

Appendix A

Guide to Programmers

A1 Introduction

This section explains how to use the RS232 interfaces for all of Ophir Optronics' power and energy meter products. It is primarily a guide for programmers wishing to write programs that use the RS232 interface.

This section covers all five of the instruments made by Ophir Optronics which provide an RS232 interface, namely models Laser-Star, Nova, Orion, Nova-II, and Vega. The five instruments use the same instruction set and instruction format, but since the various instruments offer differing functions, some instructions can not be used with all instruments. Also, some instruments have built-in RS232 hardware, and some use external interface electronics.

All instruments allow power and energy data to be transferred using the interface and can be controlled remotely using the interface. They can also be used to gather a limited amount of data while not connected to a computer, and later transfer the gathered data to a computer using the interface.

Section A2 - A6 is organized as follows:

- A2** Explains the hardware used for RS232 for each of the instruments, and how to prepare cables if required.
- A3** Describes examples of different tasks that may be required from an RS232 interface, and explains in which groups of commands can be used to perform each task.
- A4** Provides general help for programmers about writing programs using RS232 interfaces.
- A5** This is the reference section, defining the technical details of the communication protocols and listing the available commands and their exact syntax.
- A6** Shows some flowcharts, which summarize techniques described in sections A3-5.

A2 Description of Hardware

A2.1 Nova, Old Style RS232 Adapter

This section refers to the old style Nova RS232 Adapter, Ophir P/N 1Z04281X.

The NOVA instrument requires a special optional RS232 adapter, which contains active circuitry in its 25-pin plug. Connect the 25-pin plug to your computer and connect the other end between the NOVA instrument and the detector head.

Note:

If a 9-pin connector is required at the computer end, an inexpensive standard adapter can be purchased.

If the cable needs to be extended, do not cut off the 25-pin plug or attempt to extend the 15-pin connections, but add an extension lead from the 25-pin plug to the computer. To make such an extension lead, connect leads as follows:

| NOVA 25-pin adapter | | Direction | Computer | | |
|---------------------|----------|-----------|----------|--------|-------|
| Pin | Function | | Function | 25-Pin | 9-Pin |
| 2 | Receive | << | Transmit | 2 | 3 |
| 3 | Transmit | >> | Receive | 3 | 2 |
| 4 | RTS | << | RTS | 4 | 7 |
| 5 | CTS | >> | CTS | 5 | 8 |
| 7 | Ground | <--> | Ground | 7 | 5 |
| 20 | DTR | << | DTR | 20 | 4 |

Note:

If writing your own software, make sure to raise DTR and RTS. This ensures that the connector gets the proper power supply.

In the case of a 25-pin connector at the computer, IDC connectors and ribbon cable can be used in places where electromagnetic interference is not expected to cause problems.

A2.2 Nova, New Style RS232 Adapter

This section refers to the new style Nova RS232 Adapter, Ophir P/N 1Z10140-1Z10145.

The NOVA and ORION instrument requires a special optional RS232 adapter, which contains active circuitry in the D15-D15 adapter section. Connect the 9-pin plug to your computer and connect the other end between the NOVA instrument and the detector head.

Where a 25-pin connector is required at the computer end, an inexpensive standard adapter can be purchased.

The following summarizes the pin connections of the D9 plug.

| NOVA 9-pin adapter | | Direction | Computer 9-pin Port | |
|--------------------|----------|-----------|---------------------|------------|
| Pin | Function | | Function | Pin Number |
| 3 | Receive | << | Transmit | 3 |
| 2 | Transmit | >> | Receive | 2 |
| 5 | Ground | <--> | Ground | 5 |

Note:

In NOVA instruments whose ROM version is 2.36 or earlier, the baud rate is fixed at 4800. Nova instruments with ROM versions 2.40 and higher offer the following baud rates: 300, 1200, 4800, 9600 and 19200. To set the baud rate, unplug the head of the Nova and switch the on. Press "select" until "Baud rate" is highlighted and press "go". Press "select" until the required baud rate is displayed and press "exit". The baud rate is now saved to EEROM (non volatile) memory.

