77700B-M

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PROGRAMMING MANUAL FOR MS257™

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1. INTRODUCTION

1.1 Conventions Used in This Manual

Various typefaces are used to represent different types of input and responses to and from MS257™.

- This typeface, ***RESPONSES***, indicates responses that are sent by MS257™ over the RS-232 or IEEE-488 interface.
- This typeface, **COMMANDS**, indicates commands that are sent from a Hand Controller, terminal or computer to MS257™ over the RS-232 or IEEE-488 interface.
- Unless otherwise stated, bold characters enclosed in square brackets refer to ASCII control characters, e.g. **[CR]**.
- Commands that require a device selector are shown using 'n', e.g. **?FILTn** which can be used as either **?FILT1** or **?FILT2**.
- Command parameters can be one of three types:
  - Wavelength command parameters are shown as 'www', e.g. **!GW www** which can be used as **!GW 546.1**. Note, that all wavelength parameters, both sent and received, will be in the currently selected wavelength units (**UNITS**).

    Note: Although wavenumbers are a unit of frequency (cm^{-1}), for ease of use we group them under the generic "wavelength units" banner, also.
  - Integer command parameters are shown as 'x', e.g. **!GRAT x** which can be used as **!GRAT 1**
  - Alphanumeric command parameters are shown as 'a', e.g. **=UNITS aa** which can be used as **=UNITS NM**
- Programming statements or commands to be entered at the DOS command line are shown in a monospaced font:

```
QBASIC /RUN EXAMPLE.BAS
```

2. GETTING STARTED WITH THE RS-232 INTERFACE

The Oriel MS257™ can be completely controlled and configured by commands sent to its RS-232 serial port. This is a simple, 3-wire serial interface running at 9600 baud. The communications parameters are fixed, see below.

Baud Rate	9600
Data Bits	8
Parity	None
Stop Bits	1

Table 1. RS-232 communication parameters

2.1 Connecting the MS257™ to Your Computer

Cabling

The MS257™ is configured as a Data Communications Equipment (DCE). In other words, it will appear the same as an external modem to your computer. Its serial port is a standard DB-9 female connector. Most personal computers (PCs) are configured as Data Terminal Equipment, or DTE's, and have male DB-25 or DB-9 connectors.

- If your computer's serial connector is a DB-9 male, then use the supplied 'straight-through' DB-9 female-to-male cable.
- If your computer's serial connector is a DB-25 male, then you can use the supplied cable with a standard DB-9 to DB-25 adapter (not included) or you can use a standard DB-9 to DB-25 conversion cable (not included).

RS-232 Signal Usage and Handshaking

The MS257™ uses a simple, 3-wire serial communications scheme. Hardware handshaking is not used. The MS257™ does, however, keep several of the handshaking lines asserted for those computers that require them. Table 2. outlines the relevant RS-232 signals, their direction, and connector pin assignments:

			Supplied DB-9 Male to Female Cable		
RS-232 Signal		**PC DB-25 Male (DTE)**	**PC DB-9 Male (DTE)**	**Signal Direction**	**MS257™ DB-9 Female (DCE)**
Transmit Data	TxD	2	3	→	3
Receive Data	RxD	3	2	←	2
Signal Ground	GND	7	5	↔	5
The following 3 signals, although not strictly needed for 3-wire serial communications, are available for those DTE's that require them. CTS is always asserted by the MS257™, DSR is looped back from the incoming DTR signal.					
Clear To Send	CTS	5	8	←	8
Data Set Ready	DSR	6	6	←	6
Data Trm Ready	DTR	20	4	→	4

Table 2. RS-232 signals, and pin assignments

2.2 Writing a QuickBasic Program to Communicate with the MS257™

Every version of Microsoft's MS-DOS® since v5.0 comes with QBasic®. This version of the BASIC language supports high speed serial communications through your computer's COM1 or COM2 serial ports. It provides an easy way to get up and running quickly with your MS257™.

- Bring up QBasic® by typing:

  ```
  QBASIC
  ```

  at the DOS prompt

- In the main editing window, enter the following short program. Make sure to substitute the COM port actually connected to MS257™ for COM1 on the first line.

  ```
  OPEN "COM1:9600,N,8,1" FOR RANDOM AS #1
  PRINT #1, "!GRAT 1"
  RESP$ = INPUT$(3, #1)
  PRINT #1, "!GW 350"
  RESP$ = INPUT$(3, #1)
  ```

- Run the program and your MS257™ should select grating #1 and position itself to 350 nm. Note that this program is very simple and makes several

assumptions about how your MS257™ is configured. If the program does not work, several possibilities exist:

- The program assumes that each command will be met with a 3 character response from your MS257™ indicating success:

  [CR][LF]>

  If error is signaled by your MS257™, the program will not detect it.
- The program assumes that MS257™ has its Wavelength Units set to nanometers. If your MS257™ is configured for microns or wavenumbers, a position of 350 is probably not valid. See page 31 for the commands to set and query your MS257™'s current setting.
- The program assumes that 350 nm is within the positioning range of the first grating installed in your system. This will be the case for gratings from 300 - 2400 lines/mm. when set to use the first order.

