The intent of the backup file is to let you retrieve the last setup if you made a mistake in the one you have just saved. To take advantage of this file, you need to exit the program to DOS so that you can use DOS commands to first delete or rename the .PRM version and then rename the backup file as M1470.PRM.

The setup parameters in M1470.PRM include calibration coefficients (including Model 123X spectrograph center wavelength and grating choice), the Area/Equation Table, data acquisition parameters, and the display setup. If the system is turned off without first pressing **<F10>**, the current setup is not saved.

When you start the program, it performs two checks of the hardware before it resets its startup parameters to those contained in M1470.PRM. It checks to see that the detector (1462 or 1463 type) is compatible with the detector type used when M1470.PRM was written. It also checks that the detector array lengths are the same. If the actual configuration and the file information do not agree, the actual configuration information is used for the setup.

4.10B Reset to File

Resetting to a file allows you to set all times, calibration coefficients, display choice, and areas/equations to those in a previously acquired and stored set of data. By resetting to a file, you can duplicate acquisition parameters and use them as a starting point or as the actual acquisition parameters for new data collection.

To use this function, select **Reset to File** from the **Data Acquisition** menu. Then, move the highlight bar through the file listing on the **Reset to File** screen (Figure 4-25) until it highlights the file to be used. This will place the

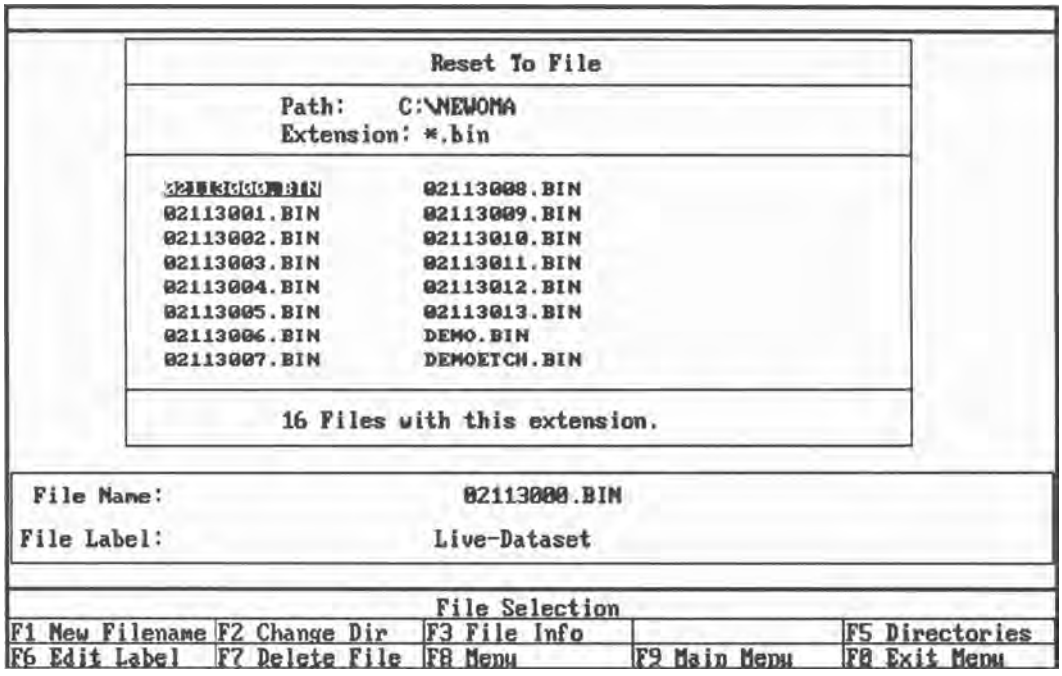


Figure 4-25. RESET TO FILE SCREEN

name of the selected file and its label (if any) in the editing box below the file listing, where they can be edited if desired. Then press **<Enter>**. To complete the reset, press **<F10>**. This will apply all setup parameters in the selected file to the current file.

To quit the selection process without resetting to the setup parameters of the selected file, press **<Esc>** instead of **<F10>**.

To change the name of the selected file in the editing box, press **<F1>**, type the desired filename, and press **<Enter>**. To add a label to the selected file or change an existing one, press **<F6>**, type the desired label, and press **<Enter>**.

Note: You can load calibration coefficients via the **Calibrate X Axis** submenu without affecting other data acquisition factors. You can also load an area/equation file or table via the **Set Display** or **Y:T Analysis** submenu without affecting other data acquisition factors. The **Y:T Analysis** submenu is reached via the **Graphics** submenu (accessible from both the **Data Acquisition** and **Data Analysis** menus).

4.11 LABELING A CURVE SET

Before storing Live or Accumulated data, you can add an explanatory label to the data, or change an existing label. Select **Label Data-Set** from the **Data Acquisition** menu and key in the label information. Up to 80 characters are allowed in the file label. Press **<Enter>** to enter the label or press **<Esc>** to back out of labeling without entering a label. This label is used by the software with each subsequent save of data, automatic or manual, until changed.

Label entry is set up for automatic insertion: characters keyed in are inserted to the left of the cursor. The cursor arrow keys <→> and <←>, <Home>, <End>, and <Del>, and the backspace <←> key can be used to edit the label while you are keying it in. The arrow keys move the cursor to the right or to the left. <Home> moves the cursor to the beginning of the label; <End> moves it to the end. <Del> deletes the character at the cursor. The backspace <←> key deletes the character to the left of the cursor.

A recommended procedure is to include the experiment name, type, time, or other identifying information in the label before starting the run. After the run is over, the user could leave the **Label Data-Set** selection active. This would make it easy to update the label for the next run.

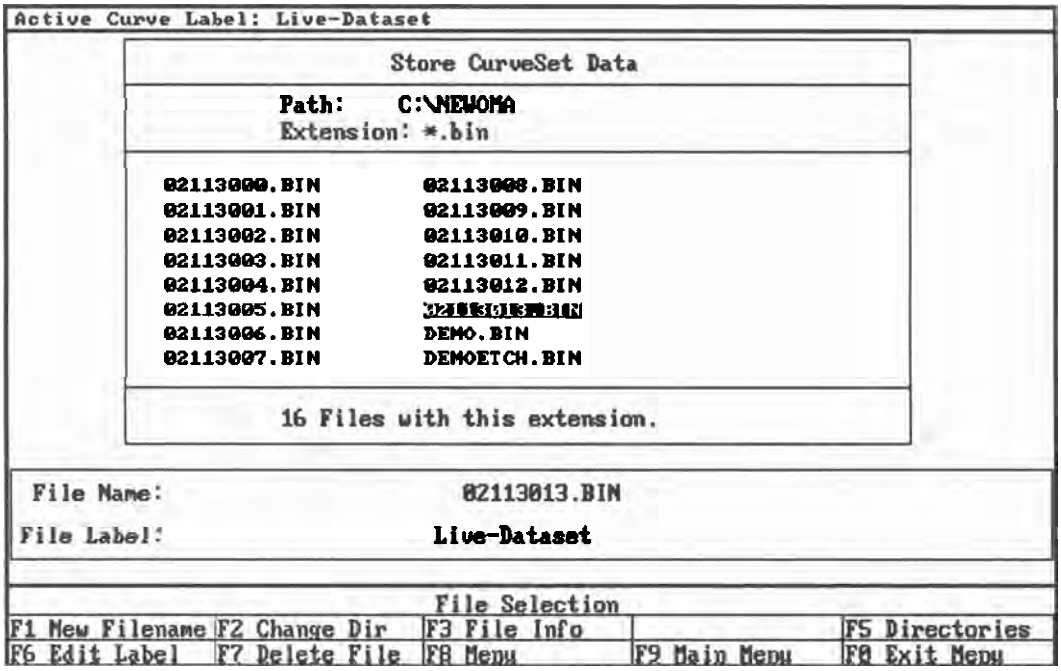


Figure 4-26. STORE CURVESET DATA SCREEN

4.12 STORING DATA TO DISK

4.12A Automatic Data Storage

When accumulated data is acquired it is stored in memory, and it is also automatically stored in a disk file. The filename assigned by the program is created using the current date and the order of acquisition for that date. It has the form MMDDYNNN.BIN, where MM indicates the month, DD is the day, Y the last digit of the year, and NNN the sequential number of the run from 001 to 999. A filename such as 10130005.BIN, for example, indicates that this data was taken on 10/13/90 and was the sixth set of accumulated data to be acquired.

Before you begin data acquisition, do a background subtraction (refer to Sections 4.3F and 4.3G) so the stored data does not include background noise. Background subtraction should also be done after changing the detector or the data acquisition parameters.

The Label function described in Section 4.11 allows you to edit and customize the label that can be stored with the filename. This should be done before taking data.

4.12B Manual Data Storage

Accumulated data can also be stored manually using the **Store Curveset Data** screen (Figure 4-26), which is accessed via the **Data Acquisition** menu. This screen can be used to change the disk directory, store Live data, change the filename of an automatically stored Accumulated curve set, and add or edit a file label. In addition to storing data, you can delete files from the current disk directory.

When the **Store Curveset Data** screen is displayed, the following function keys are active:

Key	Function
F1	**New Filename:** Allows you to specify the name of the file in which the curve set will be saved. Alternatively, you can select an existing file by appropriately positioning the inverse-video bar. By either method, when you press **<Enter>**, you are given the opportunity to add a new label or edit the existing one. The existing label will not be changed but the new (edited) label will be stored in the file. This allows setting up a "template" label and editing it before storage. **Example:** **Template Label:** "This is sample #" **Edited Label:** "This is sample # 123, ..." When **<Enter>** is pressed, the data and acquisition parameters will be saved with the new filename. The extension .BIN is automatically added to the filename.
F2	**Change Dir:** Allows you to edit the directory path to change the directory used by the program: this, in effect, changes the Data Directory set in the System Configuration menu. The path entered must be a valid DOS path. The directory changes when **<Enter>** is

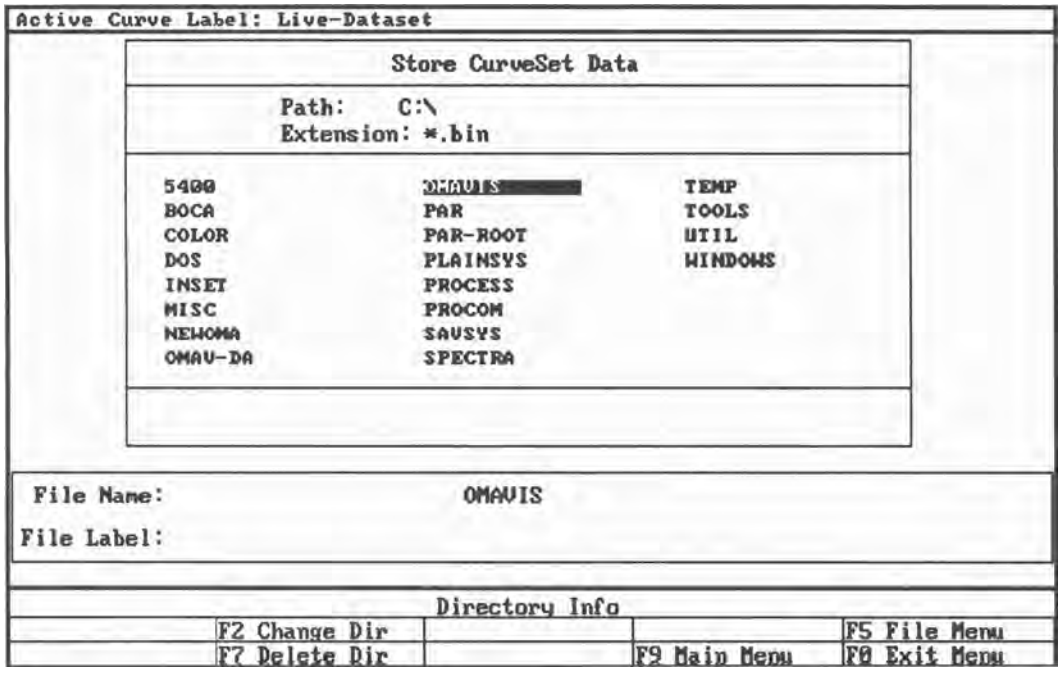


Figure 4-27. DIRECTORY INFORMATION SCREEN

pressed. If the directory name keyed in does not exist, the program allows you to make it at this time.

F3 **File Info:** Displays information about the file such as number of spectra and channels, type of detector controller and spectrograph, exposure and sample times, detector parameters, and area and equation definitions.

F5 **Directories:** Displays a listing of the currentdirectory's subdirectories. A subdirectory can then be selected by moving the highlight bar and pressing <Enter> twice. Note that a single dot (.) listing means the current directory and a double dot (..) means the parent directory. When **F5** is selected, two functions keys change as follows.

F5 File Menu: Returns to the File Selection screen.

F7 Delete Dir: Deletes selected directory.

F6 **Edit Label:** Allows you to add or edit the file label for the currently selected file.

F7 **Delete File:** Deletes the currently selected file.

F9 **Main Menu:** Returns to the **Main** menu.

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The **<Esc>** key is used to cancel your last choice or to return to the screen and menu last displayed. It often has the same effect as pressing **<F10> Exit Menu.**

Changing the Disk Directory: If the directory to be used differs from that shown on the **Store Curveset Data** screen, change the directory by pressing **<F2> Change Dir,** keying in the new path, and pressing **<Enter>** when you are through. You can also use this function to create a new directory by keying in a new path and answering **Y** at the prompt. The path consists of the drive and the directory name. **C:\OMAVIS, C:\Data, C:\OMAVIS\Data, C:\,** and **A:** are examples of paths.

If you decide that you want to see what subdirectories exist for the current directory, you can press **<F5> Directories.** On this screen you can change the current directory or delete an empty directory. Changing to a listed subdirectory is done by selecting it from the listing and then returning to the File Menu by pressing **<F5>** again.

A typical sequence for manually saving a data file is:

1. If you want the data stored in a disk directory other than the one named, press **<F2>.**
2. Press **<F6>** to add or edit the label. (The Label function is described in Section 4.11.)
3. Press **<F1>** to edit the filename displayed. If you don't edit the filename, the data will overwrite any data in the currently selected file. The filename must conform to the DOS standard 8-character filename

format. The extension .BIN is automatically added to the filename when the data is stored.

4. Press **<Enter>** to store the data to the selected directory with the new filename.

When the data is stored, the file label and the data acquisition parameters associated with the data also will be stored. These parameters include run time, spectrum time, number of spectra, display setup parameters, calibration coefficients, and the area/equation table.

Note: If you change the path to the A: drive, be sure to change it back before removing the floppy disk. Many software functions access the current directory, and the lack of a diskette in drive A: when that is the current directory could hinder smooth operation of the system.

4.13 SENDING DATA TO A PLOTTER OR PRINTER

The Live data spectral display on the **Live Data Acquisition** screen can be plotted *or printed* by pressing **<F7>**. When **<F7>** is pressed, Live data acquisition is halted; it resumes after the data has been sent to the plotter or printer.

After you press **<F7>**, the message "Hard Copy Device Connected? (Y/N)" is displayed on the screen. This is a precaution against trying to send data when there is no plotter or printer connected to COM1, which would cause the computer to lock up. If you have a printer or plotter connected, press **Y**, and the software will respond with the message "Sending Data to Plotter".

The data is sent to the plotter or printer that was designated when the Install program was last run. This device must be connected to the port selected in the install procedure.

Note that even though it says "F7 Plot" in the function key area, the output device connected can be either a printer or a plotter. If you wish to change the type of output device used by F7, you must run the Install program again. Refer to Chapter 2 for instructions on running Install.

If you have an Epson 9-pin or compatible printer connected to LPT1, the parallel printer port, you can also print the data on the screen with the computer's Print Screen function. This is done by pressing **<PrtScn>** while holding down **<Shift>**. (Some computer keyboards may not require the **<Shift>**). It is also possible to print to an HP LaserJet or HP 500C or 550C DeskJet printer by substituting HCOPY_HP or HCOPY_DJ respectively for EGAHCOPY in the AUTOEXEC.BAT file.

See Chapter 5, Section 5.3 for information about sending 2-D overlays, 3-D, and equation plots of Accumulated data to the plotter or printer.

4.14 GRAPHICS

The **Graphics** menu allows spectra to be plotted on the screen or to an external plotter or printer in a 3-D array or as a 2-D overlay of up to eight selected spectra. Note that the **Graphics** screen can also be accessed from the **Data Analysis** menu, and is described in detail in Chapter 5, ***Data Analysis.***

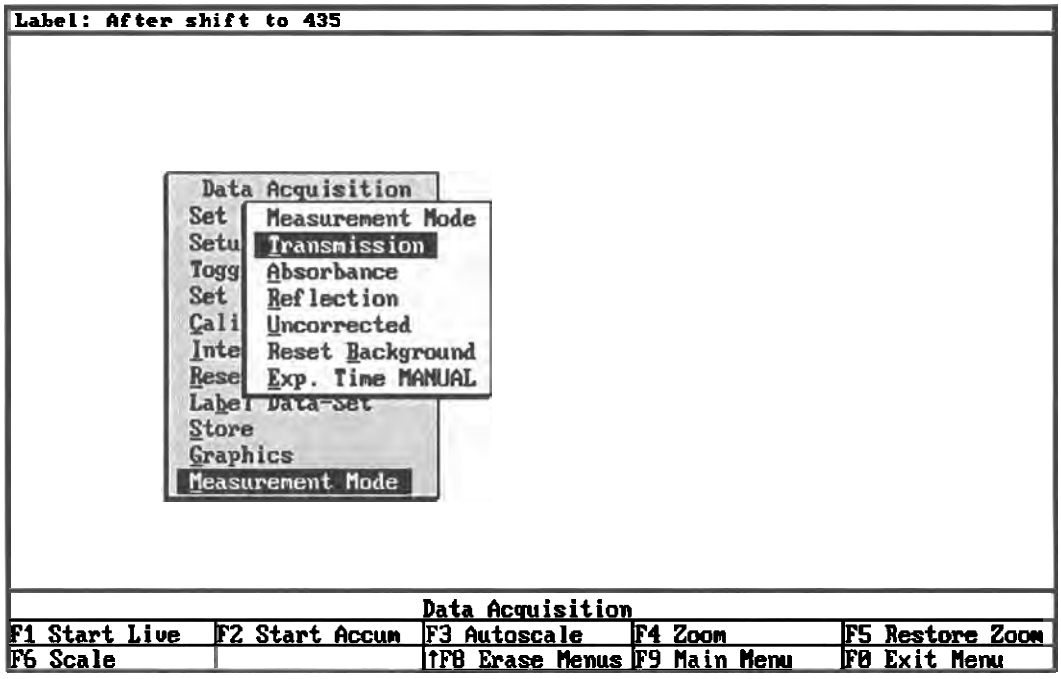


Figure 4-28. MEASUREMENT MODE MENU

4.15 MEASUREMENT MODE

4.15A Introduction

The Measurement Mode selection allows you to select one of four types of measurement (Figure 4-28) to be implemented when data is acquired. You have a choice of transmission, absorbance, reflection, or uncorrected measurement. In addition, you can reset the background to be used during acquisition of the reference spectrum and the spectra of interest and allow the program to determine the maximum exposure time. Transmission, absorbance, and reflection modes allow you to take, store, and load a reference spectrum to be used in calculating the data curve. After a reference spectrum has been loaded, acquisition can be started and the selected mode will be applied to the incoming data. The resulting curve is displayed on the screen.

4.15B Reset Background

Generally, it's a good idea to take a new background just before acquiring data, reference or otherwise. This minimizes the effect of background signal drift over time.

If the program is not aware of a background curve (Background Subtraction has been turned OFF in the Data Acquisition/Set Times menu or there is no background in memory), it warns you that there is no background when you go the Measurement Mode menu and automatically moves the highlight bar to the **Reset Background** choice after you press a key. At that point you can decide whether or not you want to acquire a background. Note that acquiring a background automatically turns Background Subtraction ON.

Choose **Reset Background** whenever you decide to acquire a new background. Prepare to take a background spectrum and then press any key other than <Esc>: pressing <Esc> quits the operation without taking a background. The background spectrum will be acquired, Background Subtraction will be turned on, and the background will be subtracted from the incoming data before any other data manipulation.

4.15C Reference Spectrum

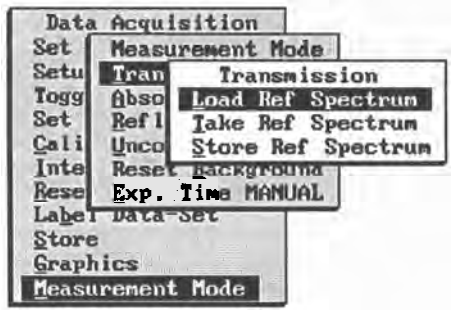


Figure 4-29. TRANSMISSION MODE MENU

The Reference Spectrum used when a "corrected" measurement mode has been selected can be acquired, loaded, or stored via any one of the four measurement mode menus (Figure 4-29, for example). It is advisable to reset the background before selecting a measurement mode and acquiring a reference spectrum.

Whenever a reference spectrum is acquired, it is automatically stored to disk. The filename used is the next

available date/#.BIN filename. The current data acquisition setup information, area/equation tables, and file label are stored with the counts/sec for this spectrum. If a background was available and background subtraction was turned on, the data is stored with the background subtracted out.

Loading a reference spectrum is simply a matter of selecting an appropriate spectrum from one of the available .BIN curvesets.

A newly taken or loaded reference spectrum will be used in the Transmission, Absorbance, or Reflection modes without regard to the menu under which it was acquired or loaded. If no reference has been loaded or acquired, no "correction" will be made to the incoming data.

The reference spectrum, when taken, was stored to disk using the standard .BIN filename format and the current file label. Even though it was stored to disk it still exists in memory and will be used for any of the "corrected" measurement modes until another reference spectrum is acquired or loaded from disk. Because it is in memory you can take advantage of the **Store Ref Spectrum** option to manually store the data again but this time with a distinctive .BIN filename and label.

4.15D Transmission
Transmission mode divides the incoming data by the data in the reference spectrum on a pixel by pixel basis. The raw data is thrown away and the corrected data is displayed on the screen. If the Accumulate acquisition was used, the corrected data is automatically stored to disk in a standard .BIN file.

4.15E Absorbance
Absorbance mode calculates the common logarithm of the reference spectrum divided by the incoming data on a pixel by pixel basis. The raw data is thrown away and the corrected data is displayed on the screen. If the Accumulate acquisition was used, the corrected data is automatically stored to disk in a standard .BIN file.

4.15F Reflection
Reflection mode divides the incoming data by the data in the reference spectrum on a pixel by pixel basis. The raw data is thrown away and the corrected data is displayed on the screen. If the Accumulate acquisition was used, the corrected data is automatically stored to disk in a standard .BIN file.

4.15G Uncorrected
Uncorrected mode simply allows the incoming data to be displayed and stored without modification other than background subtraction, if background subtraction is ON and a background spectrum is in memory.

4.15H Exp. Time MANUAL/AUTO
The **Exp. Time MANUAL/AUTO** setting determines whether or not a user-entered exposure time or a program-calculated exposure time will be used when **<F2> Start Accum** is pressed or when a reference spectrum is acquired for a measurement mode such as Transmission.

MANUAL tells the software that it is to use the exposure time that appears in the **Data Acquisition/Set Times** menu. Background subtraction may or may not be turned on.

Briefly, **AUTO** tells the software to determine the exposure time, acquire an appropriate background, turn on background subtraction, and then use the exposure time and background to acquire the actual data. The actual sequence of events followed to calculate the exposure time that will be used is:

1. With the system looking at the signal, an acquisition is performed at two times the system's minimum exposure time (2 x MinET).
2. A second acquisition is performed at 1 x MinEt.
3. The second acquisition is subtracted from the first to get the maximum value of the sample signal at the minimum exposure time (2 x MinET - 1 x MinET) = Max_{SAMPLE}.
4. a. If the Max_{SAMPLE} value is > 20 counts, the software proceeds to Step 5.

   b. If the Max_{SAMPLE} value is ≤ 20 counts the error message **"Unreasonable results, check System and Source."** is displayed, the exposure time is unchanged, and the final acquisition is performed (Step 8).
5. The new exposure time is determined by dividing 16000 by the Max_{SAMPLE} and then multiplying by the MinET for the system or

$$NewET = (16000/Max_{SAMPLE}) \times MinET$$

6. a. If NewET is within 20% of original ET (ET currently set in **SET TIMES** menu), the original value is used and the sample is taken (Step 8).

   b. If the difference is greater than 20%, then the NewET will be used as the exposure time and a background will be acquired based on it (Step 7).
7. a. If the spectrograph is a Model 1240 or has a shutter, the software will close the shutter, automatically take a background, open the shutter, turn on background subtraction, and then proceed to Step 8.

   b. If there is no shutter, the software prompts you to prepare to take a background, takes the background, turns on background subtraction, and then prompts you to prepare to take the sample (Step 8).
8. The sample is acquired.

Chapter 5
Data Analysis

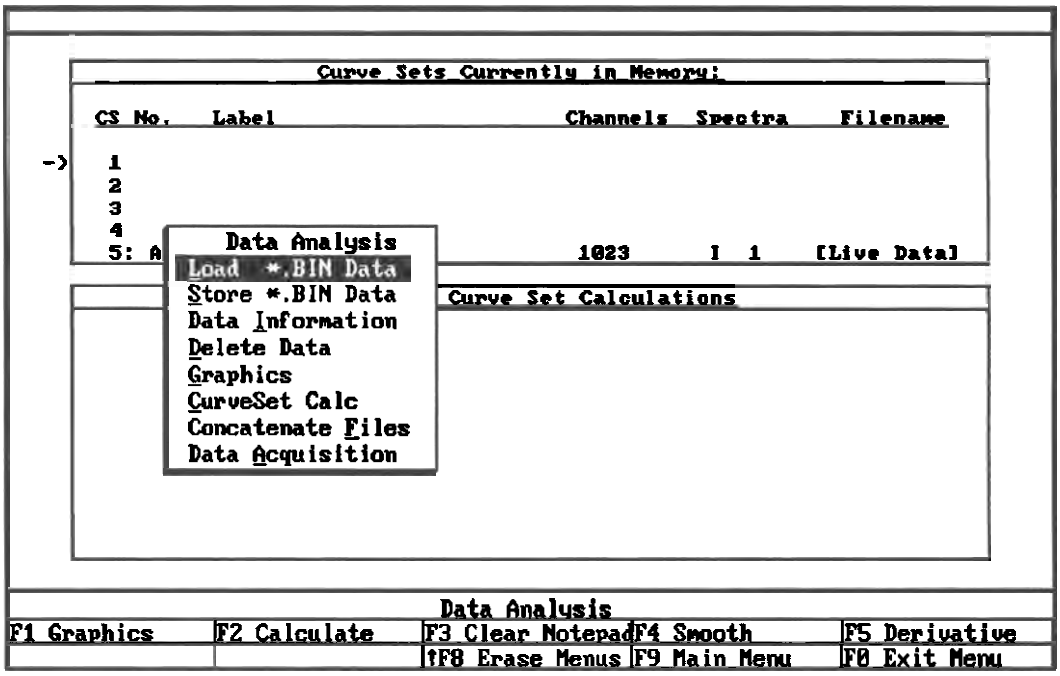


Figure 5-1. DATA ANALYSIS SCREEN AND MENU

5.1 INTRODUCTION

The functions included in the Data Analysis portion of the OMA Vision data acquisition and analysis software allow off-line analysis of previously acquired data. Data can be plotted to the screen and to an external plotter in a variety of graphics formats, significant spectral lines and areas can be evaluated via user-generated equations, and data can manipulated using the built-in arithmetic and mathematic functions.

5.2 DATA ANALYSIS SCREEN

The **Data Analysis** screen (Figure 5-1) is divided into two sections. The top portion of the screen allows you to select the data to be analyzed. The bottom portion of the screen summarizes the calculations performed on spectral data. The Curve Calculations function can be accessed via <F2> or the **CurveSet Calc** choice on the Data Analysis menu. This function is described in Section 5.4.

5.2A Function and Esc Keys

The following function keys are active when the **Data Analysis** screen is displayed:

Key	Function
F1	**Graphics:** Accesses the **Plot** screen. (Equivalent to selecting **Graphics** from the **Data Analysis** menu.)
F2	**Calculate:** Accesses the Curve Calculations function. The operations available allow arithmetic and mathematic manipulation of the data currently in memory.
F3	**Clear Notepad:** Erases all of the calculations shown in the Summary of Curve Calculations box.
F4	**Smooth:** Smoothes the data pointed to. At the prompt, enter the number of points between which to smooth: three to 25 points may be used for smoothing.
F5	**Derivative:** Takes the derivative of the data pointed to.
↑F5	**Time Derivative:** Calculates the time-based derivative of the data pointed to.
F8	**Menu:** Accesses the menu associated with the current display screen.
↑F8	**Erase Menus:** <Shift><F8> erases all menus on the screen.
F9	**Main Menu:** Accesses the **Main** menu.
F10	**Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The <Esc> key is used to return to the screen or menu last displayed. It often has the same effect as pressing

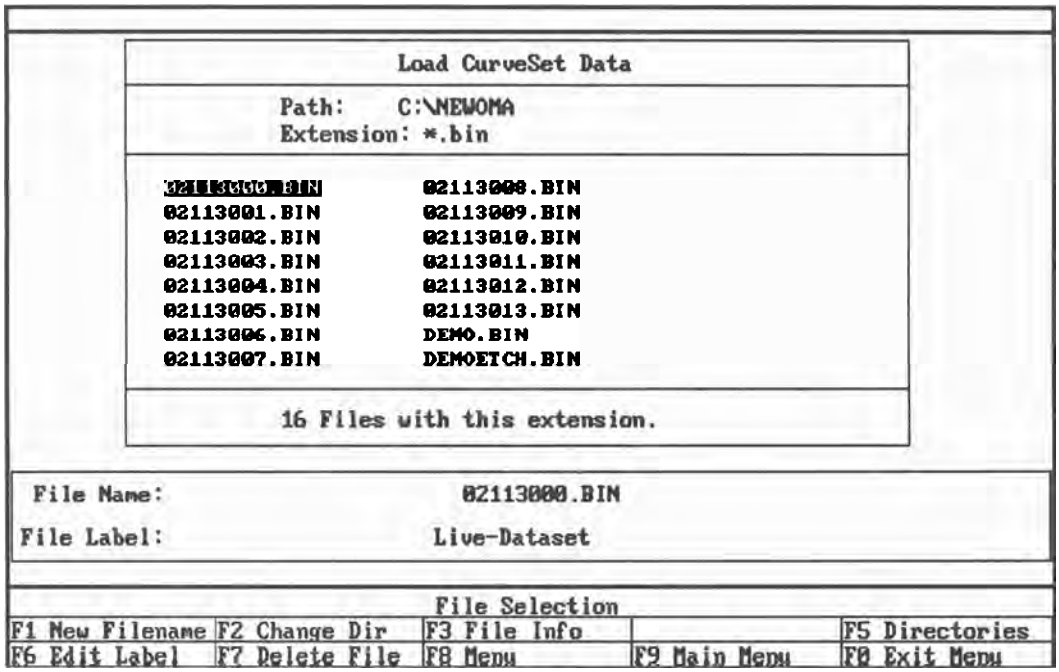


Figure 5-2. FILE SELECTION SCREEN
Load Curveset Data

<F10> Exit Menu. If a single menu is showing on a curve display screen, pressing **<Esc>** will remove the menu. Pressing **<Esc>** again will return to the previous screen.

5.2B Loading Data

Curve sets in memory are indicated in the **Curve Sets Currently in Memory** box at the top of the **Data Analysis** screen. The five memory numbers (1-5) reflect the fact that up to five curve sets can be in memory at any one time. The listing for each curve set is written next to its memory number and includes the file label, the start and number of channels, the Internal/External designation (explained below), the number of spectra, and the filename. Of the five curve sets possible, four can be loaded from existing files into the first four memory locations. The fifth memory location, however, is reserved for Live data acquisition.

Because the available memory is limited, curve sets containing large amounts of data could exceed the memory availability. When this is the case, data can be made "External" rather than "Internal." The "I" (Internal) designation indicates that the data is in memory. "E" (External) indicates that information in memory points to the data file on disk. Making a curve set External allows you to analyze more than one large curve set without running out of memory space. Because both memory and the disk must be accessed, plotting and curve calculations using External data take a little longer.

Before loading data, move the arrow cursor to the line (1 to 4) where the data description is to be listed. If the **Data Analysis** menu is already on the screen, move the arrow cursor by using the **<Shift><↓>** or **<Shift><↑>** key combination. If the **Data Analysis** menu is *not* displayed, move the cursor with the **<↓>** or **<↑>** cursor key to the appropriate line and press **<F8>** to display the menu. Make sure that the cursor is pointing to the memory number where you want the data to be loaded. Otherwise, any data already stored in that memory location will be overwritten when the new data is loaded. Then, select **Load Data** to open the **File Selection** screen.

The **File Selection** screen (Figure 5-2) now contains both the **Load Curveset Data** box and the function key assignments for keying in a filename, changing the disk directory to be used, and looking at the file information. If the curve set you are looking for is not in the current directory (shown in the **Load Curveset Data** box as the **Path**), you can change the directory by pressing **<F2>**, editing the directory pathname shown, and pressing **<Enter>**. Another way to change the current directory is to select a subdirectory via the **<F5> Directories** function and then returning to the file listing by pressing **<F5>** again.

After the correct directory listing is shown, the next step is to select a data file and indicate the range of curves to be loaded. Selecting a file is accomplished by either highlighting a filename in the file listing and pressing **<Enter>** or by pressing **<F1>**, keying in the filename, and pressing **<Enter>**. The program then prompts for the first spectrum of the curve set and then the number of spectra. The default first spectrum is the first spectrum in

the data file; the default number of spectra are all spectral curves in the file (the first spectrum and all subsequent spectra). Pressing **<Enter>** at both prompts will load all of the spectra contained in the file. A subset of the entire data set is selected by keying in the appropriate numbers at the prompts. **Note:** The minimum number of entries are needed. For example, a curve set with one spectrum doesn't ask for the first or the number. Also, if you ask for the last spectrum, it doesn't ask for the number.

The **<F3> File Info** function is provided to assist in selecting a file. When **<F3>** is pressed, the data information associated with the currently highlighted file is displayed. This information includes data acquisition parameters, detector setup parameters, and area/equation information. To return to the **Data Analysis** screen, simply press any key (such as **<Enter>**).

The function keys active in the **File Selection** screen are listed and described below:

Key	Function
F1	**New Filename:** Allows you to key in the filename to be used in the Load/Store operation. The operation occurs when **<Enter>** is pressed.
F2	**Change Dir:** Allows you to edit the directory path to change the directory used by the program. The path entered must be a valid DOS path. The directory changes when **<Enter>** is pressed. If the directory name keyed in does not exist, the program allows you to make it at this time.
F3	**File Info:** Displays data acquisition parameters, detector parameters, and area-equation information for the current curve set. The screen is exited by pressing **<F3>** again or by pressing **<Enter>**.
F5	**Directories:** Displays a listing of the current directory's subdirectories. A subdirectory can then be selected by moving the highlight bar and pressing <Enter> twice. Note that a single dot (.) listing means the current directory and a double dot (..) means the parent directory. Two function keys take on new meaning when **F5** has been accessed.
	F5 File Menu: Returns to the File Selection screen.
	F7 Delete Dir: Allows you to delete the currently selected directory.
F6	**Edit Label:** Allows you to add or change the file label associated with the currently highlighted curve set.
F7	**Delete File:** Allows you to delete the currently selected file.
F8	**Menu:** Exits the screen and redraws the menu/s.
F9	**Main Menu:** Accesses the **Main** menu.
F10	**Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

Remember: Loading a curve set will cause that data to overwrite any data at the memory location pointed to in the **Curve Sets Currently in Memory** box.

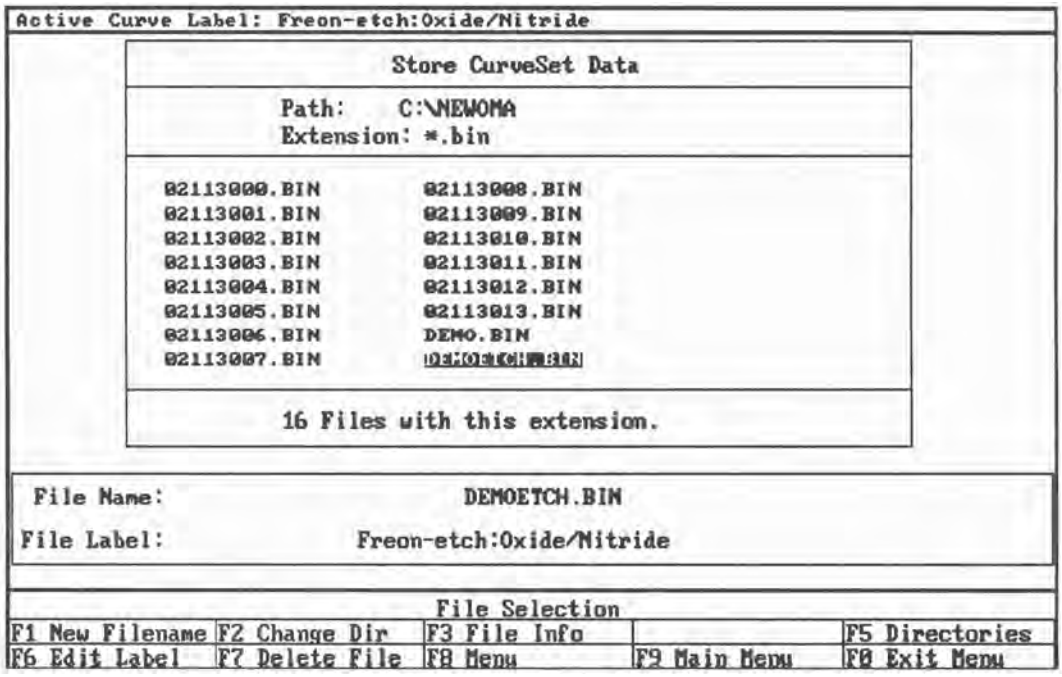


Figure 5-3. FILE SELECTION SCREEN
Store Curveset Data

5.2C Storing Data

Before storing data, move the arrow cursor to the line (1 to 5) where the data description is listed. Then press **<F8>** to access the **Data Analysis** menu, and select **Store *.BIN Data**. These steps open the **File Selection** screen.

The **File Selection** screen (Figure 5-3) now contains both the **Store Curveset Data** box and the function key assignments for keying in a filename, changing the disk directory to be used, and looking at file information. The "Active Curve Label" is the label that will be stored with the data. The active keys are listed and described below:

Key	Function
Enter	Selects the currently highlighted filename as the file to store that data in. The "Overwrite" prompt allows you to respond <Y> to overwrite the existing data in that file or <N> to quit the store operation. If you press <Y>, you will also be able to edit the file label. Pressing **<Enter>** completes the store operation.
F1	**New Filename:** Allows you to key in the filename to be used in the Load/Store operation. After you press **<Enter>**, you are prompted for a new file label; it is not required that you change the label. A second press of **<Enter>** completes the store operation. The extension .BIN is automatically added to the filename.
F2	**Change Dir:** Allows you to edit the directory path to change the directory used by the program. The path entered must be a valid DOS path. The directory changes when **<Enter>** is pressed. If the directory name keyed in does not exist, the program allows you to make it at this time.
F3	**File Info:** Displays data acquisition parameters, detector parameters, and area/equation information for the current curve set. The screen is exited by pressing **<F3>** again or by pressing **<Enter>**.
F5	**Directories:** Displays a listing of the current directory's subdirectories. A subdirectory can then be selected by moving the highlight bar and pressing <Enter> twice. Note that a single dot (.) listing means the current directory and a double dot (..) means the parent directory. **File Menu:** Returns to the File Selection screen.
F6	**Edit Label:** Allows you to add or change the file label associated with the currently highlighted curve set. The label is being edited in Figure 5-3.
F7	**Delete File:** Allows you to delete the currently selected file.

F8 **Menu:** Exits the screen and redraws the menu/s.

F9 **Main Menu:** Accesses the **Main** menu.

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

Selecting a directory other than the one specified by **Path** in the **Store CurveSet Data** box is accomplished by pressing **<F2>**, editing the directory pathname shown, and pressing **<Enter>** or by selecting a subdirectory via the **<F5> Directories** function and then returning to the file listing by pressing **<F5>** again. Storing the curve set to that directory is then accomplished by either selecting a filename from the file listing or by pressing **<F1>**, keying in the filename, pressing **<Enter>**, editing/ accepting the file label, and pressing **<Enter>** again.

Selecting a filename from the file listing will cause the data you are storing to overwrite the data currently in that file. Using **<F1>** and keying in the filename allows you to assign a unique name to the curve set that you are storing. In both cases, you are als shown the active curve label so that you can either use that label oredit it before continuing the store process; this label will be stored with the data after you press **<Enter>**. Note that the active curve label is not changed; only the label stored with data is affected.

Pressing **<Esc>** will back out of either of the two functions, **<F1> New Filename** or **<F2> Change Dir.**

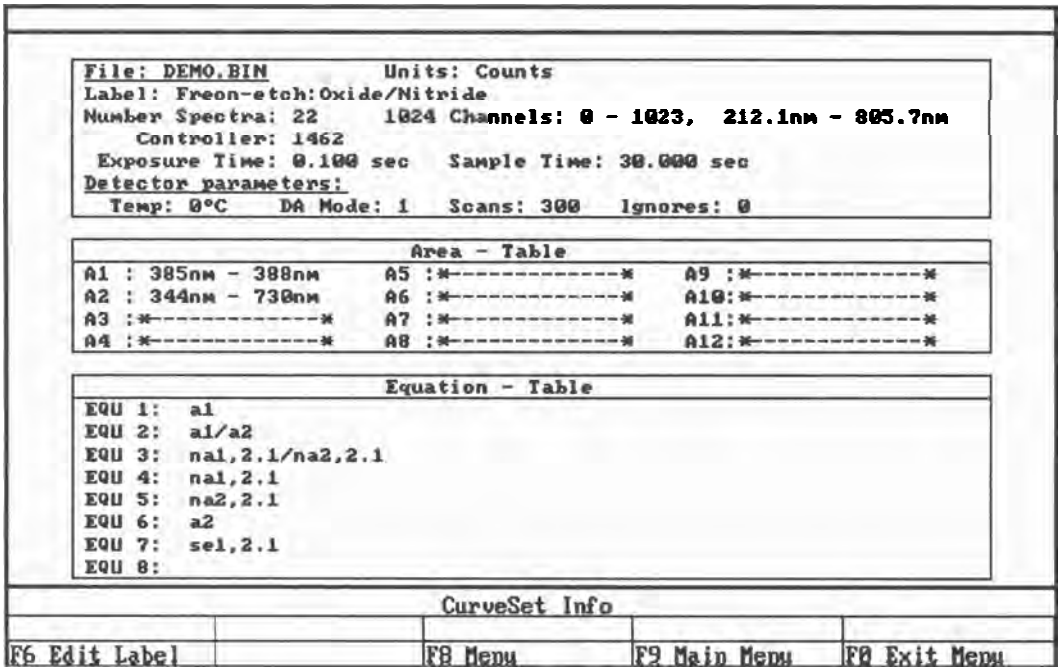


Figure 5-4. CURVESET INFO SCREEN

5.2D Information about the Data

Additional information about the selected curve set and the detector parameters can viewed by selecting **Data Information** from the **Data Analysis** menu or by choosing **<F3> File Info** while in the **Load** or **Store Curveset Data** screens. The information presented on these screens is the same: it includes the curve set name (filename or Live), the label, the number of spectra, the areas defined, the detector, the number and types of scans, the data acquisition mode, exposure and scan time, and the temperature setting.