A2.3 LaserStar

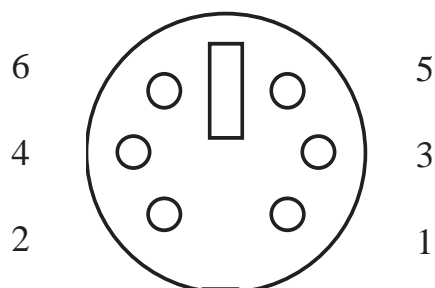
On the rear panel of the LaserStar is a 25-pin D-type connector. Use the cable provided with the instrument to connect the instrument to a computer. The 25-pin connector on the LaserStar instrument is not a dedicated RS232 connector since it also provides connections for the optional IEEE adapter, analog output and external trigger input. Therefore, standard RS232 cables should NOT be used and may cause damage if used. If you have to make your own cables, then connect ONLY the three wires as shown below:

| LaserStar | | Direction | Computer | | |
|-----------|----------|-----------|----------|--------|-------|
| Pin | Function | | Function | 25-Pin | 9-Pin |
| 3 | Transmit | >-----> | Receive | 3 | 2 |
| 2 | Receive | <-----< | Transmit | 2 | 3 |
| 7 | Ground | <-----> | Ground | 7 | 5 |

Follow the instructions in your LaserStar manual in order to set up the baud rate and polled/automatic transmission mode.

A2.4 Nova-II and Vega

The Nova-II and Vega have a Mini-DIN socket on the rear panel that can support two types of communications cable – USB and RS232. This section describes the design of the RS232 cable.



| Nova-II & Vega mini-DIN | | Direction | Computer | |
|-------------------------|----------|-----------|----------|-------|
| Pin | Function | | Function | 9-Pin |
| 6 | Transmit | >-----> | Receive | 2 |
| 4 | Receive | <-----< | Transmit | 3 |
| 2 | Ground | <-----> | Ground | 5 |

Note:

Ground is actually carried through the metal casing from the D9 connector on the PC side to the metal casing of the mini-DIN on the Nova-II side. Inside the connector, the casing is shorted to pin 5 and pin 2 respectively.

A3 Using the Interface

See also section A5.4 for full details of each command. This section describes in broad terms how to achieve various tasks using the interface. The setup required is explained briefly, and further details are generally to be found in the instruction manual supplied with your instrument. Similarly, some of the interface commands are listed, but their full syntax is detailed in chapter 5.

Modes of Operation

The communication interface can be used in three distinct ways. These modes will be referred to as polled mode, stream mode and stored data mode. The polled mode is the most usual method for working, and is available for all instruments.

A3.1 Polled Mode

In polled mode, the host computer sends an instruction, and the instrument returns a reply. The instrument then stops transmitting until it receives a new command.

Measuring Power

Transmit "\$SP" (Send power) from the host computer to the instrument. If the instrument is currently measuring power, the instrument will return the currently measured power in Watts as an ASCII string in scientific notation. If you want the computer to set up measurement range or laser wavelength using the interface, see below under "Controlling the Instrument".

Measuring Energy of a Single Pulse

The command "\$SE" (Send Energy) returns the energy in Joules of the last pulse to be measured. In order to establish whether the pulse a new pulse has been detected, or whether this pulse has already been read using the interface, or use "\$EF" (Energy Flag) command. For thermopile heads, if you want to determine whether the instrument is ready to measure a pulse, that is, whether a pulse may be fired by your laser, use the "\$ER" (Is Energy Ready?) command. See also the flowchart in the appendix.

Measuring on a Dual-Channel LaserStar

When two heads are connected to a dual-channel LaserStar, both readings can be read with one command. After issuing the \$SB (Send Both) command, the LaserStar will respond with an ASCII string containing both readings (channel A first, channel B second).

A3.2 Stream Mode

In stream mode, the PC issues a Continuous Send (\$CS) command. The instrument then transmits data without additional commands from the computer. The device continues reporting readings until issued another command. Stream mode is supported by the LaserStar in GPIB as well as by the Nova-II and Vega devices in USB. It is also available in RS232 after issuing the \$DU command. The NOVA and Orion do not support stream mode. For a detailed description of Stream Mode, see "Alphabetic Listing of Commands".

A3.3 Stored Data Mode

Stored-data mode is used when data such as laser power must be recorded in a situation where communication or connection cannot be made while the measurements are in progress.

The instrument stores a limited amount of data, and is then brought to a computer to which the data where the data is transferred. This transfer actually takes place in using polled mode instructions. This mode is useful when working away from the computer or working with one computer and several instruments simultaneously and also when recording a burst of high-speed laser pulses where there is insufficient time between pulses to transfer the data using RS232.

Nova

First use the soft keys of the instrument to get to the "Log data" screen, and collect the required data using the instrument alone. When this is done, connect the instrument to a computer. The computer should first use the "\$LI" (Log buffer Info) command to establish how much data was recorded and at what rate. Next the "\$LR" (Log buffer pointer Reset) command should be transmitted once to tell the instrument that the first data point to be transmitted is the first one stored in the buffer. Next, stored data are read in blocks of 10 by using the "\$LS" (Logged data Send) command. The "\$LS" command is repeated for all required data blocks.