2.3 Tips for Success in Writing More Advanced RS-232 Programs

- Use buffered, interrupt-driven serial communication routines to read and write from the COM port to which you have connected your MS257™. This will ensure that you do not drop characters at the 9600 baud communication rate. Many development environments have such serial communication routines built-in (e.g. QBasic®, Visual Basic®, LabWindows®, LabView®). Other languages, such as Borland® or Microsoft® C, rely on your PC's relatively slow BIOS communications functions. In these cases, a third party serial communications library will help guarantee success.
- When reading responses from your MS257™, remember that the length of the response may vary, especially if an error is reported. The longest response is 100 characters from retrieving a fully populated filter wheel changeover table.
- Remember that a ***[CR][LF]*** comes at the beginning of all responses from the MS257™. Responses are normally terminated by a greater-than sign (**>**). During a scan, a colon (**:**) is used to terminate data point responses. For a BASIC programming example, see the ReadResponse routine on page 51.
- Error responses from the MS257™ start with an ***E*** following the initial ***[CR][LF]***. This can be used to uniquely identify errors, as there are no normal responses from the MS257™ that begin with this letter. Error responses when the MS257™ is not scanning take the form ***[CR][LF]Exxxx>***. Errors encountered while the MS257™ is scanning are reported as ***[CR][LF]Exxxx[CR][LF]www:*** where ***www*** is the current scan data point.

- Always wait for MS257™'s response to a command before issuing the next command.
- Set a suitably long communications timeout on read operations. Several seconds can elapse even during a simple move if automatic grating, filter wheel, and output port changes are triggered. A timeout of 30 seconds is not unreasonable.

3. GETTING STARTED WITH THE IEEE-488 INTERFACE

The Oriel MS257™ can be completely controlled and configured by commands sent through its IEEE-488 parallel port. The communications parameters are in accordance with IEEE std. 488-1978 electronically and mechanically.

Up to 15 instruments can be connected in one system, but the total length of the communications cables should not exceed 20 m.

3.1 Addressing the MS257™

Use of the IEEE-488 interface requires that it has a communications address. The primary address is set by using the dip switches on block U12 on the IEEE-488 interface board, see figure 1. The switches on block U11 should not be used. Table 3 depicts the range of primary addresses which can be used, the factory default address is 6. The listen and talk addresses are set at 32 and 64 above the primary address respectively.

Note: The address directly preceding the primary address will also be occupied by the MS257™. For the factory default configuration, this will be address 5. This address is used for communication to the IEEE-488 interface itself.

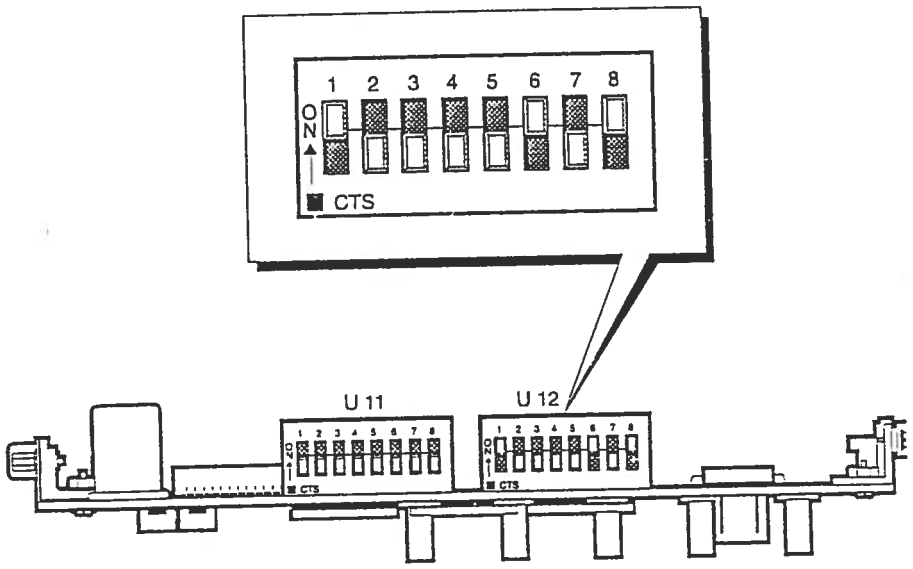

Figure 1. Switch block for setting the IEEE-488 communications primary address. Switches 1 - 3 must be left as shown, switches 4 - 8 are used to set the address per Table 3.

Primary Address	Switches				
	8	7	6	5	4
1*	OFF	OFF	OFF	OFF	OFF
2	ON	OFF	OFF	OFF	OFF
3	OFF	ON	OFF	OFF	OFF
4	ON	ON	OFF	OFF	OFF
5	OFF	OFF	ON	OFF	OFF
6	ON	OFF	ON	OFF	OFF
7	OFF	ON	ON	OFF	OFF
8	ON	ON	ON	OFF	OFF
9	OFF	OFF	OFF	ON	OFF
10	ON	OFF	OFF	ON	OFF
11	OFF	ON	OFF	ON	OFF
12	ON	ON	OFF	ON	OFF
13	OFF	OFF	ON	ON	OFF
14	ON	OFF	ON	ON	OFF
15	OFF	ON	ON	ON	OFF
16	ON	ON	ON	ON	OFF
17	OFF	OFF	OFF	OFF	ON
18	ON	OFF	OFF	OFF	ON
19	OFF	ON	OFF	OFF	ON
20	ON	ON	OFF	OFF	ON
21	OFF	OFF	ON	OFF	ON
22	ON	OFF	ON	OFF	ON
23	OFF	ON	ON	OFF	ON
24	ON	ON	ON	OFF	ON
25	OFF	OFF	OFF	ON	ON
26	ON	OFF	OFF	ON	ON
27	OFF	ON	OFF	ON	ON
28	ON	ON	OFF	ON	ON
29	OFF	OFF	ON	ON	ON
30	ON	OFF	ON	ON	ON
31	OFF	ON	ON	ON	ON