Function Keys: The **CurveSet Info** screen (Figure 5-4) is accessed by selecting **Data Information** from the Data Analysis menu. The only function keys active in the **CurveSet Info** screen are:

Key	Function
F6	**Edit Label:** Allows you to assign a label to a curveset. This does not change the file label, just the curve set label in RAM.
F8	**Menu:** Restores the **Data Analysis** menu.
F9	**Main Menu:** Accesses the **Main** menu.
F10	**Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The same information screen pops up in the **File Selection** screen (Figure 5-5) when **<F3> File Info** is pressed. Although function key assignments are shown on the screen, none of them are active. Any keypress will exit from the information display to the previously displayed **Load or Store Curveset Data** box.

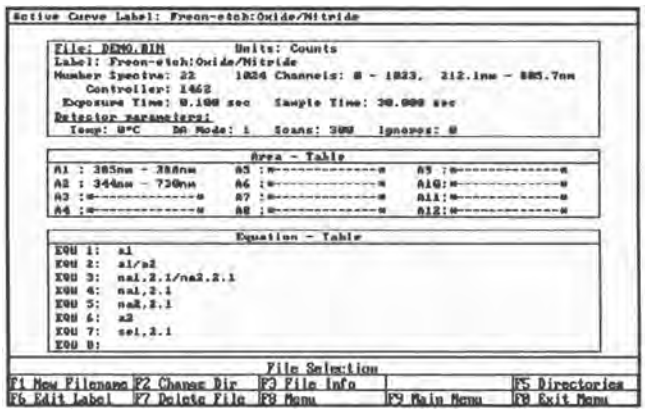


Figure 5-5. FILE INFO SCREEN

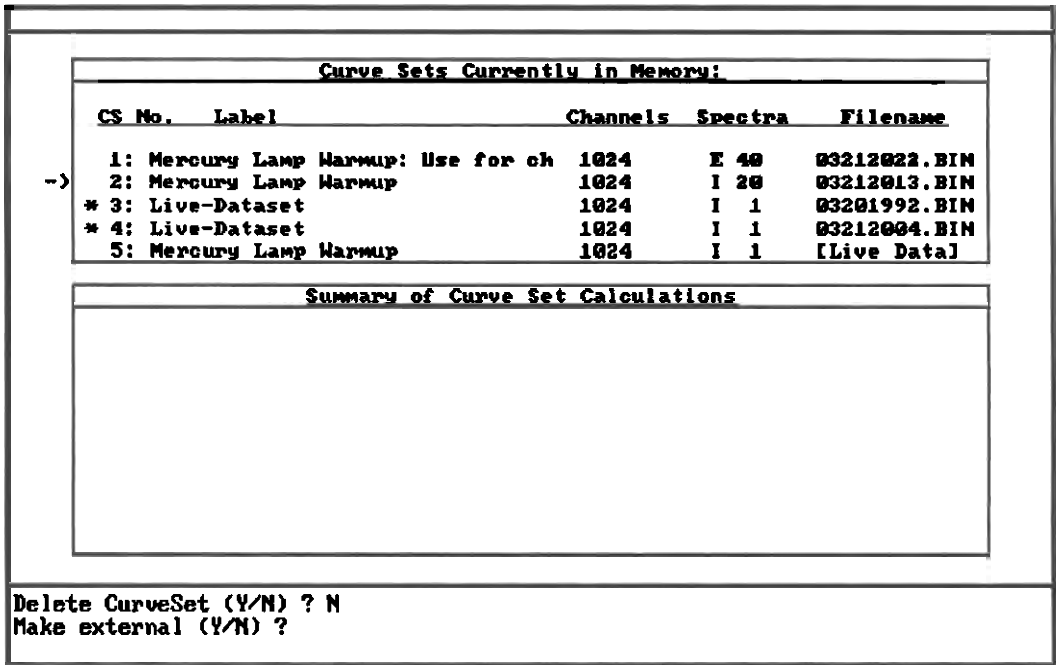


Figure 5-6. CURVE SET 1 BEING MADE EXTERNAL
Curve Sets 3 & 4 Tagged

5.2E Deleting Data

Clearing a curve set from memory frees up that portion of memory. However, you can no longer plot that curve set to the screen or use it in calculations.

To remove a curve set from memory, point to the data description (use the cursor keys to move the pointer) and press **<F8>** to access the **Data Analysis** menu. After you select **Delete Data**, you will be asked to respond Y or N. Key in N to continue to the "Make External" prompt or press **<Esc>** to quit the deletion process. Key in Y and press **<Enter>** to clear the data from memory.

5.2F Making a Curve Set "External"

Another way to free up memory is to make the data "External". Making a curve set External is especially important when dealing with large curve sets that might otherwise exceed the available memory space. While plotting the data or performing calculations using that data will take longer, you have the advantage of still being able to access the data without loading it again.

To make a curve set such as Curve 2 in Figure 5-6 External, point to the data description and press **<F8>** to access the **Data Analysis** menu. After selecting **Delete Data**, key in N at the "Delete CurveSet" prompt. When the second prompt "Make External" appears, key in Y and the "I #" will change to "E #" (where # is the number of spectra). This "E" marks the curve set as external.

5.2G Tagging and Untagging Curve Sets

Curve sets loaded into memory can be tagged for display on the Plot screen by using <Ins> to tag each curve set pointed to. This places an asterisk "*" next to the tagged curve set (see Figure 5-6). <Del> removes the asterisk and untags the curve set pointed to.

Tagged curve sets, as well as the curve set pointed to, can then be viewed on the Plot screen. One curve per curve set is displayed in the Plot screen. Moving from curve set to curve set is done by using <Shift><+>: the <+> key is the one on the numeric/cursor keypad. Each curve in the selected curve set can be viewed one at a time by using the <↑> and <↓> keys. If you then select 3D Plot, the selected curve set will be displayed. To change the curve set displayed in the 3D Plot, simply return to the Plot screen, press <Shift><+> until the desired curve set is selected, and then reselect 3D Plot.

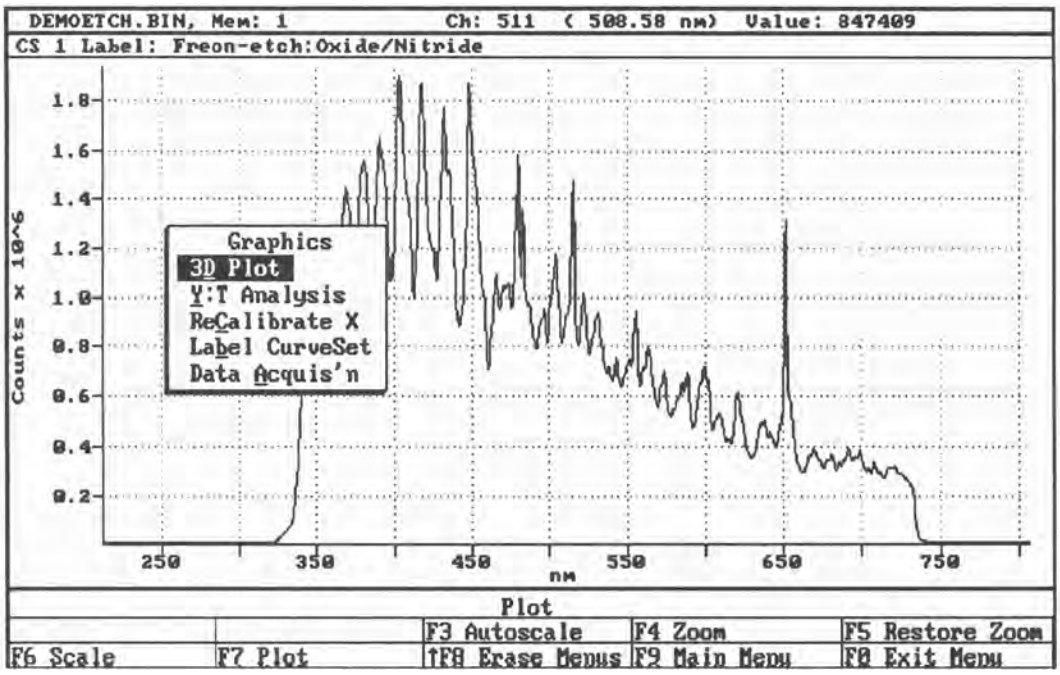


Figure 5-7. GRAPHICS PLOT SCREEN

5.3 GRAPHICS FUNCTIONS

Spectra can be plotted on the screen or to an external plotter or printer in a 3-D fashion or as a 2-D overlay of up to eight selected spectra. Pressing **<F1> Graphics** or selecting **Graphics** from the **Data Analysis** menu opens the **Plot** screen. The **Plot** screen displays the first spectrum of a curve set and the **Graphics** menu. A 3-D plot of the data can be seen by selecting **3D Plot** from the **Graphics** menu. Up to eight of the spectra shown on the **3D Plot** screen can be selected for a 2-D overlay and be viewed on the **Memory-Overlay** screen.

5.3A Plot Screen

The **Plot** screen (Figure 5-7) is accessed from the **Data Analysis** screen by pressing **<F1> Graphics** or selecting **Graphics** from the menu. This screen displays the first spectrum in a curve set. Moving the cursor along a spectrum is accomplished by using the cursor keys **<←>** and **<→>** to move from channel to channel or **<Shift><←>** and **<Shift><→>** to speed up cursor movement along the spectrum. **<C>** or **<X>** can also be used to move to a channel or a wavelength. However, if a menu with a key letter "c" or "x" is visible, the menu selection takes precedence over the cursor. For example, "c" in Figure 5-7 would select ReCalibrate X.

Other spectra in the curve set can be viewed one at a time by using:

<↑> and **<↓>** to page through the spectra one at a time.

<Shift><↑> and **<Shift><↓>** to page through every fifth spectrum.

<Shift><Home> and **<Shift><End>** to go to the first memory and the last memory, respectively.

<*> (on the numberpad) to key in the desired spectrum/memory number.

<Shift><+> to move from curve set to curve set when more than one curve set is tagged and/or pointed to in the **Curve Sets Currently in Memory** box.

Function and Esc Keys: The following function keys are active when the **Plot** screen is displayed.

Key	Function
F3	**Autoscale:** Automatically scales the Y axis of the spectra for the best fit to the display area.
F4	**Zoom:** Expands a designated section of a spectrum to fill the display area.
F5	**Restore Zoom:** Restores the data display to its unzoomed state, where all of the active channels are displayed.
F6	**Scale:** Accesses the **Scale** menu through which spectral X- and Y-axis values can be changed. On the **Scale** menu: **Y Autoscale** automatically rescales the Y axis for the best fit of the data plot to the screen.

F6 **Scale: (cont.)**

X AutoScale automatically rescales the X axis to show the complete curve set.

X Min, Max and **Y Min, Max** control the X- and Y-axis scaling for the spectral data display. Changing one of these values is accomplished by highlighting the parameter to be changed and pressing **<Enter>**. Then, key in the new minimum value and press **<Enter>**. Next, key in the new maximum value and press **<Enter>** again. Accept either value as unchanged simply by pressing **<Enter>**.

F7 **Plot:** Plots the current curve set to the plotter or printer connected to the port, selected during installation, after a **<Y>** response and **<Enter>** are keyed in at the "Hard Copy Device connected?" prompt. The message "Sending Data to Device" is displayed while the data is being sent.

If you wish to change the type of output device used by F7, you must run the Install program. Refer to Chapter 2 for instructions on running Install.

F8 **Menu:** Accesses the menu associated with the current display screen.

↑F8 **Erase Menus:** <Shift><F8> erases all menus on the screen.

F9 **Main Menu:** Returns to the **Main Menu**. The program can be exited from the **Main Menu**.

F10 **Exit Menu:** Exits the currently displayed menu. Pressed again, it exits the current screen. **<F10>** can be used to exit back up the menu tree until the **Main Menu** is displayed.

The **<Esc>** key is used to return to the screen or menu last displayed.

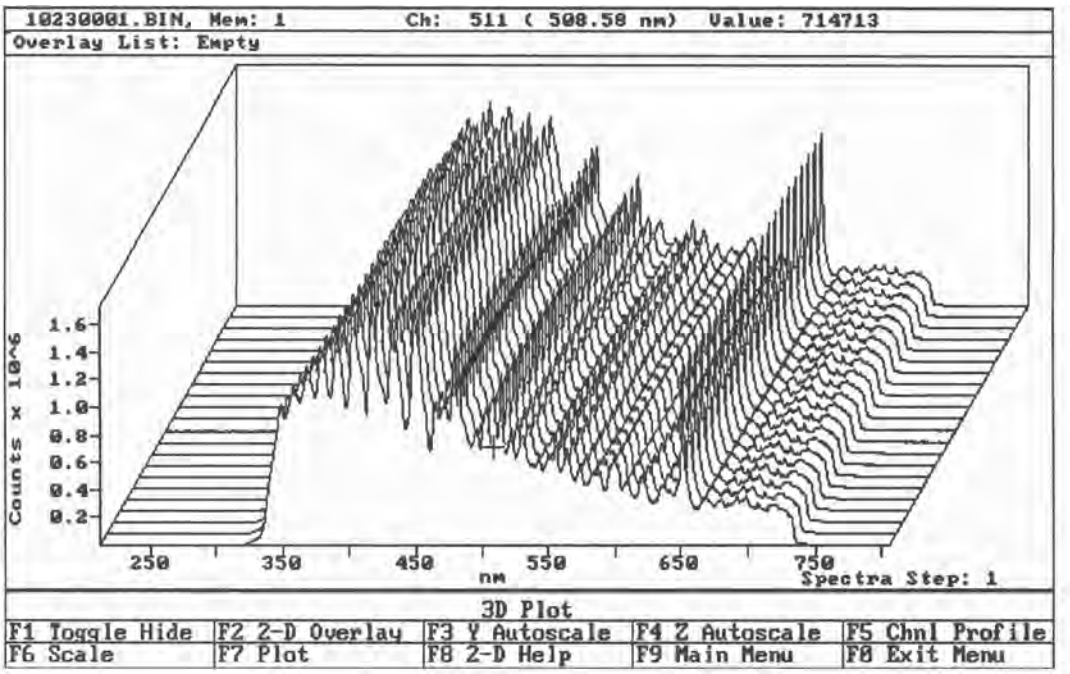


Figure 5-8. 3D PLOT SCREEN

5.3B 3-D Plot Screen

The data that is plotted on the screen is the data in the file pointed to in the **Data Analysis** screen (Figure 5-1). To plot the selected curve set in a 3-D plot, select **3D Plot** from the **Graphics** menu. This action opens the **3D Plot** screen (Figure 5-8) and plots the spectra according to the current scaling factors.

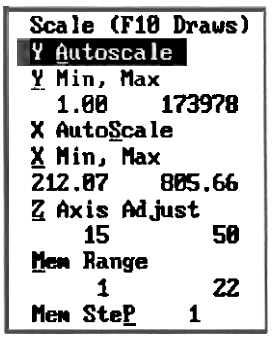


Figure 5-9. SCALE MENU

The current scaling factors can be changed by pressing **<F6> Scale** and making changes to the parameters in the **Scale** menu (Figure 5-9). These parameters include the X- and Y-axis minimum and maximum values, the Z-axis angle, the range of spectra, and the size of the step between spectra. Changes made to these values take effect when **<F10>** is pressed.

The order, the range, and the step intervals in which the curve set spectra are plotted are determined by the spectra numbers entered for the **Mem Range** and the step increment value entered for **Mem Step**. The entire curve set or a subset of it can be plotted in either ascending or descending order depending on whether the number of the starting spectrum is smaller or larger than the number of the ending spectrum. The **Mem Step** parameter determines which spectra between the start and end spectra will be displayed. For example, an entry of 1 for the step will display all spectra; an entry of 5 will display every fifth spectrum.

Note: Entering a negative step size will cause the start and end spectra in the Mem Range to be switched just as putting a higher number spectrum as the first in the display range will change the current step size to a negative number.

The cursor is moved from one spectrum to another by using the **<↑>** and **<↓>** cursor keys or across several spectra by using **<Shift><↑>** and **<Shift><↓>**. Cursor movement along a spectrum is accomplished via the **<←>**, **<→>**, **<Shift><←>**, **<Shift><→>**, **<Home>**, and **<End>** cursor keys. **<C>** or **<X>** can be used to move the cursor to a specific channel or wavelength.

Function and Esc Keys: The following function keys are active when the **3D Plot** screen is displayed:

Key	Function
F1	**Toggle Hide:** Toggles between revealing or hiding spectral lines that appear behind other spectral information.
F2	**2-D Overlay:** Opens a screen similar to the

Plot screen. Up to eight selected spectra can be displayed using the same baseline.

F3 **Y Autoscale:** Automatically scales the Y axis of the spectra for the best fit to the display area.

F4 **Z Autoscale:** Automatically sets the Z axis to the *X* and *Y* coordinates Z(*x*) = 15 and Z(*y*) = 50.

F5 **Chnl Profile:** Graphically displays the intensity of a selected peak on each spectrum (memory) on the Z-scale. This screen is described in more detail in Section 5.3C.

F6 **Scale:** Accesses the **Scale** menu through which spectral X-, Y-, and Z-axis values can be changed. The screen is not redrawn until **<F10> Exit Menu** is pressed. On the **Scale** menu:

Y Autoscale automatically rescales the Y axis for the best fit of the data plot to the screen.

X AutoScale automatically rescales the X axis to show the complete curve set.

X Min, Max and **Y Min, Max** control the X- and Y-axis scaling for the spectral data display. To accept the minimum value shown, just press **<Enter>**. To change it, key in the new minimum value and then press **<Enter>**. Follow the same step/s for the maximum value.

Z Axis Adjust is used to change the *X* and *Y* coordinates of the Z axis. Both coordinates can be chosen within a range of 0 to 90.

As soon as Z Axis Adjust is selected you can use the <←>, <→>, <↑>, and <↓> keys to make the adjustment. To complete the cursor adjustment, press <Esc>.

Another way to adjust the Z axis is to press **<Enter>** and key in or accept the value for Z(x). You will be prompted for the value of Z(y) when you press **<Enter>**. The next **<Enter>** completes the adjustment.

Mem Range is specified by choosing the starting and ending spectra to be displayed. To change either the starting and ending spectra, select **Mem Range**, key in the number of the starting memory, and then press **<Enter>**. Then, key in the number of the last memory and press **<Enter>**. Accept either value as unchanged simply by pressing **<Enter>**.

Mem Step determines which spectra between the start and end spectra will be displayed. For example, an entry of 1 will display all spectra; an entry of 5 will display every fifth spectra.

F7 **Plot:** Plots the current curve set to the plotter or printer connected to the port, selected during installation, after a **<Y>** response and **<Enter>** are keyed in at the "Hard Copy Device connected?" prompt. The message "Sending Data to Device" is displayed while the data is being sent.

If you wish to change the type of output device used by F7, you must run the Install program. Refer to Chapter 2 for instructions on running Install.

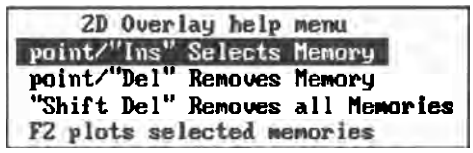


Figure 5-10. 2D OVERLAY HELP MENU

F8 **2-D Help:** Selects the **2D Overlay Help** menu (Figure 5-10) which tells how to select memories for plotting or deletion. On this menu, **point/"Ins"** means to move the cursor over the spectrum you wish to select and press **<Ins>**. Similarly, **point/"Del"** means to move the cursor over the spectrum you wish to delete and press **<Del>**. More details are given in the next section.

↑F8 **Erase Menus:** <Shift><F8> erases all menus on the screen.

F9 **Main Menu:** Accesses the **Main** menu.

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The **<Esc>** key can be used to return to the **Plot** screen. If a menu is showing, pressing **<Esc>** will remove it (the same effect as pressing **<F10> Exit Menu**). Pressing **<Esc>** again will return to the **Plot** screen. Pressing **<Esc>** while spectra are being plotted stops the plotting.

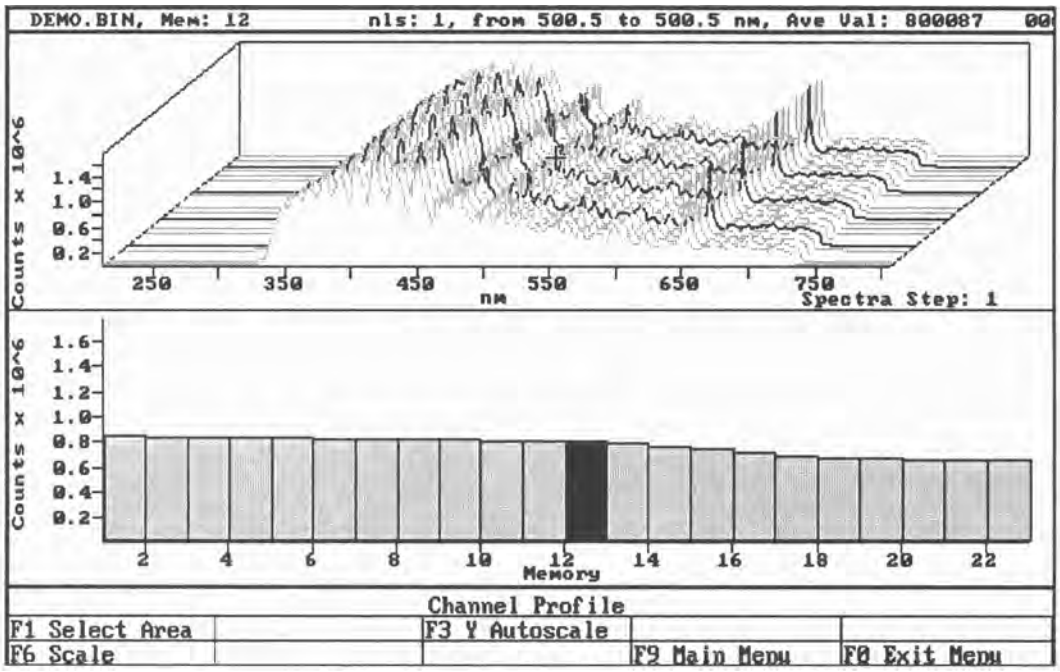


Figure 5-11. CHANNEL PROFILE SCREEN

5.3C Channel Profile Screen

The Channel Profile screen allows you to look at the intensity changes in a peak across the spectra (memories) in the data set. For example, the profile in Figure 5-11 shows the fluctuations in intensity for one channel at 546 nm. Note that the intensity at the cursor position is reported as Ave Val or Average Value in the information bar. This term is used because one or more side-by-side channels can be grouped into a single "super" channel for the purposes of the profile or for area selection.

The upper portion of the Channel Profile screen shows the curve set and the lower shows the channel profile. Regardless of the size of the channel (one or more channels), the **<←>**, **<→>**, **<Home>**, and **<End>** cursor keys or the "X" and "C" values position the cursor in the upper box. A new channel profile is generated when the cursor moves to its new X-axis position. The cursor position in the channel profile is indicated by the blue intensity bar. By using the **<↑>** and **<↓>** keys or **<Shift><↑>** and **<Shift><↓>** keys, you can move the cursor through the channel profile from one spectrum to the next.

As indicated previously, two or more channels may be combined to create a channel profile. To create a profile based on a group of channels or wavelength range use the **<Ins>** key. Each press of the key increases the group size by one channel; first to the right and then to the left of the current cursor position. To decrease the group size by one channel at a time, press **<Del>**. To collapse the group back to one channel, simply press **<Shift><Del>**.

Function and Esc Keys: The following function keys are active when the **Channel Profile** screen is displayed:

Key	Function
F1	**Select Area:** Adds the selected area to the active Area/Equation Table and allows you to include a comment. The actual area selection is based on the current cursor position and channel size. A grouped channel will create a larger area. Deleting an area is a matter of pointing to the area in the Area/Equation Table, selecting **<F4> Delete Item**, and then pressing **<Y>** followed by <Enter>.
F3	**Y Autoscale:** Automatically scales the Y axis of the channel profile for the best fit to the display area.
F6	**Scale:** Accesses the **Scale** menu through which spectral X-, Y-, and Z-axis values can be changed. The screen is not redrawn until **<F10> Exit Menu** is pressed. On the **Scale** menu: **Y Autoscale** automatically rescales the channel profile Y axis for the best fit of the data plot to the screen. **X AutoScale** automatically rescales the X axis to show the complete curve set. **X Min, Max** and **Y Min, Max** control the X- and Y-axis scaling for the data display. To change one

of these values, select the parameter to be changed, key in the new minimum value, and press **<Enter>**. Next, key in the new maximum value and press **<Enter>** again. Accept either value as unchanged simply by pressing **<Enter>**.

Z Axis Adjust allows you to change the *X* and *Y* coordinates of the Z-axis. Both coordinates can be chosen within a range of 0 to 90 on a scale of 0 to 100.

As soon as Z Axis Adjust is selected you can use the <←>, <→>, <↑>, and <↓> keys to make the adjustment. To complete the cursor adjustment, press <Esc>.

Another way to adjust the Z axis is to press **<Enter>** and key in or accept the value for **Z(x)**. You will be prompted for the value of **Z(y)** when you press **<Enter>**. The next **<Enter>** completes the adjustment.

F9 **Main Menu:** Returns to the **Main Menu**. The program can be exited from the **Main Menu.**

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The **<Esc>** key can be used to return to the **3D Plot** screen (the same effect as pressing **<F10> Exit Menu**. Pressing **<Esc>** while spectra are being plotted stops the plotting.

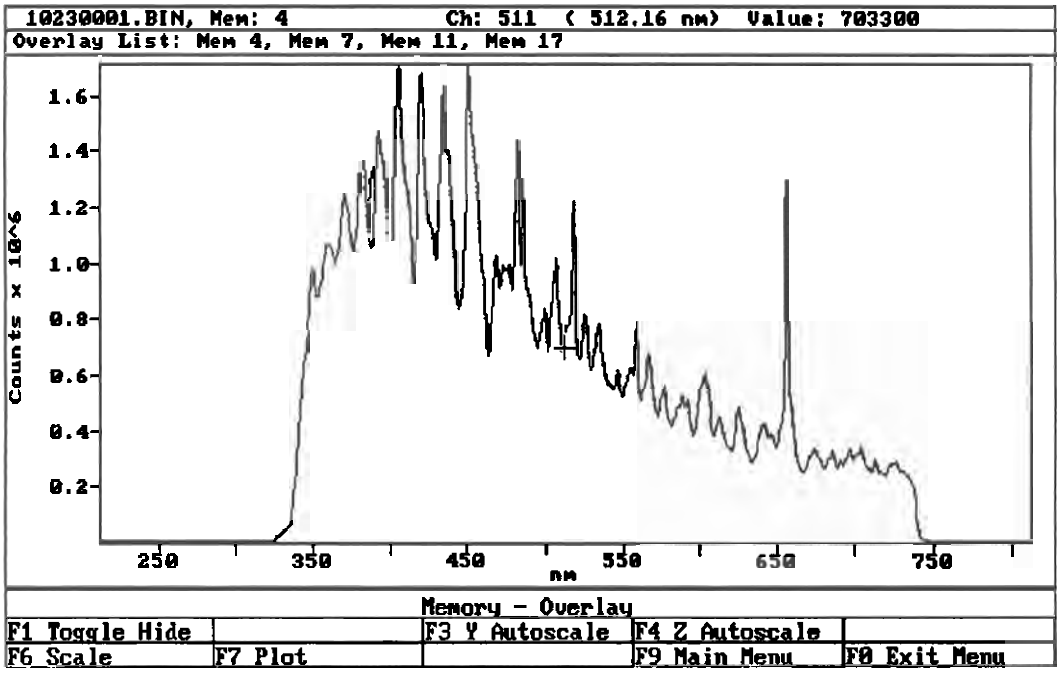


Figure 5-12. 2-D OVERLAY EXAMPLE

5.3D 2-D Plot Screen

A 2-D plot can contain up to 8 spectra selected from the curve set pointed to in the **Data Analysis** screen. It is this curve set that is displayed in the **3D Plot** screen. To select spectra for a 2-D plot, make sure you are in the **3D Plot** screen and press **<F8> 2-D Help** to access the **2D Overlay** help menu (Figure 5-13). To add a spectrum to the spectral list, move the cursor to the spectrum of interest and press the **<Ins>** key. To delete a spectrum from the list, move the cursor to that spectrum and press **<Del>**. To clear all spectra from the list, press **<Shift><Del>**.

The list of selected spectra is displayed near the top of the screen. To plot these spectra, press **<F2> 2-D Overlay**. Figure 5-12 shows the 2-D overlay of memories 4, 7, 11, and 17 selected from File DEMO.BIN. Figure 5-14 shows the same set of memories in the **Memory-Overlay** screen with a different Z axis and the hide spectral lines function in effect.

Function and Esc Keys: The following function keys are active when the **Memory-Overlay** screen is displayed:

Key	Function
F1	**Toggle Hide:** Toggles between revealing or hiding spectral lines that appear behind other spectral information.
F3	**Y Autoscale:** Automatically scales the Y axis of the spectra for the best fit to the display area.



Figure 5-13. 2D OVERLAY HELP MENU

F4 **Z Autoscale:** Automatically sets the Z axis to the *X* and *Y* coordinates $Z(x) = 0$ and $Z(y) = 0$.

F6 **Scale:** Accesses the **Scale** menu through which spectral X-, Y-, and Z-axis values can be changed. The screen is not redrawn until **<F10> Exit Menu** is pressed. On the **Scale** menu:

Y Autoscale automatically rescales the Y axis for the best fit of the data plot to the screen.

X AutoScale automatically rescales the X axis to show the complete curve set.

X Min, Max and **Y Min, Max** control the X- and Y-axis scaling for the spectral data display. To change one of these values, select the parameter to be changed, key in the new minimum value, and press **<Enter>**. Next, key in the new maximum value and press **<Enter>** again. Accept either value as unchanged simply by pressing **<Enter>**.

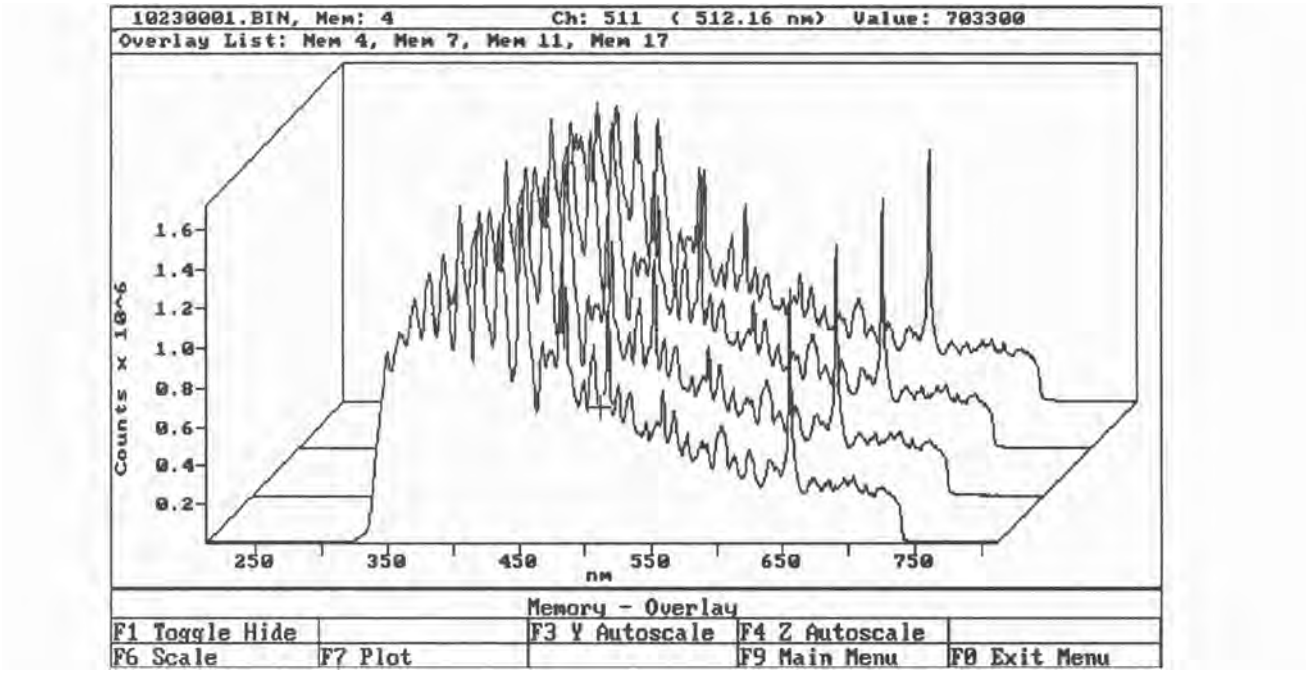


Figure 5-14. 2-D OVERLAY WITH NEW Z AXIS

Z Axis Adjust allows you to change the *X* and *Y* coordinates of the Z axis. Both coordinates can be chosen within a range of 0 to 90 on a scale of 0 to 100.

As soon as Z Axis Adjust is selected you can use the <←>, <→>, <↑>, and <↓> keys to make the adjustment. To complete the cursor adjustment, press <Esc>.

Another way to adjust the Z axis is to press **<Enter>** and key in or accept the value for Z(x). You will be prompted for the value of Z(y) when you press **<Enter>**. The next **<Enter>** completes the adjustment.

F7 **Plot:** Plots the current curve set to the plotter or **printer connected to the port, selected during** installation, after a **<Y>** response and **<Enter>** are keyed in at the "Hard Copy Device connected?" prompt. The message "Sending Data to Device" is displayed while the data is being sent.

If you wish to change the type of output device used by F7, you must run the Install program. Refer to Chapter 2 for instructions on running Install.

F9 **Main Menu:** Returns to the **Main Menu**. The program can be exited from the **Main Menu**.

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The **<Esc>** key can be used to return to the **3D Plot** screen (the same effect as pressing **<F10> Exit Menu**). Pressing **<Esc>** while spectra are being plotted stops the plotting.

The cursor is moved from one spectrum to another by using the **<↑>**, **<↓>**, **<Shift)<↑>**, and **<Shift><↓>** cursor keys. Cursor movement along a spectrum is accomplished via the **<←>**, **<→>**, **<Shift><←>**, **<Shift><→>**, **<Home>**, and **<End>** cursor keys.

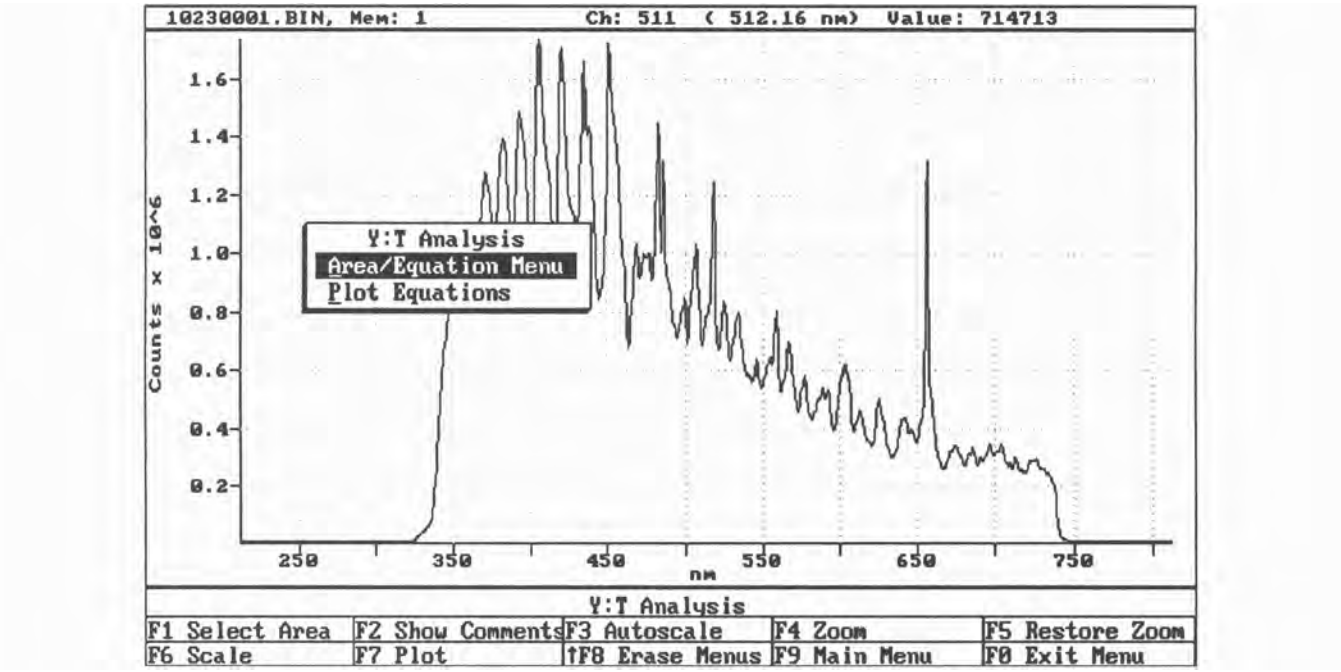


Figure 5-15. Y:T ANALYSIS SCREEN

5.3E Y:T Analysis Screen

Y:T analysis of data can be accomplished by selecting **Y:T Analysis** from the **Graphics** menu. A previously stored area/equation file can be recalled and applied to the current data, or new areas and equations can be defined. The results of the equations can be plotted to the screen to view the changes in intensity over time that occurred when data was acquired. This section basically describes the function keys. Section 5.6, Y:T Analysis, covers the subjects of Y:T analysis, areas, and equations in much greater depth.

Function and Esc Keys: The following function keys are active when the **Y:T Analysis** screen (Figure 5-15) is displayed.

Key	Function
F1	**Select Area:** Allows you to define and comment an area of a spectrum for monitoring or clearing. The **<←>** and **<→>** cursor keys and the **<C>** and **<X>** keys can be used in this process. More details are given in Section 5.6.
F2	**Show Comments:** Shows or hides the comment associated with each area. A comment can be added when the area is selected or can be added in the View/Edit Areas/Equations screen with the <F6> Comment function.
F3	**Autoscale:** Automatically scales the Y axis of the spectra for the best fit to the display area.
F4	**Zoom:** Expands a designated section of a spectrum to fill the display area.
F5	**Restore Zoom:** Restores the data display to its unzoomed state, where all of the active channels are displayed.
F6	**Scale:** Accesses the **Scale** menu through which spectral X- and Y-axis values can be changed. The screen is not redrawn until **<F10> Exit Menu** is pressed. On the **Scale** menu: **Y Autoscale** automatically rescales the Y axis for the best fit of the data plot to the screen. **X AutoScale** automatically rescales the X axis to show the complete curve set. **X Min, Max and Y Min, Max** control the X- and Y-axis scaling for the spectral data display. Changing one of these values is accomplished by highlighting the parameter to be changed and pressing **<Enter>**. Then, key in the new minimum value and press **<Enter>**. Next, key in the new maximum value and press **<Enter>** again. Accept either value as unchanged simply by pressing **<Enter>**.
F7	**Plot:** Plots the current curve set to the plotter or printer connected to the port, selected during installation, after a **<Y>** response and **<Enter>** are keyed in at the "Hard Copy Device connected?" prompt. The message "Sending Data to Device" is displayed while

the data is being sent.

If you wish to change the type of output device used by F7, you must run the Install program. Refer to Chapter 2 for instructions on running Install.

F8 **Menu:** Accesses the menu associated with the current display screen.

↑F8 **Erase Menus:** <Shift> <F8> erases all menus on the screen.

F9 **Main Menu:** Accesses the **Main** menu.

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The **<Esc>** key is used to stop an operation before completion or to return to the screen or menu last displayed.

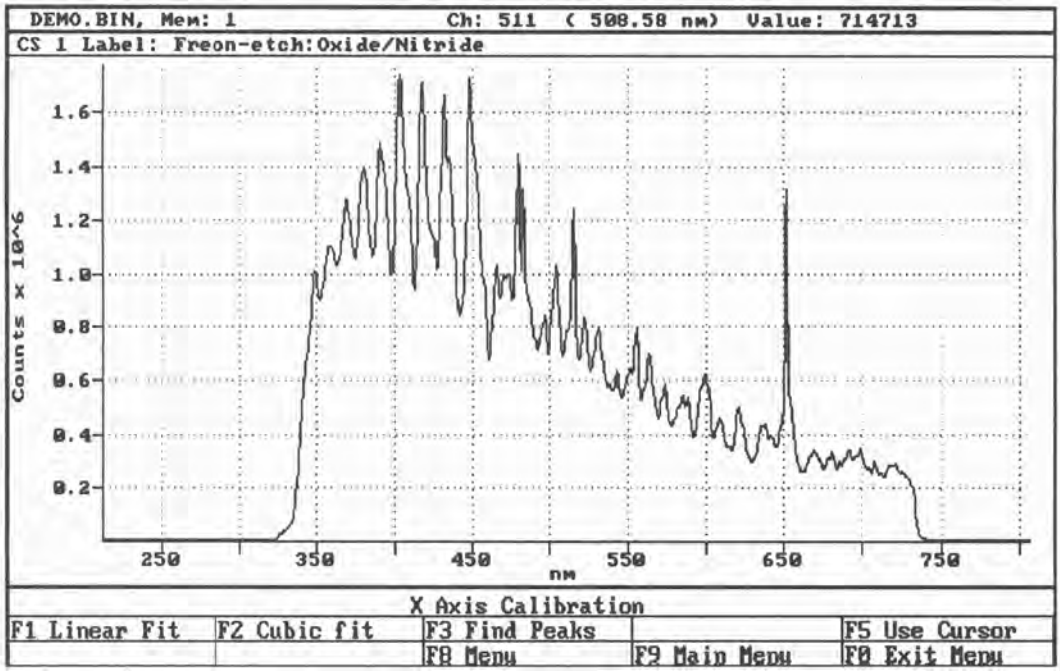


Figure 5-16. NEW CALIBRATION SCREEN

5.3F Recalibrating the X Axis

New Calibration
Changing the current X-axis calibration is accomplished in one of two ways. The first method is to key in new wavelength values for spectral lines. This is called **New Calibration.** The second method is to recall the calibration coefficients from a previously acquired and stored curve set. This is called **Load Cal. Coef.** .

To do a new calibration, select **Graphics** from the **Data Analysis** menu or press **<F1> Graphics.** Then, select **Recalibrate X** from the **Graphics** menu, and select **New Calibration** from the **Calibrate X Axis** menu. The **X Axis Calibration** screen will appear (Figure 5-16). **<F4> Flatten** is active only when Curveset 5 is displayed.

Note: Recalibrating does not change the file but rather only the curveset in RAM. To change the file, recalibrate and then *store* the curveset.

Function and Esc Keys: The following function keys are active when the **X Axis Calibration** screen is displayed.