LaserStar, Nova-II, and Vega

The LaserStar, Nova-II, and Vega devices can store up to 11 files in on-board static RAM. They will maintain the contents of these files even after being turned off (up to about 3 months). In order to select a file to upload, use the "LF" command with a parameter in the range 0 - 10. Afterwards, you can proceed as in the standard, stored data mode. See section A5.4 for details of more advanced commands (\$LC, \$LD, \$LL).

A3.4 Commands for Controlling the Instrument

So far it has been assumed that the instrument is set up manually, that is by actually pressing the soft keys of the instrument by hand. Such set-up may include selection of power or energy measurement mode, the selection of an appropriate measurement range, and selection of wavelength. Often, this is sufficient, especially since the instruments can be set to start up in any combination of these when switched on. However when considering industrial automated tests, or tests requiring a variety of different ranges, it becomes useful to control the settings of the instrument using the host computer's software. The following provides a summary of the instructions for remote control of an instrument. Programmers are advised to check in A5 that all the commands they intend to use are available for the instrument in question. See A5 for full details and restrictions.

A3.4.1 Commands for Changing an Instrument's status or settings

"\$FC" (Force Configuration)

"\$FE" (Force Energy)

"\$FP" (Force Power)

"\$FS" (Force Screen)

"\$RE" (Reset instrument)

"\$SK" (Simulate Key) Simulates a manual press of one of the soft keys. "\$WL", "\$WW" (Wavelength) Sets the wavelength to a particular wavelength or laser type.

A3.4.2 Status Inquiry Commands

The following are inquiry commands that return some information about what the instrument is doing and what settings are active. They do not change any settings.

"\$BC" (Battery condition)

"\$RN" (Range Now)

"\$KL" (Key legends)

"\$VE" (Software Version of ROM)

"\$FZ" (FreeZe updating the display)

"\$DI" (send Display bitmap). This reads the display's pixels.

A4 General Advice for Programmers

A4.1 Trying out the interface

Before writing an application, try out the device's command interface interactively, using the terminal utility provided by Microsoft Windows. Select the terminal application and set the following options:

| | |
|-----------------------|--------------|
| Terminal Emulation: | TTY, Generic |
| Terminal Preferences: | Local Echo |
| Baud Rate: | 9600 |
| CR-> CR/LF: | Both |
| Data bits: | 8 |
| Stop bits: | 1 |
| Parity: | None |
| Flow control: | None |
| Parity check: | No |
| Carrier Detect: | No |

You can now issue commands and see the instrument's responses.

A4.2 Writing RS232 Communications Subroutines.

At Ophir, we've developed applications that communicate with our devices in the following development environments.

1. Borland Pascal (In-house calibration facility)
2. Delphi (In-house calibration facility)
3. Visual Basic (StarCom)
4. Visual C++ (Test Applications)
5. LabVIEW (VI's package)
6. LabWindows (Test Application)

A4.3 Sample program in Visual BASIC:

This sample is written in Visual Basic 6.0. It allows the User to query the Nova for one measurement of power (Command1), or one measurement of energy (Command2). An option to stop the energy query is also provided (Command3). It assumes that a thermopile head is attached to the Nova.

1. Create Form1
2. Add Microsoft Comm Control to the Form
3. Add 3 command buttons on the form

Private bGoon As Boolean 'Flag to stop energy loop

'Measure power

Private Sub Command1_Click()

```

Dim strResponse As String
Call OpenComm           ' open commm
' force power
Call WriteFrame("FP", strResponse)
' todo: Wait until device enters power mode (about 1/2 second)
' send power
Call WriteFrame("SP", strResponse)
MSComm1.PortOpen = False ' close the port
Call MsgBox(strResponse) ' display power result

```

End Sub

'measure thermo energy till user press stop button (Command3).

Private Sub Command2_Click()

```
Dim strResponse As String
Call OpenComm          ' open commm
' force energy
Call WriteFrame("FE", strResponse)
' todo: need to wait till device enter in power mode 1/2 second
bGoon = True 'Flag that starting energy loop

While bGoon          ' bGoon will be set to false when user click on button stop
'check energy was measured
' send EF
Call WriteFrame("EF", strResponse)
If InStr(strResponse, "1") Then
    ' send energy
    Call WriteFrame("SE", strResponse)
End If
DoEvents ' give a chance to perform communications and other events
Wend
MSComm1.PortOpen = False          ' close the port
```

End Sub

'stop energy measurements

Private Sub Command3_Click()

```
bGoon = False
Call MsgBox("Energy Loop Stopped")
```