Table 3. Primary address switch settings for IEEE-488 interface

* Do not use this address as the primary address for the MS257™, since the address directly preceding the primary address needs also be occupied by the MS257™.

3.2 Communicating with the MS257™ Using IEEE-488

The information in this section was written with National Instruments® IEEE-488 interface boards and NI-488® software drivers in mind. Refer to the manuals that came with your particular board and software for exact details on how to setup and configure your system.

Configuring Your IEEE-488 Interface Board

National Instruments® supplies a configuration program called IBCONF that you can use to configure your interface board and the devices connected to it. Because MS257™ uses different delimiters than the default settings, it is important to use IBCONF to set the following parameters for MS257™'s primary address.

Note: It is possible to configure these same parameters from within your application program by using the NI-488® ibconfig() function. By using the IBCONF program to configure the interface instead, you can keep applications that you write much simpler.

- Bring up the configuration program by typing:

  ```
  IBCONF
  ```

  at the DOS prompt

- The GPIB Device Map is displayed on a screen. Press F3 key (AutoConfig) to start scanning for devices.

- The IBCONF will detect a pair of GPIB devices for each MS257™ connected to your interface board, since two communication addresses need to be occupied by one MS257™ (see section 3.1).
  For example, If the primary address on the MS257™'s IEEE-488 interface board is set to 6 (default), then two devices, DEVA (with the primary address 5) and DEVB (with the primary address 6), will be a pair of GPIB devices that corresponds to the MS257™.

- You have to configure the parameters for the device whose address equals to the MS257™'s primary address (set by using the dip switches on the MS257™ interface board, see section 3.1). In our example, it is the device DEVB. See the table on the next page for the parameter settings.

- The parameters for the device whose address is used for communication to the MS257™ IEEE-488 electronics should not be changed. In our example, it is the device DEVA.

Parameter	Setting	Rationale
Primary GPIB Address	6	The primary address set by using the dip switches on block U12 on the IEEE-488 interface board.
Secondary GPIB Address	NONE	Not needed.
Timeout setting	30sec	See section 3.4.
Serial Poll Timeout	30sec	See section 3.4.
Terminate Read on EOS	Yes	IEEE-488 reads from the MS257™ should terminate when the '>' character is seen.
Set EOI with EOS on Writes	No	The '>' delimiter is not used to terminate commands written to the MS257™.
Type of Compare on EOS	8-bit	Use 8-bit compare.
EOS Byte	'>' (x3E = 62 decimal)	All responses from the MS257™ are terminated by the '>' character, except for data points reported during a scan.
Send EOI at End of Write	No	Not needed.
Enable Repeat Addressing	No	Not needed.

- Press F9 key to return to the GPIB Devices Map and save the settings to the disk.

A short routine helps you check the IEEE-488 communications from the DOS commnad line:

- Bring up the IEEE-488 Interface Bus Interactive Control Program by typing
  `IBIC`
  at the DOS prompt.
- Type
  `IBFIND DEVB`
  at the **:** prompt.
- Type
  `IBWRT "!GS 280\r"`
  at the **DEVB:** promt. The MS257™ should position itself at 280 steps if the communication is set correctly.
- Type
  `IBWRT "?PS\r"`
  at the **DEVB:** prompt.
- Read the response from the MS257™ by typing
  `IBRD 6`
  at the **DEVB:** prompt.
- Type
  `Q`
  at the **DEVB:** prompt to exit the program, or send any other command to your MS257™ following the pattern shown above.

3.3 Writting a QuickBasic Program to Communicate with the MS257™

- Bring up QBasic® by typing:

  ```
  QBASIC
  ```

  at the DOS prompt

- In the main editing window, enter the following short program. Make sure to substitute the name of the GPIB device corresponding to MS257™ for DEVB on the first line.

```
OPEN "DEVB" FOR OUTPUT AS #1
OPEN "DEVB" FOR INPUT AS #2
PRINT #1, "!GRAT 1" + CHR$(&HD)
resp$ = INPUT$(3, #2)
SLEEP 1
PRINT #1, "!GW 350" + CHR$(&HD)
resp$ = INPUT$(3, #2)
```

- Run the program and your MS257™ should select grating #1 and position itself to 350 nm. Note that this program is very simple and makes several assumptions about how your MS257™ is configured. If the program does not work, several possibilities exist:
  - The program assumes that MS257™ has its Wavelength Units set to nanometers. If your MS257™ is configured for microns or wavenumbers, a position of 350 is probably not valid. See page 31 for the commands to set and query your MS257™'s current setting.
  - The program assumes that 350 nm is within the positioning range of the first grating installed in your system. This will be the case for gratings from 300 - 2400 lines/mm. when set to use the first order.
  - If error is signaled by your MS257™, the program will not detect it.