Key	Function
F1	**Linear Fit:** Selects Linear Fit as the calibration technique. At least two points are required to make the fit. Uses a movable threshold in determining peaks of interest unless **<F5> Use Cursor** has been pressed before selection.
F2	**Cubic Fit:** Selects Cubic Fit as the calibration technique. At least four points are required to make the fit. Unless **<F5> Use Cursor** has been pressed, uses a movable threshold in determining peaks of interest. To use Cubic Fit, set the threshold to pick peaks from left to right, then follow prompts. When there are no new peaks, the calibration will be recalculated.
F3	**Find Peaks:** Automatically labels all peaks above the threshold you set. A "peak" is the spectral energy plotted between a positive-going crossing of the threshold and the following negative-going crossing. To set the threshold after you press **<F3>**, position it with the **<↑>** and **<↓>** cursor keys, and press **<Enter>** when it is where you want it. The *X* value of the peak (in channels or wavelength) is the horizontal center of the area bounded by the peak above the threshold line. The center of area is the point where the number of counts on the left equals the number of counts on the right.
F4	**Flatten:** Smoothes the baseline. Only available when the data displayed is a **Live** curve (Curveset 5). Normally the program averages a bulge in a spectral curve above the threshold into a single peak for wavelength identification. As a result, there may be peaks of interest on that bulge not identified by the program as separate peaks. Pressing **<F4>** applies an algorithm that generates artificial peaks above the threshold at wavelengths with sharp slopes. This process

results in distortion of the data but is useful in removing broad continuous peaks, making it easier to calibrate on smaller peaks riding on top of a continuum.

F5 **Use Cursor:** Allows you to use the cursor to select peaks when either Linear or Cubic Fit is accessed. This function must be selected before selecting the fit. It allows you to quickly "handpick" peaks. Automatic peak finding may not be desirable when the peaks are not symmetrical. Follow prompts and press **<Esc>** to end entry of calibration peaks.

F8 **Menu:** Accesses the menu associated with the current display screen.

↑F8 **Erase Menus:** <Shift><F8> erases all menus on the screen.

F9 **Main Menu:** Accesses the **Main** menu.

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The **<Esc>** key is used to end calibration and return to the **Plot** screen. In the **X Axis Calibration** screen it has the same effect as pressing **<F10> Exit Menu**.

Critical Peaks: Before changing the current calibration, you might want to review the wavelength values for critical peaks in the displayed spectrum. The **<F3> Find Peaks** function uses a movable threshold as a baseline for peak searches. Press **<F3>** to bring up the **Peak Display** screen. The message

Set Threshold; then press Enter

will appear at the bottom of the screen. Move the threshold with the **<↑>** and **<↓>** cursor keys until it is positioned below the peaks of interest. When you press **<Enter>**, the peaks above the threshold will be labeled with their current wavelength values.

You can use either *Linear Fit* (requires at least 2 points for calibration) or *Cubic Fit* (requires at least 4 points) to change the current calibration. Peak selection may be accomplished either through moving the cursor (**<F5> Use Cursor** must be selected beforehand) or by using the adjustable threshold to eliminate low-intensity peaks as calibration points.

To select peaks with the cursor, first press **<F5> Use Cursor**, then select the type of calibration fit, **<F1> Linear Fit** or **<F2> Cubic Fit**. The message

Move Cursor to peak, press Enter; [break with Esc]

will appear at the bottom of the screen. Move the cursor to a peak of interest and press **<Enter>**. The "Number of Calibration Points" message will show that "0" points have been selected. Respond either Y or N and press **<Enter>** again. If you press **Y** you are prompted for the wavelength. After keying in the wavelength, press **<Enter>**. The next time peak selection prompt appears, the "Number of Calibration Points" message will show that 1 point has been selected. Repeat the process for the required number of points. Note that the cursor can be moved to the left or right of previously selected peaks for selecting additional points. Press **<Esc>** when you are through. This action sets the new calibration.

To select peaks using the threshold, select the appropriate calibration function (**<F1> Linear Fit** or **<F2> Cubic Fit**). The message

Set Threshold; then press Enter

will appear at the bottom of the screen. Adjust the threshold by using the **<↑>** and **<↓>** cursor keys. Then press **<Enter>** to begin entering points.

The program moves from left to right through the spectral curve and finds each peak above the threshold. Each time the program finds a peak above the threshold, it asks if that peak should be used for calibration. A **Y** response allows you to enter the new wavelength. An **N** response moves the cursor to the next peak. The "Number of Calibration Points" message keeps track of the number of points that have been selected. Keeping in mind the minimum number of calibration points required, select peaks and enter new wavelength values. If desired, you can move the threshold as you proceed through selecting points. When a sufficient number of wavelength values have been entered, press **<Esc>** to set the new calibration.

If you fail to select the minimum number of points, a prompt telling you that there are not enough points for calibration will appear in the center of the screen:

Not enough Calibration points! <Press any Key>

If this happens the calibration will not be performed and you will have to start over again. Intentionally pressing **<Esc>** before completing peak selection can be used to back out of the calibration process without affecting the current calibration.

Unless the calibration coefficients are changed again, they will be stored in the M1470.PRM file that is created each time the program is exited normally (i.e., exited via <F10>). This calibration and the data acquisition setup and display parameters stored at the same time are loaded the next time the OMA Vision software is used.

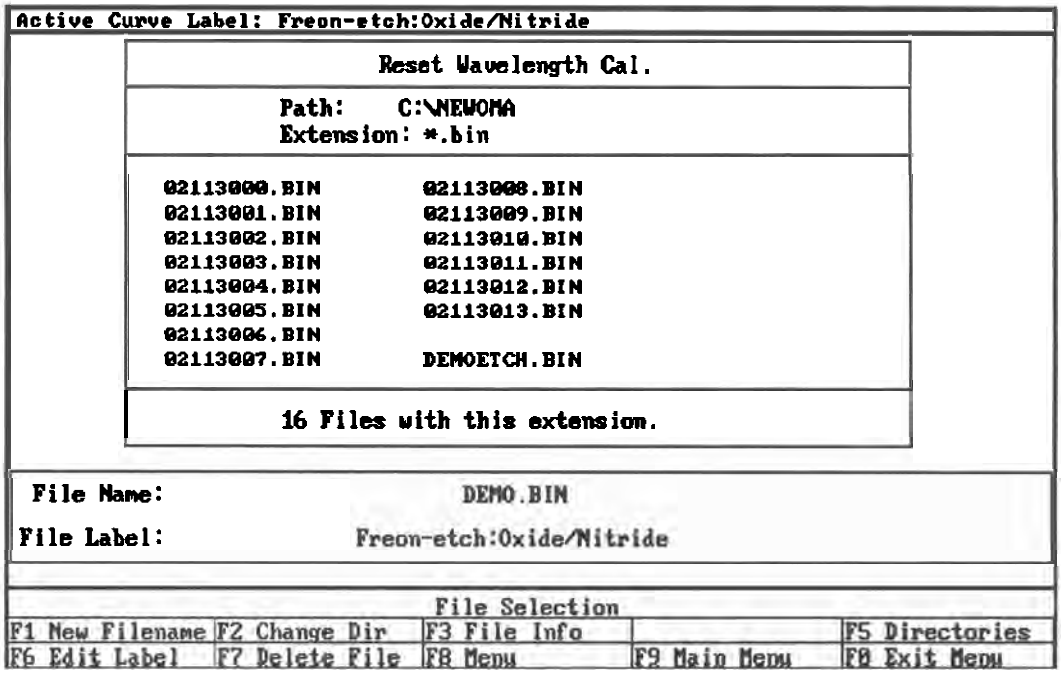


Figure 5-17. RESET WAVELENGTH CAL. SCREEN

Load Cal. Coef.
If a curve set already exists with the appropriate calibration, its calibration coefficients can be applied to the axes used to display the currently selected curve set in the **Data Analysis** screen. If the curve set pointed to is CS1, CS2, CS3, or CS4; the calibration coefficients will be applied to that curve set alone. If the curve set pointed to is CS5 [Live Data], the calibration coefficients will be changed for the current Live curve and for subsequent curve sets acquired in the Data Acquisition screen.

To recall the calibration from another file, select **Load Cal. Coef.** from the **Calibrate X Axis** menu. When the **Reset Wavelength Cal.** screen appears (Figure 5-17), move the highlight bar until the correct data file is highlighted and press **<Enter>**. Press **<Enter>** again to load the calibration coefficients, or press **<Esc>** to back out of the operation and select another file. Press **<Esc>** twice to completely back out of the operation.

Generally, areas that have been selected from wavelength-calibrated data are preserved when the *X*-axis calibration is reset. Areas are not preserved when they are outside the boundaries of the new calibration.

Note: Data that has been calibrated or recalibrated must be freshly stored in a disk file for the new coefficients to be retained since the calibration is only done in memory for the curve set.

5.3G Labeling the Curve Set

The **Label CurveSet** selection from the **Graphics** menu allows you to key in a descriptive label for the curve set being displayed. This label will be used on the hardcopy output if you decide to send the plot (F7 Plot) to an attached hardcopy device. However, this label is temporary unless the curve set is then stored to disk using the **Store *.BIN Data** function listed in the **Data Analysis** menu.

5.3H Data Acquisition

This selection returns you to the **Data Acquisition** menu, which discussed in depth in Chapter 4.

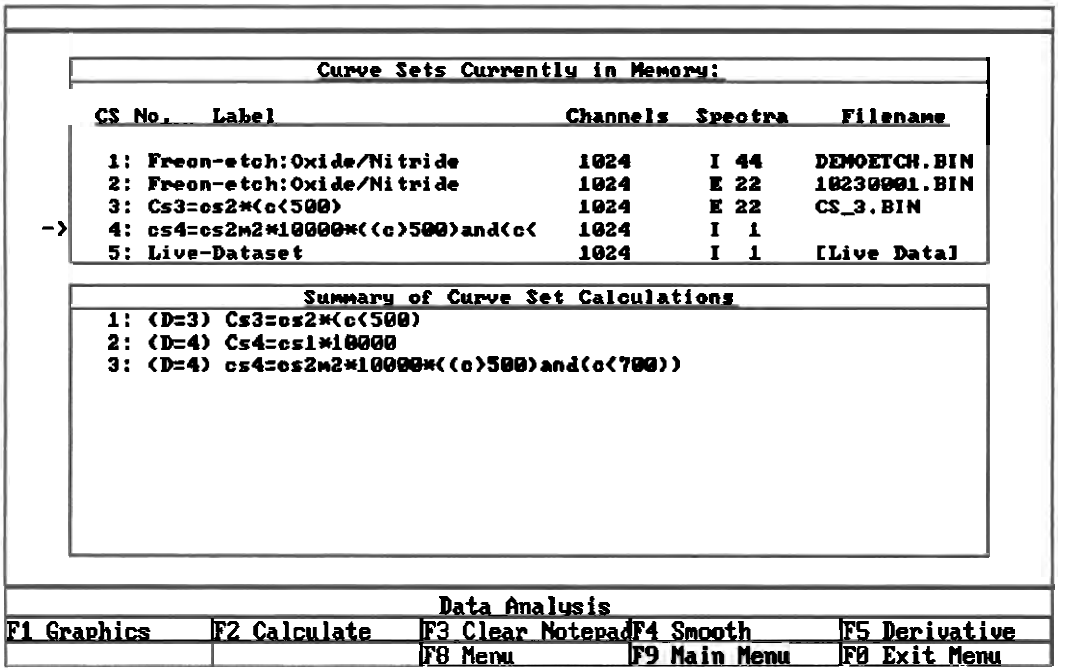


Figure 5-18. SUMMARY OF CURVE SET CALCULATIONS

5.4 CURVE CALCULATIONS

Arithmetic or Boolean operations can be performed on curve sets via the OMA Vision program's built-in calculation feature. This feature is accessed either by selecting **CurveSet Calc** from the menu or by pressing **<F2> Calculate**. Once the calculation feature has been selected, calculations can be done on any curve set shown in the **Curve Sets Currently in Memory** box. For example, a curve set calculation has been performed on Curve 2 in Figure 5-18 above to create Curve 3. Curve 3 retains the Y axis intensity of all data at channels less than 500 and zeroes out all data from channels equal to and greater than 500.

As can be seen in Figure 5-18 above, a notepad of the calculations entered is kept in the **Summary of Curve Set Calculations** box. This notepad serves as a temporary scratchpad and gives you a history of the curve calculations performed. Each line states the memory location where the result was stored (D=*n*) as well as the calculation performed. The notepad is cleared by pressing **<F3> Clear Notepad**; it is also cleared when the program is exited.

If there is sufficient space in memory, the results will be stored only in memory as "Internal" data and you will have to use **Store Data** from the **Data Analysis** menu to store the information in a disk file. If there is not enough room in memory, the results will be stored in a disk file as **CS_#.BIN**, where # is the memory location, and the data will be made "External". Examples of this can be seen in Figure 5-18. The result of the calculation can be seen graphically by pointing to the memory location number with the arrow cursor and pressing **<F1> Graphics** or selecting **Graphics** from the menu.

5.4A Rules and Syntax

Curve calculations can be performed only on data that is listed in the **Curve Sets Currently in Memory**. The curve calculation feature itself is accessed either by selecting **CurveSet Calc** from the menu or by pressing **<F2> Calculate**. Once the feature has been accessed, a calculation can then be keyed in at the **Equation:** prompt.

The rules, syntax, operations, and operators described here and in the remainder of Section 5.3 determine whether or not a calculation will be recognized as valid when **<Enter>** is pressed. If the program finds an error, a blue error message will be displayed. If no errors are found, the calculation will be performed, the result entered at the appropriate memory line, and the text of the calculation listed in the Notepad when **<Enter>** is pressed. A help reference (shown in Figure 5-19) lists operators, functions, and formats: it can be accessed by keying in a ? as the first character.

1. A curve set is identified in a calculation by its memory location number preceded by "CS". Curve Set number 4 would be indicated by entering **CS4**.

2. The lefthand side can have one of three formats:

   a. "CS*x*", where *x* is between 1 and 4. This will generate an entire file. If *x* already has data associated with it, the data will be overwritten.

   b. "CS*x*M*y*", where there must be a curve set associated with *x* and this set must include a

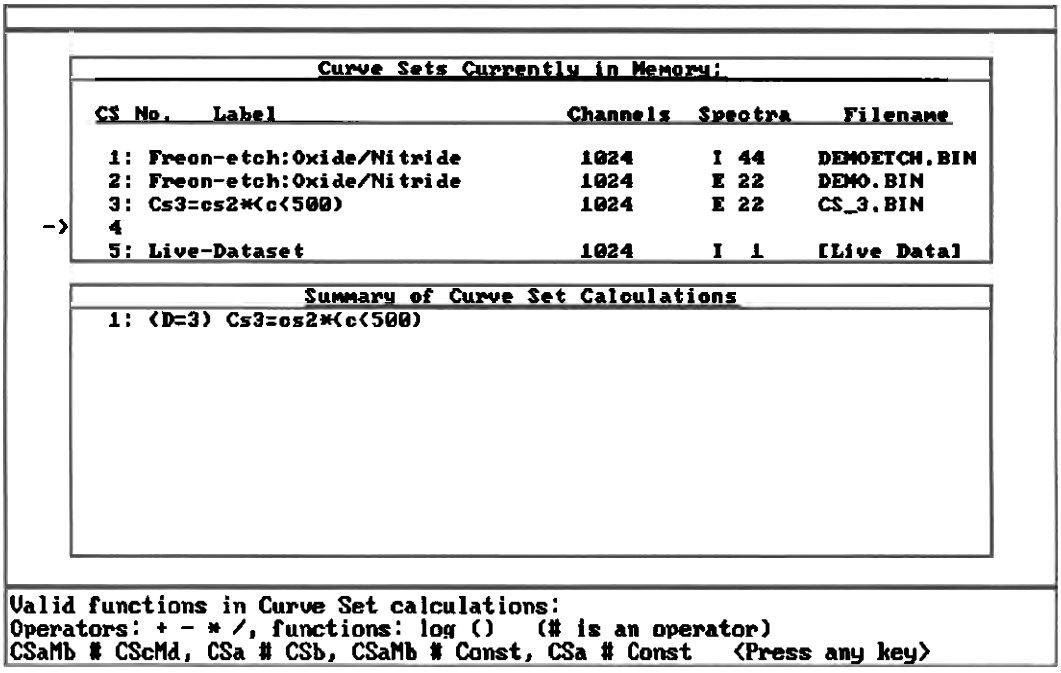


Figure 5-19. CALCULATIONS HELP MESSAGE

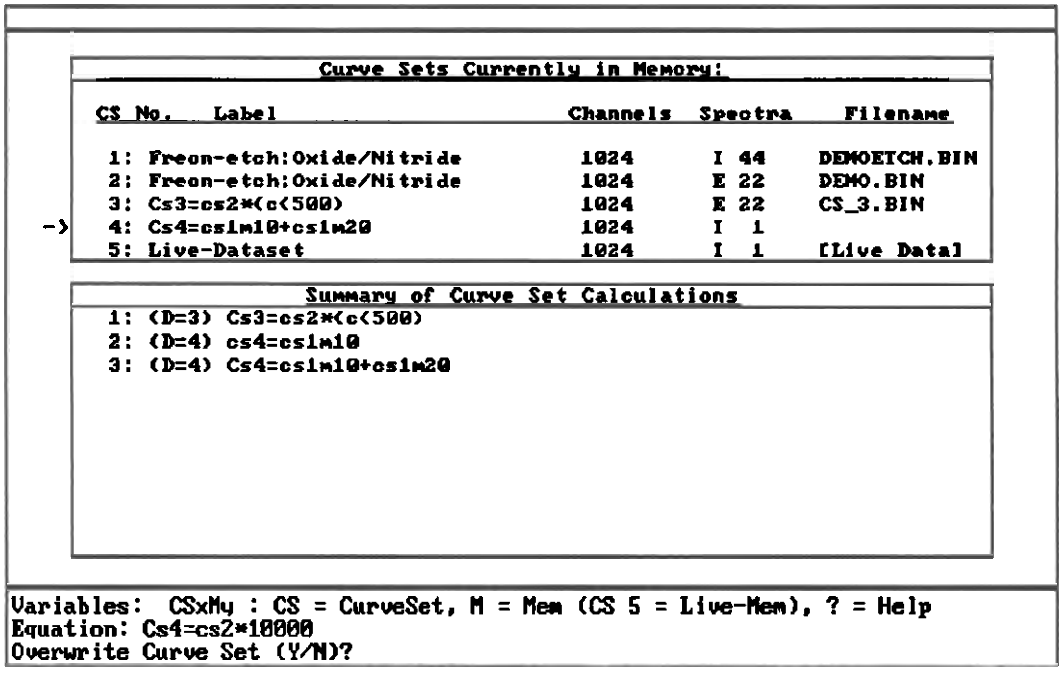


Figure 5-20. CALCULATIONS ENTRY BOX

memory *y*. This will replace memory *y* with the result of the calculation.

c. " ", where there is no lefthand side. This is interpreted as "CS*x*" where *x* is the set referenced with the arrow in the **Curve Sets Currently in Memory** box. This will generate an entire file. If *x* already has data associated with it, the data will be overwritten.

3. The righthand side cannot reference the destination file. "CS2 = CS2 + CS4", "CS2 = CS2/CS2M3", and "CS2M3 = CS2M5" are all illegal.

4. The righthand side can contain a mix of "CS*y*" and "CS*y*M*z*". When the destination is "CS*x*" or " ", the destination file will inherit the properties of either:

   - the first file "CS*y*" in the righthand side, or
   - the first file "CS*y*M*z*" if "CS*y*" is not used in the righthand side, or
   - the Live curve set if no "CS*y*" or "CS*y*M*z*" is used. The memory "CS*y*M*z*" will be used on all memories in the destination. That is, "CS2 = CS3/CS3M5" will divide all of the memories in CS3 by CS3M5.

5. If both "CS*y*" and "CS*z*" are in the righthand side, then both must have the same number of memories.

6. When the destination is "CS*x*M*y*" the righthand side can have "CS*y*" or "CS*y*M*z*". If "CS*y*" is used, the program assumes that it is really "CS*y*M1" even if "CS*y*" has more than one memory. The destination file will retain CS*y*M1's properties.

7. Either "x" or "c" can be used in the righthand side as part of a conditional statement as in (x>500) or (c!=367). "x" or "c" indicate the cursor location. Use "c" when the curve or file is not calibrated; use "x" when it is.

8. Conditional statements must be enclosed in parentheses as in the equation CS2=CS1*(c<700).

5.4B Valid Operators

+, -, *, and /	Arithmetic operators
^	Exponentiation
(n)	An expression
Log(n)	Base 10 logarithm of *n*
Ln(n)	Natural logarithm of *n*
Sin(n)	Sine of *n*
Cos(n)	Cosine of *n*
Tan(n)	Tangent of *n*
Cot(n)	Cotangent of *n*
Sqrt(n)	Square root of *n*
Abs(n)	Absolute value of *n*
Int(n)	Integer portion of *n*
Sgn(n)	Sign of *n*: returns 1 if +, 0 if -
(m)AND(n), (m)OR(n), (m)XOR(n)	Logical operators where (*m*) and (*n*) are constants, curve sets, or conditions.

5.4C Valid Lefthand Operands

Memory location 5 is reserved for Live data acquisition and cannot be used as a destination for a curve calculation.

no left hand operand Uses CS*x* where *x* is the memory location indicated by the arrow cursor.

CSx where *x* is one of the four memory locations (1-4).

CSxMy CS*x* has one or more spectra (memories) and is one of the curve sets in memory. *y* is one of these spectra.

5.4D Valid RightHand Operands

The lefthand side of the calculation cannot be referenced in the righthand side. The operands in the righthand side of a calculation can be a mix of single and multi-memory curve sets, numbers, and conditional statements. See Section 5.4A for the rules to follow when using single and multi-spectra curve sets.

CSx where *x* is one of the four memory locations (1-4).

CSxMy CS*x* has one or more spectra (memories) and is one of the curve sets in memory. *y* is one of these spectra.

CSxMyCz Cz is a specific channel for Memory y of CSx. The last channel of each memory is the source compensation channel. If the curve set is listed as having 700 channels (in the Information screen), the source compensation channel is 700 and channels 0-699 are spectral data.

number (-number) Integers and real numbers. If the number has has a negative sign, the number and sign

must be enclosed in parentheses.

conditional statements Conditional statements return either a 1 or a 0 depending on the truth of the statement. These statements return a 1 whenever the statement is true and return a 0 whenever it is false. The following are conditional statements:

(m>n) Returns a 1 whenever *m* is greater than *n*.

(m<n) Returns a 1 whenever *m* is less than *n*.

(m==n) Returns a 1 whenever *m* is equal to *n*.

(m!=n) Returns a 1 whenever *m* is not equal to *n*.

c or x *c* or *x* are used in conditional statements to indicate channel or wavelength number. *c* is used when the data is not calibrated; *x* is used when it is calibrated.

5.4E Types of Calculations

In the types of calculations shown below, the symbol "#" is used to indicate an operation either arithmetic or logical. Note that trigonometric and other operations require that the operand be enclosed in parentheses. Conditional statements must be enclosed in parentheses.

1. CS*x* = CS*y* # CS*z* curve sets (files) have the same number of spectra and file length. The resulting curve set will have the same properties.

2. **CS*x* = CS*y* # CS*z*M*w*** **CS*y* may contain one or more** spectra. CS*z* contains multiple spectra of which only M*w* will be used in the calculation. The spectra in CS*y* and CS*z* have the same length. CS*x* will be the same length as CS*y* and CS*z* and contain the same number of spectra as CS*y*.

3. CS*x*M*y* = CS*u*M*z* # CS*q*M*w* CS*u* and CS*q* are multi-spectra curve sets of the same length. A single spectrum from each is used in the operation. The result is placed in a memory of an existing multi-spectra curve set.

4. CS*x* * (*C* == *y*) The value of this term is zero except for channel *y*, when its value is the same as CS*x*.

5. CS*x* = CS*y* # (constant) The constant can be either a number or a conditional statement. For example, the calculation **CS1 = CS2*(10000)** creates a curve set in which the value of each data point in CS2 is multiplied by 10000. A calculation such as **CS1 = CS2*(c<500)** creates a curve set in which all of the data at channels below channel 500 are multiplied by 1 and are preserved; all values at channels 500 and higher are multiplied by 0.

   Note: The parentheses are not required when the constant is a positive integer.

6. CS*x*M*y* = CS*u*M*z* # (constant) The constant can be either a number or a conditional statement. For example, the calculation **CS1M3 = CS2M1*(10000)** creates a curve set in which the value of each data point in CS2M1 is multiplied by 10000 and stored in the third memory of the multi-spectra curve set at memory location 1. A calculation such as **CS1M3 = CS2M1*(c<500)** overwrites the third spectrum in the curve set at memory location 1 with the result of the calculation. The calculation multiplies all of the data at channels below channel 500 by 1 so that their values are preserved; all values at channels 500 and higher are multiplied by 0.

   Note: The parentheses are not required when the constant is a positive integer.

5.4F Sample Calculations

CS1/CS2	Divides each data point in CS1 by its equivalent in CS2. The result is stored in the memory location indicated by the arrow cursor.
CS3 = CS1/CS2	Divides each data point in CS1 by its equivalent point in CS2. The result is stored in memory location 3.
CS2 = CS1*5000	Multiplies each data point in CS1 by the constant "5000". The result is stored in memory location 2.
CS2 = CS1*(-5000)	Multiplies each data point in CS1 by the constant "(-5000)". The result is stored in memory location 2.
CS2 = CS1	Copies each data point in CS1 to CS2.
CS3 = CS1-CS2	Subtracts each data point in CS2 from its equivalent in CS1. This is useful when correcting for background.
CS3=CS1/CS2	Creates a single- or multiple-spectra curve set. All of the values in each spectral curve set are divided by their equivalents in another curve set containing the same number of spectra. The resulting curve set is placed in memory location 3.
CS3=CS2/CS2M1	Creates a curve set having the same length and the same

number of spectra as CS2. All of the values in CS2 are divided by their equivalents in the first spectrum of the multi-spectra curve set. The resulting curve set (placed in memory location 3) shows the changes that occurred during the acquisition. Spectral lines that have grown will be above 1; those that have shrunk will be below 1; those that haven't changed will be approximately equal to 1. If a line has grown by a factor of 2 since the acquisition of the first memory, its value will be 2.

CS3=CS1/(CS2*50000) Creates a single- or multiple-spectra curve set. All values in CS2 are multiplied by 50000 and then divided into CS1.

CS3=CS1/CS2*50000 Creates a single- or multiple-spectra curve set. The data points in CS1 are divided by their equivalents in CS2 and the result is multiplied by 50000.

CS3=CS1*(C>200) Creates a curve set in which the values of all of the data points above the cursor location in CS1 have been preserved. All values of points at or below the cursor location at 200 are multiplied by 0. Useful in getting rid of strong spectral lines which might overshadow lines of interest.

CS3=CS1*(C<700) Creates a curve set in which the values of all of the data points below the cursor location in CS1 are preserved. All values of points at or above the cursor location at 700 are multiplied by 0. Useful in getting rid of strong spectral lines which might overshadow lines of interest.

CS2=CS1*(C==724) Creates a curve set in which only the values of the cursor at location 724 is preserved. All other points are multiplied by zero. Useful in isolating a spectral line of interest.

CS3=CS1*((X>544)AND(X<547)) Creates a curve set in which the values of the wavelengths between 544 and 547 are preserved.

CS3=CS1*((C>150)AND(C<850)) Creates a curve set in which the values of data points between channels 150 and 850 are preserved and all other points are multiplied by zero. Useful in suppressing non-intensified channels of a Model 1455 detector.

CS4=(CS1M1*0)+((C>500)AND(C<700)) Creates a single-spectrum curve set that is the same length as CS1. The value of each data point between channels 500 and 700 is 1. The value of each data point outside of this range is 0. This curve set can then be used as a mask to speed up calculations to achieve the same effect as CS3=CS1 *((C>500)AND(C<700)).

CS5=CS1*CS3 Uses the CS4 created in the previous example which contains only 1's and 0's. The values of data points between channels 500 and 700 in CS1 are preserved and all other points are multiplied by 0.

CS3=CS1*((C>500)XOR(C<700)) Creates a curve set in which the values of data points between channels 500 and 700 are multiplied by 0 and all other points are preserved.

CS3=CS1+CS2*(C==150) Adds the value of Curve Set 2 at channel 150 to Curve Set 1, and puts the result in Curve Set 3.

CS4=(CS1M1C1024/CS2M1C1024)*CS2 Takes a ratio of the source compensation values (in this case, curve set length is 1024) for the first memories in CS1 and CS2 and multiplies the result by the memories in CS2. In this way the source compensation value (if a source compensation signal is being input) can be used to normalize for fluctuations in light intensity or whatever the source compensation signal is based on.

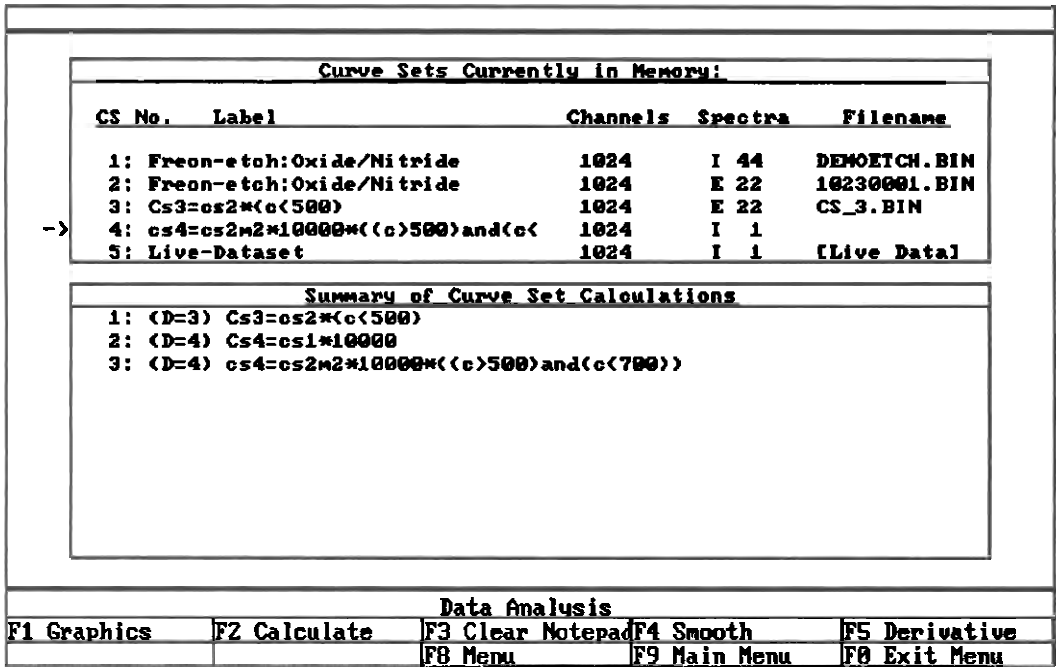


Figure 5-21. CURVE CALCULATION EXAMPLE

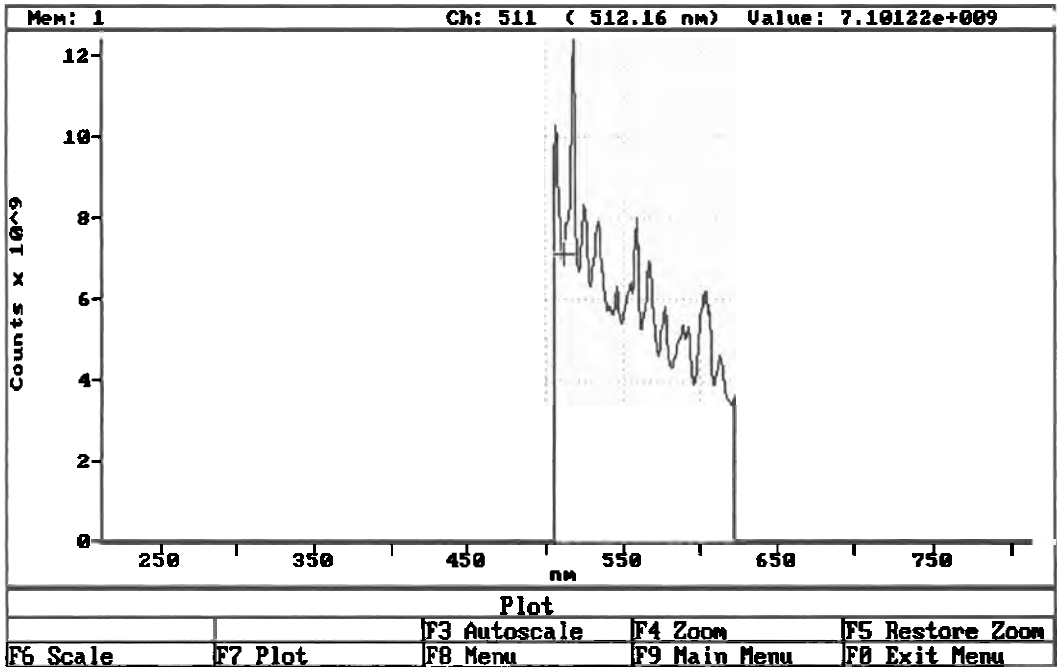


Figure 5-22. SCREEN PLOT OF THE CURVE CALCULATION

5.4G Viewing the Result of a Calculation

Figure 5-21 shows a calculation that could be made on one of the curve sets in memory. Refer to Line 3 of the notepad for the entire text of the calculation.

Figure 5-22 shows the plot of that calculation. Notice that all of the data points have been zeroed out with the exception of the data points between channels 500 and 699.

5.5 SMOOTHING AND DIFFERENTIATION

A curve set can smoothed, differentiated, or smoothed and differentiated. The order in which the operations are performed does not matter. As is the case with curve calculations, the result of any of the smoothing or derivative functions overwrites the data existing in the memory location pointed to.

Note: These functions can only be performed on curve sets that fit into memory (internal curves represented by **I** under **Spectra**). The data is modified in memory, leaving the original data on disk intact. If the curve set is large enough to have been made external (**E** under **Spectra**) or other curve sets are taking up memory space, either delete the other curve sets or only load a portion of the set you want to act on.

5.5A Smoothing

When <F4> Smooth is performed on a selected curve set, a binomial smooth operation is done on the curve/s. The extent of the smoothing depends on the number of points selected (3-25). The higher the number, the greater the degree of smoothing.

5.5B Derivative

When <F5> Derivative is selected, a binomial differentiation is performed on the selected curve set as a function of wavelength (or the X axis). The **Summary of Curve Set Calculations** will list the derivative function as **Deriv. (X)**. To take a second derivative, use <F2> twice; a third derivative, three times; etc..

5.5C Derivative as Function of Time

When <Shift><F5> is selected, the derivative is taken as a function of time. This provides a quick way to identify which wavelengths changed during the acquisition and draws attention to the lines that had the most rapid transitions.

The time derivative is taken by positioning the pointer at the desired multispectra curve set and then pressing <Shift><F5>. The curve set is then replaced by a new one, with each memory showing the difference between two spectra. Except for the first and last memories, each memory(n) will be the sum of [memory(n+1) - memory(n-1)]. The new memory 1 will have the result of [memory(2) - memory(1)]. The last memory(z) will be [memory(z) - memory(z-1)]. The **Summary of Curve Set Calculations** will list the time derivative as **Deriv. (t)**.

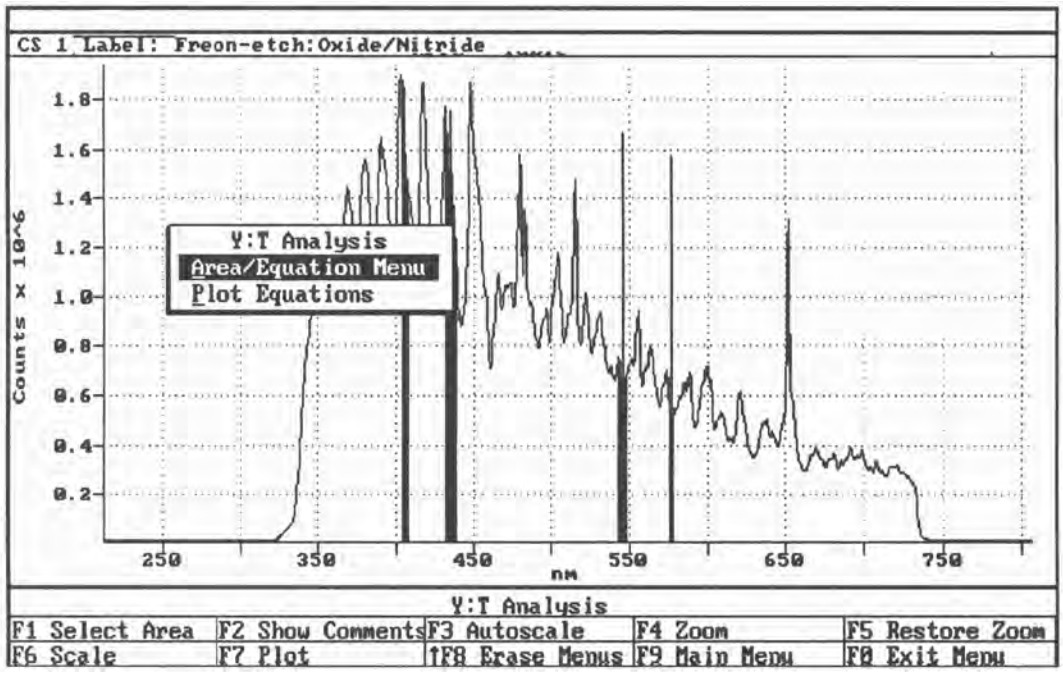


Figure 5-23. Y:T ANALYSIS SCREEN

5.6 Y:T ANALYSIS

5.6A Y:T Analysis Screen

Y:T analysis allows you to select areas under a previously acquired spectral curve and apply equations to them that can then be plotted to see the change in intensity over time. Accessing the Y:T analysis section of the program is accomplished by selecting **Y:T Analysis** from the **Graphics** menu. A previously stored area/equation file can be recalled and applied to the current data, or new areas and equations can be defined. The results of the equations can be plotted to the screen to view the changes in intensity over time that occurred when data was acquired.

This section describes the function keys that are present on the **Y:T Analysis** screen (Figure 5-23). The sections that follow it describe in detail how to use the **Area/Equation Menu** functions to select areas and create equations for the purpose of analyzing the currently selected data. Also described are the two types of equations plots that can be generated and displayed when **Plot Equations** is selected from the **Y:T Analysis** menu.

Function and Esc Keys: The following function keys are active when the **Y:T Analysis** screen (Figure 5-23) is displayed.

Key **Function**

F1 Select Area: Allows you to define and comment up to twelve areas of a spectrum for monitoring.

To select an area, first press <F1>. Then, using either the cursor keys or <C> or <X>, move the cursor to what will be the lefthand side of the area and press <Enter>. Now move the cursor to the right until you reach what will be the righthand side of the area; notice the highlighting used to indicate the area. Press <Enter> again. At the **Area Number** prompt either press <Enter> to accept that area number or key in the area number you want to assign and then press <Enter>. At this time you can also key in a comment for this area and press <Enter> once more to complete the area selection process. The area selection and comment will be entered into the Area/Equation Table and the comment can be displayed on the Y:T Analysis screen via <F2> Show Comments.

To delete an area, go to the Area/Equation Table and point to the area to be deleted. Press <F4> Delete Item, and press <Y> followed by <Enter>.

Note: Reusing a previously assigned area number overwrites the previous area selection.

F2 Show Comments: Shows or hides the comment associated with each area. A comment can be added when the area is selected or it can be added in the View/Edit Areas/Equations screen with the <F6> Comment function.

F3 Autoscale: Automatically scales the Y axis of the spectra for the best fit to the display area.

F4 Zoom: Expands a designated section of a spectrum to fill the display area.

F5 Restore Zoom: Restores the data display to its unzoomed state, where all of the active channels are displayed.

F6 Scale: Accesses the **Scale** menu through which spectral X- and Y-axis values can be changed. The screen is not redrawn until **<F10> Exit Menu** is pressed. On the **Scale** menu:

Y Autoscale automatically rescales the Y axis for the best fit of the data plot to the screen.

X AutoScale automatically rescales the X axis to show the complete curve set.

X Min, Max and **Y Min, Max** control the X- and Y-axis scaling for the spectral data display. Changing one of these values is accomplished by highlighting the parameter to be changed and pressing **<Enter>**. Then, key in the new minimum value and press **<Enter>**. Next, key in the new maximum value and press **<Enter>** again. Accept either value as unchanged simply by pressing **<Enter>**.

F7 Plot: Plots the current curve set to the plotter or printer connected to the port, selected during installation, after a **<Y>** response and **<Enter>** are keyed in at the "Hard Copy Device connected?" prompt. The message "Sending Data to Device" is displayed while the data is being sent.

If you wish to change the type of output device used by F7, you must run the Install program. Refer to Chapter 2 for instructions on running Install.

F8 Menu: Accesses the menu associated with the current display screen.

↑F8 Erase Menus: <Shift><F8> erases all menus on the screen.

F9 Main Menu: Accesses the **Main** menu.

F10 Exit Menu: Exits the currently displayed menu. In some cases, it also exits the current screen.

The cursor is moved from one spectrum to another by using the **<↑>**, **<↓>**, **<Shift)<↑>**, and **<Shift><↓>** cursor keys. Cursor movement along a spectrum is accomplished via the **<←>**, **<→>**, **<Shift><←>**, **<Shift><→>**, **<Home>**, **<End>**, **<C>**, and **<X>** keys.

The **<Esc>** key is used to stop an operation before completion or to return to the screen or menu last displayed.

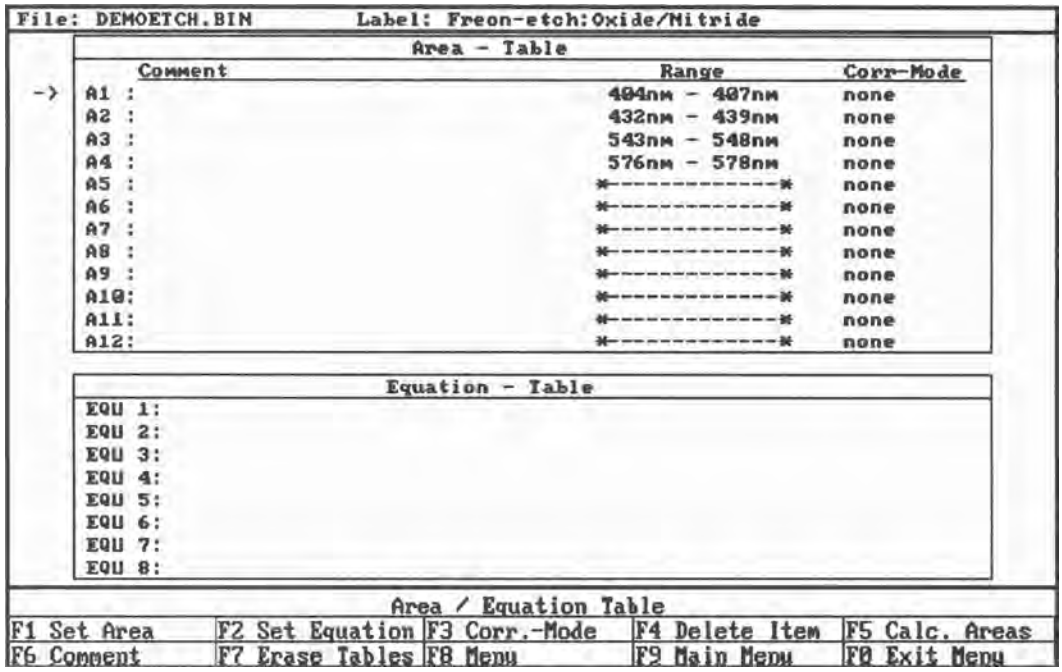


Figure 5-24. AREA/EQUATION TABLE

5.6B Defining and Deleting Areas

Up to 12 areas can be defined for the current (selected) data. These areas can be used in equations to monitor change of specific spectral lines or areas as data is acquired.