End Sub

'open comm

Private Sub OpenComm()

```
' set comm settings (baud rate 9600 no parity, 8 data and 1 stop bit
MSComm1.Settings = "9600, N, 8, 1"
MSComm1.CommPort = 2          ' com2
MSComm1.InputLen = 0          ' read the entire buffer on input
' The NOVA instrument does not have a built-in RS-232 support.
' An external plug with the RS-232 scematic uses the voltage
' coming from the PC via DTR and RTS lines. Therefore we set
' these line to be "high".
MSComm1.DTREnable = True      ' set Data Terminal Ready line to "high"
MSComm1.RTSEnable = True      ' set Request To Send line to "high"
MSComm1.PortOpen = True      ' open the port
```

End Sub

```

'Write command and wait for device response
Private Sub WriteFrame(ByVal strCmd As String, ByRef strResponse As String)
    Dim strFullCmd As String
    strFullCmd = "$" + strCmd + Chr(13)
    MSComm1.Output = strFullCmd
    strResponse = ""

    ' This is an infinite loop because demo only
    ' In a proper application the correct approach is to use events from the
    ' COMM object. Should also add a Timer to keep the application from
    ' getting stuck if no response comes from the Nova

    Do
        ' check if something in received buffer
        If MSComm1.InBufferCount > 0 Then
            strBuff = MSComm1.Input
            strResponse = strResponse + strBuff
            If InStr(strResponse, Chr(10)) Then
                Exit Do
            End If
        End If
    Loop While 1
    strResponse = strResponse
End Sub

```

A5 Syntax definitions

A5.1 Communication Parameters

The following communications parameters are used:

| | | |
|-------------------|--------|------------------------------------------|
| Data byte length: | 8 Bits | |
| Stop bits: | | 1 |
| Parity: | None | |
| Parity checking: | None | |
| CTS line: | | Not used except in NOVA |
| DTR, RTS lines: | | Must be high at all times for NOVA only. |
| XON/XOFF: | | Not supported |

Available Baud rates:

| | |
|---------------------------------------|-----------------------------------------|
| NOVA until version 2.36: | 4800 Fixed. |
| NOVA version 2.40 & Higher and Orion: | 300, 1200, 4800, 9600, 19200 |
| LaserStar, Nova-II, and Vega: | 300, 1200, 4800, 9600, 19200, 38400. |

A5.2 Instruction Format

In polled mode, all instructions have the following format:

The "\$" symbol (that is ASCII 36 decimal)

The two letters that constitute the command: These may be upper or lower case in any combination.

An optional space character

Any parameters if required

A carriage return <CR> character (that is ASCII 13 decimal)

An optional line-feed <LF> character.

The instrument does not start to process a command until the <CR> is received. The instrument responds with either a valid response or an error message.

A valid response always begins with an asterisk "*". (ASCII 42 decimal) This is true even for instructions which do not return any data, such as \$SK. Thus where an instruction is listed as "Returns: nothing" in section A5.4, an asterisk is still returned. It is important to check that an asterisk has been received by the computer as a way of ensuring that the instrument has accepted the instruction and that the instrument is ready for the next command. It is also important to remove the asterisk from numeric data received before trying to convert it to a numeric variable in software.

Error messages begin with a question mark "?" (ASCII 63 decimal). The text of the error message usually explains the nature of an error in a short English phrase.

Examples of error messages are:

```
? UNKNOWN COMMAND 'XX'  
? PARAMETER ERROR  
? THIS HEAD CANNOT MEASURE ENERGY  
? HEAD NOT CONNECTED
```

All responses are terminated with a <CR> character. Programs should not send further commands until the <CR> has been received. NOVA and Laser-Star instruments also send a line-feed character after the <CR>.

Where data are returned in scientific notation, this is the familiar E notation, such as "**1.234e5" which represents the number 123400.

In automatic mode, each transmission is terminated with a <CR> and a <LF>.

A5.3 Additional restrictions for NOVA instruments

When writing applications for the NOVA instrument, the following three additional rules apply.

1. The modem control lines DTR and RTS must be high at all times.
2. The computer should transmit only when CTS is asserted
3. RS232 operation of pyroelectric heads in their most sensitive ranges may not be reliable. This is because pyroelectric heads are very sensitive and the pulsing caused by the RS232 communication can cause false triggering.

A5.4 Alphabetic Listing of Commands

The following section is an alphabetic listing of all the commands intended for normal use. There are other commands not listed here to which the instruments will respond. These are used for automatic calibration and test at Ophir. Do not experiment with commands other than those listed here; it is possible to corrupt the calibration of the instrument by doing so. However it is unlikely that such damage will occur accidentally: Instructions that write to the permanent memory of the instruments contain checksums that will not generally arise accidentally from random data.