3.4 Tips for IEEE-488 Success with Your MS257™

- When reading responses from your MS257™, remember that the length of the response may vary, especially if an error is reported. The longest response is 100 characters from retrieving a fully populated filter wheel changeover table.
- Remember that an explicit **[CR]** must be sent to the MS257™ to terminate a command. For example, to position to wavelength 450 from the C programming language you would use:

```
ibwrt("!GW 450\r")
```

Note: The '\r' is the explicit **[CR]** in C programming language. The exact form of **[CR]** will vary from language to language. See the QuickBasic program above as an example.

- Set a suitably long communications timeout on read operations. Several seconds can elapse even during a simple move if automatic grating, filter wheel, and output port changes are triggered. A timeout of 30 seconds is not unreasonable.
- Remember that a **[CR][LF]** comes at the beginning of all responses from the MS257™. Responses are normally terminated by a greater-than sign (**>**). During a scan, a colon (**:**) is used to terminate data point responses.
- Error responses from the MS257™ start with an ***E*** following the initial ***[CR][LF]***. This can be used to uniquely identify errors, as there are no normal responses from the MS257™ that begin with this letter. Error responses when the MS257™ is not scanning take the form ***[CR][LF]Exxxx>***. Errors encountered while the MS257™ is scanning are reported as ***[CR][LF]Exxxx[CR][LF]www:*** where ***www*** is the current scan data point.
- Always wait for MS257™'s response to a command before issuing the next command.
- There are two alternative approaches to handling the change in EOS character that occurs while the MS257™ is scanning.

  The first approach is to change the EOS character to a colon (**:**) before the scan, read each data point during the scan, and use a read timeout to indicate the end of the scan when MS257™ sends the greater-than sign (**>**) again. The major drawback is that you may need to use a relatively long timeout setting if you have a lot of automatic changeover tables enabled. This scenario is outlined schematically, below:

	ibconfig EOS to ':'	Set IEEE-488 reads to terminate on the colon character
ScanLoop:	ibwrt("!GO\r")	Go to the first/next data point in the scan
	status = ibrd(....)	Read MS257™'s response. Arrival at a scan data point will generate a ***[CR][LF]www:*** response. The end of the scan will be signalled by a ***[CR][LF]>*** response with a timeout error.
	if status <> timeout error then goto ScanLoop	If the scan is not over, go to the next data point
	ibconfig EOS to '>'	Reset IEEE-488 reads to terminate on the greater-than sign

The second approach is to change the EOS character to a colon (:) before the scan begins and count the data points as the scan progresses. This count is then compared to the number of data points (**POINTS**) for which the scan was originally programmed. When the correct number of data points have been read, the scan is over. This scenario is outlined schematically, below:

	ptsRead = 0	Initialize the number of data points read
	ibconfig EOS to ':'	Set IEEE-488 reads to terminate on the colon character
ScanLoop:	ibwrt("!GO\r")	Go to the first/next data point in the scan
	ibrd(....)	Read MS257™'s arrival at a scan data point. This will be of the form ***[CR][LF]www:***
	ptsRead = ptsRead+1	Increment the number of data points read
	if ptsRead <> **POINTS** then goto ScanLoop	If the scan is not over then go to the next data point.
	ibconfig EOS to '>'	Reset IEEE-488 reads to terminate on the greater-than sign
	ibwrt("!GO\r")	Issue the final !GO command after data has been collected at the last data point. MS257™ repositions to the **HOME** positon for the current grating (auto-home if Automatic Grating Selection Mode is enabled).
	ibrd(....)	Read MS257™'s acknowledgement as ***[CR][LF]>***

4. COMMAND SYNTAX

MS257™ is configured and controlled using the Oriel Standard Instrumentation Command Set. Instructions are simple ASCII character strings that can be entered from a terminal or sent from a software program. Commands are not case sensitive and must be terminated by a **[CR]**. Line-feeds after the **[CR]** are ignored.

4.1 Command Echo

MS257™ does not echo any of the characters or command strings sent to it via RS-232. Therefore, if you are controlling the instrument via a terminal or terminal emulation program, local echo should be enabled so you can see what you are typing.

4.2 Command Response

During normal operation, MS257™ indicates successful completion of the previous command and its readiness to accept the next command by issuing a 3 character prompt:

[CR][LF]>

If an error occurred during execution of the previous command, the prompt will be preceded by the 4-digit error code. For example, a prompt of

[CR][LF]E0001>

would indicate that the previous command was not recognized.

4.3 Action Commands

Commands that cause MS257™ to perform an immediate action are considered Action Commands. An Action Command always begins with an exclamation mark (**!**) followed by the command name. Optional parameters can follow, separated by spaces. For example, to set the wavelength to 200 nm, you would send:

!GW 200 [CR]

4.4 Read Commands

MS257™ maintains an extensive list of operating parameters. All parameters can have their current values read by sending a command that consists of a question mark (**?**) followed by the parameter name. MS257™ will display the parameter's current value followed by the greater-than (**>**) completion prompt.