Defining an area can be accomplished in any one of three ways. You can graphically select the **<F1> Select Area** function in the **Y:T Analysis** screen (Figure 5-23) and use the cursor to mark off the areas to be used. You can select an area based on the selected channel in a channel profile. Or, you can edit the **Area/Equation Table** (Figure 5-24) to define the area or areas. All of these methods can be used to update the same Area/Equation Table.

The first method, area selection via the cursor in the Y:T Analysis screen, is discussed under the description of the <F1> Select Area function in Section 5.6A.

The second method of area selection, the method based on the current channel or "super" channel in the Channel Profile screen, is described in Section 5.3C.

The third way to define an area by entering actual values in the **Area/Equation Table**. This method will now be discussed.

To access the Area/Equation Table from the **Y:T Analysis** screen, press **<F8> Menu** if the menu is not already displayed. From the menu, select **Area/Equation Menu**. From this menu, select **View/Edit Areas/Equations**. This will bring up the **Area/Equation Table**, which lists any areas and equations previously entered and can be edited to change or add areas and equations. The advantage to entering areas via the table is that you can define overlapping areas of interest.

Deleting an area is a matter of pointing to the area in the Area/Equation Table, selecting **<F4> Delete Item**, and then pressing **<Y>** followed by <Enter>.

Function and Esc Keys: The following function keys are active in the **Area/Equation Table** screen. More details about their use are given in the next section.

Key	Function
F1	**Set Area:** Opens the next unused area entry line.
F2	**Set Equation:** Opens the next unused equation entry line.
F3	**Corr.-Mode:** Toggles among the three possible types of baseline correction: none, baseline, and area.
F4	**Delete Item:** Allows you to clear the area pointed to in the Area table.
F5	**Calc. Areas:** Calculates and displays the values for the areas listed. These values are based on the wavelength boundaries and the active correction mode for each area.
F6	**Comment:** Allows you to add a comment to the area entry line. The comment may have a maximum of 29 characters. Comment entry is set up for automatic insertion at the cursor. The

standard editing keys **<Home>**, **<End>**, **<→>**, **<←>**, **<Del>**, and **<Backspace>** can be used in entering and editing the comment.

The comment is displayed on the Area/Equation Table. It can also be displayed on the Y:T Analysis screen when <F2> Show Comments is selected and will be shown on the Equation Plot screen. In addition, a comment displayed on the Y:T screen or Equation Plot will be drawn on the hardcopy if <F7> Plot is selected.

F7 Erase Tables: Deletes all areas and equations. For safety, before it does so it displays the message

Erase Areas and Equations (Y/N)?

If you change your mind, press **N**. To erase everything, press **Y**.

F8 Menu: Exits the screen and redraws the menu/s.

F9 Main Menu: Accesses the **Main Menu**.

F10 Exit Menu: Exits the currently displayed menu. In some cases, it also exits the current screen.

Pressing **<Esc>** ends any operation you have started with the function keys without it taking effect. Pressing it again returns to the **Area/Equation** menu.

Defining Areas: To define an area from the table, press **<F1> Set Area** to open the next unused area entry line, key in the start and end channels as prompted, and press **<Enter>** to complete the entry. To edit an existing area, move the cursor to the area listing and press **<Enter>**. Key in the start and end channels as prompted and press **<Enter>** to complete the entry.

To delete an area or equation, move the cursor to the item to be deleted and press **<F4> Delete Item**. At the prompt "**Delete Item**" key in **Y** to delete the area or equation.

Corr.-Mode: In addition to specifying the range of the area, you can specify the type of baseline correction via the **<F3> Corr.-Mode** function. This allows you to remove unwanted background noise or signal. To designate a baseline correction, press **<F3>** to select one of the three options: "none", "Baseline" (area corrected for baseline), or "Area *X*" (one of the twelve possible areas). Press **<F3>** until the desired correction type is shown in the area listing.

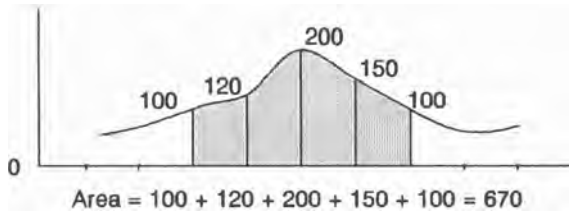
None: No correction is made for the area. The area calculation (<F5>) will be based on the summed Y values in the intensified area as shown in Figure 5-25. Entering **0** when prompted for an area number will turn baseline correction off.

Baseline: Baseline correction will be done by taking the intensified channels at either end of the intensified area and drawing an imaginary line (or baseline) between them as shown in Figure 5-25. The resulting corrected area is that part of the area above this line. Baseline correction is calculated by taking the uncorrected value or the area and subtracting the area below the baseline. This calculation may be expressed as:

$$Correction_{Base} = Area_U - \left(\frac{C_{First} + C_{Last}}{2} * Chnls \right)$$

Where:

$Area_U$ is the uncorrected value of the area.
C_{First} is the first intensified channel.
C_{Last} is the last intensified channel.
Chnls is the number of channels in the area.



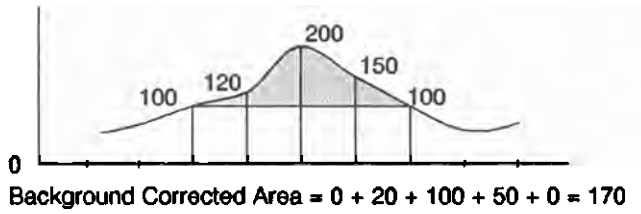
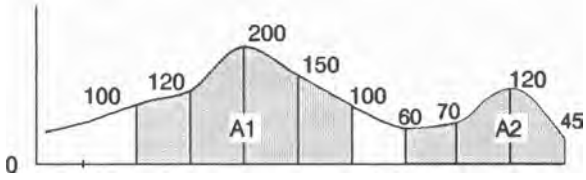


Figure 5-25. BASELINE CORRECTED AREA

Corr.-Mode: (cont.)

Area X: Area correction is made by subtracting the uncorrected value of the area selected for Corr.-Mode from the area being corrected. Area correction is selected when <F3> is pressed and the "Background Area:X" prompt appears, where *X* is the last setting used or 1 if no area has been set. Key in the number of the area to be used for the correction and press **<Enter>**, or just press **<Enter>** to accept the number shown. Area correction can be turned off by keying in a **0** and pressing **<Enter>**. Figure 5-26 shows the calculation of A1's area correction by A2.



A1 = 100 + 120 + 200 + 150 + 100 = 670
A2 = 60 + 70 + 120 + 45 = 295
A1 corrected by A2 = 670 - 295 = 375

Figure 5-26. AREA CORRECTED AREA

5.6C Entering and Editing Equations

Equations using the operators, variables, and operations described in Sections 5.6E through 5.6H can be entered or modified in the **Area/Equation Table** (Figure 5-24). These equations are used to monitor changes in the areas of interest over time. The use of the function keys that are active in the **Area/Equation Table** screen is described in the last section.

To enter a new equation, press **<F2> Set Equation** to open the next unused equation entry line, key in the equation, and press **<Enter>** to complete the entry. To modify an existing equation, move the cursor to the equation line for entry or modification, press **<Enter>**, key in the modification, and press **<Enter>**.

Equations can be commented when they are first entered or at a later time. Commenting an equation is accomplished by keying in the equation, keying in a colon **<:>**, keying the comment, and pressing **<Enter>** when you've finished. The colon tells the software that anything that follows should be ignored when the equation is processed. The line below, for example, says that Area 1 is to be evaluated as Equation 1; the comment will be ignored, but all or most of it will be displayed with the equation.

EQ1: a1: this is a comment

5.6D Loading and Storing Areas and Equations

Equations previously saved with another curve set can be loaded into the **Area/Equation Table** for the currently selected curve set. Loading Area/Equation values is done by selecting **Area/Equation Menu** from the **Y:T Analysis** menu, and from this selecting **Load Area/Equation Table.** The File Selection screen (Figure 5-27) that appears allows you to look through the file listings in the current directory, change the current directory, edit labels, delete files, and examine the file information associated with the highlighted file. The file information includes the Area/Equations information associated with a curve set.

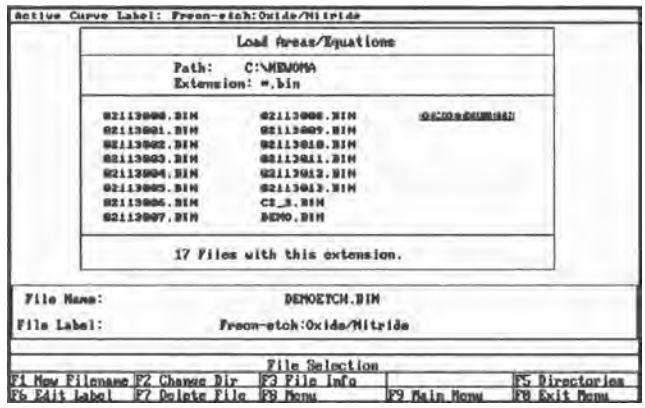


Figure 5-27. FILE SELECTION SCREEN Load Areas/Equations

To load the Area/Equation table from the selected file into memory, move the highlight cursor to a file containing the Area/Equations setup of interest and press **<Enter>**. Now the setup will be used by the program when equations are plotted.

Storing the Area/Equation Table: An important point to remember is that an Area/Equation table that has been loaded has been loaded into memory. If you make changes and want to store the Area/Equation setup with the current curve set, you must enter the **Area/Equation** menu and select **Store Area/Equation Table** or you could store the entire curve set. The File Selection screen that appears allows you to look through the file listings in the current directory, change the current directory, edit labels, delete files, and examine the file information associated with the highlighted file which is the current curve set. The screen will have a similar appearance to the **Load Area/Equation** screen (Figure 5-27), except that it will say **Store Areas/Equations** at the top.

To store the Area/Equation table, simply press **<Enter>**. The Area/Equation information associated with the current curve set will be overwritten with the new Area/Equation table values. Note that instead of saving the Area/Equation table you could simply store the entire curve set depending on what you had originally loaded into memory.

The function keys active in the Load Areas/Equations and Store Areas/Equations screens are:

Key	Function
F1	**New Filename:** Allows you to key in a filename to be used when storing an Area/Equation table.
F2	**Change Dir:** Allows you to edit the directory path to change the directory used by the program. The path entered must be a valid DOS path. The directory changes when **<Enter>** is pressed. If the directory name keyed in does not exist, the program allows you to make it at this time.
F3	**File Info:** Opens another window that shows detailed information about a selected file, including the Area/Equation table.
F5	**Directories:** Displays a listing of the current directory's subdirectories. A subdirectory can then be selected by moving the highlight bar and pressing <Enter> twice. Note that a single dot (.) listing means the current directory and a double dot (..) means the parent directory. **File Menu:** Returns to the File Selection screen.
F6	**Edit Label:** Allows you to add or change the file label associated with the currently highlighted curve set.
F7	**Delete File:** Deletes the selected file. For safety, the program asks you first if you really mean to do this, and requires a <y> or <n> answer to the prompt.
F8	**Menu:** Exits the screen and redraws the menu/s.
F9	**Main Menu:** Accesses the **Main** menu.
F10	**Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

To select a file, move the highlight bar with the ↑ and ↓ keys until it is highlighted. You can preview the Area/Equation information associated with that file with the **<F3> File Info** function. Press a key such as **<Enter>** or the spacebar to leave the information screen.

If the highlighted file contains the table of interest, press **<Enter>** to load the information. Press **<Esc>** or **<F10> Exit Menu** to back out of the operation without changing the current table and return to the **Area/Equation** menu.

5.6E Valid Operators

Operators that can be used in Y:T equations are :

+ , -, *, /	Arithmetic operators
^	Exponentiation
(n)	An expression
Log(n)	Base 10 logarithm of *n*
Ln(n)	Natural logarithm of *n*
Sin(n)	Sine of *n*
Cos(n)	Cosine of *n*
Tan(n)	Tangent of *n*
Cot(n)	Cotangent of *n*
Sqrt(n)	Square root of *n*
Abs(n)	Absolute value of *n*
Int(n)	Integer portion of *n*
Sgn(n)	Sign of *n*: returns 1 if +, 0 if -
(V1)AND(V2), **(V1)OR(V2),** **(V1)XOR(V2)**	Logical operators where (*V1*) and (*V2*) are area, equation, time, or threshold.

5.6F Valid Conditions

>	greater than
<	less than
= =	equal to
!=	not equal to

5.6G Variables

The variables that can be used in Y:T equations are areas, equations, elapsed time, actual time, and source compensation.

A1-A12	Areas 1-12.
E1-E8	Equations 1-8. Earlier equations can be used as variables in subsequent equations.
T	Elapsed time. Lowercase t is also valid.
number	Actual time or time period expressed in seconds, applied to current equation or area.

SC — Source Compensation input. This is a 0 to 10 VDC input on the rear panel that is digitized once per exposure time. It can be used to read signal from laser interferometers, RF impedance, matchbox error voltage, etc. The SC value is output in ADC counts per second. To convert to volts (or other units) use an equation: (SC-offset)/(exposuretime*ADC-maxcounts)*10 volts (or equivalent full scale units such as watts. ADC-max counts is 16383 for Models 1470/1462/99, 1461/1462/99, or 1463 and 32768 for Models 1470A and 1471A.

5.6H Valid Operations

The operations that can be performed in Y:T equations are simple arithmetic operations, normalization, slope, and logic operations.

Arithmetic Operations: operations using the operators listed in Section 5.6E.

Normalization:

Syntax: Eq# = N*V,T*

Where:

Eq# is the equation pointed to in the Areas/Equation Table.

N indicates normalization.

V is the area (A1-A12) or equation (E1-E8) to be used in the normalization.

T is the point in time (expressed in seconds) to use as the basis for the normalization.

Explanation: The result of the equation will be 1 for time < *T*. Whenever the time is ≥ *T*, the result of the equation will be *V(t)/V(T)* where (*t*) is the actual point in time.

Example: NA1,2

tells the program to normalize the counts in Area 1 to the intensity at 2 seconds. This is useful for eliminating variations between runs caused by window fogging or RF power level setting changes. A negative slope can be corrected by multiplying by -1 or using a time that ensures that the A1 value is positive.

Average:

Syntax: Eq# = AV*t*(expression)

Where:

Eq# is the equation pointed to in the Area/Equation Table.

AV indicates mean value.

t is the average window in seconds.

(expression) is the area (A1-A12), equation (E1-E8), normalized area or equation, or calculation to be used to determine the average.

Explanation: Average is the mean value of the expression overt the time window.

Example: AV3(A1/A3)

tells the program to take the mean value of the expression A1/A3 for the 3 second window preceding the current time.

Slope:

Syntax: Eq# = SL*t*(expression)

Where:

Eq# is the equation pointed to in the Areas/Equation Table.

SL indicates slope.

t is the slope window in seconds.

(expression) is the area (A1-A12), equation (E1-E8), normalized area or equation, or calculation to be used to determine the slope.

Explanation: Slope is calculated using linear regression of *the expression* over *t* preceding the current time. If the current time < *t*, the slope is calculated from time = 0 to the current time. At time = 0, slope = 0.

Example: SL3(NA1,5/NA3,5)

tells the program to take the slope of the expression NA1,5/NA3,5 for the 3 second window preceding the current time.

Logic (AND, OR, XOR):

Syntax: Eq# = *V*1(cond1)*V*2 AND *V*3(cond2)*V*4

Where:

Eq# is the equation pointed to in the Area/Equation Table.

V is the area, equation, time, or threshold.

cond is one of four conditions represented by <, >, = =, and != . These symbols mean:
< less than
> greater than
= = equal to
!= not equal

The result of the equation will be 0 if false and 1 if true.

Example: Eq5 = A1 > 40,000 AND A2 < 1E6

where 1E6 (1 x 10^6) is 1,000,000 expressed in scientific notation. The equation value would be 1 if the intensity of A1 was above 40,000 counts per second while A2 was less than 1,000,000 counts per second.

5.6I Sample Equations
Figures 5-29 through 5-31 are provided as background for the equations described on the following pages. These figures show the spectral data (10230001.BIN) being used, the **Y:T Analysis** screen, the **Area/Equations Table**, and some of the equation plots.

The left side of the sample equations is omitted. When using these equations, the left side is the equation line (Equ *n*:) in the Equation Table where the equation is being entered. Previously created equations in the table can be used in subsequent equations.

Note that in Figure 5-31, the Equ# displayed is labeled on the Y axis and its comment is printed at the bottom of the equation's plot window.

Equation Syntax:

A1 Referring to the **Area/Equation Table** (Figure 5-30), A1 is the summed intensity for the area between 385 nm and 388 nm.

A1/A2 Referring to the **Area/Equation Table** (Figure 5-30), A1 is the summed intensity for the area between 385 nm and 388 nm. A2 is the summed intensity for the area between 344 nm and 730 nm. This equation derives the ratio of the two areas.

A1*(T>30) This entry tells the program to plot the change in Area 1 so that data acquired during the first 30 seconds is ignored.

A1*((T>30)and(T<50)) This entry tells the program to plot the change in Area 1 so that data acquired during the first 30 seconds and after a total of 50 seconds has elapsed is ignored.

NA1,2.1 This entry tells the program to normalize the data in Area 1 to the intensity at 2.1 seconds.

NA2,2.1 This entry tells the program to normalize Area 2 to the intensity at 2.1 seconds.

NA1,2.1/NA2,2.1 This equation ratios the normalized data for Areas 1 and 2.

SL2(A1) This entry tells the program to take the slope of A1 for the 2 second window preceding the current time.

5.6J Plotting Equations
Except when in the Strip Chart mode, up to four equations can be plotted on the **Equation Plot** screen (Figure 5-31). In the Strip Chart mode, as many as eight can be displayed on the same time axis.

The **Equation Plot** screen is accessed by selecting **Plot Equations** from the **Y:T Analysis** menu. The program then prompts you for the equations to display. At each prompt, accept the equation number suggested by pressing **<Enter>** or enter an equation number and press **<Enter>**. If fewer than four equations are selected, press **<Esc>** or **0** after the last entry made to initiate the plot.

Moving along an equation plot is done by using the **<→>** and **<←>** cursor keys. Moving from one equation plot to another is done by using the **<↑>** and **<↓>** cursor keys. If four equations are plotted, pressing the **<↑>** key moves the cursor sequentially from Equation 1 to Equation 2 to Equation 3 to Equation 4. Pressing the **<↓>** key moves the cursor sequentially from Equation 4 to Equation 3 to Equation 2 to Equation 1.

Horizontal expansion and contraction of equations about the cursor is accomplished via **<Ins>** and **<Del>**, respectively. The **<PgUp>** and **<PgDn>** keys can be used to shift the window being viewed along the X axis. The **<*>** key autoscales the X axis. The **<F6> Scale** function is used to change the Y axis minimum and maximum values for a particular equation.

Function and Esc Keys: The following function keys are active when the **Equation Plot** screen is displayed.

Key	Function
F1	**Select Eqns:** Prompts you to key in the number of the equation you wish to display. To accept the suggested equation number, press **<Enter>**. The program will continue to prompt you to enter equation numbers. To exit the selection process before four have been entered, press **<Esc>**.
F2	**Strip Chart:** Selects strip chart mode which

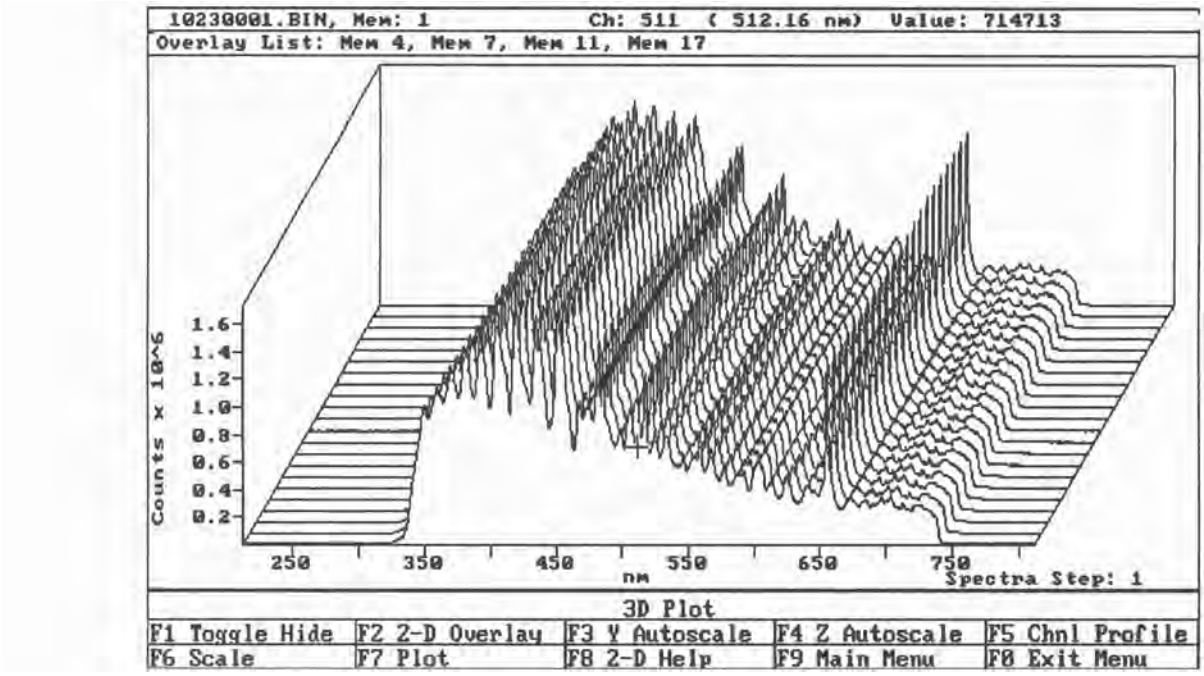


Figure 5-28. 3-D PLOT OF 10230001.BIN

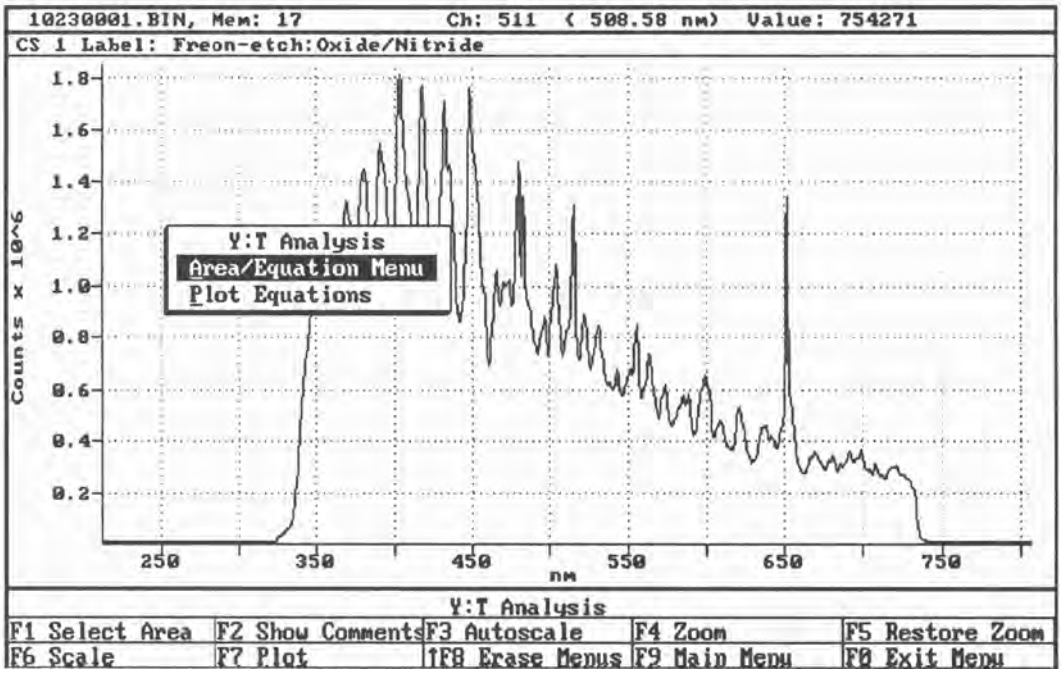


Figure 5-29. Y:T PLOT SCREEN

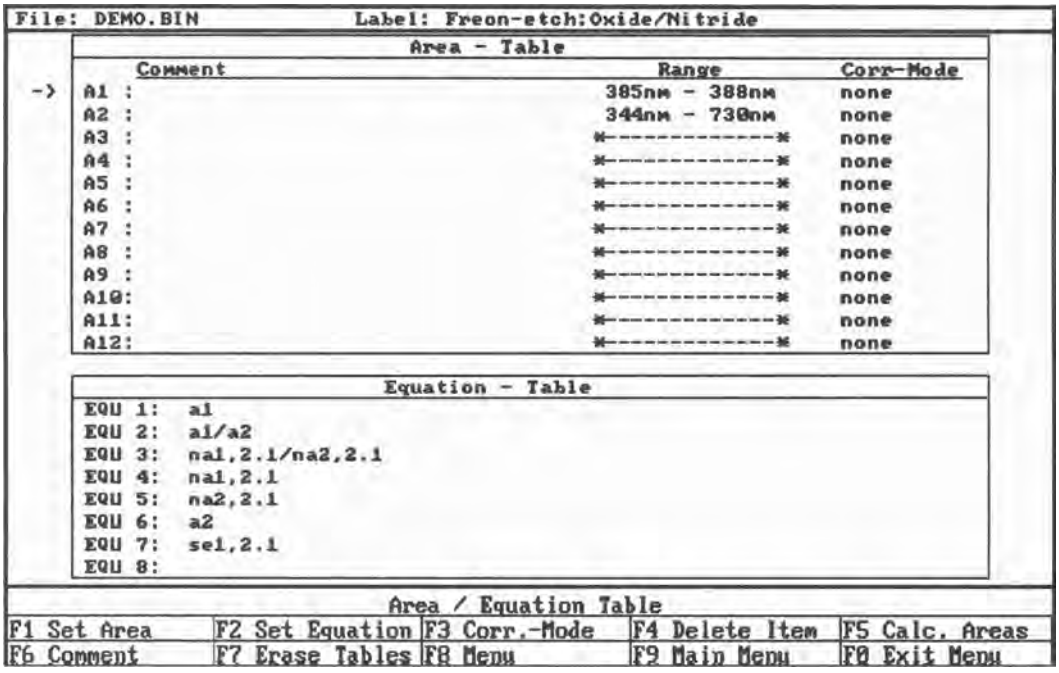


Figure 5-30. AREA/EQUATION TABLE WITH DATA FROM 10230001.BIN

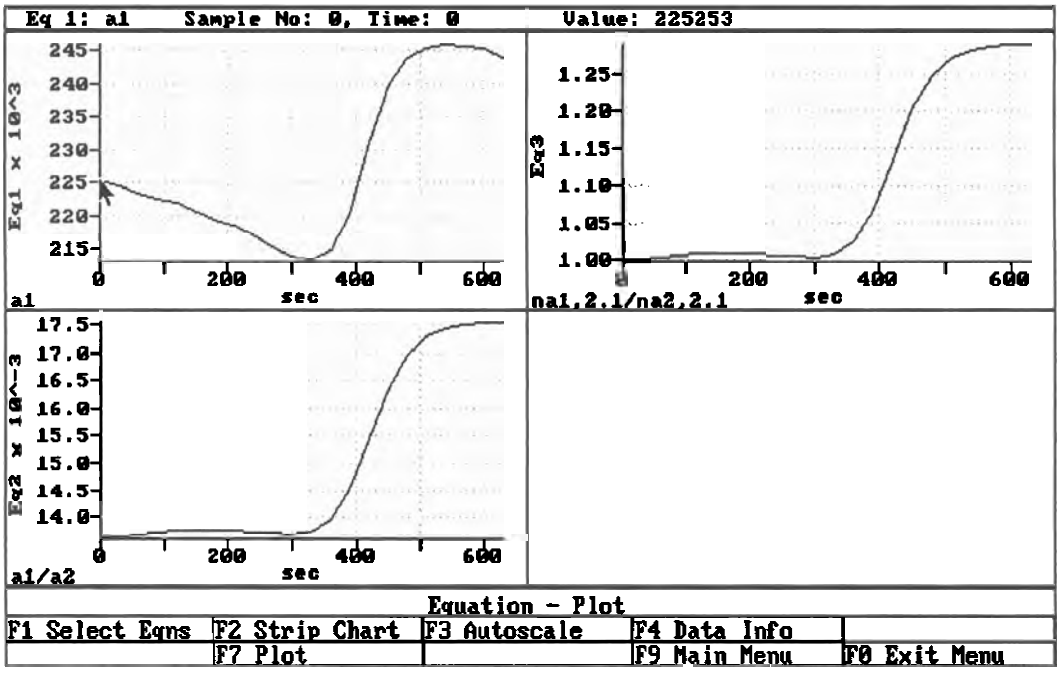


Figure 5-31. Y:T EQUATION PLOT FROM 10230001.BIN DATA

displays as many as eight equations on the same time axis. The program prompts you in the same manner as in **<F1> Select Eqns.**

F3 **Autoscale:** Automatically scales the Y axis of the equation graphs for the best fit to the display area.

F4 **Data Info:** Shows information regarding the source file and the area/equation table. You can use this as an aid while using **<F1>** or **<F2>** to select the equations to be plotted. To return to the **Equation Plot** screen, simply press any key (such as **<Enter>**).

F6 **Scale:** Prompts you for an equation number (current equation is the default) and allows you to key in new values for the Y-axis minimum (YMin) and maximum (YMax) for that equation.

F7 **Plot:** Plots the current curve set to the plotter or printer connected to the port, selected during installation, after a **<Y>** response and **<Enter>** are keyed in at the "Hard Copy Device connected?" prompt. The message "Sending Data to Device" is displayed while the data is being sent.

F9 **Main Menu:** Accesses the **Main** menu.

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

The **<Esc>** key is used to return to the screen or menu last displayed.

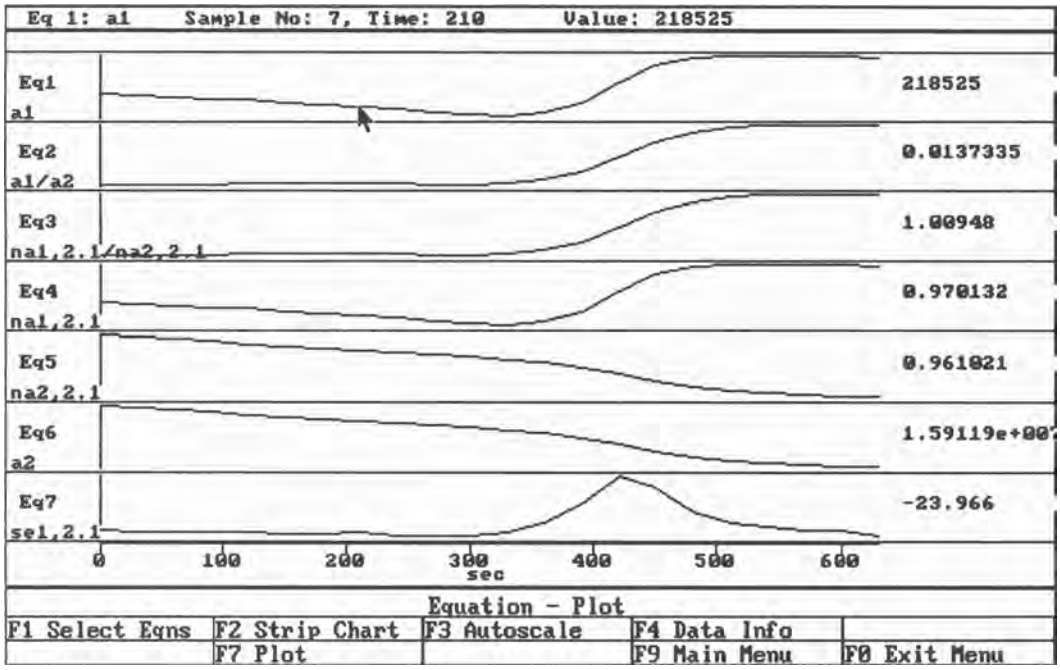


Figure 5-32. STRIP CHART MODE

5.6K Strip Charts

For convenient comparison, you can plot as many as eight equations on a single time axis in the Strip Chart mode (Figure 5-32). This mode is most convenient when you want to compare the Y:T results of three or more equations on the same time axes.

The Strip Chart mode is selected by pressing **<F2>** from the **Equation Plot** screen (Figure 5-31). Then at the prompt, you enter the number for each equation to be displayed. If you have eight equations (up to eight can be defined), you can display all eight by keying in each equation number followed by **<Enter>**. If you have fewer than eight or you want to view a subset of the equations, key in the equation number and press **<Enter>** until you have selected all of the desired equations. At that point you can either key in a **0** followed by **<Enter>** to plot the equations or press **<Esc>** for the same effect.

Note: Selected equations will be displayed on the screen in the order that they were entered. If Equation 3 was selected first, it will be drawn at the top of the plot display. If Equation 1 was then selected, it will be the next one drawn.

In addition to the actual Y:T curves, the equation number, equation, and any equation comment are shown at the lefthand side of the screen for each Y:T curve being displayed. The Y-axis value at the Sample Time reported in the information box is reported at the far right of each Y:T curve. That Y-axis value is updated for each curve whenever the cursor is moved along the X axis.

Cursor control is straightforward. The **<↓>** and **<↑>** keys move from Y:T curve to Y:T curve. The **<→>** and **<←>** keys move the cursor along the X axis of the current curve. **<Shift><→>** and **<Shift><←>** speed up cursor movement along the X axis. **<Home>** and **<End>** place the cursor at leftmost and rightmost X axis position, respectively, on the curve. The cursor position (in terms of Equation number, Sample Time, and Y-axis value) is reported in the information bar at the top of the screen.

Horizontal expansion and contraction of equations about the cursor is accomplished via **<Ins>** and **<Del>**, respectively. The **<PgUp>** and **<PgDn>** keys can be used to shift the window being viewed along the X axis. The **<*>** key autoscales the X axis. The **<F6> Scale** function is used to change the Y axis minimum and maximum values for a particular equation.

5.7 CONCATENATION

5.7A Introduction

The **Concatenate Files** feature allows you to add spectra of different spectral ranges together into a single curve (not to exceed 14000 pixels) for display and storage. You are allowed to choose a wavelength interval for normalizing all curves used in the concatenation.

This function can also be used to normalize spectra from different system to have the same x-axis parameters, thus enabling direct overlay for graphic comparison.

5.7B Concatenation Procedure

1. Load a curve or curve set. If more than one curve is loaded, the first curve in the set will be used in the concatenation. For best results, the wavelength calibration of the files to be concatenated must be accurate from end to end.

2. Determine the overall wavelength range for the concatenated file. For example, you might have curves that range from 325 nm to 400 nm, 395 nm to 450 nm, and 455 nm to 495 nm. In this case you might want to use 320 nm to 500 nm as the wavelength range. The range for each curve can be found by using the Data Information function or the <F3> File Info key.

   Also consider the wavelength interval to be used in the file. The interval is arbitrary (.05 nm, 1 nm, 10 nm, 0.0718 nm, etc). In other words, you can use any interval providing it is not so small as to cause more than 14000 data points, that is:

   (High - Low)/Interval < 14000

   The file with the shortest wavelength will have the smallest interval, which will be the default interval, but will result in the files with the largest number of data points.

3. After deciding on the range, select **Concatenate Files**, enter the low end of the wavelength range, press **<Enter>**, key in the high end, press **<Enter>**, key in the wavelength interval to be used to normalize the curves, and press **<Enter>** again. Note that the default values are from the curve that you loaded. If just putting individual spectra on a common x-axis, press F10 or ESC, move the curve-set pointer to an open CS slot, and load the second file. Select **Concatenate** and enter the same start and interval values used for the first curve.

4. Select the next curve from the **Concatenate another File?** screen. If the curve set contains more than one curve, **"First Spectrum:"** will appear so that you can choose which spectrum to use. Key in the number and press **<Enter>**. or just press **<Enter>** to accept Spectrum 1 as your choice. The data from that spectrum will be added into the concatenated file at the appropriate points in the wavelength range. You will then be prompted for another spectrum.

   The points where spectra overlap are averaged and gaps between spectra are zeroed to create a continuous curve. If either or both endpoints of a spectrum fall outside the wavelength range for the concatenation, they will be ignored.

5. After you have selected all of the spectra for the concatenation, press **<F10> Exit Menu** or **<Esc>** to leave the process.

6. Now that you are back in the **Data Analysis** screen, you can view the concatenation by selecting **Graphics** from the menu or by pressing **<F1> Graphics.**

Chapter 6
System Configuration

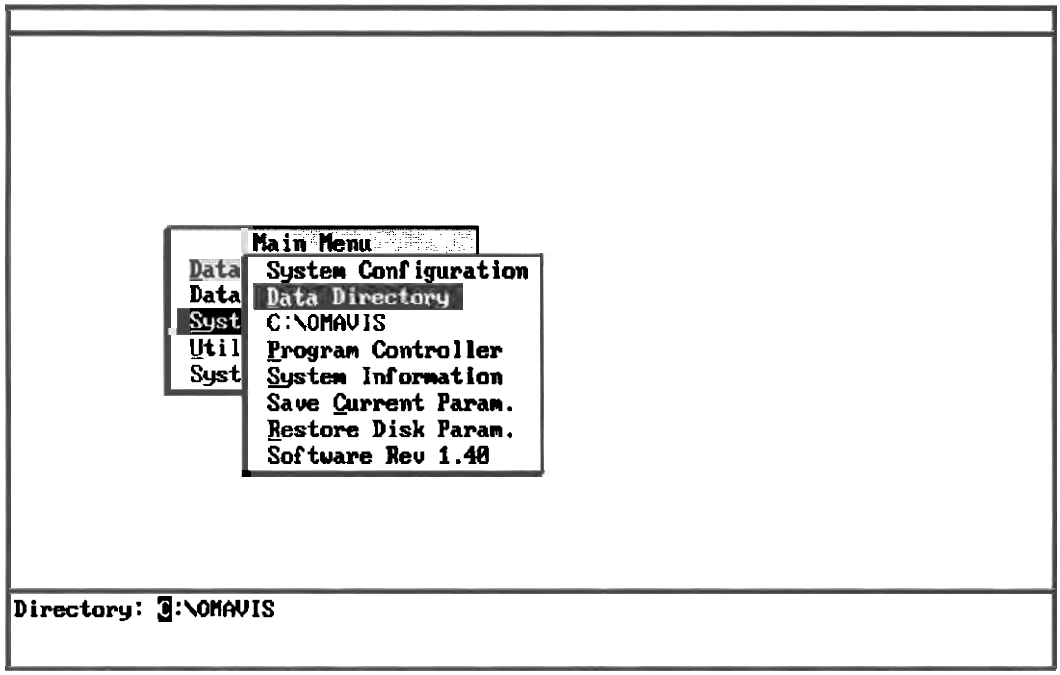


Figure 6-1. SYSTEM CONFIGURATION MENU: Data Directory Selected

6.1 INTRODUCTION

The System Configuration menu allows you to name a default data directory, program a detector, look at and change system information, save parameter settings to the M1470.PRM file, retrieve these settings if these settings are changed between turning the system on and prior to exiting the OMA Vision program, and check the OMA Vision software revision number.

The active function keys in the System Configuration screen are:

F8 **Menu:** Accesses the menu associated with the current display screen.

↑F8 **Erase Menus:** <Shift><F8> erases all menus on the screen.

F9 **Main Menu:** Accesses the **Main** menu.

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

6.2 DATA DIRECTORY

The **Data Directory** is the sub-directory where new files should be stored. This can be used to separate the data for different experiments; it should also be used to keep the total number of files in any directory below 500.

As can be seen in Figure 6-1, the current directory is C:\OMAVIS. A new default directory can be selected by choosing **Data Directory** from the System Configuration menu, keying in the name of valid DOS directory at the **Directory:** prompt, and then pressing <Enter>. If the directory already exists, the program stores the new default in the M1470.BIN file and uses it each time you acquire, load, and store data. If the sub-directory does not already exist when you key in the directory name, you will be asked if you want to create it; a **Y** response makes the new directory and changes the Data Directory to that directory at the same time.

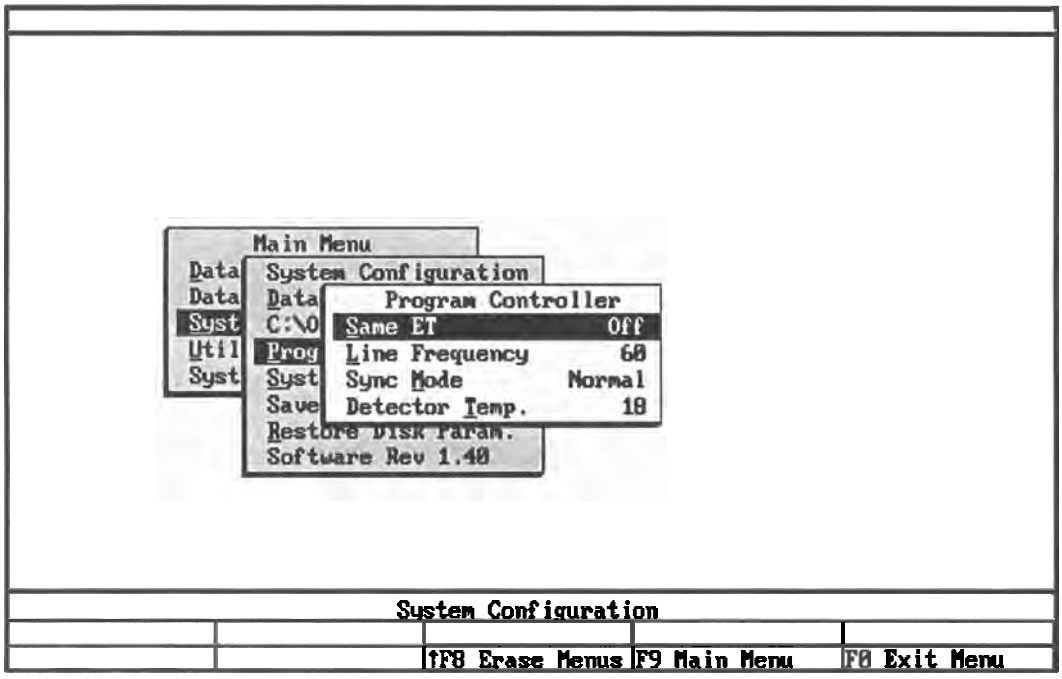


Figure 6-2. PROGRAM CONTROLLER MENU

6.3 PROGRAM CONTROLLER MENU

The Program Controllermenu (Figure 6-2) is opened when **Program Controller** is selected from the System Configuration menu. This submenu allows you to note whether the Same ET feature is supported by the system. It additionally allows you to monitor and/or change the power frequency setting, to possibly set the synchronization mode, and to select or indicate detector temperature (depending on the detector controller)

6.3A Same ET

The Same Exposure Time (ET) default setting is ON if **Same ET** is supported by the system. When Same ET is ON, the detector will, while idling, scan at the same exposure time that will be used when data acquisition is started; the effect of this is to stabilize dark current levels. When Same ET is OFF, the detector scans at the minimum exposure time when at idle and uses the set exposure time when data acquisition is started.