Except for the following list of commands, commands noted as supported on the Nova are also supported on the various Orion displays.

- AT command
- Energy specific commands on Orion-TH, Orion-PD, and Orion-PD200 devices
- Power specific commands on Orion-PE
- Wavelength specific commands (example WL) on the Orion-PD200

\$AF Average Flag**(Request for data)**

| | | | | |
|--|------------------|--|--|-----------------------|
| | LaserStar | | | With all heads |
|--|------------------|--|--|-----------------------|

Description: Checks if a new averaged reading has been prepared since previous use of \$SG command

Parameters: None.

Returns: 0 (no new average) or 1 (new average prepared).

Limitations: From LaserStar version 2.50.

See also **\$AQ, \$SG**

Other Details:

Thermopile (and RP) heads do not have an averaging option when measuring energy. If the command is sent when in energy mode, the instrument will return an error string

\$AQ Average Query**(Remote control)**

| | | | | |
|--|------------------|--|--|-----------------------|
| | LaserStar | | | With all heads |
|--|------------------|--|--|-----------------------|

Description: Query and set the average setting of the head.

Parameters: 0 for query (default if no parameter sent)
1 for first setting ("NONE")
2 for second setting
etc.

Returns: String containing index of presently active Average setting as well as literal description of set of all available Average settings. If Remote User specified an unsupported index, will prefix a '?' to the response.

Limitations: From LaserStar version 2.50.

See also **\$AF, \$SG**

Other Details:

Thermopile (and RP) heads do not have an averaging option when measuring energy. If the command is sent when in energy mode, the instrument will return the error string.

\$AR All Ranges

(Request for data)

| | | | | |
|--|------------------|----------------|-------------|-----------------------|
| | LaserStar | Nova-II | Vega | With all heads |
|--|------------------|----------------|-------------|-----------------------|

Description: Returns all ranges available to head. This is prefixed by the index of the presently active range.

Example: For a PD300 in the 30 microwatt range (with filter out), the LaserStar would return "* 3 dBm AUTO 30.0mW 3.00mW 300uW 30.0uW 3.00uW 300nW 30.0nW"

Parameters: None

Limitations: 1. Available for LaserStar ROM version 1.75 and later.
2. If no head is connected, the device will return "?NO HEAD CONNECTED"

Other Details:

- 1 The character 'u' was chosen to represent the prefix "micro".
This is for 2 reasons. The first is that extended ASCII (values above 127) is not 488.2 compliant. Secondly, different fonts on different PC's might not recognize ASCII 230 as 'µ'. The character 'u' is considered the correct prefix (see the 488.2 standard page 74 table 7-2).
- 2 The index of the highest numeric range is 0.
The index of AUTO (when applicable) is -1
The index of dBm (when applicable) is -2

These values were chosen because they are consistent with the parameter of the \$WN (Write raNge) command. If this PD300 was sent a "\$WN 3" it would be put in the 30 microwatt range.

\$AT ATtenuation factor

(Request for data)

| | | | | |
|-------------|--|--|--|-----------------------|
| Nova | | | | With all heads |
|-------------|--|--|--|-----------------------|

Description: For Nova 304 and above. Returns percentage of beam that Nova has been programmed for and its inverse.

Example: Nova programmed for 100% would respond "* 1.0 1"

\$AW All Wavelengths

(Request for data)

| | | | | |
|--|------------------|----------------|-------------|-----------------------|
| | LaserStar | Nova-II | Vega | With all heads |
|--|------------------|----------------|-------------|-----------------------|

Description: Returns string fully describing the wavelengths that the head is configured to work with.

Example 1. PD300 with Filter Out. The LaserStar returned:

“CONTINUOUS 350 1100 1 633 488 978 NONE NONE NONE”

The remote access user would know that it is a continuous curve head (from the prefix CONTINUOUS), that the range of wavelengths is 350nm through 1100nm that the present wavelength that the head is configured to measure for is 633 (from the index 1) and the 6 favorite settings as they would be displayed on the LaserStar (above 10000nm would be displayed as 10.0). The second and third parameters delimit the range of values that the \$WL command would succeed with.

Example 2 3AP head. The Nova-II returned.

“DISCRETE 1 VIS NIR”

The remote access user would know that this head is configured for a discrete set of wavelengths (from the prefix DISCRETE), that the head is presently configured to work at the VIS wavelength (from the index 1) and that the set of wavelengths that the head could be configured to work with (via the \$WW command) is "VIS" and "NIR".

\$BC Battery condition

(Request for data)

| | | | | |
|-------------|------------------|----------------|-------------|--|
| Nova | LaserStar | Nova-II | Vega | |
|-------------|------------------|----------------|-------------|--|

Description: Requests the status of the battery.
Parameters: None
Returns: 1 if battery is OK, 0 if battery is low.
Limitations: None.