For example, to ask the spectrograph to display its current position in the current wavelength units you would send:

?PW [CR]

If the spectrograph is currently positioned at 375 nm and the wavelength units are set to nanometers, it will respond with:

[CR][LF]375.00>

4.5 Write Commands

Some parameters are read-only and are only set internally by the spectrograph as the result of some other operation. Others are considered read/write (R/W) and can be set directly. Writing a parameter is accomplished by sending an equals sign (=) followed by the variable name and the new parameter value.

For example, to set the starting wavelength for a scan to 450 nm, you would send:

=STARTW 450 [CR]

To query the start wavelength, you would send:

?STARTW [CR]

The response would be:

[CR][LF]450>

5. ALPHABETICAL COMMAND INDEX

Commands & Parameters	Description	Hand Control	Page Reference
!ABORT	Abort the current scan and return to home	Abort	26
!ADH	Go to absolute drive home		34
=BANDPASS www	Set automatic slit bandpass	Band	38
?BANDPASS www	Query automatic slit bandpass	Band	38
=BLAZE aaaa	Blaze wavelength for selected grating	Blaze	22
?BLAZE	Query blaze wavelength for selected grating	Blaze	22
=CALWAV www	Set calibration wavelength at current position	Calib	23
?CALWAV	Query calibration wavelength at current position	Calib	24
=CHNGF1 x:www:x	Changeover points for filter wheel 1	(F1) Table	36
?CHNGF1	Query changeover points for filter wheel 1	(F1) Table	37
=CHNGF2 x:www:x	Changeover points for filter wheel 2	(F2) Table	36
?CHNGF2	Query changeover points for filter wheel 2	(F2) Table	37
=CHNGGR x:www:x	Changeover points for grating mount	(Grat) Table	24
?CHNGGR	Query changeover points for grating mount	(Grat) Table	25
=CHNGPI x:www:x	Changeover point for input port		40
?CHNGPI	Query changeover point for input port		41
=CHNGPO x:www:x	Changeover point for output port	(Port) Table	39
?CHNGPO	Query changeover point for output port	(Port) Table	40
!DL	Recall factory default parameters		31
=ENDW www	End wavelength for a scan	End	27
?ENDW	Query end wavelength for a scan	End	27
=EXTGO 1	External Trigger Mode	Ext St	29
=EXTGO 0	Internal Trigger Mode	Int St	29
?EXTGO	Query Trigger Mode		29
!FASTSH xxx	Activate fast shutter for xxx milliseconds		43
!FILT1 x	Select filter position for filter wheel 1	F1	35
?FILT1	Query current filter in filter wheel 1	F1	35
!FILT2 x	Select filter position for filter wheel 2	F2	35
?FILT2	Query current filter in filter wheel 2	F2	35
!GH	Go to Grating Home	Go Hom	20
!GO	Start or Continue a scan	Go	26
!GRAT x	Select a grating, 0 to 4	Grat	19
?GRAT	Query current grating	Grat	19
?GRMOUNT	Query which grating turret is installed		21
!GS xxxx	Go to position by motor steps		33

Commands & Parameters	Description	Hand Control	Page Reference
!GW www	Go to position by wavelength	Go Wav	20
=HOME x	Home for current grating	Home	23
?HOME	Query home for current grating	Home	23
=HS 1	Handshake mode on		30
=HS 0	Handshake mode off		30
?HS	Query handshake mode		30
=INTERVAL www	Wavelength interval between scan moves	Intvl	28
?INTERVAL	Query wavelength interval between scan moves	Intvl	28
=LABELF1 aaaa	Label for selected filter for filter wheel 1	F1 Labl	35
?LABELF1	Query label for selected filter for filter wheel 1	F1 Labl	36
=LABELF2 aaaa	Label for selected filter for filter wheel 2	F2 Labl	35
?LABELF2	Query label for selected filter for filter wheel 2	F2 Labl	36
=LINES xxxx	Lines/mm for current grating	Lines	21
?LINES	Query lines/mm for current grating	Lines	21
[LOCAL]†	Transfer control to Hand controller	Local	44
?MAXW	Query maximum wavelength for current grating		21
!MS +xxxx	Move forwards by motor steps	Step >	33
!MS -xxxx	Move backwards by motor steps	Step <	33
=OFFSET xxxx	Set offset angle for current grating in radians		22
?OFFSET	Query offset angle for current grating in radians		23
=ORDER x	Set order for current grating		22
?ORDER	Query order for current grating		22
!PAUSE	Pause during a scan		26
=POINTS xxxx	Set number of data points in a scan	Points	28
?POINTS	Query number of data points in a scan	Points	28
!PORTIN a	Select input port A, D, or 0		40
?PORTIN	Query input port		40
!PORTOUT a	Select output port B, C, or 0	Port	39
?PORTOUT	Query output port	Port	39
?PS	Query current step position		33
?PW	Query current wavelength position	[displayed]	20
[REM]†	Transfer control to PC	Rem	44
=SHTRTYPE a	Set shutter type to Slow, Fast, or Manual		42
?SHTRTYPE	Query shutter type		42
!SHUTTER 1	Activate slow shutter	CL Sh	42
!SHUTTER 0	Deactivate slow shutter	Op Sh	42
!SLITA xxxx	Set Slit A width in microns	Slit A	38
?SLITA	Query Slit A width in microns	Slit A	38