6.3B Line Frequency

The number reported for Line Frequency should agree with the line frequency (50 or 60 Hz) of the power line that the system is connected to. To change the Line Frequency shown, simply key in an L or move the cursor to **Line Frequency** and press **<Enter>**.

6.3C Sync Mode

The OMA Vision software recognizes two Sync Modes: Line and Normal. Users with a Model 1471A or Model 1470A detector interface can effectively have a third sync mode because of the External Sync switch on the rear of that instrument. Read the Model 1471A or Model 1470A manual to learn how to implement external synchronization with software that only recognizes Line and Normal modes.

6.3D Detector Temperature

Condensation Caution!:

If the setting for **Detector Temp** is below the dew point, moisture will condense on the pins of the array, causing current leakage, and therefore dark current problems. Condensation on the detector face will broaden and diffract peaks and will reduce signal. Therefore, the detectors should be purged with dry nitrogen (NOT argon), unless run well above the dew point, i.e., at +18°C with the relative humidity held below 50%.

> **WARNING!**
>
> Corrosion caused by condensation may lead to a potentially catastrophic failure of the array.

On M1471A and M1470A units, DEFAULT indicates that the thermoelectric cooler (Peltier) is turned off, and the dark current may be both relatively high (more than 2,000 counts/second) and drifting with the air temperature. Model 1471A and Model 1470A units can select temperatures from 20°C to -40°C (liquid cooling assistance may be required below 0 C), in 1 degree increments and the Peltier will try to lock on the selected temperature. If the temperature is set to a temperature in the range of +21 to +25°C, the Peltier will be deactivated and the

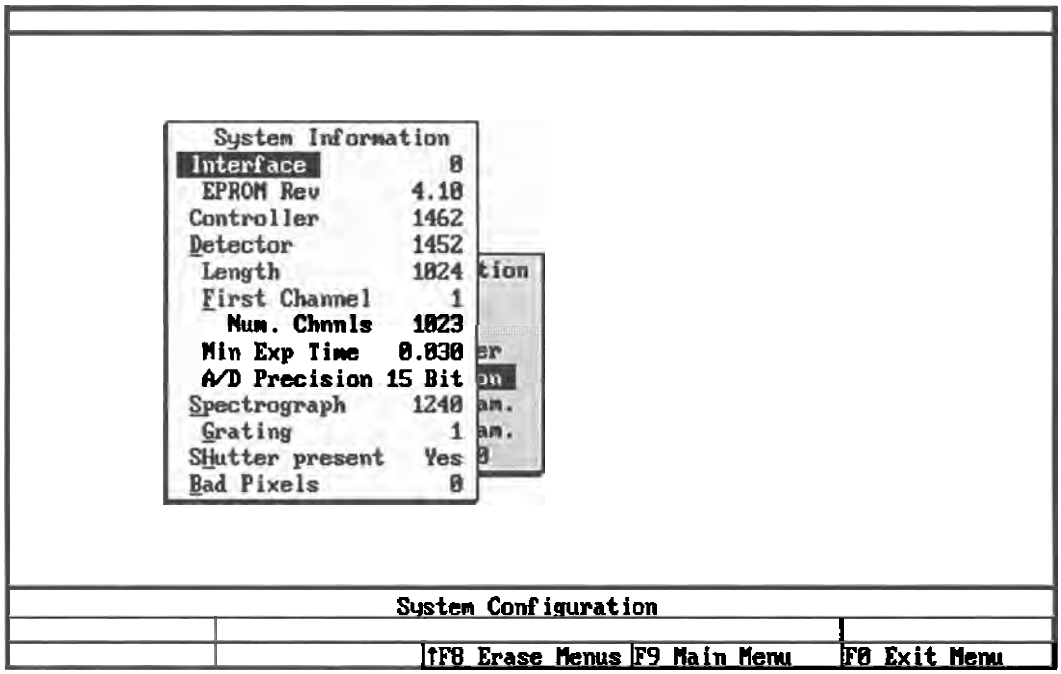


Figure 6-3. SYSTEM INFORMATION MENU

program will report DEFAULT.

The original 1461/1462 systems set the temperature of the Peltier by means of a resistor. The software can select one of two temperature settings Default and Alternate. Most M147Os have a label on the 1462 board with the temperatures these settings will achieve, usually with DEFAULT = 18°C and ALTERNATE = ~+3°C.

However, many units, and all 1461/1462 units, left the factory set to +5° and -5°C as the default and alternate settings. Older 1462 cards have a variable resistor to set the Alternate temperature.

A point to keep in mind about purging --- Peltier ON/OFF Status: Since the software does not turn off the Peltier (if it is active) before you exit the program, the purge should be continued as long as there is power to the detector (i.e., as long as the 1470A/1471A is turned on).

6.4 SYSTEM INFORMATION MENU

The first time the OMA Vision program is started (booted), several items should be reviewed or initialized in System Information submenu shown in Figure 6-3. The selections under **System Information** customize the software for the particular detector and spectrograph in use.

This menu is used to display certain information transmitted by the detector interface module, tailor the width of the spectrum to match the active area of the detector, and to inform the software of the spectrograph model the detector is mounted in or on. The information displayed on this menu can be very helpful to our customer support personnel in diagnosing system problems. Try to have it at hand when calling us for assistance.

6.4A Interface

The items under this heading report the model number of the detector interface and the revision level of its EPROMs.

6.4B Controller

This line simply reports the detector controller module that was found by the system upon boot up.

6.4C Detector

The items under the **Detector** heading allow you to indicate the model being used (this is recorded with the data) and to tell the software the range of channels to scan. For the 1455x-700-xx detector, the **First Channel** and **Num. Chnnls** lines allow you to transfer and display only the intensified channels.

Since the detector interface cannot identify the detector that is connected to the system, it is necessary to enter a detector identification number. This number is then stored in the 1470.PRM file upon exiting the program in a normal fashion. When the program is started again, this detector identification number will be the default.

In most cases the detector identification number corresponds to the detector model number. For example, 1455 would be entered for a Model 1455 detector. The exception to this convention is the Model 1452-NIR detector. For a variety of reasons (including its 256-diode

array, unlike the 1452A's 512-diode array) **the identification number 1457 must be entered to correctly identify the 1452-NIR detector.**

To determine the best values to enter for channel parameters, start Live Data Acquisition and use the spectrograph to position a peak from the room light spectrum towards one end of the display. (Start with **First Channel** set to 0 and **Num. Chnnls** set to 1024.) Stop Live and use the cursor to read out at which channel the intensity starts to fall off, and the channel that is half of that intensity.

Repeat the experiment with the peak near the opposite edge of the display. Decide what range of channels give you the best coverage, then subtract the last channel # from the first. This will be the value for **Num. Chnnls.** If you have more than one system, you may want to use the same number of channels for all systems to make comparisons of spectral data possible.

Other information reported includes the minimum exposure time for the detector and the A/D precision.

6.4D Spectrograph and Grating Selection
By selecting Spectrograph from the System Information menu you can tell the system that you are using a Model 123X (includes 1235, 1236, and 1237) or a Model 1240. This information is used by the software to modify OMA Vision menus. 1235 or 1240 are the values that should be entered on the **Spectrograph** line for the appropriate models; 1235 for the 123X spectrographs and 1240 for the 1240: all other spectrograph model numbers will not be recognized. **Grating** is the current initial grating selection.

Model 1235, 1236, or 1237
If you have a Model 123X spectrograph in your system, its gratings and calibration can be controlled via the OMA Vision program. If it is not already on, turn on the 1235 and wait for the initialization to complete. Press F1 on the 1235 control panel until the active grating appears. To indicate that there is a Model 123X, key in **1235** at the **Spectrograph** prompt. After you press <Enter>, the program automatically selects **Grating** and displays the **Grating** prompt. Key in the active grating and press <Enter>. The display will indicate **busy** and the software will communicate with the 1235. If it cannot, the error message **"Spectrograph Communications Failure"** will appear. After you have entered the model number and the aftive grating number, go to DATA ACQUISITION and choose CALIBRATION, then NEW CALIBRATION. You will now see a new option on the menu, **M1235 Control.** Currently, the **M1235 Control** menu allows you to change gratings and to choose a new center wavelength for the grating. Entry of the 1235 number will cause the system to try to communicate with the spectrograph via the IEEE-488 (GPIB) at address 11, whenever the OMA Vision program is started. The spectrograph will then be reset to its last setting consistent with the current X-axis calibration. If the spectrograph does not respond, the **Spectrograph Communications Failure** error message will appear. The calibration is not canceled, but there is a possibility that it no longer matches the spectrograph's position (if someone moved it manually for instance, or it shifted slightly with the power off).

Refer to Section 4.6C for information about calibrating the X axis and changing the grating.

Model 1240
The entry of 1240 adds two menu lines to the **Data Acquisition/Set Times** menu for controlling the shutter and internal lamp.

6.4E Shutter Present
Choosing 1240 automatically toggles **Shutter Present** to **Yes.** For other spectrographs, the choice of **Yes** indicates that you have connected a shutter to Pin 8 (PIA Bit 7) of the PIA connector on the rear of the 1471A or 1461. Note that whenever the shutter is used, the shutter control line in the detector cable and Bit 7 will both be toggled.

6.4F Bad Pixels
Sometimes there are one or more bad pixels at the start of a PDA. Should this be the case, by entering the number of bad pixels via this selection, any data they contain will be discarded.

6.5 SAVE CURRENT PARAMETERS
The **Save Current Param.** selection saves all variables (exposure time, areas, display mode, calibration, etc.) for use the next time the program is booted. This duplicates the function of exiting the program and answering Yes to the prompt. At the time the information is saved, the existing M1470.PRM (if there was one) is renamed M1470.BAK and a new M1470.PRM file is created.

The intent of the backup file is to let you retrieve the last setup if you made a mistake in the one you have just saved. To take advantage of this file, you need exit the program to DOS so that you can use DOS commands to first delete or rename the .PRM version and then rename the backup file as M1470.PRM.

6.6 RESTORE DISK PARAMETERS
By selecting **Restore Disk Param.** you cancel any changes made to the parameters since starting the system.

6.7 SOFTWARE REV.
This line reports the revision level of the OMA Vision software that you are using.

Chapter 7
Utilities

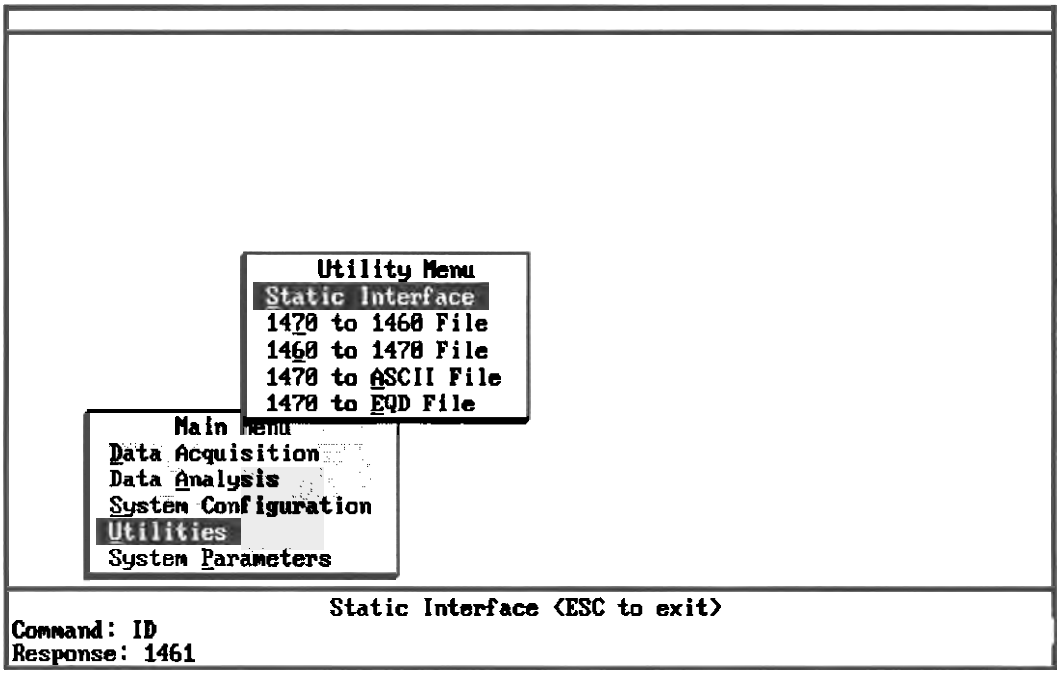


Figure 7-1. UTILITIES MENU: Static Interface Selected

7.1 INTRODUCTION

The Utilities Menu (Figure 7-1) includes a choice of static interface communication capability and several file conversion utilities. The static interface allows you to send 1471A or 1461 commands/command strings to the attached detector interface. The file conversion utilities convert data to the following formats:

- Model 1470 (OMA Vision) to Model 1460
- Model 1460 to 1470 (OMA Vision)
- Model 1470 (OMA Vision) to ASCII
- Model 1470 (OMA Vision) to EQD.

If the optional report generator utility has been purchased and installed in the program directory, it will also be shown as one of the Utility Menu items.

Note: In order for the file conversion utilities to work, the file FILCNVT.EXE must be in the same directory as the OMAVIS.EXE file (OMADESK.EXE if you are running OMA Desk.). If it is not, the Utility menu will report that FILCNVT.EXE is missing.

The active function keys in the Utility Menu screen are:

F8 **Menu:** Accesses the menu associated with the current display screen.

↑F8 **Erase Menus:** <Shift><F8> erases all menus on the screen.

F9 **Main Menu:** Accesses the **Main** menu.

F10 **Exit Menu:** Exits the currently displayed menu. In some cases, it also exits the current screen.

7.2 STATIC INTERFACE COMMUNICATION

The purpose of the Static Interface utility is to allow you to send commands to and receive responses from the attached detector interface (Model 1461 or 1471A) over the GPIB. This provides a way of checking communication between your computer and the detector interface. Ordinarily, use of the Static Interface uitlity would be limited to checking communications.

Caution! The Static Interface bypasses control of the detector and changes made using the Static Interface are not passed to the OMA Vision software for screen updating or storage in the curveset parameters. Use the menu entries to change detector parameters (ET, Temp, I, J, K, etc). Failure to observe this caution could easily result in operator confusion and program failure.

When **Static Interface** is selected from the Utilities menu, the function key area is changed so that you can key in a command or command string at the **Command:** prompt. If the command/command string is valid, it will be sent over the GPIB when you press **<Enter>**. The **Response:** message will then be displayed under the **Command:** prompt. The response message will vary depending on the

command/s and the syntax (See Section 7.2B).

7.2A Command Entry and Editing

Valid Commands
Commands keyed in at the **Command:** prompt must be valid for the detector interface (Model 1461 or Model 1471A) being used. If the command or commands are not valid, an error condition will result and subsequent commands in the command line will be ignored. Refer to your detector interface manual for a listing of valid commands.

Command Syntax

1. Commands are case insensitive. That is to say, they may be keyed in using uppercase, lowercase, or mixed upper and lowercase letters. **ID**, **id**, and **Id** are all acceptable.

2. Commands which have operands are entered with a space separating the command from its operand. If you wanted to change the exposure time to 300 msecs, you would key in **ET 0.3** or **ET .3**. In this case, ET is the command and **0.3** or **.3** is its value.

3. Commands in a command string are separated by a semicolon (;). For example, **ID;DM;ET 0.03**, requests information on the detector interface and the detector module and sets the exposure time.

Command Line Editing
Several of the cursor control keys can be used to edit the command while you are entering commands or command strings. The editing keys and key combinations are listed below with a brief description of their functions.

<Home>	moves the cursor to the start of entry.
<End>	moves the cursor to the end of entry.
<→>	moves the cursor one character to the right.
<←>	moves the cursor one character to the left.
<Del>	deletes the character at the cursor.
<Backspace>	deletes the character to the left of the cursor.
<Shift><Home>	(pressing **Home** while holding down **Shift**) erases all changes and restores the original entry.
<Shift><Del>	(pressing **Del** while holding down **Shift**) erases the contents of the command line.

7.2B Responses

- **Response: #** A command was sent that reads a value. This could be either a Read Only (R/O) such as **ID** or a Read Write (R/W) command such as **ET** without its operand. **#** represents value returned. If a command string contains two or more read commands, each value returned will be listed and separated from the next by a space: the values are listed in the order of the commands.

- **Response: Done** A Write Only (W/O) or a Read/Write (R/W) command was sent to the detector interface to set a value. A R/W command such as **ET 0.030** results in a **Done** response. **Done** only appears when the command or each command in a command string sets a value. If the command string includes a command or commands that read a value or values, the response will only contain the information read.

- **Response: Error** A command/command string is not valid or does not use the proper syntax. Refer to the Model 1461 or Model 1471A manual for the correct syntax. A command such as **ET0.030** or a string such as **ID DM** would result in an Error response. The correct entries are **ET 0.030** and **ID;DM**. The first sets the exposure time to 30 msec; the second asks which detector interface and detector module are being used.

Note: Each command in a string is sent in the order in which it is keyed into the Command line. If an invalid command or improper syntax is detected, no other commands will be sent. For example, the command string **J 3;IT;K 7** would result in setting **J** to 3. Since **IT** is not a valid command, the **Error** message would appear and **K 7** would not be sent. In addition, the **error** light on the Model 1461's or 1471A's front panel would turn on. This light goes out when the next valid command is sent.

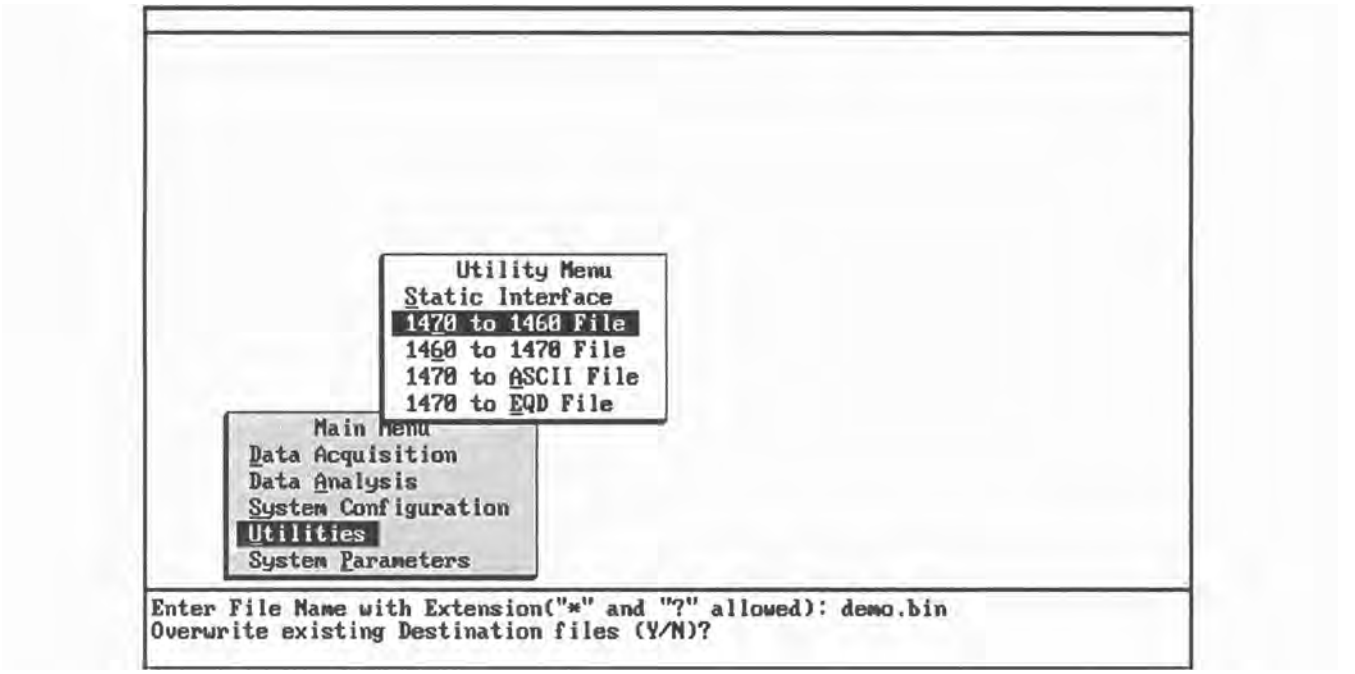


Figure 7-2. UTILITIES MENU: 1470 to 1460 Selected

7.3 1470 to 1460 FILE CONVERSION

This utility converts data acquired via the OMA Vision program to data that can be read and plotted on a Model 1460 OMA system.

To convert an 1470 OMA Vision file (.BIN extension) to a 1460 OMA file (.DAT extension):

1. Verify that the file/s to be converted are in the current OMA Vision data directory or change the data directory (via the System Configuration menu) to the appropriate directory.

2. Select **1470 to 1460 File** from the Utility menu.

3. Enter the OMA Vision .BIN filename with its extension at the prompt. Multiple files can be converted by using the DOS * and ? wildcard characters as part of the filename. **Do not use wildcard characters in the file extension.**

> CAUTION
> Only use wildcards in the filename. This prevents accidental conversion of non-data files.

4. Press the <Enter> key to indicate you have finished entering the filename and extension.

5. Answer Y or N at the Overwrite prompt.

   a. A Y response causes the new file to overwrite an existing .DAT of the same name.

   b. A N response allows conversion to occur if no other .DAT file exists having the same filename. If a file already exists, the **Cannot Open Output File** message will appear and no conversion will take place.

6. Press <Enter> to begin the conversion. The message **Convert File FILENAME.BIN to FILENAME.DAT** (where FILENAME is the actual filename) will appear. If there are multiple spectra, the spectrum number and the total number of spectra will be displayed as the conversion takes place. The new file will be stored in the same directory as the source file.

   Note: The file conversion process can by stopped before completion by pressing **<Ctrl><C>**.

7. Copy the new file to a floppy disk suitable for your 1460 OMA system.

8. Boot up your 1460.

9. Insert the disk and use the 1460's **MS-DOS to OMA** conversion utility to complete the conversion process.

10. Verify the conversion by plotting the data to the 1460's screen.

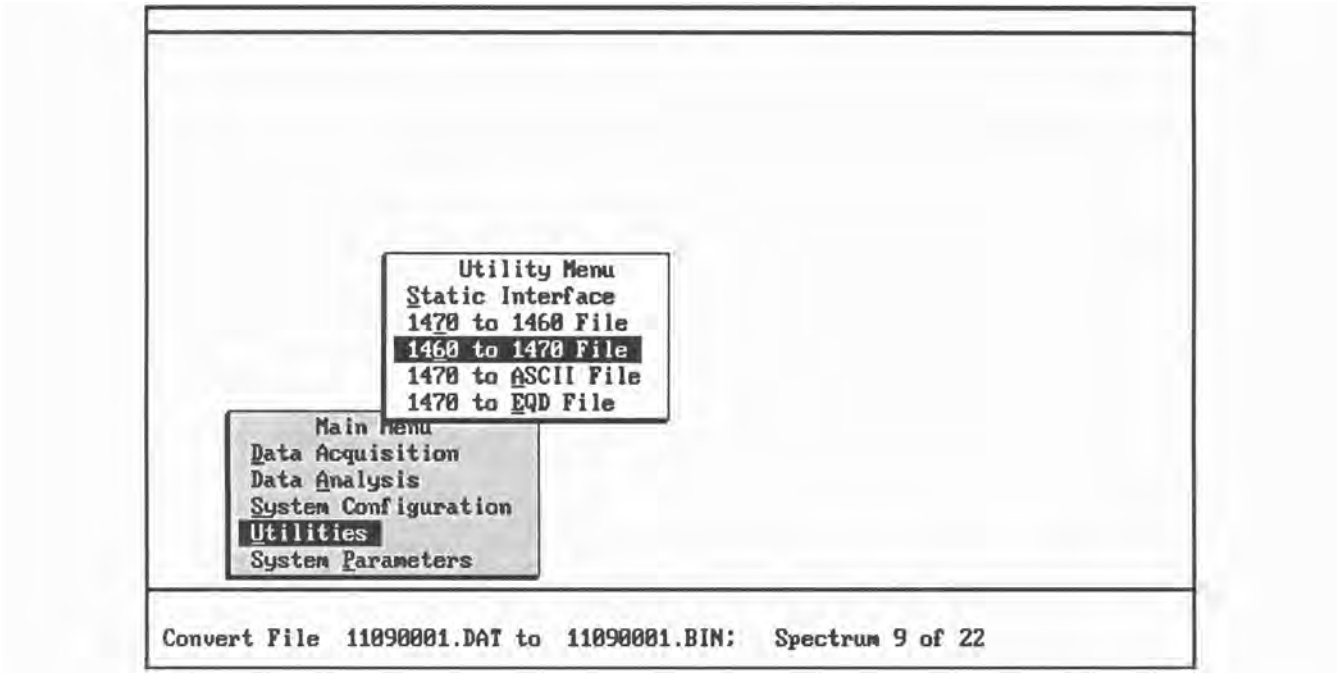


Figure 7-3. UTILITIES MENU: 1460 to 1470 Selected

7.4 1460 to 1470 FILE CONVERSION

This utility converts Model 1460 data which has already been converted to DOS format by the 1460 software so that it can be read, plotted, and manipulated by the OMA Vision program.

To convert an Model 1460 data file (.DAT extension) to an OMA Vision file (.BIN extension):

1. Make an MS-DOS readable version of the 1460 file.
2. Copy this file to the current OMA Vision data directory or change the data directory (via the System Configuration menu) to the directory where the file exists.
3. Access the Utility menu and select **1460 to 1470 File**.
4. Enter the Model 1460 .DAT filename with its extension at the prompt. Multiple files can be converted by using the DOS * and ? wildcard characters as part of the filename. **Do not use wildcard characters in the file extension.**

> CAUTION
> Only use wildcards in the filename. This prevents accidental conversion of non-data files.

5. Press the <Enter> key to indicate you have finished entering the filename and extension.
6. Answer Y or N at the Overwrite prompt.
   a. A Y response causes the new file to overwrite an existing .BIN of the same name.
   b. A N response allows conversion to occur if no other .BIN file exists having the same filename. If a file already exists, the **Cannot Open Output File** message will appear and no conversion will take place.
7. Press <Enter> and the conversion will begin. The message **Convert File FILENAME.DAT to FILENAME.BIN** will appear. If there are multiple spectra, the spectrum number and the total number of spectra will be displayed as the conversion takes place. The new file will be stored in the same directory as the source file.

   Note: The file conversion process can by stopped before completion by pressing **<Ctrl><C>**.
8. Verify the conversion by loading the new .BIN file via the Data Analysis menu and plot the data to the screen.

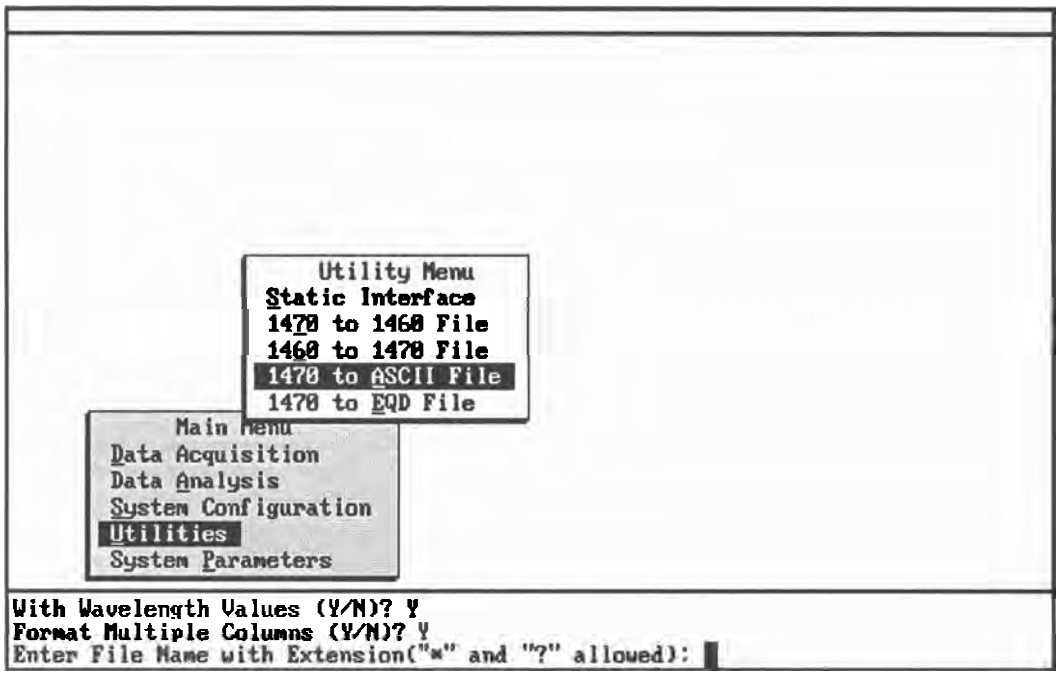


Figure 7-4. UTILITIES MENU: 1470 to ASCII Selected

7.5 1470 to ASCII FILE

This utility converts data acquired via the OMA Vision program to ASCII text format. The resulting file can then be read into any wordprocessor or other program that supports ASCII or DOS text importation.

To convert an OMA Vision file (.BIN extension) to an ASCII text file (.ASC extension):

1. Verify that the file/s to be converted are in the current OMA Vision data directory or change the data directory (via the System Configuration menu) to the appropriate directory.

2. Select **1470 to ASCII File** from the Utility menu.

3. Answer **Y** or **N** in response to the first two prompts. Your responses determine whether or not the ASCII file will contain wavelength information (X calibration value for each point) or will contain more than one column if there a multiple spectra in the file.

4. Enter the OMA Vision .BIN filename with its extension at the prompt. Multiple files can be converted by using the DOS * and ? wildcard characters as part of the filename. **Do not use wildcard characters in the file extension.**

> CAUTION
> Only use wildcards in the filename. This prevents accidental conversion of non-data files.

5. Press the <Enter> key to indicate you have finished entering the filename and extension.

6. Answer **Y** or **N** at the Overwrite prompt.

   a. A **Y** response causes the new file to overwrite an existing .ASC of the same name.

   b. A **N** response allows conversion to occur if no other .ASC file exists having the same filename. If a file already exists, the **Cannot Open Output File** message will appear and no conversion will take place.

7. Press <Enter> and the conversion will begin. The message **Convert File FILENAME.BIN to FILENAME.ASC** (where FILENAME is the filename and .BIN is the OMA Vision extension) will appear. The row being converted and the total number of rows (data points) is shown while the conversion process is taking place. The new file will be stored in the same directory as the source file.

   Note: The file conversion process can by stopped before completion by pressing **<Ctrl><C>**.

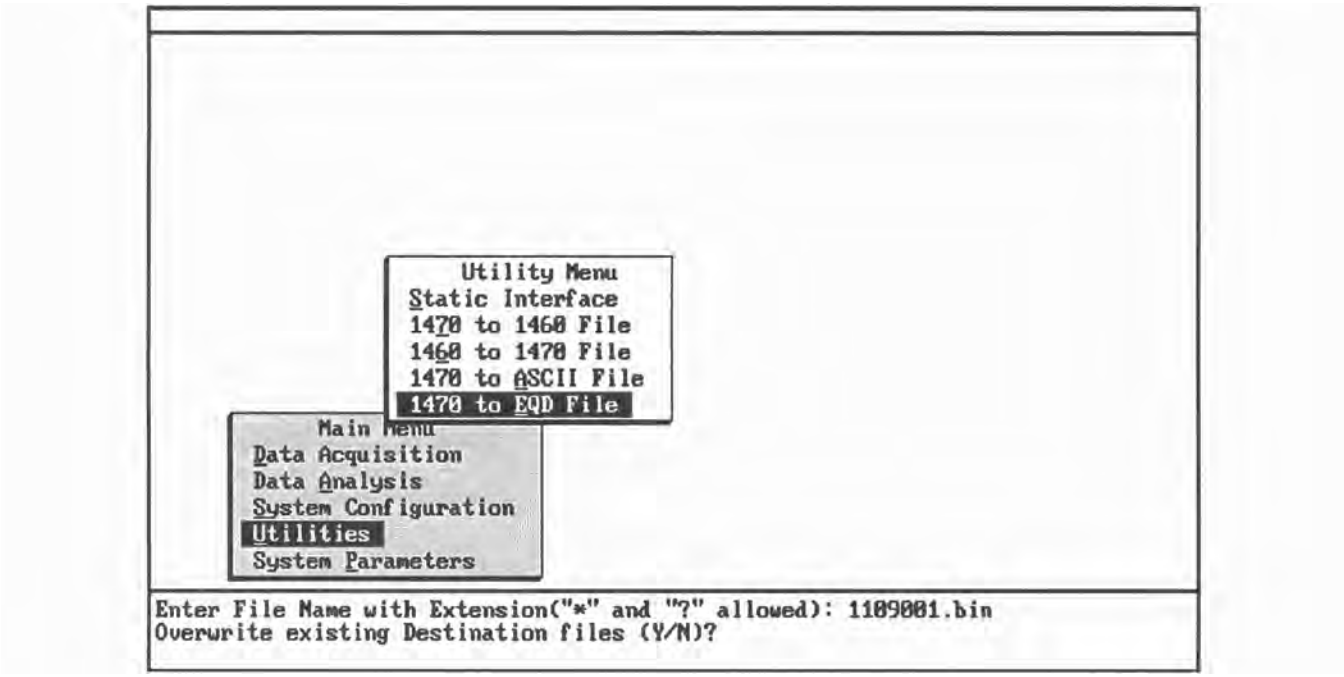


Figure 7-5. UTILITIES MENU: 1470 to EQD Selected

7.6 1470 to EQD FILE

This utility converts equation information contained in an OMA Vision '.BIN' file to an ASCII text format.

To perform the conversion to an .EQD file:

1. Verify that the file/s to be converted are in the current OMA Vision data directory or change the data directory (via the System Configuration menu) to the appropriate directory.

2. Select **1470 to EQD File** from the Utility menu.

3. Enter the OMA Vision .BIN filename with its extension at the prompt. Multiple files can be converted by using the DOS * and ? wildcard characters as part of the filename. **Do not use wildcard characters in the file extension.**

> CAUTION
> Only use wildcards in the filename. This prevents accidental conversion of non-data files.

4. Press the <Enter> key to indicate you have finished entering the filename and extension.

5. Answer Y or N at the Overwrite prompt.

   a. A Y response causes the new file to overwrite an existing .EQD of the same name.

   b. A N response allows conversion to occur if no other .EQD file exists having the same filename. If a file already exists, the **Cannot Open Output File** message will appear and no conversion will take place.

"Datafile: TRIAL.BIN"
"Label: trial process"

"Number of equations: 2"
"Points per equation: 3"

"Equation 1: A1"
"Equation 2: a2"

"Time"	"Equation 1"	"Equation 2"
0.112000	-3.030303	115.151520
1.042000	0.000000	124.242432
2.752000	-6.060606	109.090912

Figure 7-6. CONTENTS OF SAMPLE EQD FILE

6. Press <Enter> and the conversion will begin. The message **Convert File FILENAME.BIN to FILENAME.EQD** (where FILENAME is the actual filename) will appear. The new file will be stored in the same directory as the source file.

   Note: The file conversion process can by stopped

before completion by pressing **<Ctrl><C>**.

The **1470 to EQD** conversion can be used to convert Y:T curve so that it can be pulled into a spreadsheet program such as Lotus 1-2-3®. By using **1470 to EQD**, the data can be pulled into a spreadsheet and the Y:T plots can be generated there.

7.7 REPORT GENERATOR

The optional Report Generator utility is listed in the Utility menu whenever the program finds the program RPTGEN.EXE in the program directory. This utility is not provided with the OMA Vision/Desk software but may be purchased separately. Appendix E, *Report Generation* provides directions on how to create a template file for report generation and includes both a sample template and the report generated from that sample template.

7.8 FILE CONVERSION ERROR MESSAGES

This section describes the error messages that may be encountered while using the file conversion utilities.

Error Message **Meaning**

Cannot Open Input File.
The conversion utility could not find the file to be converted. Check the filename. Check to see that the file is in the current data directory.

Cannot Open Output File.
The utility had been told not to overwrite existing files and a file with the same filename and extension as the output file was found.

Not Enough Memory.
There is not enough available RAM to load the conversion utility and perform the conversion. Thismay be due to curve sets currently in memory. Check the Data Analysis screen. If there are several or large curve sets in memory, you may be able to regain memory by deleting curve sets. You may also choose to perform conversion only after bootup and prior to running data acquisition or loading curve sets into memory.

Error Reading Source.
Source file indicated is bad.

Error Writing Curve Header.
Output file curve header information cannot be written. Output location or disk may be bad.

Error Writing Curve Data.
Output file curve data information cannot be written. Output location or disk may be bad.

Wrong File Type.
Wrong type of file was keyed in as the source file for the conversion selected. With the exception of 1460 .DAT files, the conversion program checks the validity of the file type by looking at information in the file.

Format Option Not Available.
The format selection, although shown as a Utilities menu item, is not recognized by the file conversion utility. Check the revision level of the FILCNVT.EXE file to see if it is current with the OMAVIS.EXE file. If it is an earlier revision, update the FILCNVT.EXE file.

Chapter 8
System Parameters

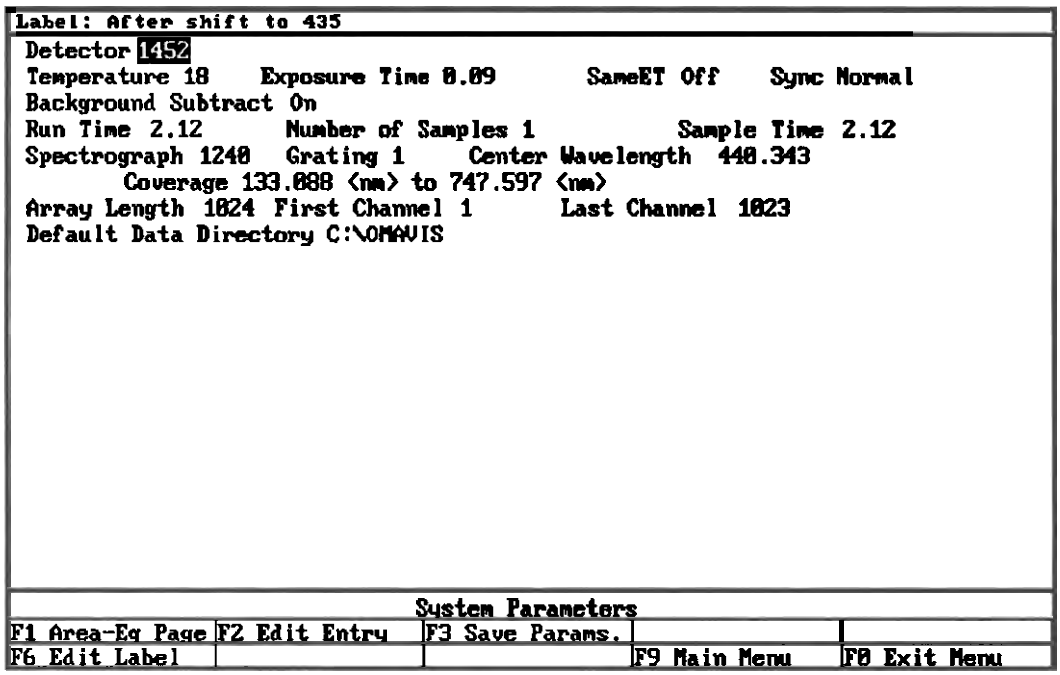


Figure 8-1. SYSTEM PARAMETERS SCREEN

8.1 INTRODUCTION

This selection brings up the System Parameters screen (Figure 8-1), which shows the current parameter values. These parameter values will be stored in **M1470.PRM** when the program is exited. The function keys allow a variety of operations to be performed as described in the following paragraph.

8.2 FUNCTION KEYS

Key **Function**

F1 Area-Eq Page: Displays the Area-Equations page so that it can be reviewed and/or changed.

F2 Edit Entry: Allows the displayed parameters to changed. The cursor-positioning keys are used to step from parameter to parameter. Pressing **<Enter>** causes the value for the parameter to be displayed so that it can be edited. On completing the edit of the parameter, press **<Enter>** execute the new value and continue.

F3 Save Params: Allows the displayed parameter values to be saved in **M1470.PRM**. This selection causes the message:

Store current parameters ad default (Y/N)?

to appear. Answering **Y** causes the parameters to be immediately saved. Selecting **N** exits the save routine.

F6 Edit Label: Allows the label to be edited.

F9 Main Menu: Restores the Main menu.

F0 Exit Menu: Exits the System Parameters menu.

Appendix A
Glossary

< >: symbols used to indicate a key on the keyboard.

<ESC>: key used to quit an input box or parameter setting or to close a submenu or menu without changing the current setup.

Cursor: an arrow, a highlight, or a "+" symbol used to indicate a selection, read magnitude and location of data; and to create a zoom box.

Curve set: a set of information, stored and processed together, relating to the acquired spectra. A curve set may be the spectral data complete with data acquisition parameters, Area/Equation table, and calibration coefficients. Or, a curve set may be just the acquisition parameters or the Area/Equation table or the calibration coefficients.

Default parameters: the initial parameters (see **Parameter**) used by the system at startup.

EPROM: Erasable Programmable Read Only Memory. An integrated chip (IC) that contains information required by the detector interface. It contains the instructions that are most frequently used or are most general in nature. The information contained in the EPROM is often called firmware.

Escape: to exit from an input box, parameter, submenu, or menu without changing the current setup. This function is performed by pressing the <Esc> key on the keyboard.

Function key area: lists function key assignments for the data acquisition mode named at the far left of the area.

Input box: the box which appears near the bottom of the screen when the program requires information to set a parameter, select or name a file, perform a calculation.

Key letter: the underlined character in a menu name or menu item. By typing this character, you gain access to the menu or menu item.

Menu: a set of commands, parameters, or submenus grouped. The menu for a particular screen is accessed via the <F8> Menu function. The Main menu is accessed via <F9> Main Menu when this function is active or by exiting back to the Main menu.

Operand: a value sent to the detector interface via the Static Interface utility. Operands are associated with Write Only (W/0) and Read/Write (R/W) commands. Alternatively, a quantity on which a mathematical operation is performed, as used by the Curve Calculation facility.

Operator: a symbol, such as a plus sign, that represents a mathematical operation, as used by the Curve Calculation facility.

Parameter: a value set into the system to determine how the spectral data will be acquired, interpreted, and processed, such as run time, sample time, or exposure time.