\$BM BC20 mode**(Remote control)**

| | | | | |
|-------------|--|--|--|------------------------|
| Nova | | | | With BC20 heads |
|-------------|--|--|--|------------------------|

Description: For BC20 smart heads, changes mode from HOLD (0) to CONTINUOUS (1).

Limitation: From ROM version 3.09 and higher

Parameters: BC 0 = hold mode, BC 1 = continuous mode

Returns: "?NOT A BC20 HEAD" : Head isn't a BC20-SH
 "?PARAM ERROR" : If missing parameter or parameter is greater than 1
 "*" : If successful

\$BQ BC20 Query**(Remote control)**

| | | | | |
|--|------------------|----------------|-------------|------------------------|
| | LaserStar | Nova-II | Vega | With BC20 heads |
|--|------------------|----------------|-------------|------------------------|

Description: Query and set BC20 smart heads mode (HOLD or CONTINUOUS).

Parameter Value: 0 for query
 1 for HOLD (if applicable)
 2 for CONTINUOUS

Response: string containing index of present BC20 Mode as well as a literal description of both modes If Remote User specified an unsupported index, will prefix a '?' to the response.

Errors: "?NO HEAD CONNECTED" If no head connected
 "? BQ COMMAND NOT SUPPORTED FOR THIS HEAD" for photodiode, pyroelectric, and nanoJoule heads. Will also be returned for non-BC20 thermopile heads.

Limitations: LaserStar version 2.27 and higher supports this command. All versions of Nova-II and Vega support this command.

\$CS Continuous Send

(Request for data)

| | LaserStar | Nova-II | Vega | With all heads |
|--|-----------|---------|------|----------------|
|--|-----------|---------|------|----------------|

Description: Requests the device to report all measurements that it makes. Also known as Stream Mode.

Parameters:

Parameter 1 [0|1]: Off (0) or On (1)

Parameter 2 [0-65535]: Transmit one of X readings. If 0 or 1, LaserStar will transmit every reading.

Parameter 3 [1|2|3]: Response Format
Standard (1): * 1.234e-3<LF>
Compressed (2): *1234<LF>
Extended (3): See Below

If this command is sent while the LaserStar is in dual-channel mode the LaserStar will add "A " (or "B ") between the leading star ("*") and the reading. For Example, if LaserStar is in measuring power ratio and User requests \$CS 1 75 2 once every 5 seconds the LaserStar will send.

*A 2050<LF>

*B 1020<LF>

The last 2 parameters are optional. If not present, the LaserStar will default to sending every measurement in standard format.

Any command (including undefined ones) received by the LaserStar or Nova-II will turn this mode off. (Similarly, SDC, DCL, and IFC will turn this mode off for a LaserStar communicating in GPIB).

Keypresses will not turn this mode off (e.g. if started in channel-A-only mode, and then the User switch to power ratio mode, the LaserStar will continue to report measurements as if it was still in channel-A-only mode).

For a LaserStar communicating via GPIB, this command assumes a total dedication of the GPIB to the LaserStar as Talker and some other device(s) as Listener. This limitation does not apply to the Nova-II or Vega communicating via USB.

Note :

As of LaserStar 2.09, the \$CS command can be driven to return measurement-sensitive response formats. This mode, known as Extended \$CS, is entered if the last parameter is set to 3.

Extended Formats. The following is the list of measurement-sensitive response formats:

1. For Pyroelectric and nanoJoule heads measuring exposure (same format as response to \$EE command).
2. Frequency (if changed since last reported) for Pyroelectric, nanoJoule, and RP heads. “* **<energy-reading> "FREQ" <present-frequency>**”
3. String describing state of Single-Shot energy measurement for thermopile and RP heads:
 - *RESET: Waiting for head to stabilize
 - *WAITING: Waiting for start of pulse
 - *SUMMING: In process of measuring a pulse
 - *<energy>: Successful energy measurement
 - *OVER: Measured Energy was overrange
 - *PEAK OVER: Energy too great at peak to be measured (Error Condition)
 - *ENERGY OVER: Total energy too great to be measured (Error Condition)
4. Power readings as before
5. RP relative readings as before
6. RP absolute readings are reported in 3 different stages.
 - Stage 1. Relative readings until DCF is established
 - Stage 2. <First-absolute-reading> "DCF" <dcf to apply to previously reported relative readings>
 - Stage 3. <Absolute-reading>

Note:

Stage 1 might be left out. Stage 3 is not reached until after stage 2. Therefore the Remote control user can always know if this measurement is absolute or relative

7. RP energy (absolute or relative) with missing pulses “* **<energy-reading> "MISSING" <number of missing pulses between this measurement and the preceding one>**”.