Commands & Parameters	Description	Hand Control	Page Reference
!SLITB xxxx	Set Slit B width in microns	Slit B	38
?SLITB	Query Slit B width in microns	Slit B	38
!SLITC xxxx	Set Slit C width in microns	Slit C	38
?SLITC	Query Slit C width in microns	Slit C	38
=STARTW www	Start wavelength for a scan	Start	27
?STARTW	Query start wavelength for a scan	Start	27
!SYSINFO 0	Disable system information during scan	No Inf	32
!SYSINFO 1	Enable system information during scan	Inf	32
?SYSINFO	Query system information mode		32
=UNITS aa	Wavelength units; nm, µm or wn	Units	31
?UNITS	Query wavelength units	Units	31
!UL	Recall the user default parameters	Load	31
!US	Save active parameters as user defaults	Save	31
?VER	Query firmware version	Ver	31
=WAIT xxxx	Set wait time during a scan	Wait	29
?WAIT	Query waiting time during a scan	Wait	29
?ZEROSTEP	Query step position of system zero angle		33
!ZEROANG	Set the system zero angle		34

† Available from Hand Controller only.

8. MS257™ OPERATING STATES

MS257™ has several distinct operating modes or states. Since different commands are recognized in each mode, it is important to understand what these modes are and under what conditions the modes change. Figure 4. illustrates the major operating states of the MS257™.

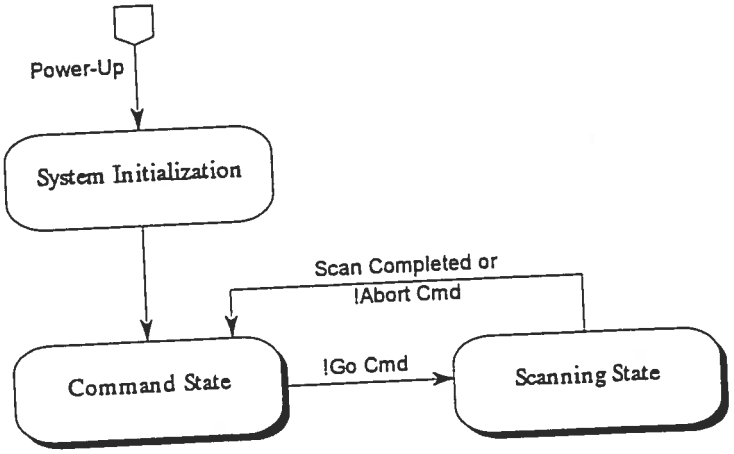

Figure 4. MS257™ Operating State transition diagram

8.1 System Initialization State

MS257™ enters the System Initialization State when:

- the system is powered up

When MS257™ enters the Initialization State, it:

- recalls the last stored parameters from non-volatile memory
- reinitializes the grating drive by finding its absolute home.
- sets the grating selection, flip mirror, filter wheels, and slits to their last position or to their auto mode settings if auto mode was enabled.
- sets the grating to its home wavelength.

During system initialization and self-test, commands from the PC are not recognized. A ***[CR][LF]>*** prompt is issued when the start up procedure is completed and the system is ready to receive commands.

8.2 Command State

MS257™ enters the Command State when:

- the System Initialization State completes successfully
- a scan has completed
- a scan has been terminated via the Abort (**!ABORT**) command.

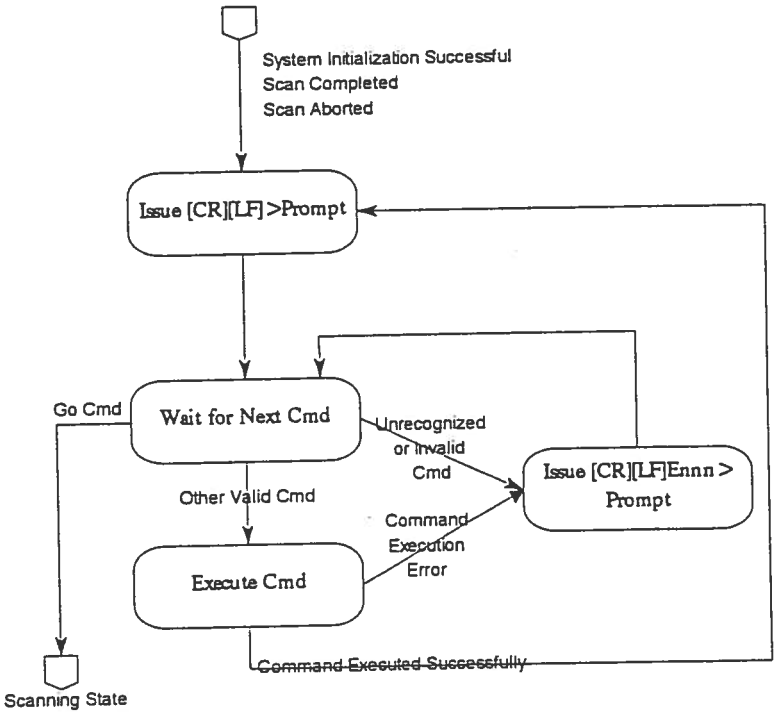

Figure 5 MS257™ Command State transition diagram

Commands Not Supported in the Command State

While in the Command State, the spectrograph waits for and recognizes most commands. The commands that are **not** supported in this mode are those that are specific to the Scanning State:

- **!PAUSE**
- **!ABORT**

If one of these commands is sent, the error prompt **[CR][LF]E0001>** will be issued.