Select: to open a menu, choose a menu item, toggle a parameter, or access an input box. This can be accomplished using the keyboard cursor keys to move the highlight and pressing the <Enter> key or by keying in the key letter for the item.

Submenu: a subordinate menu to currently active menu.

Wildcard character: either an * or a ? character which is used to indicate any character or set of characters that can be substituted following DOS conventions.

Zoom box: a rectangular box created by using the cursor and <Enter> keys to mark first one corner and then a second corner of a section of the displayed data for expansion.

Appendix B
Calibration Lines

MERCURY	184.91 194.17	226.22 237.83 248.20 253.65** 265.20 280.35 289.36 296.73	302.15 312.57* 313.17 334.15 365.02* 365.44 366.33	404.66* 407.78 434.75 435.84*	507.30* (2x253.65) 546.07* 576.96 579.07	625.14 (2x312.57) 626.34 (2x313.17)	730.04 (2x365.02) 760.95 (3x253.65)	
ARGON			394.90	404.44 415.86* 416.42 418.19 419.10 420.07* 425.94 427.22 430.01 433.36		696.54*	706.72 727.29 738.40 750.39 751.46 763.51** 772.38* 794.82	800.62 801.48 810.37 811.53* 826.45 840.82 842.46
NEON			336.99 341.79 344.77 346.66 347.26 352.05* 359.35		533.08 534.11 540.06 585.25** 588.19 594.48 597.55	603.00 607.43 609.62* 614.31* 616.36 621.73 626.65 630.48 633.44 638.30* 640.23* 650.65* 653.29 659.90 667.83* 671.70 692.95	702.41 703.24* 705.91 717.39 724.52 743.89 748.89 753.58 754.41	837.76 849.54 863.46 865.44 878.20 878.38 885.39

200 300 400 500 600 700 800

* indicates strong line within a wavelength group.
** indicates strongest line for the element.
() indicates 2nd or 3rd order.

Table B-1. WAVELENGTH CALIBRATION LINES (in nanometers)

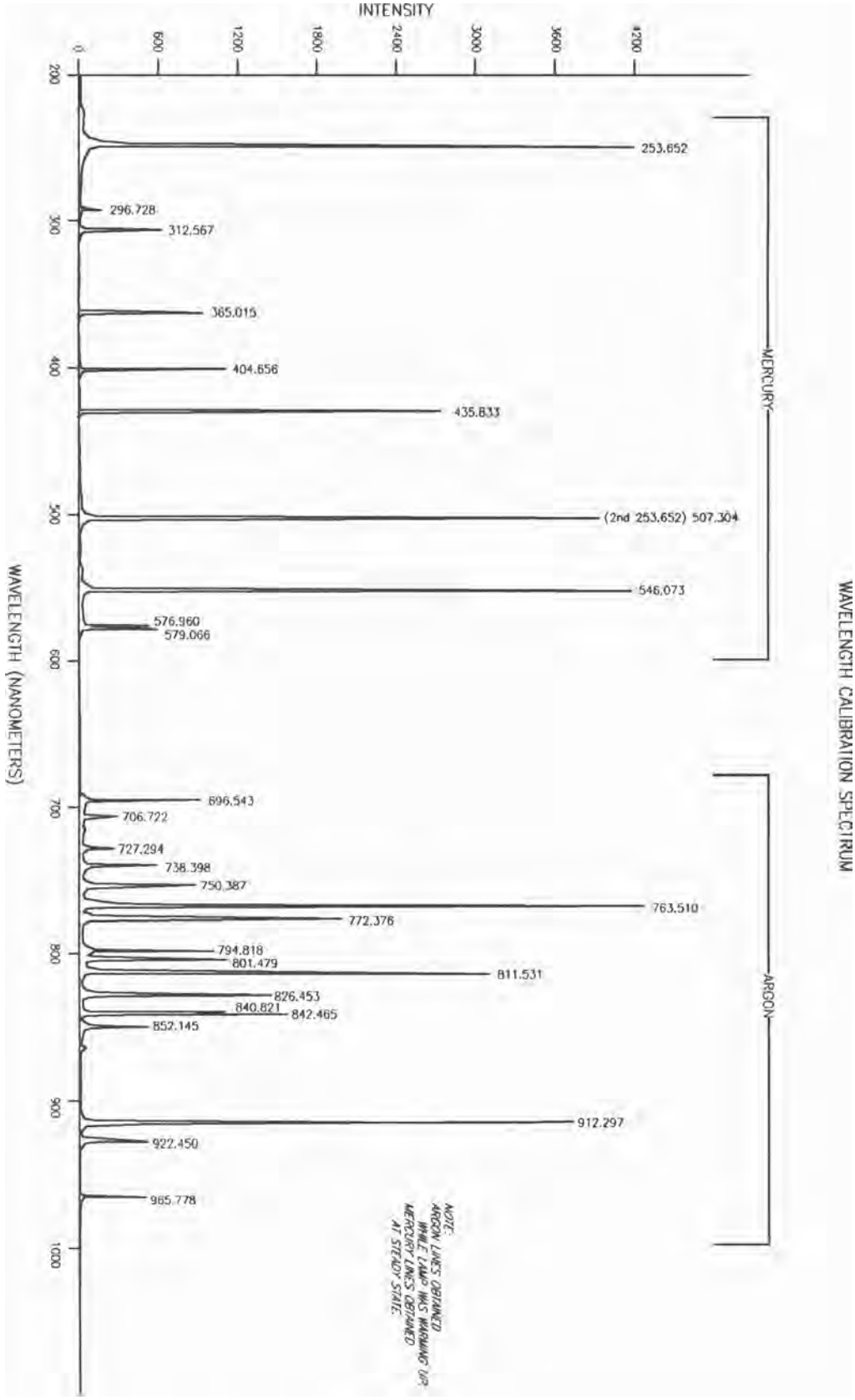


Figure B-1. WAVELENGTH CALIBRATION SPECTRUM

Appendix C
Data Acquisition Modes

CONTENTS:

	PG
C.1 INTRODUCTION	109
C.2 STORING AND ADDING MODES	110
DATA ACQUISITION MODE 1	111
DATA ACQUISITION MODE 2	111
DATA ACQUISITION MODE 3	112
DATA ACQUISITION MODE 4	112
DATA ACQUISITION MODE 5	113
DATA ACQUISITION MODE 6	113
DATA ACQUISITION MODE 7	114
DATA ACQUISITION MODE 8	114
DATA ACQUISITION MODE 9	115
DATA ACQUISITION MODE 10	115
DATA ACQUISITION MODE 11	116
DATA ACQUISITION MODE 16	116
DATA ACQUISITION MODE 17	117
C.3 SUBTRACTION MODES	117
DATA ACQUISITION MODE 12	118
DATA ACQUISITION MODE 13	118
DATA ACQUISITION MODE 14	119
DATA ACQUISITION MODE 15	119

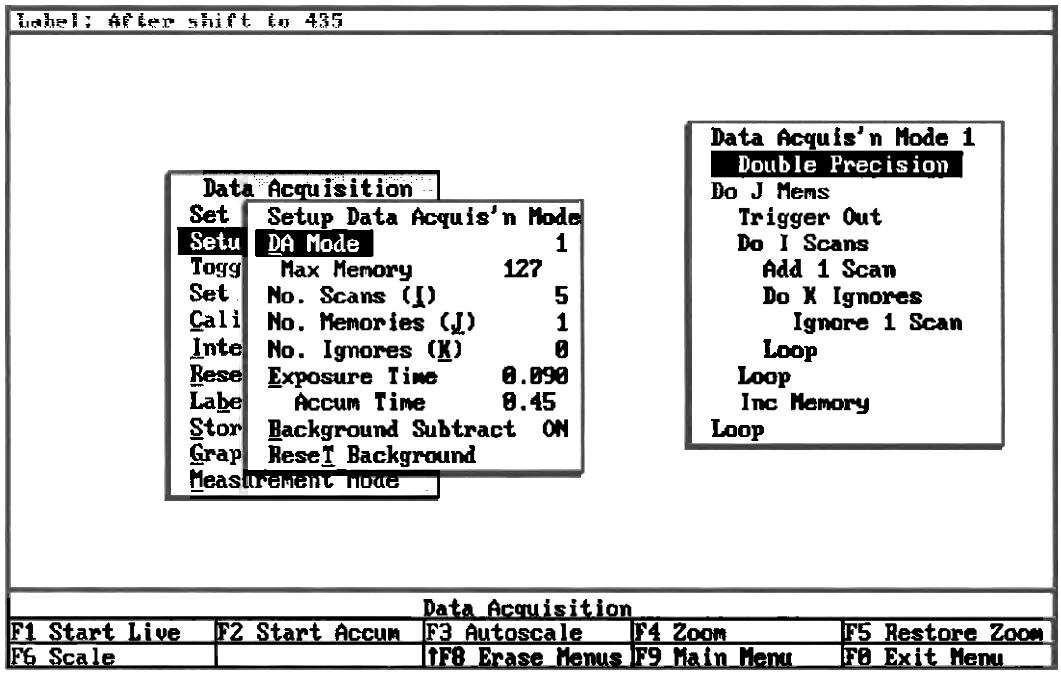


Figure C-1. SETUP DA MODE SCREEN

C.1 INTRODUCTION

The OMA Vision software provides seventeen Data Acquisition modes to facilitate configuring the system for a large number of different measurement situations. Mode selection is done by selecting **Setup DA Mode** on the **Data Acquisition** screen. This brings up the **Setup Data Acquisition Mode** screen as shown in Figure C-1. As shown, this screen contains two windows. The one to the left is used to select the desired mode and to set the data acquisition parameters. The one on the right contains a flow-chart of the selected mode, and reports the data precision. Mode selection is done by simply highlighting **DA Mode** and pressing **<Enter>**. This will cause the **DA Mode** prompt to appear at the bottom of the screen. You then key the mode number (range 1 to 17) and press **<Enter>**. This will restore the normal Function Key Area display and cause the flowchart for the selected mode to be displayed. Entering '99' as the DA mode number accesses the Data Acquisition Design (DAD) facility, which allows user generated DA programs to be loaded and executed. Appendix D discusses the DAD facility in depth. Section 4.4 in Chapter 4 discusses the **Setup Data Acquisition Mode** screen. The purpose of this chapter is primarily to provide convenient descriptions of the

individual Data Acquisition modes. The thirteen *Storing and Adding* modes are discussed first, followed by the four *Subtraction* modes.

The choice of DA Mode determines whether or not ignore scans are used, whether or not curves are added into a memory, whether or not curves are subtracted from a memory, and other factors that determine how the data is scanned from the detector array and stored. There are seventeen standard DA modes.

When you select **DA Mode** from the menu, you can enter the number of one of the standard DA modes or enter 99 to bring up the **Load DAD Program** screen (Figure 6-?). If the mode selected is a standard one, its listing is presented at the right of the screen so that you don't have to refer to the manual. If you enter **99**, it is assumed that you know the contents of the DAD program that you are loading. The acquisition mode selected will be used to acquire data when you select **Run Data Accum** from the menu.

The number of scans, ignores, and memories are set via these selections. The values entered are used in the DA Mode. See your detector interface manual for more information.

The Accumulate Time is based on the exposure time, the number of scans, the number of ignores, and the number of memories. This is a report only line.

Each mode description in this chapter begins with a program listing of the mode, followed by both a discussion of the events that take place when the mode is accessed and an example of how the mode may be used. The descriptions identify each of the modes, define them accurately and fully, and help the user develop a "feeling" for how the individual modes function. It is particularly useful that the program listings for these modes are written with Data Acquisition Design (DAD) commands. Because the listings are written in this fashion, these modes may be readily incorporated into DAD programs when timing considerations permit.

Take care to differentiate between **Trigger Out**, a trigger generated by the detector controller and sent to the experiment, and **On Trigger**, a trigger generated by the experiment and applied to the Detector Interface. Data acquisition timing, as it relates to triggering, is fully explained in the Detector Interface manual.

C.2 STORING AND ADDING MODES

Whenever a Data Acquisition (DA) mode contains an ADD instruction, data will be added into a memory whether or not there is data already in that memory. To differentiate between single and multiple adds, the terms "STORE" and "ADD" are used in the explanation that follows each DA mode listing. If during data acquisition, the data from only one scan is added into a particular memory, we say that it has been STORED. If data from more than one scan are added together in the same memory, we say that it has been ADDED. Remember that each scan contains many pixels of information, which are accumulated in distinct locations, or "memories" within the detector interface RAM. Adding the results of 'n' scans into a single memory results in an improvement in the signal-to-noise ratio of $n^{1/2}$ over that of a single scan. All examples assume that the starting Memory # is 1.

The precision is directly set by the choice of mode. Each word of STORED data is 16 bits wide (single precision). On the other hand, ADDED data is 32 bits wide (double precision) to accommodate the very large numbers that can result when data sets are added.

When a series of commands is to be repeated 'n' times, DO and LOOP commands establish a program loop. The DO-LOOPS used in these modes use the variables 'I', 'J', and 'K'. For example, if 'I' is used as the variable and was previously set to 5, DO I ... LOOP will cause the series of commands between the DO and LOOP commands to be executed one at a time until there have been 5 repetitions. In some instances, DO-LOOPS are nested. When this appears in a program, the LOOP command for the inner loop must be executed before the LOOP command of an outer loop.

Data Acquisition Modes (1) through (11), (16), and (17) STORE and/or ADD information, but they DO NOT SUBTRACT data. The SUBTRACT modes are described in Section C.3.

DATA ACQUISITION MODE 1

```
Data Acquis'n Mode 1
  Double Precision
Do J Mems
  Trigger Out
  Do I Scans
    Add 1 Scan
    Do K Ignores
      Ignore 1 Scan
    Loop
  Loop
  Inc Memory
Loop
```

Explanation: 'J' sets of scans take place, with 'I' scans in each set. Each set of scans is preceded by a Trigger Output (TOUT) pulse generated in the detector controller. Each set of data is ADDED into a separate memory. There is provision for ignoring 'K' scans after each ADDED scan.

Example Settings: 'J' = 12 (memories), 'I' = 3 (scans), and 'K' = 10 (ignored scans).

Effect: The following sequence of events takes place:

1. Following a Trigger Out pulse, a single scan is read and the data is placed into Memory #1.
2. 10 scans are then ignored.
3. Another scan is read and the data is ADDED into Memory #1.
4. 10 scans are ignored.
5. Another scan is read and the data is ADDED into Memory #1.
6. 10 scans are ignored.
7. After the Memory # has been incremented, Steps 1 through 6, above, are repeated, with all data being ADDED into Memory #2.
8. Step 7 is repeated for Memories 3 through 12, for a total of 396 scans (33 scans for each of 12 memories).

DATA ACQUISITION MODE 2

```
Data Acquis'n Mode 2
  Double Precision
Do J Mems
  Trigger Out
  On Trigger
  Do I Scans
    Add 1 Scan
    Do K Ignores
      Ignore 1 Scan
    Loop
  Loop
  Inc Memory
Loop
```

Explanation: 'J' sets of scans take place, with 'I' scans in each set. Each set of scans is preceded by a Trigger Out (TOUT) and an On Trigger (ON.TRIG). A complete set of 'I' scans is taken after each On Trigger pulse that is received, and the results from each set are ADDED into separate memories. There is provision for ignoring 'K' scans after each ADDED scan.

Thus, Mode (2) is identical to Mode (1), except that the instrument must wait for an incoming On Trigger signal before beginning each set of scans.

Example Settings: 'J' = 12 (memories), 'I' = 3 (scans), and 'K' = 10 (ignored scans).

Effect:

1. When the RUN command is entered, the first memory is assigned and a trigger signal (TOUT) is sent from the detector interface to the experimental equipment.
2. Then the detector interface waits for a trigger signal (ON.TRIG) to be received from the external apparatus. When this takes place, data acquisition begins.
3. A scan takes place and the data is placed in Memory #1.
4. Ten scans are then ignored.
5. Steps 3 and 4 are repeated two more times.
6. Steps 1 through 5 are repeated for Memories 2 through 12.

DATA ACQUISITION MODE 3

```
Data Acquis'n Mode 3
  Double Precision
Do J Mems
  Trigger Out
  On Trigger
  Do I Scans
    Add 1 Scan
  Loop
  Inc Memory
Loop
```

Explanation: 'J' sets of scans take place, with 'I' scans in each set. Each set of scans is preceded by a Trigger Out (TOUT) and an On Trigger (ON.TRIG). A complete set of 'I' scans is taken after each On Trigger and the results from each set are ADDED into separate memories.

Thus, except for not providing for ignored scans, this mode is identical to Mode (2).

Example Settings: 'J' = 2 (memories) and 'I' = 6 (scans).

Effect:

1. The detector interface sends a Trigger Out pulse to the experiment and then waits for an On Trigger signal from the external setup.

2. Following the On Trigger, six scans occur and the results are ADDED into Memory 1.

3. Steps 1 and 2 are repeated for the second memory.

DATA ACQUISITION MODE 4

```
Data Acquis'n Mode 4
  Double Precision
Do I Scans
  Trigger Out
  Add 1 Scan
  Do K Ignores
    Ignore 1 Scan
  Loop
Loop
```

Explanation: There is one set of 'I' scans, with a Trigger Out (TOUT) sent from the detector controller before each scan. The results of all 'I' scans are ADDED into the same memory, and there is provision for ignoring 'K' scans after each ADDED scan, if desired.

Example Settings: 'I' = 5 (scans) and 'K' = 10 (ignored scans).

Effect:

1. A scan is performed, with a Trigger Out signal sent at the beginning of the exposure time.

2. The data from the scan in Step 1 are ADDED into Memory #1.

3. The next 10 scans are ignored.

4. Steps 1 through 3, above, are repeated four more times. (The data from unignored scans are ADDED into Memory #1).

DATA ACQUISITION MODE 5

```
Data Acquis'n Mode 5
  Double Precision
Do I Scans
  Trigger Out
  On Trigger
  Add 1 Scan
  Do K Ignores
    Ignore 1 Scan
  Loop
Loop
```

Explanation: There is one set of 'I' scans, with a Trigger Out (TOUT) and an On Trigger (ON.TRIG) before each scan. The results of all 'I' scans are ADDED into the same memory, and there is provision for ignoring 'K' scans after each ADDED scan, if desired. This Mode is identical to the previous mode, except that Mode (5) requires the detector interface to receive a trigger signal before each scan.

Example Settings: 'I' = 10 (scans) and 'K' = 20 (ignored scans).

Effect:

1. A Trigger Out signal is sent from the detector controller to the experimental apparatus.
2. The detector interface waits for an On Trigger signal to be received.
3. The first scan is read and the collected data is ADDED into Memory 1.
4. The next 20 scans are ignored.
5. Steps 1-5 are repeated 9 more times, with all data being ADDED into Memory 1.

DATA ACQUISITION MODE 6

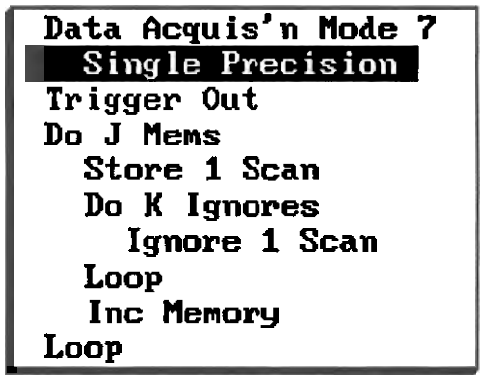
```
Data Acquis'n Mode 6
  Double Precision
Do J Mems
  Do I Scans
    Add 1 Scan
  Loop
  Inc Memory
Loop
```

Explanation: A set of 'I' scans is added into each of 'J' memories. There is no provision for triggering or for ignoring scans. This mode is useful for acquiring background or experimental data when the experimenter is not concerned with triggering. (Trigger cables that may already be in place do not have to be disconnected.) Backgrounds thus acquired could be stored on disk for later subtraction from data sets acquired in Modes (1) through (4). If an experimental data set is acquired in this mode, collected background data could be subtracted from it. (The memory allocation used is compatible with all of these modes.)

Example Settings: 'J' = 3 (memories) and 'I' = 4 (scans).

Effect: Four scans of data are integrated into each of 3 memories.

DATA ACQUISITION MODE 7



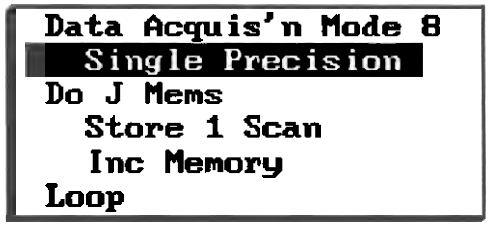
Explanation: Following a single Trigger Out (TOUT), 'J' scans take place. The result of each is STORED in a different memory. There is provision for ignoring 'K' scans after each STORED scan.

Example Settings: 'J' = 12 (memories) and 'K' = 5 (ignored scans).

Effect:

1. The detector interface sends a single Trigger Out (TOUT) pulse to the experimental apparatus.
2. A scan is performed and the data is STORED in Memory #1.
3. Five scans are then ignored.
4. Steps 2 and 3 are repeated for Memories 2 through 12.

DATA ACQUISITION MODE 8



Explanation: 'J' scans take place and the data from each is STORED in a different memory. There is no provision for ignoring scans or for triggering. This mode is well suited for acquiring background data without need for triggering concerns. (Trigger cables already in place do not need to be disconnected.) Background data thus taken can be stored on disk for later subtraction from experimental data.

Example Settings: 'J' = 10 (memories)

Effect: Data from 10 consecutive scans are stored in each of the first ten memories.

DATA ACQUISITION MODE 9

```
Data Acquis'n Mode 9
  Double Precision
Do I Scans
  Trigger Out
  Do J Mems
    Add 1 Scan
    Do K Ignores
      Ignore 1 Scan
    Loop
    Inc Memory
  Loop
Loop
```

Explanation: This mode uses a set of 'J' memories, into which data is sequentially ADDED 'I' times. Thus, by the end of the measurement, each memory in the set holds the contents of 'I' scans. There is a Trigger Out (TOUT) at the start of each memory sequence, and provision is made to ignore 'K' scans after each ADDED scan, if desired. (This mode is particularly well suited to the averaging of a series of kinetics measurements.)

Example Settings: 'I' = 4 (scans), 'J' = 3 (memories), and 'K' = 0 (ignored scans).

Effect: There are no ignored scans, and the scan data in each memory are added together as follows:

'I' = SCAN NO.	MEMORY
1	1
2	2
3	3
4	1
5	2
6	3
7	1
8	2
9	3
10	1
11	2
12	3

Thus, data from scans 1, 4, 7, and 10 (representing J = 1) is added together in Memory 1. The scan data that is integrated into memories 2 and 3 is determined in the same manner.

DATA ACQUISITION MODE 10

```
Data Acquis'n Mode 10
  Single Precision
Do J Mems
  Trigger Out
  Store 1 Scan
  Do K Ignores
    Ignore 1 Scan
  Loop
  Inc Memory
Loop
```

Explanation: There are 'J' scans, each preceded by a Trigger Out (TOUT) signal. The results of each scan are STORED in a different memory. There is provision for ignoring 'K' scans after each STORED scan, if desired.

Example Settings: 'J' = 7 (memories) and 'K' = 20 (ignored scans).

Effect:

1. A Trigger Out signal is sent out from the detector controller.
2. Data is collected from a scan and stored in a unique memory.
3. The next 20 scans are ignored.
4. This entire process of sending a Trigger signal, storing data, and ignoring scans (Steps 1, 2, and 3, above) is repeated 6 more times.

DATA ACQUISITION MODE 11

```
Data Acquis'n Mode 11
  Single Precision
Do J Mems
  Trigger Out
  On Trigger
  Store 1 Scan
  Do K Ignores
    Ignore 1 Scan
  Loop
  Inc Memory
Loop
```

Explanation: There are 'J' STORED scans, each preceded by a Trigger Out (TOUT) and an On Trigger (ON.TRIG). The results of each scan are STORED in separate memories. There is provision for ignoring 'K' scans after each STORED scan. Thus, this mode is the same as Mode (10), except that the detector interface must now wait for ON.TRIG pulses to be received before data scans can occur.

Example Settings: 'J' = 8 (memories) and 'K' = 100 (ignored scans).

Effect:

1. A memory (#1 is used first) is assigned and a TOUT pulse is sent.
2. Upon receiving an On Trigger pulse, the first scan takes place and the data is stored in the current memory.
3. 100 scans are then ignored.
4. Steps 1, 2 and 3, above, are repeated for the next 7 memories.

DATA ACQUISITION MODE 16

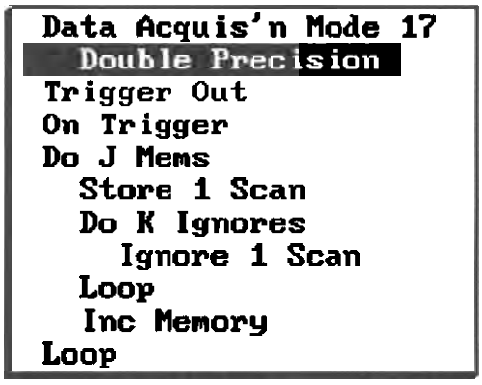
```
Data Acquis'n Mode 16
  Double Precision
Do J Mems
  Trigger Out
  Do I Scans
    Add 1 Scan
  Loop
  Do K Ignores
    Ignore 1 Scan
  Loop
  Inc Memory
Loop
```

Explanation: Following a TOUT signal, the data from 'I' scans are added into a single memory. Following this, 'K' scans are ignored. The entire process, including the TOUT signal, is repeated 'J' times, with the results being stored into 'J' separate memories.

Example Settings: 'J' = 5 (memories), 'I' = 4 (scans), and 'K' = 7 (ignored scans).

Effect: Following a Trigger Out (TOUT) signal, 4 scans of data are added into the first memory. Following this, 7 scans are ignored. This process is repeated 5 times, with each set of data being stored in a unique memory.

DATA ACQUISITION MODE 17



Explanation: A single Trigger Out (TOUT) is sent by the detector interface. When an On Trigger (ON.TRIG) is received by the detector interface, data acquisition will begin and 'J' scans will take place. The result of each is STORED in a different memory. There is provision for ignoring 'K' scans after each STORED scan.

Example Settings: 'J' = 3 (memories) and 'K' = 2 (ignored scans).

Effect:

1. A Trigger Out is sent by the detector interface to begin the experiment.
2. The detector interface waits for an On Trigger signal to be received.
3. A scan is performed and the data is STORED in Memory #1.
4. Two scans are then ignored.
5. Steps 3 and 4 are repeated for Memories 2 and 3.

C.3 SUBTRACTION MODES

In SUBTRACTION MODES, sets of data are subtracted from one another. The data to be subtracted is usually interpreted as background information.

Data words to be SUBTRACTED are sixteen bits wide (single precision). They can be subtracted from either 16-bit (STORED) or 32-bit (ADDED) data and they yield either single or double precision results, respectively.

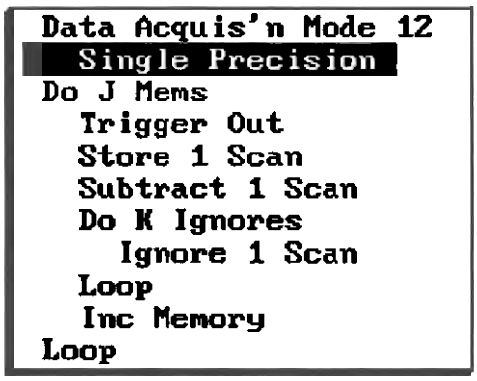
The following four modes allow for the rapid and convenient subtraction of background data during an experiment. However, the user has to control the experiment so that experimental data and background signals will be applied to the detector during the STORE (or ADD) and SUBTRACT scans respectively. Remember, when the SUBTRACT operation is used within a data acquisition mode, scans are always taken in pairs. The first scan in each pair should read experimental results and the second should gather background data. The operation to be performed (i.e., ADDING, STORING, or SUBTRACTING) on each scan of the pair is explicitly stated in the program listings.

In experiments where the background fluctuates, it is frequently essential that the background be read as closely as possible to the time when the experimental light signal data is taken. In experiments where the background is quite stable, this will not be a critical consideration. In fact, with stable backgrounds, it may prove convenient to use one of the other modes and then read the background data separately, doing the subtraction as a post-measurement operation.

The SUBTRACTION modes offer additional advantages. First, by performing the background subtraction as part of the experiment itself, a significant time savings can be achieved. Second, it results in a substantial savings of CPU and disk memory space.

The following Data Acquisition Modes perform SUBTRACTION of data:

DATA ACQUISITION MODE 12



Explanation: There are 'J' scan pairs, with each pair using a different memory. Each is preceded by a Trigger Out (TOUT) signal. The first scan of each pair is STORED in memory. The second scan of each pair is SUBTRACTED from the one just STORED. There is provision for ignoring 'K' scans after each SUBTRACTED scan.

Example Settings: 'J' = 10 (memories) and 'K' = 20 (ignored scans).

Effect: The experiment is set up so that the first scan of each pair collects actual experimental data, while the second scan of the pair collects background data. The following sequence of events takes place during data acquisition:

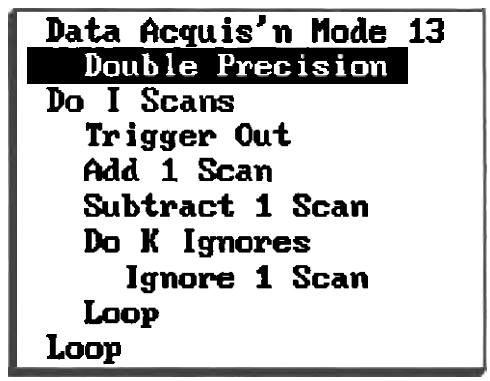
1. Following a Trigger Out (TOUT) signal, the data from the first half of a scan pair is stored in a unique memory.

2. The data from the second half of the pair is then subtracted from the data just STORED in memory, leaving data which represents the difference of the two scans stored in that same memory area.

3. Twenty scans are then ignored.

4. The entire process repeats until ten memories are filled with "background corrected" experimental data.

DATA ACQUISITION MODE 13



Explanation: Data is acquired from 'I' scan pairs. Each scan pair is preceded by a Trigger Out (TOUT). The first scan of each pair is ADDED into memory, while the second scan of each pair is SUBTRACTED from that same memory's contents. There is provision for ignoring 'K' scans after each SUBTRACTED scan.

Example Settings: 'I' = 10 (scans) and 'K' = 50 (ignored scans).

Effect:

1. Following a Trigger Out pulse, data from the first scan of a scan pair is ADDED into the first memory and the data from the second scan of the pair is SUBTRACTED from that same memory.

2. 50 scans are then ignored.

3. Steps 1 and 2 are repeated nine more times, with all data from these scan pairs being added and subtracted, as appropriate, into the same memory as the first scan pair.

DATA ACQUISITION MODE 14

```
Data Acquis'n Mode 14
  Single Precision
Do J Mems
  Trigger Out
  Add 1 Scan
  Do K Ignores
    Ignore 1 Scan
  Loop
  Subtract 1 Scan
  Inc Memory
Loop
```

Explanation: There are 'J' scan pairs, each occupying a different memory. Each pair is preceded by a Trigger Out (TOUT). The first scan of each pair is STORED in memory, and there is provision for ignoring 'K' scans after each STORED scan. If 'K' = 0, the next scan of the detector is SUBTRACTED from the STORED scan. If 'K' > 0, the SUBTRACTED scan doesn't take place until after the last ignored scan. Note: except for the timing of IGNORED scans, this mode is the same as Mode (12).

Example Settings: 'J' = 10 (memories) and 'K' = 100 (ignored scans).

Effect: The following sequence of events takes place:

1. A unique memory is assigned.
2. A Trigger Out pulse is transmitted.
3. The first scan of a scan pair is read and then stored in the assigned memory.
4. The next 100 scans are ignored.
5. The second scan of the pair is read and then SUBTRACTED from the data in the current memory.
6. Steps 1-5 are repeated for the remaining (9) memories.

DATA ACQUISITION MODE 15

```
Data Acquis'n Mode 15
  Double Precision
Do I Scans
  Trigger Out
  Add 1 Scan
  Do K Ignores
    Ignore 1 Scan
  Loop
  Subtract 1 Scan
Loop
```

Explanation: 'DP 1' selects double precision for data storage. There are 'I' scan pairs placed into ONE MEMORY. Each scan pair is preceded by a Trigger Out (TOUT). The first scan in each pair is ADDED into memory, and there is provision for ignoring 'K' scans after each ADDED scan. If 'K' = 0, the data from the next scan is SUBTRACTED from the STORED scan data. If 'K' > 0, the SUBTRACTED scan doesn't take place until after the last ignored scan. Note that, except for the timing of the IGNORED scans, this mode is the same as Mode (13).

Example Settings: 'I' = 30 (scans) and 'K' = 100 (ignored scans).

Effect:

1. After a Trigger Out pulse is sent, the data from the first scan of a scan pair is ADDED into a memory.
2. The next 100 scans are ignored.
3. The second scan of the first scan pair is SUBTRACTED from the same memory used in Step 1.
4. Steps 1, 2 and 3 are repeated 29 more times.

Appendix D
Data Acquisition Design

APPENDIX CONTENTS: PG

INTRODUCTION ---- 121
DAD DEFINED ---- 121
PROGRAMMING CONSTRAINTS ---- 122
TIMING CONSIDERATIONS ---- 122
DEFINITIONS ---- 122
OVERHEAD TIME ---- 122
LOADING AND OPERATING DAD PROGRAMS ---- 123
DAD PROGRAMMING RULES ---- 124
COMMAND FORMAT & PROTOCOL ---- 124
DAD COMMANDS ---- 125
CATEGORIES OF ---- 125
INTERACTIVE COMMANDS ---- 125
DAD ---- 125
EXIT ---- 125
LIST ---- 125
CONTROL COMMANDS ---- 126
DO ---- 126
DP ---- 126
GX ---- 126
GXH ---- 126
INC.MEM ---- 126
INC.PTR ---- 126
LOOP ---- 126
MEM ---- 126
NEW ---- 127
STOP ---- 127
STORE ---- 127
0.LPTR ---- 127
CONDITIONAL COMMANDS ---- 127
BEGIN-END ---- 127
IF-ELSE-THEN ---- 127
IF-THEN ---- 128

APPENDIX CONTENTS: PG

PIA COMMANDS ---- 128
CLR ---- 128
PLS ---- 128
SET ---- 128
TGL ---- 128
TST ---- 128
DETECTOR SCANNING COMMANDS ---- 128
ADD ---- 128
ADD.MEM ---- 128
CAL ---- 128
CLR.MEM ---- 128
MOV.MEM ---- 128
IGN ---- 128
ON.SCAN ---- 128
ON.TRIG ---- 128
SHUTTER ---- 128
SUB ---- 129
SUB.MEM ---- 129
TOUT ---- 129
ERROR REPORT ---- 129
STATUS REPORT ---- 130
ON.TRIG COMMAND TIMING ---- 130
ON.TRIG OUTSIDE LOOP ---- 130
ON.TRIG INSIDE LOOP ---- 130
SAMPLE PROGRAMS ---- 132
STOPPED FLOW ---- 132
WARM-UP BEHAVIOR OF MERCURY LAMP -- 133
200-1000 nm LIGHT SOURCE STUDY ---- 134
VARIABLE RATE SIGNAL MEASUREMENT -- 136
PULSED LASER EXPERIMENT ---- 138
SCAN RESYNCHRONIZATION ---- 139

D.1 INTRODUCTION

Although the standard Data Acquisition Modes satisfy the requirements of most experiments, situations that require customized data acquisition routines do occasionally arise. The Data Acquisition Design (DAD®) capability provides you with the flexibility to program the data acquisition operations so that your Detector Interface will meet the requirements of virtually every conceivable experiment.

Note: The Standard Data Acquisition Modes presented in the Model 1461 and Model 1471A manuals will work in DAD programs if they are incorporated as they are written in those manuals.

Only those commands and command formats described in this appendix can be used to program Data Acquisition Design modes. It might be noted that, use of the DAD language is also described in the 1461 and 1471A manuals; with the exception of *load and execute* considerations, most of the information in this appendix is the same and is provided here for user convenience.

D.2 DATA ACQUISITION DESIGN DEFINED

DAD is a dedicated programming language that includes its own compiler. Its syntax consists of a set of commands that can be placed in nearly any desired order to produce a customized sequence of data acquisition operations. The language includes certain constraints and rules that govern the order in which these commands can be implemented. Both the commands and their constraints are explained in this appendix.

You can always program a DAD mode into the 1471A or 1461, as long as successful communications have been established with the host computer or terminal.

With the Standard Data Acquisition modes, certain combinations of commands are not permitted. With DAD, however, you can design a Data Acquisition modes using a virtually limitless combination of commands, including the looping and branching techniques common to so many programming languages. With DAD, you can not only customize data acquisition sequences but you can also test and manipulate the TTL I/O lines at the 1471A's or 1461's PIA port. It is this flexibility of control that makes DAD such a powerful tool.

D.3 WRITING DAD PROGRAMS

1. DAD programs are written using an ASCII editor or a word processor able to save files in ASCII format.

2. DAD programs should be named "username.DAD", following DOS conventions. It is essential that every DAD program end in the extension ".DAD".

3. **In the Setup DA Mode Menu when the user enters "99" in response to DA Mode?", the Load DAD Program** screen appears, allowing the user to browse through all "*.DAD" files.

4. When a file is selected, it loaded into the 1461 or 1471A and the system switches to DA 99. The filename is also stored in the parameter section of M1470.PRM if F10 is used to exit the program.

5. When the program is reentered, this file is loaded into the 1461 or 1471A; if the last DA mode was 99, then this DA mode is again active.

D.4 FILE STRUCTURE

1. The first eight characters of a DAD program must be:

   M1470DAD

   Should this statement not be present, the error **Unknown File Type** will be generated when the attempt is made to load the program.

2. It is recommendeed that a version number consisting of a space, followed by a four-character number, followed by a trailing space, follow **M1470DAD**.

   Examples:

   M1470DAD 00.1 or M1470DAD 1234

3. Finally, a label can be added (starting after the space following the version number and continuing for the rest of the first line of the file).

   Example:

   M1470DAD 00.1 Test run #2 of ....

   The first line must be less than 96 characters, which limits the label to 82 characters. The system will live without the version number or the label, but if they are included, the file selector screen will display the label (as it does for other type files).

4. Begining with the second line, a line can contain up to 80 characters, including spaces.

5. Leading spaces can be added since they will be ignored when the program runs.

6. Text after a single quote ' is ignored when the program runs. This allows users to add comments to a DAD program.

   Commands that set parameters, such as ET, TEMP, I, J, K, etc.) should **not** be used in a DAD program. Such parameters should be set using the appropriate menu choices. Any parameter changes called from a DAD program will not be passed to the OMA Vision software for screen updating or storage, with a strong subsequenct possibility of unpredictable and confusing system behavior.

D.5 PROGRAMMING CONSTRAINTS

Before you learn how to write a DAD program, it is important that you first understand the timing and memory constraints fundamental to both standard and customized data acquisition. When you use any of the 1471A's or 1461's preprogrammed data acquisition modes, the software automatically sets up the system to meet these constraints. When you set up DAD modes, however, you must be very careful to satisfy the 1471A's or 1461's memory considerations and timing requirements. Otherwise, an assortment of rather frustrating error situations can arise. The flexibility of the DAD modes therefore comes at the price of increased vigilance.

Errors will cause an message box with the erroneous command and error code to be displayed. Errors in a DAD program will cause the program to be erased and leave a DAD program consisting of a single command "STOP".

With regard to memory, the 1471A or 1461 automatically allots 512 bytes of available memory to store the compiled DAD program. This capacity allows for a program that is approximately 150 commands in length, which is more than sufficient to meet the requirements of nearly any practical experiment. However, a situation might arise when part of the 512 bytes are otherwise occupied or when a particularly long DAD sequence has been written. At such times, it becomes important to understand the system's memory restrictions.

Furthermore, as explained in the next section of this appendix, data acquisition timing often becomes a primary consideration when constructing DAD modes. For this reason, before studying the DAD language, you should carefully review Chapter 6 of the 1461 or 1471A manual for information about data acquisition timing. Many of the specific timing relationships that affect DAD programming are further discussed in the remainder of this appendix.

D.6 TIMING CONSIDERATIONS

D.6A Definitions

Correct timing is critical to the operation of all data acquisition routines, including the customized DAD modes. There are certain terms that you should understand when discussing these timing relationships. With a Model 1471A or Model 1461 system, the basic unit of time is called the **Exposure Time.** This is the total time between successive reads of the same detector element. Exposure Time includes either two distinct components: **Scan Time** and **Overhead Time.**

Scan Time is the time interval during which detector elements are read and reset and data is transferred to the Detector Interface.

Overhead Time is fixed in length and it immediately

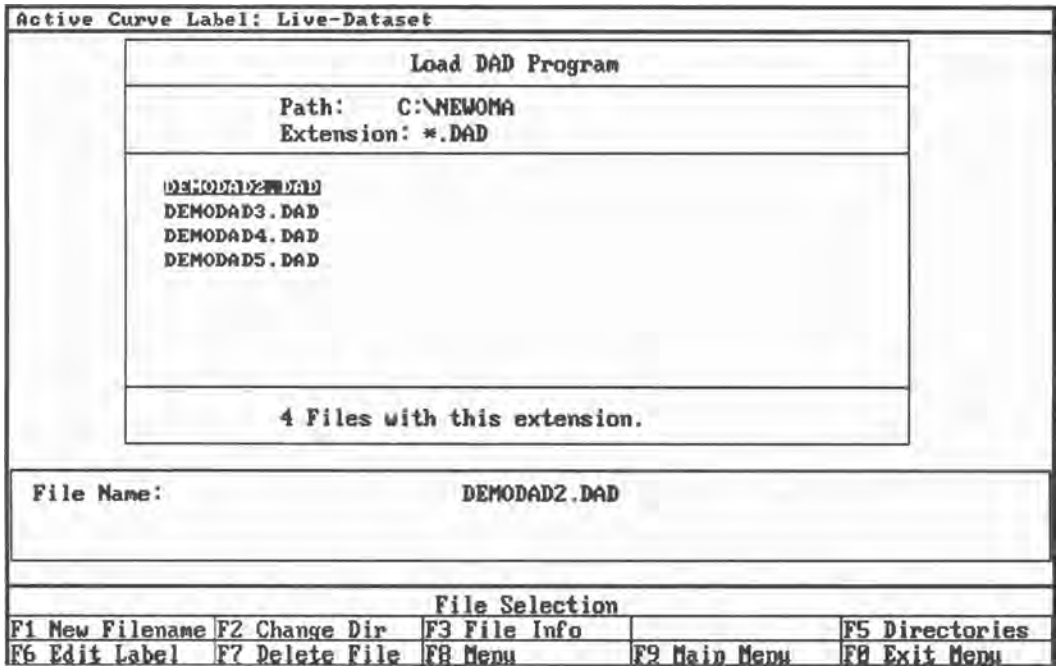


Figure D-1. LOAD DAD PROGRAM SCREEN

follows each Scan Time interval. It is during the Overhead Time that DAD commands are executed and the 1471A or 1461 makes decisions regarding the next detector scan.

D.6B Overhead Time

DAD programs are compiled and executed during the Overhead Time between scans. It is the length of the Overhead Time that is the limiting factor on the size of a DAD program. Therefore, it is important to be aware of how the interrelationship of Base Exposure time, number of detector elements, and synchronization mode affects the size of the Overhead Time.