Note 1:

As of LaserStar 1.75, the \$CS command can be used also in RS232 if communicating in full duplex mode. (See \$DU command below). All versions of the Nova-II support \$CS in RS232 (after receiving the \$DU command).

Note 2:

If operating at above approximately 400Hz, there may be some degradation of LaserStar, Nova-II, and Vega screen functions such as keypresses and screen updates. This will not affect the actual data being transmitted.

Note 3:

Extended mode formats are supported in the LaserStar from ROM version 2.09. All versions of the Nova-II and Vega support extended response formats.

In order to use the \$CS command correctly, the following steps are suggested.

For each channel:

1. Establish Communication channel (\$CH command).
2. Establish which head is being used (\$HI command).
3. Establish what is being measured (\$SI command).
4. Establish what range we’re in (\$SX command).

Based on the above information we know what to expect from the \$CS command.

Example 1. If there is only a thermopile head in channel A measuring power in autoranging, we know that the LaserStar will not insert “A “ in the response. Furthermore, we know that we shouldn’t use compressed mode (2 for value of 3rd parameter) because the range might change. Also if the 2nd parameter is 75, we know to expect a reading every 5 seconds. Therefore the command would take on the form “\$CS 1 75 1<LF>”.

Example 2. Pyroelectric head in energy mode in channel B. We know that it is safe to use compressed mode (because the head is not autoranging). Furthermore, the LaserStar will not insert “B “ because we’re in single-channel mode. We probably want to set the 2nd parameter to 1 (in order to get every pulse). Therefore the command should take the form “\$CS 1 1 2<LF>”.

\$DI LCD Data Image: NOVA (Request for data)

| | | | | |
|-------------|--|--|--|--|
| Nova | | | | |
|-------------|--|--|--|--|

Description: Requests image bitmap data of LCD
 Parameters: <column> <Number of columns> 0..121 1..4
 Returns: 1 to 4 long words (4-byte) in hexadecimal format
 Limitations: NOVA only.
 Example: \$DI 38 2 (could return * 6BA5490F 88BAB001)
 See also \$FZ

Other Details:
 A screen dump is made possible with this command. Each column of the LCD of a NOVA has 32 pixels. Each column is thus encoded into a 4-byte word in hexadecimal. Data for up to 4 consecutive columns can be read with each command.

\$DI LCD Data Image: LaserStar (Request for data)

| | | | | |
|--|------------------|--|--|--|
| | LaserStar | | | |
|--|------------------|--|--|--|

Description: Requests image bitmap data of LCD
 Parameters: Row number (0 to 63)
 Returns: A 60 character, 30-byte hexadecimal string.
 Limitations: LaserStar only.
See also \$FZ

Other Details:
 A screen dump is made possible with this command. Each row of the LCD of the LaserStar has 240 pixels. These are taken in groups of 4 and encoded as hexadecimal digits.

\$DI LCD Data Image: Nova-II (Request for data)

| | | | | |
|--|--|----------------|--|--|
| | | Nova-II | | |
|--|--|----------------|--|--|

Description: Requests image bitmap data of LCD
 Parameters: Row number (0 to 239)
 Returns: An 80 character, 40-byte hexadecimal string.
 Limitations: Nova-II only.
See also \$FZ

Other Details:
 A screen dump is made possible with this command. Each row of the LCD of the Nova-II has 320 pixels. These are taken in groups of 4 and encoded as hexadecimal digits.

\$DQ Diffuser Query (Remote control)

| | | | | |
|--|------------------|----------------|-------------|---------------------------|
| | LaserStar | Nova-II | Vega | Pyroelectric heads |
|--|------------------|----------------|-------------|---------------------------|

Description: Query and set the diffuser setting of the head.
 Parameters: 0 for query (default if no parameter sent)
 1 for Diffuser Out
 2 for Diffuser In
 Returns: String containing index of presently active diffuser setting as well as literal description of set of available diffuser settings.
 Limitations: From LaserStar version 1.97. Nova-II and Vega support this command in all versions.

\$DU Duplex**(Remote control)**

| | | | | |
|--|------------------|----------------|-------------|--|
| | LaserStar | Nova-II | Vega | |
|--|------------------|----------------|-------------|--|

\$DU [0|1] (DUplex)

This LaserStar, Nova-II, and Vega classically communicate via half-duplex (also called synchronously). That is to say, they receive a command and then issue a response. They can't receive back-to-back commands or issue back-to-back responses. This command allows the remote access user to put the device in full-duplex mode (with parameter value of greater than 0). (This is a prerequisite for RS232 use of the \$CS command).