8.3 Scanning State

The MS257™ enters the Scanning State when a !GO command is issued through a software command or an external trigger:

- A scan will start at **STARTW** and end at **ENDW.**
- At each data point, the actual wavelength is reported. If **SYSINFO** is turned on then grating, filter, and port information is also reported.
- If Handshaking mode is disabled, there is a delay for duration **WAIT** time before moving to the next wavelength.
- If Handshaking mode is enabled, the scan is suspended at each data point until a **!GO** command is sent, or the scan is aborted.

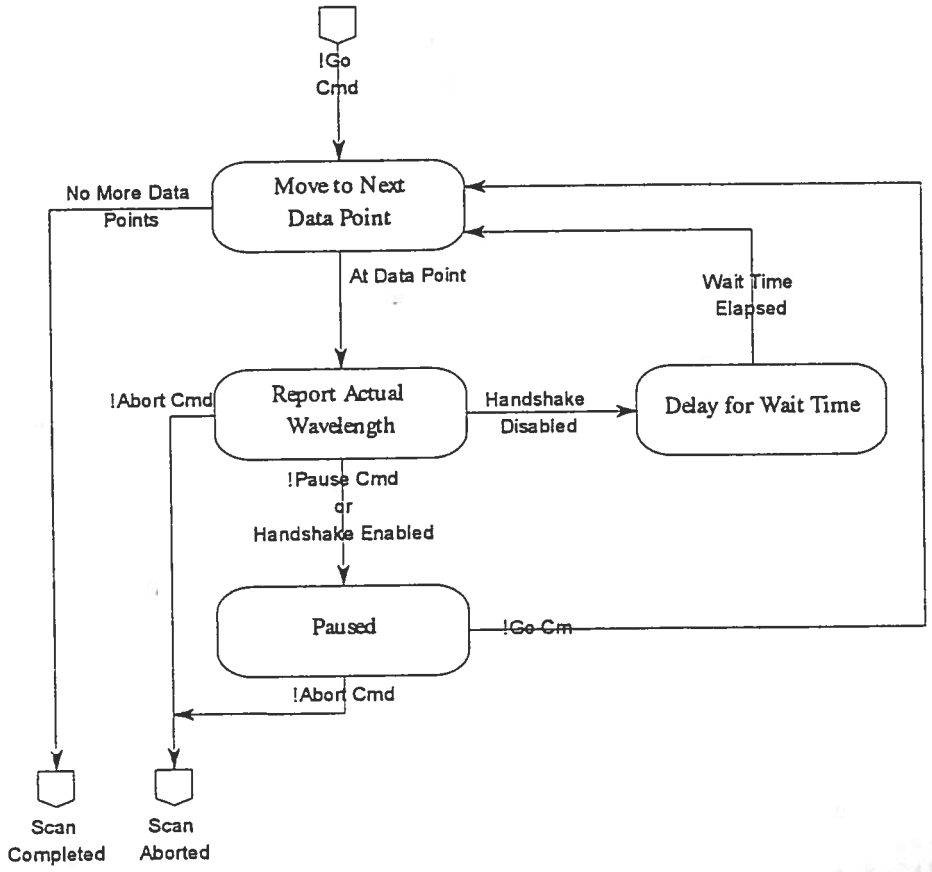

Figure 6. MS257™ Scanning State transition diagram

9. BASIC LANGUAGE RS-232 PROGRAMMING EXAMPLE

This QuickBASIC program was designed to demonstrate how to communicate with the ORIEL 77700, MS257™ spectrograph. It demonstrates several basic features of the instrument, such as selecting a grating, moving to a wavelength, inquiring which grating is selected and retrieving current wavelength information. The source code is supplied with MS257™ as the file ORI77700.BAS.

Since Microsoft QuickBASIC® supports only two communication ports, make sure you connect MS257™ to either COM1 or COM2.