The Overhead Time depends on both the Base Exposure Time and the number of elements in the detector's diode array. Furthermore, as explained in Chapter 6 of the 1461 and 1471A manuals, the Base Exposure Time further depends on whether the detector is using Normal or Line Synchronization. Tables D-1 and D-2 show the relationships between Base Exposure Time and Overhead Time, as they relate to the length of the detector's diode array. Table D-1 describes the situation with Normal Sync, while Table D-2 applies to Line Synchronization. (With Line Sync, each scan is initiated by the positive-going zero crossing of the power line input.)

Since DAD programs are only executed during the Overhead Time, the allowable size of such programs directly relates to the amount of Overhead Time that is available. For example, if the Base Exposure Time is 30 ms, there is 1.288 ms of Overhead Time to process DAD generated commands before the beginning of the next Scan Time.

Array Length	Exposure Time (ms)	Base Overhead Time (ms)
512	10	0.501
512	15	0.644
1024	20	1.039
1024	30	1.288

Table D-1. OVERHEAD TIMES - NORMAL SYNC

Array Length	Exposure Time (ms)	Overhead Time (ms)
512	16.666	2.311
512	16.666	7.168
1024	33.333	4.621
1024	33.333	14.327

Table D-2. OVERHEAD TIMES - LINE SYNC

D.7 LOADING AND OPERATING DAD PROGRAMS

DAD programs, generated using any ASCII editor or word processor, need to be stored on the hard disk, generally in the same directory as the other OMA Vision files. To Load a DAD program, proceed as follows.

1. From the **Main Menu** select **Data Acquisition.**

2. From the **Data Acquisition Mode** menu, select **Setup DA Mode** and press **<Enter>**.

3. From the **Setup DA Mode** menu, select **DA Mode** and press **<Enter>**.

4. Key **99** (DAD's Mode Number) and press **<Enter>**. This will cause the **Load DAD Program** screen to appear, as shown in Figure D-1.

5. Use the cursor keys to position the inverse video bar on the name of the DAD program to be loaded and press **<Enter>**. The program will be loaded and the **Setup Data Acquisition Mode** screen will restored. The name of the loaded DAD program will appear in the right-hand window.

6. Press the **F2 Run DA Mode** key to execute the program. **Note:** If the indicated function of **F2** is **Start Accum**, you will have to go back to the **Data Acquisition** screen, select **Toggle F1,F2 keys** and press **<Enter>**. You can then press **F2 Run DA Mode** to begin data acquisition.

Once a DAD program has been entered, it will remain the selected acquisition mode until a different mode is selected via the **Setup Data Acquisition Mode** menu.

D.8 DAD PROGRAMMING RULES

The following rules and constraints must be adhered to when generating DAD routines.

D.8A "DO-LOOP" Construction

1. Loops must always begin with the opening command, **DO**, followed by its associated parameter **n**. **LOOP** is the closing command.

2. In the **DO** command, **n** designates the number of times the loop is to be repeated. **n** can be a positive integer between 1 and 32767, or it can be one of the standard data acquisition parameter variables: I, J, K, or L. If one of these variables is assigned as the DO parameter, the DAD compiler uses the integer value that was last set for that variable outside of the DAD program. Remember that the values for I, J, and K cannot be specified within a DAD program. They can, however, be changed during the normal command mode of operation, using the standard keyboard commands. If I, J, K, or L is changed, the DAD program recompiles the new parameter values before running the DAD program.

3. DO-LOOPS can be nested three levels deep within DAD programs.

4. An unlimited number of loops can be placed within the outermost program loop as long as the preceding restrictions are not violated.

5. Although scanning commands (**ADD**, **SUBtract**, and **IGNore**) may be activated within DAD program loops, they are not required to be included as part of such loops.

D.8B Memory Assignments

1. When assigning a starting memory with **MEM n** command, **n** designates a specific memory location for data storage. **n** must be a positive integer between 1 and MAX.MEM, where MAX.MEM is a standard (non-DAD) command that is normally set to the maximum number of memories available in the system.

2. The **INC.MEM** command increments the memory assignment from its present location (specified by the **MEM** command) to the next highest number.

3. Memory commands can be placed anywhere within DAD programs.

D.8C PIA Control

1. PIA commands can be placed anywhere within DAD programs.

2. PIA commands are executed during the Overhead Time following the previous scan action (initiated by the **ADD**, **SUBtract**, or **IGNore** commands).

D.8D Program Execution

1. In every DAD program, the Data Precision command, **DP n**, must immediately follow the **DAD** command. Therefore, it is always the first DAD command to be executed.

2. The **STOP** command must be the last command in every DAD program.

3. None of the standard commands listed in the Command Index of this manual can be used within DAD programs.

D.9 COMMAND FORMAT AND PROTOCOL

D.9A Introduction

The DAD command format differs little from that of the standard 1471A or 1461 command set. Like many of the standard commands, some DAD commands also require a single parameter (operand), which follows the command and is separated from it by a delimiter. This delimiter can be a space character or a comma, and it must be the same delimiter that the system uses for standard

commands. (All examples in this appendix will use the space character as the delimiter). Every DAD command line must be completed by a terminator, which may be either a Carriage Return, <CR>, or a Carriage Return followed by a linefeed character, <CRLF>.

DAD commands must always be entered with CAPITAL letters, and some of these commands even include a period. (Periods within DAD commands have no special significance other than to separate the letters to make the command more readable.)

D.9B Compound Commands

Several DAD commands can be entered on a single line as long as each command is separated from the preceding one by a semicolon. If an error is detected at any point on a command line, the remainder of the compound command is aborted. A compound command must be followed by the system's terminator, which should be either <CR> or <CRLF>.

D.9C Command Errors

When a command error is recognized during RS232C operation, the system will respond with a question mark ?. During GPIB operation, the communications software, such as the Static Interface Routine described in the 1471A or 1461 Operating Manual, determines how the error is reported.

Note: Until you are very familiar with DAD programming, you are advised to enter one DAD command per line.

D.9D Summary

To summarize, the DAD command format is:

<C> <space> <n> <term>

Where:

<C> = The DAD command designator (may include a period).

<space> = Used only if the command requires an operand <n>.

<n> = A numeric operand, if required by the command. The operand can be a decimal integer, a variable (I, J, or K), or a number written in scientific notation.

Numbers expressed in scientific notation are coded with the letter 'E' used to indicate an exponent to the base 10. For example, the number 0.0003 is equivalent to 3*10-4. This would be coded as: **3.E-4 or 3E-4**

<term> = The system's terminator character, which can consist of either a Carriage Return <CR> or a Carriage Return/Line Feed sequence <CRLF>. The selected terminator enters the command into the system.

D.10 DAD COMMANDS

D.10A Command Categories

The following list of DAD commands is divided into seven functional categories:

1. **Interactive Commands:** These commands interact between the standard Model 1471A or Model 1461 environment and the DAD programming system. They are used to enter and leave the DAD mode and to LIST the program.

2. **Control Commands:** These commands control the Model 1471A or Model 1461 hardware itself. Included in this category are the DAD commands that set the system's Data Precision and the Memory locations in which data is to be stored. The **DO, LOOP,** and **STOP** commands are also included in this set of commands.

3. **Conditional Commands:** Using **IF-THEN** or **BEGIN-END** constructs, these commands allow you to perform conditional jumps within DAD programs.

4. **PIA Commands:** These commands control and test the sixteen TTL I/O bits at the system's PIA port.

5. **Detector Scanning:** These commands control the scanning process and the acquisition of spectral data. They are executed during the scanning portion of the exposure timing cycle.

6. **Error and Status:** These commands return programming error codes and 1471A or 1461 system status information.

D.10B Interactive Commands

DAD Enters the DAD programming mode from the standard 1471A system environment. The system prompt normally changes after the DAD mode has been entered. (See Chapter 5 of the Model 1461 or Model 1471A manual.)

EXIT PROGRAM EXIT. Exits the DAD programming mode and returns to the standard Model 1471A or Model 1461 environment. Compiles the program if necessary. The standard system prompt normally returns after the EXIT command has been executed. (Also see Chapter 5.)

LIST PROGRAM LIST. Lists the DAD

program currently in memory. The listing is displayed on the system's host computer or on an attached terminal. **LIST** can be executed when in either DAD mode or in the standard 1471A or 1461 environment. If there is no DAD program in memory or a standard Data Acquisition mode is active, no listing will occur and Error 2, Invalid Command, will be generated.

D.10C Control Commands

DO n START DO-LOOP. Causes a series of commands in a loop to be repeated 'n' times. The commands following the DO statement are executed one at a time until the appropriate LOOP statement is reached. 'n' can be an integer from 1 to 32767, or it can be a variable designated by the capital letters I, J, or K. If one of these variables is selected, the integer last set for that variable is used. (The values for variables I, J, and K must be set from without the DAD program.)

Note that if the value for the variables I, J, or K is changed between "runs" of a DAD program, the program will be automatically recompiled the next time that the RUN command is entered.

DP n DATA PRECISION. Selects either single (16-bit) or double (32-bit) precision for data storage. DP must be the first command of every DAD program. The specifications for parameter 'n' are:

n	Precision
0	16-bit
1	32-bit

GX Transmits next scan over the GPIB. Sends one complete scan.

GXH Keeps trying to send the next scan over the GPIB until the host addresses the 1471A or 1461 to talk. Sends one complete scan.

INC.MEM INCREMENT MEMORY. Increments the memory# by 1, thus selecting the next highest memory for data storage.

When INC.MEM and INC.PTR occur between two loop statements, where the second LOOP closes a loop which begins with ON.TRIG DO, INC.MEM should precede INC.PTR.

Only one action in addition to INC.MEM (including INC.PTR) should occur between the two LOOP statements in ON.TRIG DA modes.

Because processing of a DAD program takes place during the fixed Overhead Time, the action should not be a PIA or SHUTTER operation because of the time required to affect the hardware. If one of these operations is included, you may lose scan synchronization. If synchronization is lost, you can rewrite the program to include an ON.SCAN command.

INC.PTR INCREMENT L POINTER. Moves the array pointer to the next array element and places it in "L". If a fourth single value loop counter is needed, you can use **DO L** without an **INC.PTR**.

When INC.MEM and INC.PTR occur between two loop statements, where the second LOOP closes a loop which begins with ON.TRIG DO, INC.MEM should precede INC.PTR.

Only one action in addition to INC.MEM (including INC.PTR) should occur between the two LOOP statements in ON.TRIG DA modes.

Because processing of a DAD program takes place during the fixed Overhead Time, the action should not be a PIA or SHUTTER operation due to the amount of time required to affect the hardware. If one of these operations is included, you may lose scan synchronization. If synchronization is lost, you can rewrite the program to include an ON.SCAN command.

LOOP END DO-LOOP. Ends the execution of commands within a DO-LOOP. If DO-LOOPS are nested, the LOOP command for an inner loop must be executed before the LOOP command of an outer loop. DO-LOOPS cannot be nested more than three levels deep within a program.

MEM n MEMORY. Sets the starting memory for data storage. If this command is omitted, the data will be stored in the currently selected memory location. 'n' can range from 1 to the value set by the (normal mode) MAX.MEM command. (MAX.MEM is dependent on the Model 1471A or Model 1461 system configuration.)

NEW Clears the current DAD program from the 1471A's memory. This command is used only when in DAD entry mode.

If, while creating a DAD program, you find that you have omitted a command, you can use NEW to clear the DAD entries from the 1471A's RAM without leaving the DAD entry mode. Since you are still in DAD entry mode, you can immediately begin entering your program again.

STOP STOP. Ends the execution of commands within a DAD program. Does not exit the DAD programming mode.

STORE Clears the contents of a memory location and stores new data there. This command is useful when performing live versus cumulative curves.

0.LPTR ZERO L POINTER. Sets the "L" array pointer to the first element and transfers its contents to "L". Since the RUN and NEW commands automatically set the "L" pointer, this is an optional command. If it is used, 0.LPTR must appear somewhere in the program before the first use of DO L.

D.10D Conditional Commands

BEGIN-END EXECUTES A CONTINUOUS LOOP. The loop of program lines between the BEGIN and END statements is exited only when the PIA bit being tested is "1". (The TST n command must be part of the BEGIN-END loop.) If more than one TST command is within the loop, the one closest to the END statement controls the exiting of the loop. DAD programs do not allow nesting of BEGIN-END loops.

Example:

}BEGIN	Starts a continuous loop.
}PLS 2	Sends a TTL pulse out of PIA bit 2. (Such a signal could be used to pulse a stepper motor.)
}TST 3	Tests PIA bit 3. If the bit is a "1", the BEGIN-END loop is broken and the next command in the program is executed. If the bit is a "0", the loop repeats. (This could be used to prevent further pulsing when a stepper motor has reached its end stop.)
}END	Closes the BEGIN-END loop.

IF-ELSE-THEN CONDITIONAL BRANCH. Makes a decision based on the TTL level of a tested PIA bit. If the bit's value is "1", all command lines between the IF and ELSE statements are executed. If the bit's value is "0", all command lines between the ELSE and THEN statements are executed. The construct is closed by the THEN command. Note that DAD programs do not allow you to nest IF-ELSE-THEN constructs.

Example 1:

}TST	Test PIA bit 1.
}IF	If the value of bit 1 is a "1", the next command (SET 9) is executed. If the PIA bit is a "0", jump directly to the ELSE statement.
}SET 9	Set PIA bit 9 to "1" and then jump directly to the THEN statement.
}ELSE	If the tested PIA bit is a "0", execute the next command line (SET 10).
}SET 10	Sets PIA bit 10 to a "1". The THEN statement and the lines following it are then executed.
}THEN	Closes the IF-ELSE-THEN construct.

Example 2:

}TST 1	Test PIA bit 1.
}IF	If the tested PIA bit is a "1", execute all command lines until the ELSE statement is reached. If it is a "0", jump directly to the ELSE statement.
}DO 1	Begin a DO-LOOP that performs a single scan.
}ADD	Adds the scan data to memory.
}LOOP	Close the DO-LOOP and jump directly to the THEN statement.
}ELSE	If the tested PIA bit was "0", execute all command lines until the THEN statement is reached.
}DO 1	Begin a DO-LOOP that performs a single scan.
}SUB	Subtract the next scan from the previously stored data.

}LOOP Close the DO-LOOP and execute the THEN statement and the lines that follow it.

}THEN Close the IF-ELSE-THEN construct.

IF-THEN CONDITIONAL BRANCH. Makes a decision based on the TTL level of a tested PIA bit. If the bit's value is "1", all command lines between the IF and THEN statements are executed. If the bit's value is "0", the program jumps directly to the THEN statement. Note that DAD programs do not allow you to nest IF-THEN constructs.

Example:

}TST 1 Test PIA bit

}IF If the tested PIA bit is "1", the next command line (SET 10) is executed. If it is a "0", the program jumps directly to the THEN statement and executes the command that follows if.

}SET 10 Sets PIA bit 10 to a "1". The next command (THEN) is then executed.

}THEN Closes the IF-THEN construct.

D.10E PIA Commands

In all of the following DAD mode PIA command descriptions, the parameter, 'n', specifies the PIA bit being acted upon. In these commands, 'n' can range from 0 to 15. All of the PIA bits represent one standard TTL load in the input mode and they will drive one standard TTL load in the output mode. However, bits 8 through 15 are also capable of sourcing 1.0 mA at 1.5 Volts in the output mode.

Note: When the **RUN** command is issued, all of the PIA bits are set as OUTPUT BITS with logic 0. Therefore, if the PIA port is going to be used in the DAD mode, its bits should be set up at the beginning of the program.

CLR n CLEAR BIT. Clears PIA bit 'n'.

PLS n PULSE BIT. Causes the system to transmit a TTL pulse on the PIA line specified by 'n'. The pulse is approximately 35 μs wide and can be negative or positive, depending on the initial state of bit 'n'.

SET n SET BIT. Sets PIA bit 'n'

TGL n TOGGLE. Toggles PIA bit 'n' to the opposite polarity.

TST n TEST. Tests PIA bit 'n' and returns its TTL level to the DAD program. Refer to IF-THEN and BEGIN-END command descriptions for examples of how the TST command can be used.

D.10F Detector Scanning Commands

ADD ADD DATA. A scan of detector data is added to the data in the currently selected memory. Either 16- or 32-bit data is used, depending on the setting of the DP command. This command is executed during the scan time.

ADD.MEM n ADD MEMORY. Takes the current memory and adds it to memory "n".

CAL n1,n2 CALIBRATE. Autocalibrates the Model 1240 Detector/Spectrograph.

n1 = 0 Off
n1 = 1 On
n2 = time (in seconds) that the 1471A or 1461 is to wait for the lamp to warm up before taking data

CLR.MEM n Clears memory "n".

IGN IGNORE DATA. Reads one scan of the array and discards the data. This command is executed during the scan time.

MOV.MEM n MOVE MEMORY. Overwrites whatever is in memory "n" with the data in the current memory.

ON.SCAN Used to synchronize the software to the detector scanning. This command is particularly important when using DO-LOOPS which take longer than the Overhead Time or when scan sync. is lost because of a violation of the ON.TRIG DA mode timing constraint.

ON.TRIG ON TRIGGER. Sets the system to begin data acquisition as soon as an external trigger pulse is received. Refer to Section 6.4 of the Model 1461 or Model 1471A or Model 1461 manual for more details about the ON.TRIG command. See Section D.8I for a detailed discussion of the special timing considerations involved with the ON.TRIG command.

SHUTTER n1,n2 This command controls the shutter on

the detector/spectrograph. This command takes at least one parameter, which is either 1 or 0. The default setting on powerup is "1" (shutter closed).

n1 = 0 causes the shutter to open or stay open.

n1 = 1 causes the shutter to close or remain closed.

You can also include the parameter "n2", which specifies the number of milliseconds the 1471A or 1461 will wait while something happens, usually the opening or closing of the shutter. For instance, when **SHUTTER 1,100** is executed, the shutter will begin to open and the 1471A or 1461 will wait 100 ms before it begins to execute the next DAD command.

SUB SUBTRACT DATA. A scan of detector data is subtracted from the data currently in memory, using either 16- or 32-bit data precision, depending on the setting of the **DP** command. This command is executed during the scan time no matter which Detector Controller is used.

SUB.MEM n SUB MEMORY. Subtracts the current memory from memory "n".

TOUT TRIGGER OUT. Generates a trigger output at the beginning of the Exposure Time.

D.10G The Error Report

ERR ERROR CODE REPORT. Requests the 1471A or 1461 to send an error code to the host computer. This code defines the error condition that exists for the last DAD command acted upon. This command should be the first one sent after a problem occurs and whenever the 1471A's or 1461's front-panel ERROR indicator lights up.

If you are communicating through the serial interface ERR should be sent whenever a question mark ('?') appears as a response to a transmitted command. If you are communicating with the GPIB static interface routine supplied in the 1471A or 1461 Operating Manual, ERR should be sent whenever the message 'COMMAND ERROR' appears as a response to a transmitted error. Note that the GPIB response to command errors depends entirely on the remote computer and the GPIB communications routine that is used. The error codes that the 1471A or 1461 transmits to the host computer or terminal are:

CODE	ERROR
0	**NO ERROR:** The last command did not generate an error condition.
2	**COMMAND ERROR:** The 1471A or 1461 did not recognize the command it received. This code is also returned when a parameter was sent with a command which does not use one.
3	**PARAMETER ERROR:** An out-of-range parameter was sent with a command. For instance, this error code will be returned after the 1471A or 1461 receives a PIA command specifying a bit outside of the range 0 through 15.
4	**COMMAND OVERRUN ERROR:** This indicates that a character has been received from the host computer while the 1471A or 1461 was busy processing the previous command. This error alerts the users to the need for pacing commands in an orderly manner. This can be accomplished by using the serial poll via GPIB interface, or by using the prompt character } via the RS232C interface. When a command overrun condition exists, the 1471A or 1461 front-panel ERROR indicator glows at the completion of the initial command, and the TALK and LISTEN indicators turn on to indicate the overrun condition. These indicators stay lit until the next command is received.
5	**NOTHING-TO-SAY ERROR:** During GPIB communication this code is returned if the 1471A or 1461 does not have a response to a received TALK message. This error condition usually occurs when a TALK message is executed without a prior information-request message being acted upon. A Nothing-To-Say error will also be generated during a serial poll if the host computer does not send the UNTALK message before it sends the SERIAL POLL MESSAGE.
6	**NUMERIC ERROR:** A non-numeric operand was sent.
7	**COMMAND SEPARATOR ERROR:** Commands which were imbedded within a multicommand line were not separated (solely) by semicolons.
100	**UNCLOSED DO-LOOP ERROR:** Every DO statement must be closed by a LOOP statement.
102	**DO-LOOP NESTING ERROR:** DO-LOOPS are nested more than three levels deep.

103	**MISSING-THEN ERROR:** An IF statement must always be followed by a THEN statement.
104	**MISSING-END ERROR:** A BEGIN statement must always be followed by and END statement.

D.10H The Status Report

ST STATUS. This command causes the Model 1471A or Model 1461 to report its status to the host computer. The number returned to the computer is the decimal equivalent of the Serial Poll Status Byte contents. The significance of each of the 8 bits of this byte is:

BIT	MEANING
0	**COMMAND DONE:** When set, this bit signifies that the 1471A or 1461 is ready for the next command. This defaults to "1" at power-up and is set to "1" when the 1471A or 1461 is ready for the next command. This bit is cleared (set to "0") whenever the ST command is executed.
1	**COMMAND ERROR:** Bit 1 is set if the previous command was invalid. This indicator is most useful during program development.
2	**NOT USED.**
3	**NOT USED.**
4	**DAD MODE:** This bit is set whenever the DAD programming mode is entered.
5	**COOLER LOCKED:** This bit is set when the detector temperature has been reached and stabilized.
6	**SERVICE REQUEST:** This bit is set if a Service Request is currently being generated in the 1471A or 1461.
7	**OUTPUT READY:** This bit is set when the 1471A or 1461 has output ready to send to the host computer.

Discussion: The ASCII decimal number returned to the host computer by the ST command consists of the SUM of the DECIMAL VALUES of the individual set bits.

For example, if ST is applied after bits 4 (DAD MODE) and 7 (OUTPUT READY) were set, the host computer would receive the ASCII decimal number, 144, which is equivalent to the binary number, 10010000.

You should understand that sending the ST command is not the same as performing a serial poll. A serial poll can be done any time. However, ST, like every other system command, cannot be successfully sent while the 1471A or 1461 is busy executing a previously applied command. Another difference is that the response to a serial poll is an eight-bit binary byte, while the response to the ST command is an ASCII encoded decimal number. The ST command is provided so that RS232C users will have access to essentially the same information as the serial poll provides during GPIB operation.

D.10I The ON.TRIG Command - *Special Timing Considerations*

There are two ways of using the **ON.TRIG** command within DAD programs. The first method involves placing the **ON.TRIG** command outside of the Data Acquisition loop. The second involves placing the command within the loop.

ON.TRIG Placed Outside The Data Acquisition Loop: This mode of operation allows the 1471A or 1461 to carry out Data Acquisition scans without delays, thus achieving the fastest possible rates. Once the 1471A or 1461 completes a data scan, it is immediately ready to receive the next scan. This previously unavailable capability can be very important for experiments requiring the acquisition of data in the shortest possible time.

This mode has a major timing restriction associated with it. Because the 1471A or 1461 is rapidly acquiring data, and because the external trigger will generally occur somewhere within the Scan Time, there is going to be only one pixel time available between the completion of one scan and the beginning of the next. This 16 μs is the only time available in which the system can execute commands. For this reason, an acquisition loop containing an **ON.TRIG** command along with an **ADD**, **SUB**tract, or **IGN**ore command can only be followed by, at most, two additional commands: an **INC.MEM** and a **LOOP**. The system is designed to accomplish this. However, by doing so, there is no time available for the execution of any other commands. Program Segment 1 provides a sample DAD command listing for this mode, and Figure D-2A illustrates its critical timing requirements.

ON.TRIG Placed Within The Data Acquisition Loop: This mode allows the 1471A or 1461 to perform Data Acquisition scans in a more conventional manner. Once the 1471A or 1461 completes a data scan, it must wait until the next available external trigger before starting the next scan. This waiting time allows many DAD commands to be executed during the Overhead period. The number of executable commands is limited only by the amount of Overhead Time.

Using Program Segment 2 as an example, commands are executed in the first Overhead period following the initial **ADD**. The 1471A or 1461 then performs the second **ADD** only after the next external trigger is applied. Figure D-2B illustrates the timing relationships in this mode.

Note: In order to maintain data integrity no matter where the **ON.TRIG** command is placed, the Overhead period between the two halves of the **ADD** scan is restricted from executing commands.

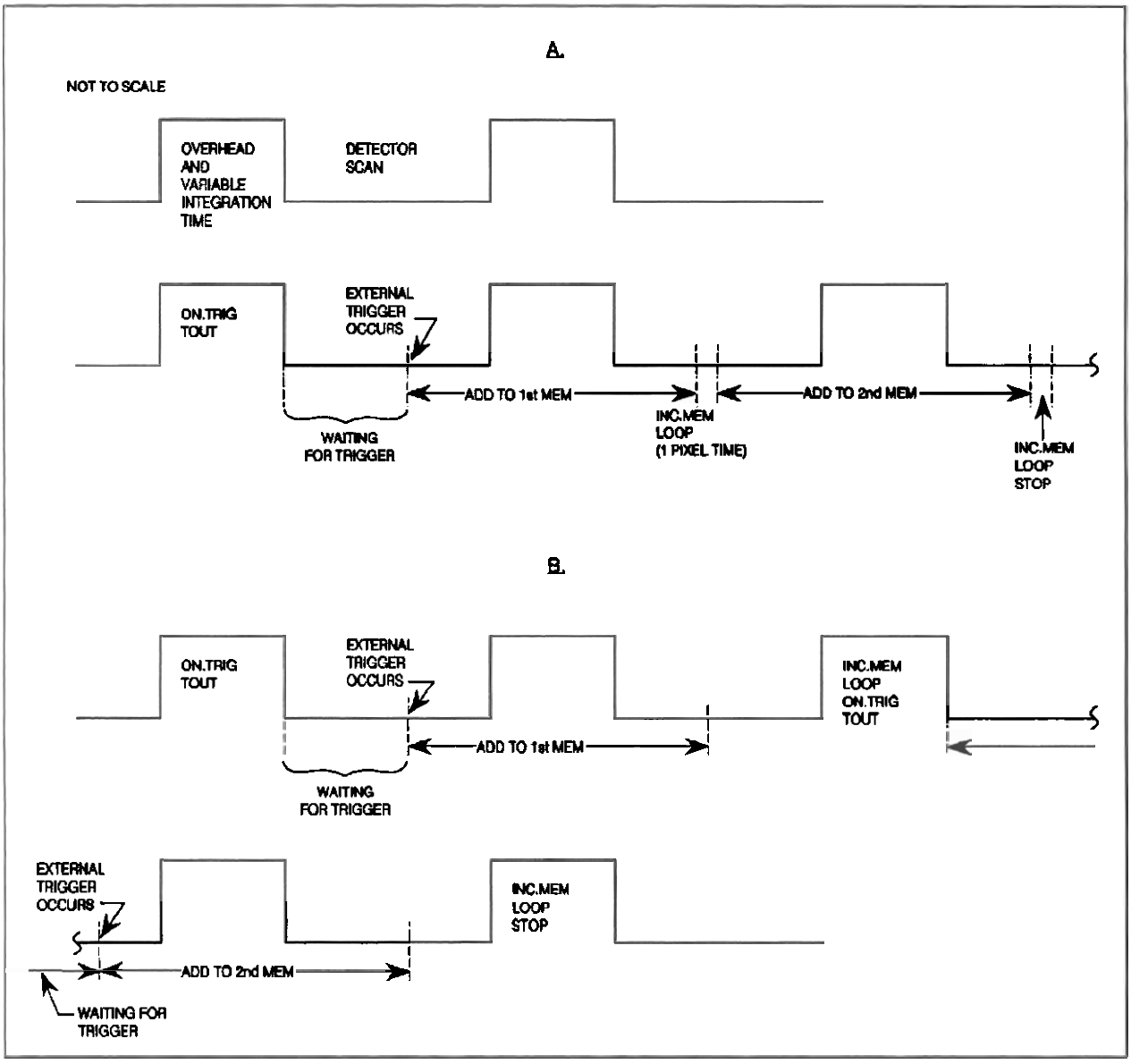


Figure D-2. TIMING DIAGRAM ILLUSTRATING THE ON.TRIG COMMAND

PROGRAM SEGMENT 1
}ON.TRIG
}TOUT
}DO 2
}ADD
}INC.MEM
}LOOP
}STOP

PROGRAM SEGMENT 2
}DO 2
}ON.TRIG
}TOUT
}ADD
}INC.MEM
}LOOP
}STOP

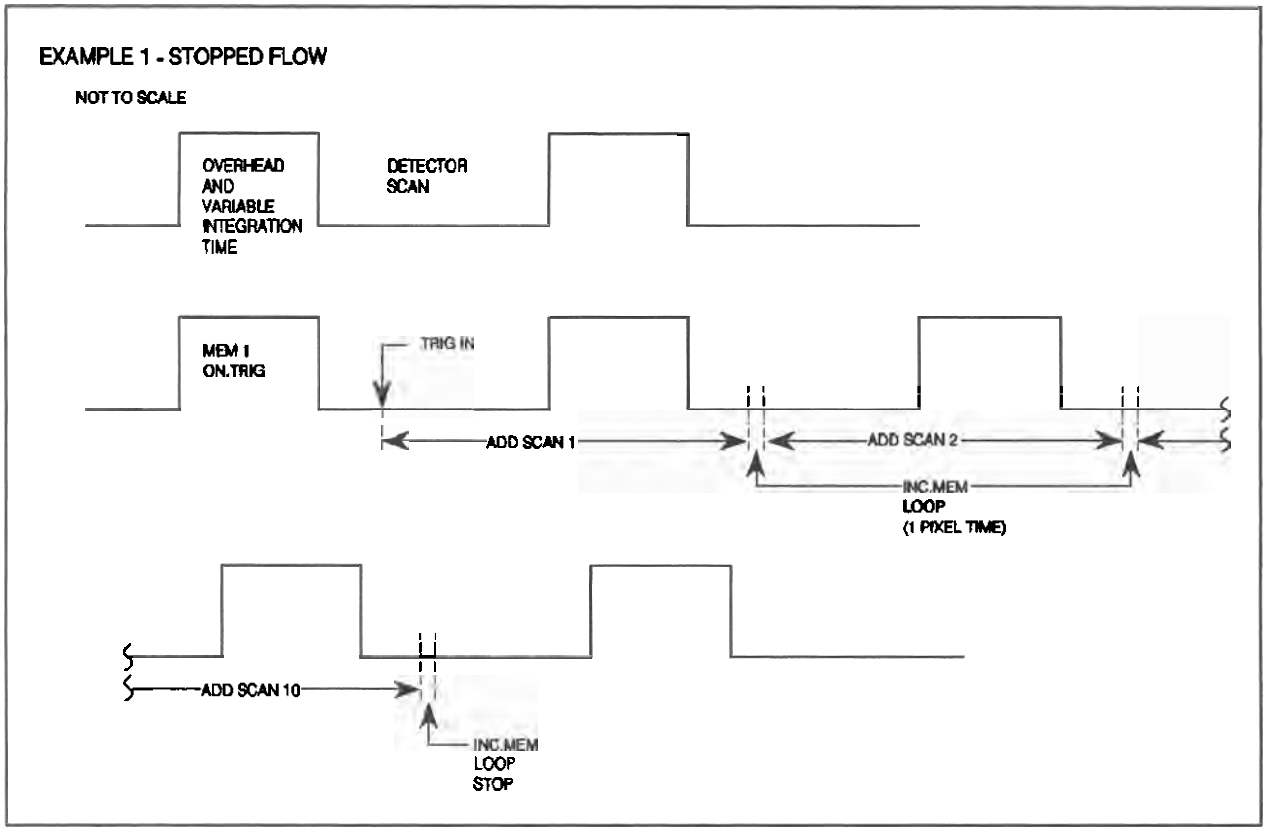


Figure D-3. TIMING DIAGRAM FOR STOPPED FLOW EXPERIMENT

D.11 SAMPLE PROGRAMS

The examples on the pages that follow present Data Acquisition Design (DAD) programs being used in actual laboratory experiments. The Model 1471A or Model 1461 used in these examples is connected to a serial terminal. The right-hand brace "}" is therefore shown as the system's response to its acceptance of DAD commands. When the system is in normal (non-DAD) mode, the usual asterisk (*) prompt is displayed.

Figures D-3 through D-7 and D-8 illustrate the timing relationships for each of these experiments. These timing diagrams are not meant to show the actual Exposure Timing cycle, as far as the polarity of the Overhead Period and the Detector Scan are concerned. Instead, they are used to illustrate when DAD commands are executed for the individual experiments.

EXAMPLE 1 - STOPPED FLOW

In this experiment, a light source is used to detect an interaction between two chemicals being mixed together. In this particular setup, there is no provision to have the 1471A or 1461 trigger the firing of the plunger that mixes the chemicals. However, there is an electrical trigger sent by the 'stopped flow'. This signal is transmitted when the flow has stopped and therefore when the data acquisition should begin. See Figure D-3.

DAD PROGRAM

*DAD	Command to enter the DAD programming mode.
}DP 0	Sets single precision data.
}MEM 1	Sets starting memory number to '1'.
}ON.TRIG	Makes the system wait for the trigger.
}DO 10	Begins DO-LOOP that takes 10 spectra.
}ADD	Adds a curve to memory.
}INC.MEM	Increments the memory pointer.
}LOOP	Repeats the loop 10 times.Closes the DO loop.
}STOP	Ends the DAD program.
}EXIT	Compiles the program and exits the DAD mode.
*RUN	Initiates the acquisition of data, using the current DAD routine.

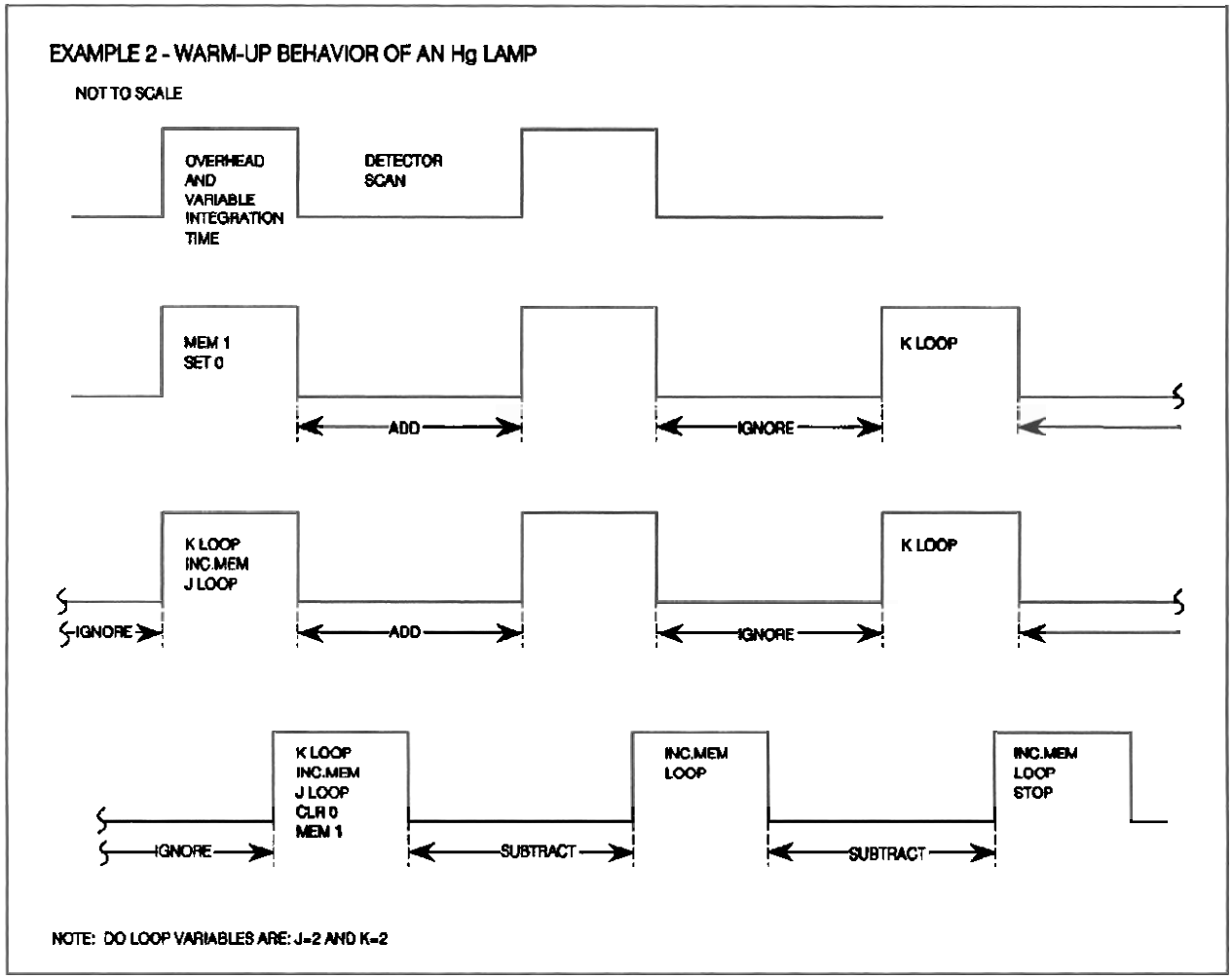


Figure D-4. TIMING DIAGRAM FOR THE MERCURY LAMP EXPERIMENT

EXAMPLE 2 - WARM-UP BEHAVIOR OF A MERCURY LAMP

This experiment studies the warm-up behavior of a low pressure Mercury Vapor lamp to determine its stabilization time. The TTL level of PIA bit 0 is used to switch the lamp ON. See Figure D-4.

DAD PROGRAM

*DAD	Command to enter the DAD programming mode.
}DP 0	Sets single precision data.
}MEM 1	Data storage to begin at memory location 1.
}SET 0	Sets PIA bit 0 to turn the lamp ON.
}DO J	Begins the data acquisition DO-LOOP, where J is the number of memories to be filled.
}ADD	Adds a spectrum into memory.
}DO K	Begins a time delay DO-LOOP, where K controls the delay between data acquisitions by ignoring a specified number of scans.
}IGN	Ignore a scan.
}LOOP	Repeats the delay loop "K" number of times and then closes this loop.
}INC.MEM	Increments the memory pointer to the next available memory.
}LOOP	Repeats the (memory counter) loop "J" number of times. Then closes it.
}CLR 0	Turns the lamp OFF and resets PIA bit 0.
}MEM 1	Resets the memory pointer to the first memory.
}DO J	Begins a DO-LOOP that starts the background subtraction process. J will equal the same number used in the first DO loop.
}SUB	Subtracts a background from the previously stored data.
}INC.MEM	Increments the memory pointer to the next data memory.

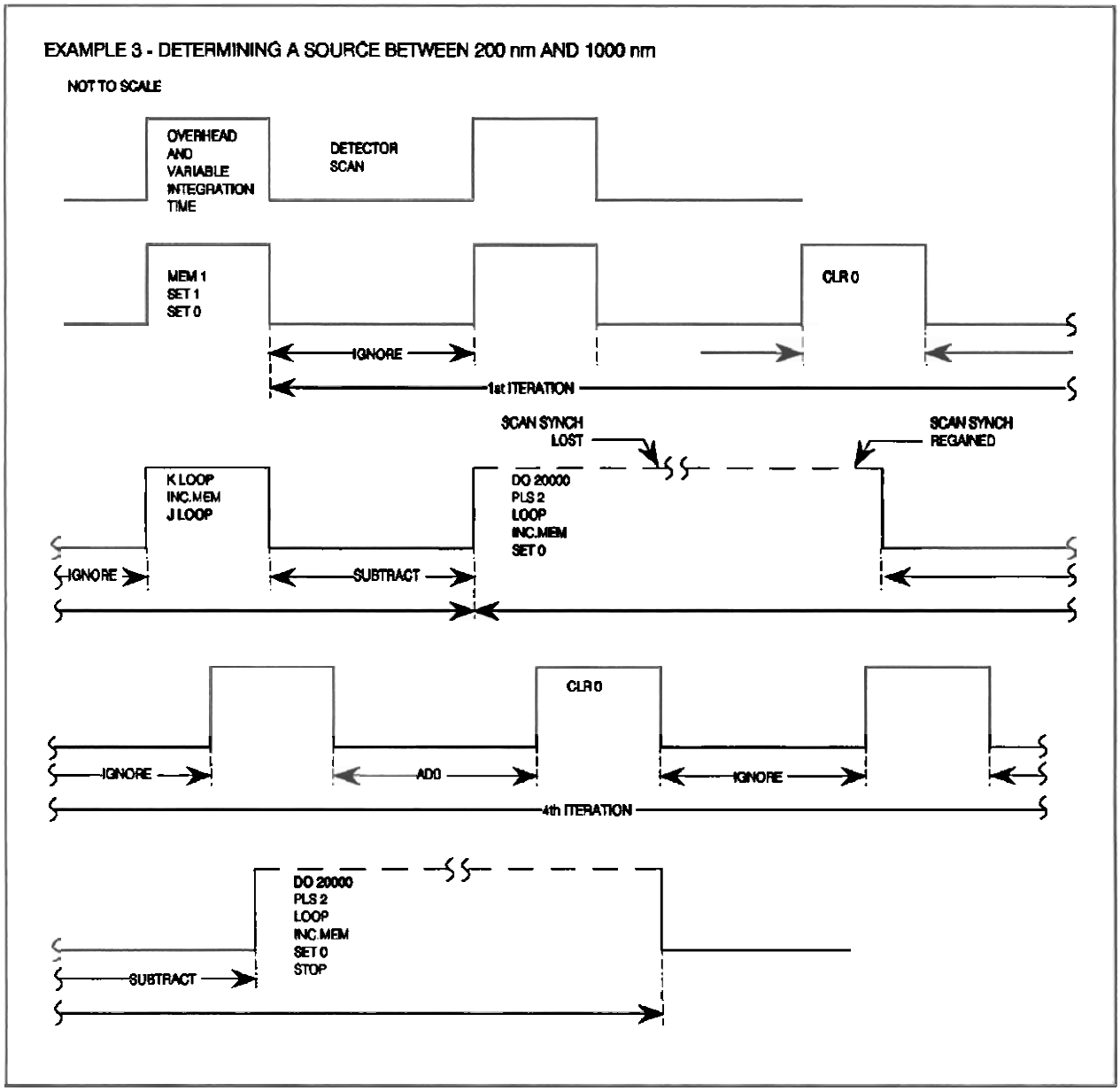


Figure D-5. TIMING DIAGRAM FOR A 200-1000 NM SOURCE

}LOOP	Repeats the loop "J" number of times. Closes only this second "J" loop.
}STOP	Completes the Data Acquisition routine and ends the DAD program.
}EXIT	Compiles the program and exits the DAD mode.
*RUN	Initiates the acquisition of data, using the current DAD routine.