The program is fully compatible with QBASIC® version 1.0 and Microsoft BASIC 7.0 Professional Development System®.

```
' ------------------------------------------------------------------------
' ORIEL 77700, MS257 Spectrograph
' QuickBASIC Demonstration Program
'
' (c) Copyright 1993 Oriel Corp.
' 250 Long Beach Blvd., Stratford, CT 06497
' Voice: (203) 377-8282 Fax: (203) 378-2457
'
' Tab stops: 3
' ------------------------------------------------------------------------
COMMON SHARED response$
DECLARE SUB GoToWL ()
DECLARE SUB GetCurrentWL ()
DECLARE SUB ReadResponse ()
DECLARE SUB GetGrating ()
DECLARE SUB SelectGrating ()
DECLARE SUB Initialize ()
DECLARE SUB GetPortNumber (port$)
CONST TRUE = 1, FALSE = NOT TRUE
CLS
COLOR 1, 11
PRINT
PRINT "========================================================================="
PRINT "                    ORIEL 77700, MS257 Spectrograph                      "
PRINT "                    QuickBASIC Demonstration Program                     "
PRINT "                                                                         "
PRINT "                     (c) Copyright 1993 Oriel Corp.                      "
PRINT "                250 Long Beach Blvd., Stratford, CT 06497                "
PRINT "                Voice: (203) 377-8282 Fax: (203) 378-2457                "
PRINT "========================================================================="
PRINT
COLOR 9, 8
PRINT "INITIALIZE THE INSTRUMENT"
CALL Initialize
CALL GetGrating
DO
PRINT
PRINT "QUIT", , 0
PRINT "SELECT GRATING", 1
PRINT "GET GRATING INFORMATION", 2
```

```
PRINT "GO TO WAVELENGTH", 3
PRINT "GET CURRENT WAVELENGTH", 4
INPUT ""; i%
SELECT CASE i%
   CASE 0
      SYSTEM
   CASE 1
      CALL SelectGrating
   CASE 2
      CALL GetGrating
   CASE 3
      CALL GoToWL
   CASE 4
      CALL GetCurrentWL
   CASE ELSE
      PRINT "Select 0, 1, 2, 3, or 4."
END SELECT
LOOP

SUB GetCurrentWL
   PRINT #1, "?PW"
   CALL ReadResponse
   PRINT "The current wave length is", , MID$(response$, 3)
   PRINT #1, "?PS"
   CALL ReadResponse
   PRINT "The current step position is", MID$(response$, 3)
END SUB

SUB GetGrating
   mode$ = "MANUAL"
   PRINT #1, "?GRAT"
   CALL ReadResponse
   PRINT response$
   IF MID$(response$, 3, 1) <> "A" AND MID$(response$, 3, 1) <> "M" THEN
      PRINT "Wrong response from MS257"
      END
   ELSE
      PRINT "The current grating number is", MID$(response$, 5, 1)
      IF MID$(response$, 3, 1) = "A" THEN
         mode$ = "AUTO"
      END IF
      PRINT #1, "?LINES"
      CALL ReadResponse
      PRINT "The lines are", , , MID$(response$, 3)
      PRINT #1, "?ORDER"
      CALL ReadResponse
      PRINT "The order is", , , MID$(response$, 3)
      PRINT "The current grating mode is", , mode$
   END IF
END SUB

SUB GetPortNumber (port$)
   DO
      answer% = TRUE
      PRINT "Enter comm port: 1 = COM1, 2 = COM2, or 0 to quit"
      INPUT ""; i%
      SELECT CASE i%
         CASE 0
            END
         CASE 1
```

```
            port$ = "COM1:"
         CASE 2
            port$ = "COM2:"
         CASE ELSE
            PRINT "Select 0, 1, or 2."
            PRINT
            answer% = FALSE
      END SELECT
   LOOP UNTIL answer% = TRUE
END SUB

SUB GoToWL
   PRINT "Enter wave length:"
   INPUT ""; wl#
   PRINT #1, "!GW" + STR$(wl#)
   ReadResponse
END SUB

SUB Initialize
   CALL GetPortNumber(port$)
   port.config$ = port$ + "9600,N,8,1"
   OPEN port.config$ FOR RANDOM AS #1
   PRINT #1, "!GRAT 0"
   CALL ReadResponse
   PRINT #1, "=LINES 400"
   CALL ReadResponse
   PRINT #1, "=ORDER 1"
   CALL ReadResponse
END SUB

SUB ReadResponse
      response$ = ""
      SLEEP 1
   DO
      valid% = TRUE
      IF NOT EOF(1) THEN
         S$ = INPUT$((1), #1)
         IF S$ = ">" THEN
            valid% = FALSE
         ELSE
            response$ = response$ + S$
         END IF
      END IF
   LOOP UNTIL valid% = FALSE
END SUB

SUB SelectGrating
   DO
      answer% = TRUE
      PRINT "Enter grating number:"
      INPUT ""; i%
      SELECT CASE i%
         CASE 0
            END
         CASE 1
            Grating$ = "1"
            Lines$ = "400"
            Order$ = "1"
         CASE 2
            Grating$ = "2"
```

```
            Lines$ = "600"
            Order$ = "1"
         CASE 3
            Grating$ = "3"
            Lines$ = "1200"
            Order$ = "1"
         CASE 4
            Grating$ = "4"
            Lines$ = "1200"
            Order$ = "1"
         CASE ELSE
            PRINT "Valid grating numbers are: 1, 2, 3, 4; 0 - to quit"
            answer% = FALSE
      END SELECT
   LOOP UNTIL answer% = TRUE
   PRINT #1, "!GRAT " + Grating$
   CALL ReadResponse
   PRINT #1, "=LINES " + Lines$
   CALL ReadResponse
   PRINT #1, "=ORDER " + Order$
   CALL ReadResponse
END SUB
```