EXAMPLE 3 - STUDYING A LIGHT SOURCE BETWEEN 200 AND 1000 nm

This experiment studies a light source known to be between 200 nm and 1000 nm in wavelength. The detector/spectrograph is restricted to a window width of 200 nm. The spectrograph has a bidirectional stepper motor drive controllable via TTL pulses. The direction depends on the logical state (0/1) of a control line. The window wavelength changes by 0.01 nm per pulse. At the start of the experiment, the spectrograph is set to cover 200 to 400 nm.

A TTL controlled shutter in the light path requires 10 ms to change positions. In addition, the detector exposure time is 20 ms. Note that the **DO 20000 - LOOP** construction in the program takes longer to execute than the time available in the Overhead period. In such cases, the 1471A or 1461 loses synchronization during detector scanning. Therefore, it is necessary to include an **IGNore** command afterward to allow time for resynchronization.

See Figure D-5.

The PIA bit assignments are:

BIT	ASSIGNMENT
0	Shutter control 0 = Shutter closed 1 = Shutter open
1	Spectrograph control line 0 = Decrement wavelength 1 = Increment wavelength
2	Stepper motor pulse input

DAD PROGRAM

*DAD	Command to enter the DAD programming mode.
}DP 0	Set single precision data.
}MEM 1	Start at memory 1.
}SET 1	Sets PIA bit 1 to "1". This sets the control line to increase spectrograph wavelength.
}DO 4	Begins DO-LOOP using 4 windows to cover the 200 to 1000 nm wavelength range.
}SET 0	Sets PIA bit 0 to a "1". This opens the shutter.
}IGN	Ignore one scan to allow time for the shutter to open.
}ADD	Adds a spectrum.
}CLR 0	Resets PIA bit 0 to a "0". This closes the shutter.
}IGN	Waits for the shutter to close.
}SUB	Subtracts the background.
}DO 20000	Begins DO-LOOP making stepper motor increment 20000 times across 200 nm wavelength range.
}PLS 2	Sends a TTL pulse via PIA bit 2 to increment the stepper motor.
}LOOP	Closes the DO-LOOP after 20000 pulses.
}INC.MEM	Points to next data memory: MEM 1 = 200 to 400 nm; MEM 2 = 400 to 600 nm MEM 3 = 600 to 800 nm; MEM 4 = 800 to 1000 nm
}LOOP	Closes the DO-LOOP which set 4 windows.
}STOP	Completes the DAD Data Acquisition routine.
}EXIT	Compiles the program and exits the DAD mode.
*RUN	Initiates DAD data acquisition.

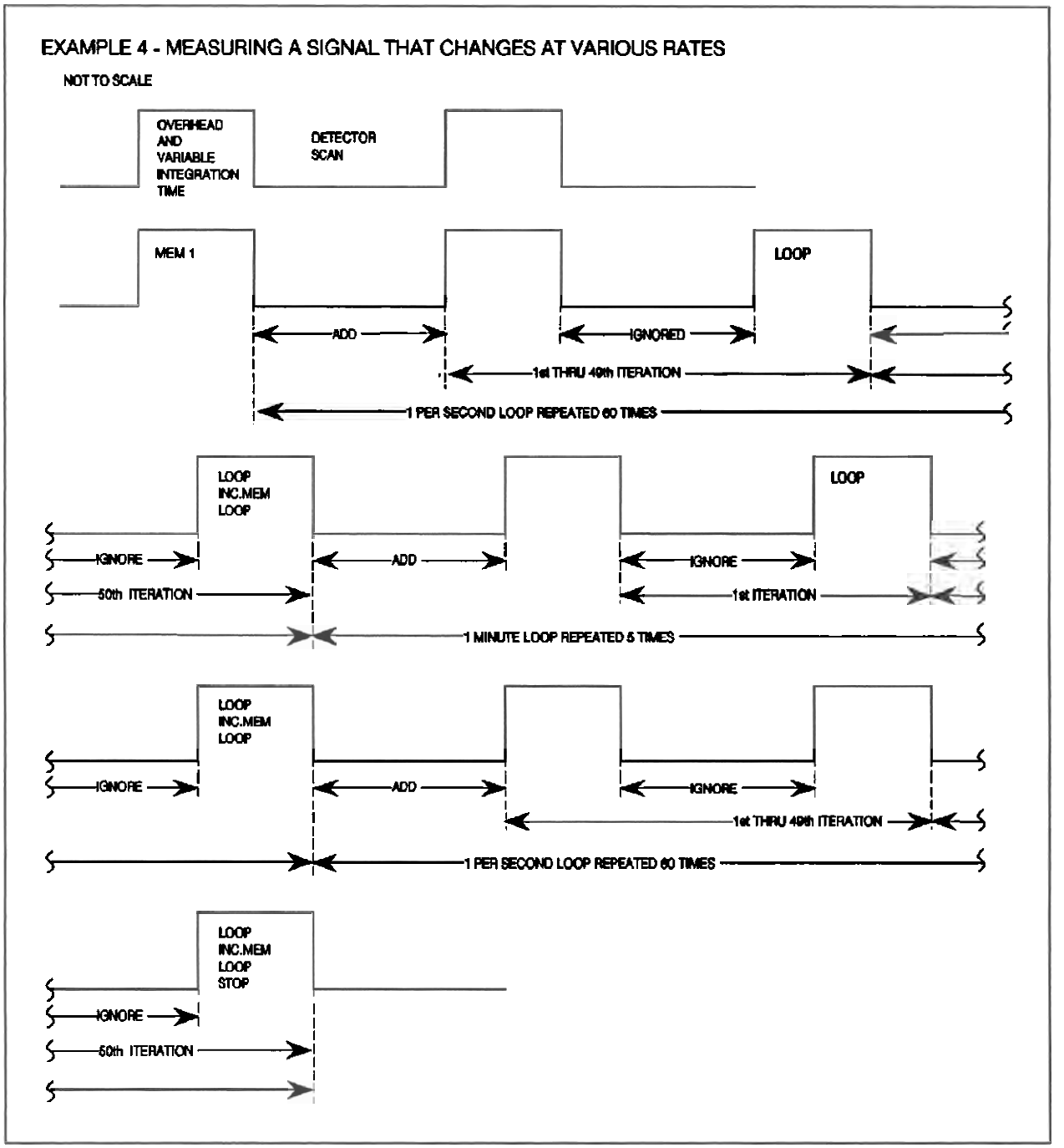


Figure D-6. TIMING DIAGRAM FOR A VARYING SIGNAL

EXAMPLE 4 - MEASURING A SIGNAL THAT CHANGES AT VARIOUS RATES

This experiment measures a signal that changes drastically during the first minute, then remains stable for 5 minutes, and varies again during the last minute. To conserve data space, the spectra should be sampled every second during the first minute, then one spectra should be taken per minute for five minutes, and finally, a spectra should be taken every second during the last minute. It is assumed that an additional memory card is installed in the Model 1471A or 1461. The exposure time is set to 20 ms. See Figure D-6.

DAD PROGRAM

*DAD	Command to enter the DAD programming mode.
}DP 0	Set the system to single precision to allow maximum data storage.
}MEM 1	Start with Memory 1.
}DO 60	Begin DO-LOOP that acquires one spectrum per second for one minute.
}ADD	Add data to memory.
}DO 50	Begin DO-LOOP that generates a 1 s time delay by multiplying the 20 ms "Ignore" Time by 50.
}IGN	Ignore one scan. (One scan takes 20 ms.)
}LOOP	Repeat the time delay DO-LOOP 50 times. Then close it.
}INC.MEM	Increments the pointer to the next memory.
}LOOP	Repeat the first data acquisition DO-LOOP 60 times. Then close this loop.
}DO 5	Begin a DO-LOOP that acquires one spectrum of data per minute for five minutes.
}ADD	Adds the spectral data to memory.
}DO 3000	Begins a DO-LOOP that generates a one minute time delay by multiplying the 20 ms "Ignore" Time by 3000.
}IGN	Ignore one scan. (One scan takes 20 ms.)
}LOOP	Closes the time delay DO-LOOP after repeating the operation 3000 times.
}INC.MEM	Increments the pointer to the next memory.
}LOOP	Closes the data acquisition DO-LOOP that is set to 5.
}DO 60	Begins a DO-LOOP that acquires one spectrum of data per second for one minute.
}ADD	Adds data to memory.
}DO 50	Begins DO-LOOP that generates a one second time delay by multiplying the 20 ms "Ignore" time by 50.
}IGN	Ignore one scan. (One scan takes 20 ms.)
}LOOP	Closes the time delay DO-LOOP that is set to 50.
}INC.MEM	Increments the pointer to the next memory.
}LOOP	Closes the data acquisition DO-LOOP that is set to 60.
}STOP	Completes the DAD Data Acquisition routine.
}EXIT	Compiles the DAD program and exits DAD mode.
*RUN	Initiates the acquisition of data, using the current DAD routine.

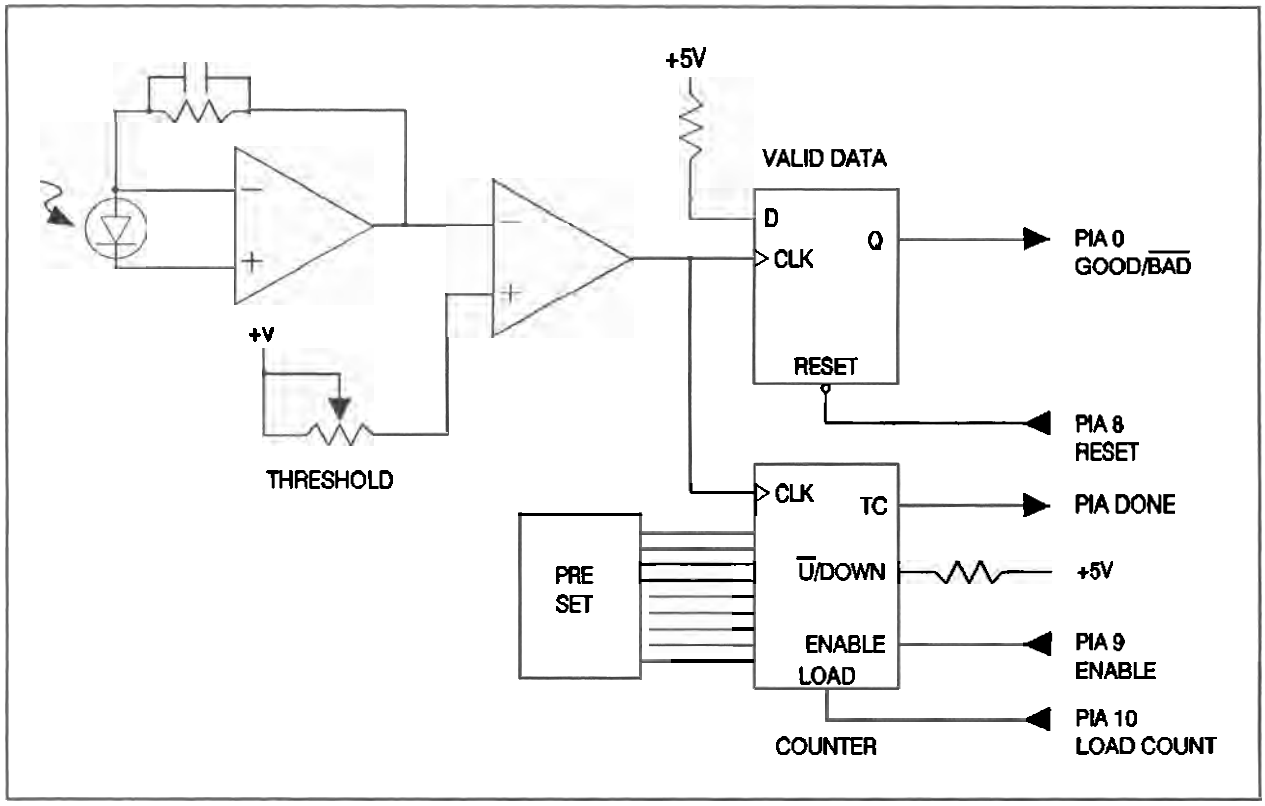


Figure D-7. PULSED LASER CIRCUIT BLOCK DIAGRAM

EXAMPLE 5 - PULSED LASER EXPERIMENT

This experiment uses a triggered laser to excite a sample. It is known that the data is only valid when the laser power is above a certain threshold. Figure D-7 illustrates the block diagram of the experimental setup that determines and counts valid laser shots. (The desired number of shots is programmed into the counter by any convenient method.) When the specified number of shots is reached (100 shots are used in this experiment), the background is then automatically subtracted. See Figures D-7 and D-8.

DAD PROGRAM

*DAD	Command to enter the DAD programming mode.
}DP 1	Sets double precision data.
}MEM 1	Begins data storage in Memory #1.
}SET 8	Sets PIA bit 8 for negative-going reset pulses.
}PLS 8	Causes a pulse to be sent via PIA bit 8 to reset the Valid Data flip-flop.
}SET 10	Sets PIA bit 10 for negative-going load pulses.
}PLS 10	Causes a pulse to be sent via PIA bit 10 to load the counters with the preset value.
}SET 9	Sets PIA bit 9 to enable the counter.
}BEGIN	Starts the data run.
}TOUT	Sends a trigger signal to fire the laser.
}TST 0	Tests PIA bit 0 to check for valid data.
}IF	If PIA bit 0 is "1", execute next command. If it is "0", jump to ELSE command.
}ADD	Adds curve to memory (if bit 0 is "1").
}ELSE	If PIA bit 0 is "0", execute next command.
}IGN	Ignores the data (if bit 0 is "0").
}THEN	Continue. Closes the IF-ELSE-THEN construct.
}PLS 8	Causes a pulse to be sent via PIA bit 8 to reset the Valid Data flip-flop.
}TST 1	Tests PIA bit 1 for run done. If bit 1 is "1",leave the BEGIN-END loop. If it is a "0", go to BEGIN and repeat.
}END	Closes the BEGIN-END loop.
}CLR	Clears the PIA bit 9 to "0" to disable the counter.
}DO 100	Begin a DO-LOOP to subtract 100 backgrounds.
}SUB	Subtract background spectrum.
}LOOP	Close the background subtraction DO-LOOP.
}STOP	Complete the DAD Data Acquisition routine.
}EXIT	Compile the program and exits the DAD mode.
}*RUN	Initiate the acquisition of data, using the current DAD routine.

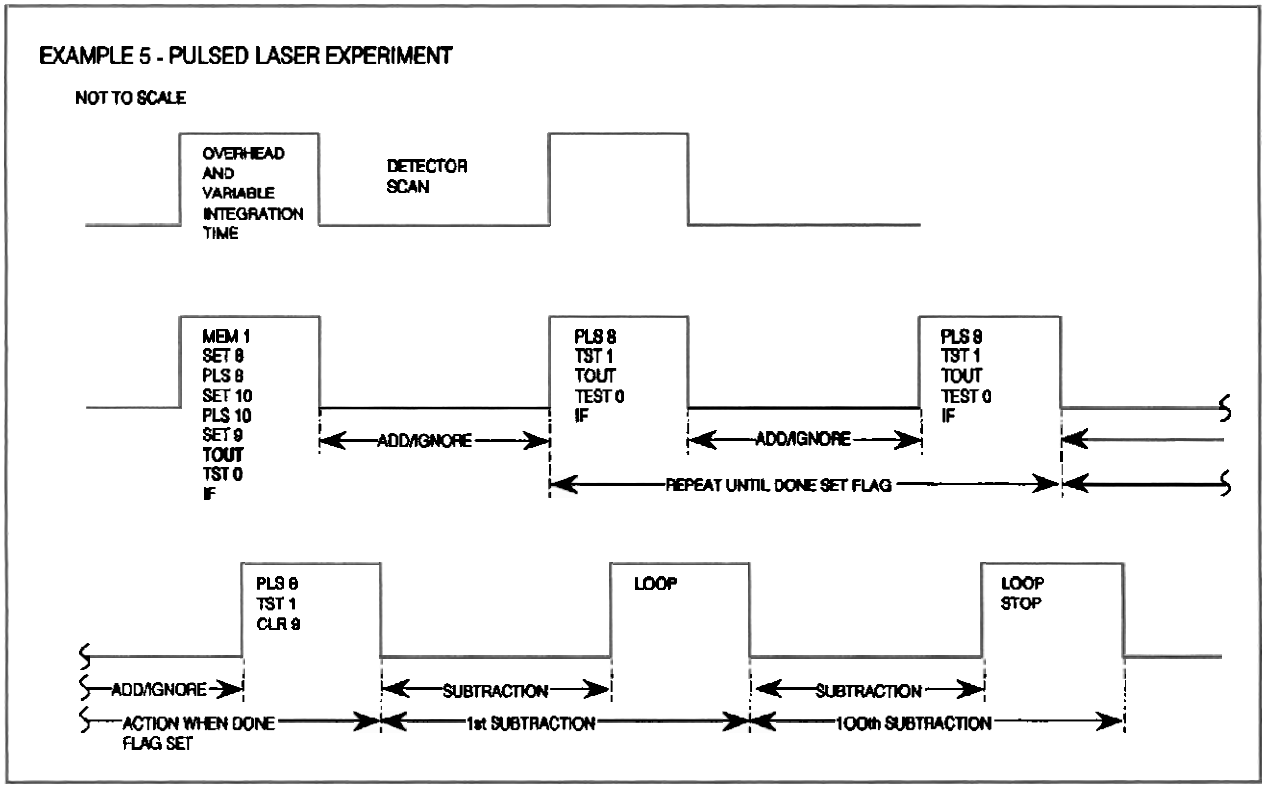


Figure D-8. TIMING DIAGRAM FOR PULSED LASER EXPERIMENT

D.12 SCAN RESYNCHRONIZATION

Scan resynchronization may be required if programmed DO-LOOPS take longer than the Overhead Time or if scan synchronization has been lost because of a violation of **ON.TRIG** timing constraints (See Section 6.4 of the 1461 or 1471A manual and D.8I of this appendix.). Resynchronization can be accomplished by using **IGN** or **ON.SCAN** to resynchronize the software to the array scan and read out.

The command to be used depends on the type of data acquisition, triggered or non-triggered. **ON.SCAN** is recommended in triggered modes although it can also be used for resynchronization in non-triggered modes. **IGN** is recommended for scan resynchronization in non-triggered modes. Because the effect of **IGN** changes depending on the trigger mode, both effects are described. The information below and Figure D-9 describe the differences and show the effect of the two commands in triggered and non-triggered data acquisition sequences.

ON.SCAN: Waits for the next overhead time and begins the exposure time at the start of that overhead time. If there is an ON.TRIG condition, **ON.SCAN** will clear it at the same time. **ON.SCAN** can be used for resynchronization in either triggered or non-triggered modes. However, its preferred use is with triggered modes.

IGN: As previously mentioned, the effect of using an ignore scan depends on whether or not ON.TRIG was used in the DAD program. In each of the cases below, one IGNore scan is assumed.

ON.TRIG not used: Waits for the overhead time, begins the exposure time at the start of that overhead time and ignores one scan's worth of data. Although **ON.SCAN** can be used for resynchronization in non-triggered modes, **IGN** is preferred.

ON.TRIG used: Skips or ignores 1025 (or 513) reads and then active scanning continues immediately. **In a triggered mode, IGN does not resynchronize scanning.** For example, if the trigger occurred at pixel 500, the readout would begin at pixel 500 for 1025 (or 513) reads. If synchronization is lost, the start pixel would change even though the program thought it was still pixel 500. A subsequent Ignore scan would begin at the current start pixel and continue for the next 1025/513 reads and then commence the next unignored scan.

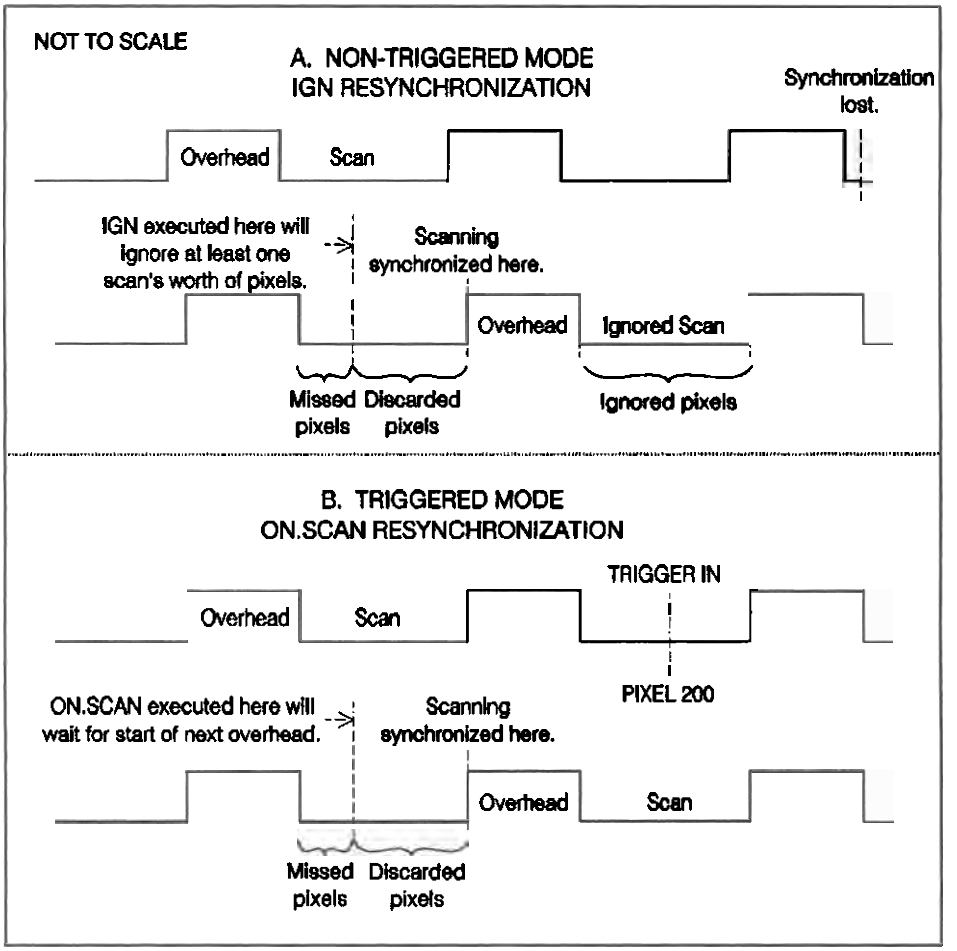


Figure D-9. SCAN RESYNCHRONIZATION NON-TRIGGERED & TRIGGERED MODES

Appendix E
Report Generation

E.1 INTRODUCTION

The optional Report Generator utility is capable of providing the user with a hardcopy report of user-selected information.

Three files are involved in generating a report. The first is the data file (FILENAME.BIN) that is the source file for the report. The second file is a file called the template file (FILENAME.TXT): this file is set up by the user to create the format and contents of the report. The contents of the template file are copied into the report file (ASCII text file, FILENAME.RPT), the third file, until a special character is encountered. At that point the action indicated by the character is performed and then the copying continues. The data and report file names are identical with the exception of the extensions used: a data file will generally have a .BIN extension, the report generated from it will have an .RPT extension.

After the report file has been generated it can then be printed by shelling to DOS and using the DOS 'PRINT' command. Alternately, the file can be printed at a later time via DOS or by bringing the report file into an editor or word processor that accepts ASCII files and printing the file from there.

Note: Multiple reports can be generated at one time by using wildcard characters when entering the data (source) file name.

E.2 TEMPLATE REPORT: Creating/Editing

E.2A Introduction

The template report is an ASCII text file that can be created using EDLIN, an ASCII text editor, or any wordprocessor that is capable of outputing ASCII text files. The file name, of course, must follow accepted DOS format. To avoid confusion as to the file type, you may want to use an .ASC or a .TXT extension.

E.2B Special Characters

% The 'percent' character causes data from the data file to be inserted into the report.

The 'pound' character precedes custom instructions to the report generator.

@ The 'at' character is used to insert comments into the template file. These comments are not copied to the report file.

\ The 'backslash' character is used to allow copying one of the four special characters to the report.

E.2C Commands supported by %

Note that "xxx" represents a number.

Pxxx	Causes parameters from the data file to be inserted into the report. See Table E-1 for a listing of all P numbers.
Sxxx,yyy Sxxx@yyy	Inserts spectral data from the data file. "Sxxx,yyy" copies data point yyy, memory xxx. "Sxxx@yyy" copies the data point at wavelength yyy, memory xxx. If "xxx" is omitted, memory 1 is used. Therefore S1,512 and S512 give the same result.
Axx,yyy	Copies the value of Area xx in spectrum yyy into the report. If "yyy" is omitted then memory 1 is used. Thus A5,1 and A5 give the same result.
Yx,yyy Yx@yyy	Inserts the YT data from the file into the report. "Yx,yyy" copies data point "yyy", from equation "x". "Yx@yyy" copies the data point at or just after time "yyy", from equation "x".
Txxx	Copies the time of YT point "xxx".
Xxxx	Copies the wavelength of channel "xxx".

The generator uses any whitespace character (space, tab, or newline)to determine the end of the "%" string. Tabs and new lines are copied to the report; the space is not. This means that the "%" string cannot have any spaces in it. As a compromise, the underline "_" character can be used to separate items in a % string to provide clarity: "%S23,512" and "%S_23,_512" are equivalent as are "%A4" and "%_A_4".

E.2D Commands supported by

The "#" character can be used immediately in front of a "@" character to insert comments into a template file without corresponding linefeeds occuring in the report file. The sample template file shown in Figure E-1 uses the #@ combination to insert four lines of comment at the

top of the template. These lines of text will not appear in the report file nor will four blank lines occur at the top of the report.

E.2E Use of @ for Comments

There are two rules for using the @ character for comments:

1. @ must the first and last character for comments in the middle of a line.

2. If no closing @ is found by the report generator, the remainder of the line will treated as a comment and will not be printed.

E.2F Use of \ for Inserting Special Characters

The backslash character, \, allows the template maker to insert any of the four special characters (%, #, @, and \) into the report. The backslash causes the next template character to be copied into the report without action. For example, "\@" places "@" into the text of the report. Note that the character must immediately follow the backslash. The sequence "\ @" will place the space in the report and then treat the @ as the start of a comment. To place a backslash into the report, use the sequence "\\".

E.2G Error Messages

If the report generator does not recognize a command, it will stop the process and issue an appropriate error message. You will have to correct the error in the template file before you can use it to generate a report from a named data file.

Number	Item
1	File name
2	File date
3	File time
4	File label
5	File type ("M1470.BIN 00.2")
6	Date report generated
7	Time report generated
10	Detector interface 1462 ...
11	Array length
12	Number of spectra
13	First channel
14	Number of channels/spectra
15	Last channel
16	Temperature
17	Cooler locked flag
18	Exposure time
19	Minimum exposure time
20	Detector 1455 ...
21	Spectrograph
22	Grating
100	DA mode
101	"I"
102	"J"
103	"K"
300	X axis calib Linear or Cubic
301-304	Calibration coefficients
305	X axis label
306	First wavelength
307	Last wavelength
308	Wavelength coverage
320	Y axis label
321	Correction curve file name, if used
401-412	Coverage of 1-12 areas, respectively
421-432	Comments for 1-12 areas, respectively
451-462	Correction types of 1-12 areas, respectively
501-508	Equations 1-8, respectively

Table E-1. "P" VARIABLE INSTRUCTIONS

```
#@This is a sample template file. Note that this line will not be printed
#@nor will any linefeeds be inserted as a result of this text.

                                                    Report Time:  %P6
                                                    Report Date:  %P7

    A test report on File:   %P1
            Time/Date:   %P3      %P2
            File type/Rev:       %P5

Label: %P4

Controller: %P10      Detector:  %P20     Length:  %P11

Detector temperature:  %P16      Exposure time:  %P18  sec

First channel:  %P13  ,  Number of channels:  %P14  ,  Last channel:  %P15

Wavelength calibration:  %P300  ,  Coverage:  %P308  %P305 s

        from  %P306  to %P307  %P305

Spectrograph:  %P20  ,  Grating:  %P21

Area        Coverage                Comments
A1:         %P401   %P421
A2:         %P402   %P422
A3:         %P403   %P423
A4:         %P404   %P424
A5:         %P405   %P425
A6:         %P406   %P426
A7:         %P407   %P427
A8:         %P408   %P428
A9:         %P409   %P429
A10:        %P410   %P430
A11:        %P411   %P431
A12:        %P412   %P432


Equations:

E1:  %P501
E2:  %P502
E3:  %P503
E4:  %P504
E5:  %P505
E6:  %P506
E7:  %P507
E8:  %P508

Area 1, Memory 1:     %A1,1
Area 2, Memory 1:     %A2,1
Area 3, Memory 1:     %A3,1
Area 4, Memory 1:     %A4,1
Area 4, Memory 1:     %A4

        Wavelength of channel 512:  %X512

Value of Memory 1 at channel 512:   %S1,512
    Value of Memory 1 at 500 nm:    %S1@500

Value of Memory 1 at channel 512:   %S_512
    Value of Memory 1 at 500 nm:    %S_@500
```

Figure E-1. SAMPLE TEMPLATE

Report Time: 09/18/91
Report Date: 15:22:06

A test report on File: 09121006.BIN
Time/Date: 15:02:24 9-12-1991
File type/Rev: M1470BIN 00.0

Label: Unknown filter , marked 620.09, looks bad!!

Controller: 1462 Detector: 1455 Length: 1024

Detector temperature: 25

First channel: 0, Number of channels: 1024, Last channel: 1024

Wavelength calibration: Linear, Coverage: 513.578 nms

from 263.567 to 777.145 nm

Spectrograph: 0, Grating: 0

Area	Coverage	Comments
A1:	434.26 - 437.77 nm	hg 435.83 nm
A2:	544.06 - 548.22 nm	hg 546.07 nm
A3:	575.83 - 577.84 nm	hg 576.96 nm
A4:	577.84 - 580.35 nm	hg 579.06 nm
A5:	403.63 - 406.65 nm	hg 404.6 nm
A6:	***** _ *****	
A7:	***** _ *****	
A8:	***** _ *****	
A9:	***** _ *****	
A10:	***** _ *****	
A11:	***** _ *****	
A12:	***** _ *****	

Equations:

E1: a1
E2: a2
E3: a1/a2
E4: s12(a1)
E5: s13(a2)
E6:
E7:
E8:

Area 1, Memory 1: 2.9178
Area 2, Memory 1: 10.9701
Area 3, Memory 1: 13.9162
Area 4, Memory 1: -55.1161
Area 4, Memory 1: -55.1161

Wavelength of channel 512: 520.607

Value of Memory 1 at channel 512: 0.479616
Value of Memory 1 at 500 nm: -0.258398

Value of Memory 1 at channel 512: 0.479616
Value of Memory 1 at 500 nm: -0.258398

Figure E-2. REPORT GENERATED FROM FILE 09121006.BIN AND TEMPLATE

Index

#-B

2-D plots of data 64
3-D plots of data 60
A/D precision 94
Absorbance mode 50
Accumulate method of data acquisition 17, 34
Applications software
  device driver files 4
  diskettes supplied 1, 3
  editing keys 13
  exiting from 13
  file conversion utilities 2
  hardware requirements 3
  host computer requirements 3
  installation 4
  Introduction to 1
  license agreement 1
  OMA Desk program files 1, 4
  OMA Vision program files 3
  overview 1
  program structure 1
  revision level 94
  shell to DOS function 13
  spectrograph control 2
  system default parameters 6
  warranty registration 1
Area
  baseline correction 31
  comment entry 31
  definition 30, 80
Area correction mode 82
Area/equation table 28
  baseline correction 31
  entering/editing equations 82
  loading 28, 82
  storing 32, 82
  viewing/editing 30
AUTOEXEC.BAT 4, 6, 16
AUTOEXEC.PAR 5, 6
Background
  baseline correction mode 81
  turning off correction 81
Background subtraction 18, 21, 24, 49
Bad Pixels 94
Baseline correction 31, 81

C

CAL.BAT 4
CAL_LINE 4
Calibration
  changing an existing calibration 68
  loading calibration coefficents 70
  loading calibration coefficients 38
  new 35
  post acquisition 68
  resetting 38
  spectrograph 35
Calibration coefficients 35, 68, 70
Center wavelength 40
CGI.CFG 5
Channel profile 61, 62
Concatenation 89
Condensation hazard 92
CONFIG.PAR 5, 6
CONFIG.SYS 4, 6
Correction curve 42
Correction mode
  area 82
  baseline 81
  none 81
Critical Peaks 69
Cubic Fit 68
Cubic fit calibration 36
Cursor
  control 15
  equation plot screens 15
  graphics screens 15
  speed 15
  text screens 15
  types of 15
Curve calculations 71
  rules and syntax 71
  samples 74
  types of 74
  valid operands 73
  valid operators 73
  viewing results of 76
Curve manipulation
  differentiation 77
  smoothing 77
  taking derivative 77
Curveset information, see File information 56

D

DA Mode
  factors influencing choice of 110
DAD
  File Structure 122
  Writing Programs 121
DAD Commands
  0.LPTR 127
  ADD 128
  ADD.MEM 128
  BEGIN-END 127
  CAL n1,n2 128
  CLR 128
  CLR.MEM n 128
  DAD 125
  DO n 126
  DP n 126
  ERR 129
  EXIT 125

GX 126
GXH 126
IF-THEN 128
IF-THEN-ELSE 127
IGN 128
INC.MEM 126
INC.PTR 126
LIST 125
LOOP 126
MEM n 126
MOV.MEM n 128
NEW 126
ON.SCAN 128
ON.TRIG 128, 130
PLS 128
SET n 128
SHUTTER n1,n2 128
ST 130
STOP 127
STORE 127
SUB 129
SUB.MEM n 129
TGL 128
TOUT 129
TST 128
DAD, see Data Acquisition Design 121
Data Acquisition 1
accumulate acquisition 34
area/equation table 28
background reset 21, 24, 49
background subtraction 21, 24, 49
DAD program 24
exposure time 21, 24
introduction to 17
labeling a dataset 34, 45
live 33
number of samples 21
plotting/printing data 48
predelay time 21
printing 48
reset background 21, 24, 49
resetting parameters to file 44
run time 20
same exposure time 92
sample time 20
Set Display Menu 26
storing to disk 34, 46
Toggle F1, F2 keys 26
Data Acquisition Design
200-1000 nm Light Source experiment 134
command format & protocol 124
command types 125
conditional commands 125, 127
control commands 125, 126
definition 121
detector scanning commands 125, 128
DO-LOOP construction 124
error & status commands 129
error and status commands 125
interactive commands 125
introduction to 121
loading and operating DAD programs 123
memory assignments 124
Mercury Lamp Warm-up experiment 133
overhead time 122
PIA commands 125, 128
PIA control 124
processing time 123, 126
program execution 124
programming constraints 122, 124
programming rules 124
Pulsed Laser experiment 138
sample programs 132
scan time 122
status report 130
Stopped Flow experiment 132
timing considerations 122
Varying Rate Signal experiment 136
Data Acquisition Modes
I 23
introduction to 109
J 23
K 23
Mode 1 111
Mode 10 115
Mode 11 116
Mode 12 118
Mode 13 118
Mode 14 119
Mode 15 119
Mode 16 116
Mode 17 117
Mode 2 111
Mode 3 112
Mode 4 112
Mode 5 113
Mode 6 113
Mode 7 114
Mode 8 114
Mode 9 115
parameter selection 23
storage & addition 110
subtraction 117
Trigger Out 110
Data Analysis 2
2-D plot screen 64
3-D plot screen 60
channel profile 61, 62
curve calculations 71
deleting data from memory 57
differentiation 77
file information 53, 56
Graphics functions 58
introduction to 51
loading calibration coefficients 70
loading data 52
plot screen 58
plotting 58
plotting equations 85
resetting X axis calibration 70
Screen 51
smoothing 77

storing data 54
strip charts 89
tagging/untagging curve sets 57
X axis calibration 68
Y:T analysis 66, 78
Data conversion, see File conversion utilities 2
Data directory (default) 91
Data display
2-D plot 64
3-D plot 60
channel profile 61, 62
equation display time 27
equations only 26
spectrum and equations 27
spectrum only 26
strip charts 27
tagging/untagging curve sets 57
Data display window 11
Data manipulation
curve calculations 71
differentiation 77
filename conventions 14
labeling a dataset 45
loading 14
plotting 16, 48
printing 16
smoothing 77
storing 14, 34
Definitions 105
Deleting
a file from disk 53, 54
data from memory 57
DEMO.BIN 4
Derivative 77
Detector controller 93
Detector maintenance
condensation prevention 93
nitrogen purge 93
Detector parameters
A/D precision 94
array length 94
channels used 94
minimum exposure time 94
model number 93
temperature, alternate 92
temperature, default 92
Device driver files 4
Differentiation 77
DISK.ID 4
DRIVERS.DAT 4
DRIVERS.LIB 4
Drivers, additional 6

E-F

Editing keys 13
EGAHCOPY.COM 4, 5, 16
EPROM revision level 93
Equation display 26
Equation display time 27
Equations
comment entry 31, 82
editing 82
entering 82
plotting 85
samples 85
syntax 85
valid conditions 83
valid operations 84
valid operators 83
variables 83
Error
codes (DAD) 129
Error messages
file conversion 101
static interface 96
Exposure time 21, 24
automatic 50
manual 50
same ET 92
External data 52, 57
FILCNVT.EXE 4, 95
File conversion utilities 95
1460 to 1470 98
1470 to 1460 97
1470 to ASCII 99
1470 to EQD 100
error messages 101
File information 53, 56
File label 16
File selection function keys 14
File version number 16
Filename conventions 14
Files, renaming 6
Filetype 16
Find Peaks 68
Flatten Function 36, 68
Function key area 11
Function key descriptions
3D Plot screen 60
Area/Equation Table screen 30, 80
CurveSet Info screen 56
Data Acquisition screen 18
Data Analysis screen 51
Equation Plot screen 85
File Selection screen 14, 28, 32, 46, 83
Lamp Table screen 43
Memory-Overlay screen 62, 64
Plot screen 58
System Configuration screen 91
Utility screen 95
X Axis Calibration screen 35, 68
Y:T Analysis screen 66, 78

G-M

Glossary 105
GPIB communication
card configuration 6
static interface utility 95

GPIB.COM 6
Gratings
  selection 40, 94
Hardware requirements
  disk drives 3
  EGA monitor (minimum) 3
  GPIB card 3
  output device (printer/plotter) 3
I 23
IBCONF.EXE 6
Information bar 11
Input box 11
INSTALL.DAT 4
INSTALL.EXE 4
Installation
  Overview 3
  Record 3
Installation files 4
Installation of software 4
Intensity calibration 41
  calibration lamp 42
  calibration units 41
  collection geometry 41
  correction curve 42
  Fixing the Spectrograph 42
  flow-chart 42
  menus 42
  Overview 42
  Resetting to a file 44
Internal data 52
J 23
K 23
Key Concepts 1
LABEL.TXT 4
Labeling a dataset 34, 45, 70
Lamp control 22
Lamp curve 42
License agreement 1
Line Frequency 92
Linear Fit 68
Linear fit calibration 35
Live method of data acquisition 17, 33
Loading data 14
M1470.PRM 7, 13, 44
M1470.PRM (system parameters) 6
Manual, How to Use 2
Measurement mode
  absorbance 50
  reference spectrum 49
  reflection 50
  transmission 50
  uncorrected 50
Media 3
Memory
  external data 52, 57
  internal data 52
Memory-Overlay, see 2-D plots of data 62, 64
Menu tree 8
Menus
  accessing 12
  exiting from 13
  selecting from 12
Model 1235 2
  calibration 39
  center wavelength 40
  GPIB address 94
  grating offset 39
  grating selection 39, 94
  intensity calibration 41
Model 1236 2
  calibration 39
  center wavelength 40
  grating offset 39
  grating selection 39, 94
  intensity calibration 41
Model 1237 2
  calibration 39
  center wavelength 40
  grating offset 39
  grating selection 39, 94
  intensity calibration 41
Model 123X spectrograph
  1235 94
  1236 94
  1237 94
Model 1240 2, 94
  background acquisition 22
  lamp control 22
  shutter control 22

N-S

Nitrogen purge 92
Number of samples 21
OMA Desk 1
  default parameters 6
  program files 4
OMA Vision
  default parameters 6, 7
  editing keys 13
  entering information 13
  exiting from 13
  menu and function structure 7
  menu structure 8
  program files 3
  screen elements 11
  shell to DOS function 13
  software revision level 94
OMADESK.EXE 3
OMADESK.TXT 3
OMAVIS.EXE 3
OMAVIS.TXT 3
Overhead time 122
Peak Finding 36
Peak Location
  manual vs automatic 37
Plotting data 16
Post Y:T analysis 78
Predelay time 21
Printing data 16
Program Structure 1

PROGRAM.DAT 4
Programming Constraints 122
Purging the detector 92
Recalibration of X axis 38
Reflection mode 50
Report Generator
  introduction to 141
  sample report 144
  sample template 143
  template report 141
Report Generator utility 101, 141
Reset background 21, 24, 49
Resetting parameters to a file 44
Resynchronization 139
RS232C parameters 6
Run time 20
Same ET 92
Sample time 20
Scan resynchronization 139
Scan Time 122
Screen
  Data Display Window 11
  Function Key Area 11
  Information bar 11
  Menus 11
Screen Elements 11
Set Display Menu 26
Set Times 20
Shelling to DOS 13
Shutter control 22
Shutter designation (yes/no) 94
Smoothing 77
Software installation 4
Software registration 1
Source compensation 84
Spectrograph Control 2
  Model 1235 2, 39, 94
  Model 1236 2, 39
  Model 1237 2, 39
  Model 1240 2, 94
  shutter (yes/no) 94
Spectrum and equation display 27
Spectrum only display 26
Static interface utility
  command line editing 96
  command syntax 96
  error messages 96
  responses to commands 96
  valid commands 96
Storing data 14
Storing data to disk 46
Strip charts 27, 89
Synchronization modes
  external 92
  line 92
  normal 92
System Configuration 2
  data acquisition mode 110
  data directory 91
  detector temperature 92
  introduction to 91
  Line Frequency 92
  Program Controller Menu 92
  restoring default parameters 94
  Same ET 92
  saving current parameters 94
  software revision level 94
  synchronization mode 92
  System Information menu 93
System default parameters 7
  plotter 6
  printer 6
  RS232C 6
System information
  A/D precision 94
  channels used 94
  detector array length 94
  detector controller 93
  detector interface 93
  detector model 93
  EPROM revision level 93
System Parameters screen 103

T-Z

Tagging/untagging curve sets 57
Temperature control 92
Threshold control 16
Toggle F1, F2 keys 26
Transmission mode 50
Triggering
  scan resynchronization 139
  Trigger Out 110
Uncorrected mode 50
Utilities 2
  introduction to 95, 103
Warranty registration 1
Wavelength calibration
  Mercury, Argon, and Neon lines 107
  Mercury-Argon spectrum 108
X axis
  calibration 35
  calibration, cubic fit 36
  calibration, linear fit 35
  expansion/contraction 12
  recalibration 38
  wavelength calibration lines 107
  wavelength calibration spectrum 108
Y axis
  calibration 41
  expansion/contraction 12
Y:T analysis
  plotting equations 85
  strip charts 89
Y:T equations, see Equations 83
Zoom mode
  box definition 16
  exiting from 13

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