The LaserStar responds

- * LASERSTAR IN FULL DUPLEX MODE to \$DU 1
- * LASERSTAR IN HALF DUPLEX MODE to \$DU 0
- ? 'DU' IS AN RS232 SPECIFIC COMMAND if communication is via GPIB (or USB in case of Nova-II)

\$EE Exposure Energy**(Remote Control)**

| | | | | |
|--|------------------|----------------|-------------|---------------------------|
| | LaserStar | Nova-II | Vega | Pyroelectric heads |
|--|------------------|----------------|-------------|---------------------------|

Description: Requests presently accumulated exposure measurement.
Parameters: None.
Returns: String containing up to date exposure measurement, number of pulses, time elapsed in tenths of seconds. Will return appropriate error string if device is not in exposure mode.
Limitations: LaserStar support of this command from Version 1.98 and higher. Nova-II and Vega support this command in all versions.
Example: “* 1.064E-1 2773 124”: 106.4mJ, 2773 pulses, 12.4 seconds.

\$EF Energy Flag**(Request for data)**

| | | | | |
|-------------|------------------|----------------|-------------|-------------------------------------|
| Nova | LaserStar | Nova-II | Vega | Thermopile, Pyroelectric |
|-------------|------------------|----------------|-------------|-------------------------------------|

Description: Requests value of energy flag.
Parameters: None.
Returns: 0 or 1.
Limitations: For use with thermopile heads measuring single shot energy (or when measuring Pyroelectric power or energy on a LaserStar or Nova-II).
See also \$SE, \$FE, \$ER

Other Details:

The energy flag equals 1 if an energy measurement has been completed and has not yet been read using the \$SE command. See EXAMPLE2.BAS and the flowchart for energy in AA 6.

\$ER Energy Ready**(Request for data)**

| | | | | |
|-------------|------------------|----------------|-------------|-------------------------|
| Nova | LaserStar | Nova-II | Vega | Thermopile heads |
|-------------|------------------|----------------|-------------|-------------------------|

Description: Requests Energy-Ready status.
Parameters: None.
Returns: 0 or 1.
Limitations: Must be measuring single shot energy.
See also \$SE, \$EF, \$FE

Other Details:

The energy ready status equals 1 if the instrument is ready to measure a single-shot laser pulse. In systems that also control firing laser pulses, this command can be used and should return a 1 before the laser pulse is fired.

\$ET Energy Threshold**(Remote control)**

| | | | | |
|--|------------------|----------------|-------------|-------------------------|
| | LaserStar | Nova-II | Vega | Thermopile heads |
|--|------------------|----------------|-------------|-------------------------|

Description: Query and set the energy threshold setting of the head.
Parameter Value: 0 for query (default if no parameter sent)
1 for low
2 for medium
3 for high
4 for optical (for heads with photodiode trigger)
Returns: String containing index of presently active energy threshold as well as literal description of set of available thresholds.
Limitations: From LaserStar version 1.96. Nova-II and Vega support this command in all versions.

\$FC Force Configuration**(Remote control)**

| | | | | |
|--|-------------------------|--|--|--------------------------|
| | LaserStar (dual) | | | 2 heads connected |
|--|-------------------------|--|--|--------------------------|

Description: Causes the certain instrument's configuration to be set up.
Parameters: L a digit 0...7 A a digit 0...4 B a digit 0...4.
Returns: Two readings as an ASCII string in scientific notation.
Limitations: Dual-channel LaserStar only. Both heads must be connected.

Other Details:

Force the following LaserStar mode, depending upon values of L, A and B.

| Value of L | LaserStar mode |
|------------|------------------------------------|
| 0 | Channel A only |
| 1 | Channel B only |
| 2 | Dual-Channel: Independent |
| 3 | Dual-Channel: Ratio (A/B) |
| 4 | Dual-Channel: Ratio (B/A) |
| 5 | Dual-Channel: Difference (A-B) |
| 6 | Dual-Channel: Difference (B-A) |
| 7 | Dual-Channel: Multiplication (A*B) |

| Value of A and B | Head mode |
|------------------|--------------------|
| 0 | Power |
| 1 | Energy |
| 2 | Kelvin |
| 3 | Celsius |
| 4 | Fahrenheit |
| 5 | RP absolute energy |
| 6 | RP relative energy |

Note:

This command will force heads out of autoranging when using modes 3 - 7.

\$FE Force to Energy screen (Remote control)

| | | | | |
|-------------|------------------|----------------|-------------|-------------------------------------|
| Nova | LaserStar | Nova-II | Vega | Thermopile, Pyroelectric |
|-------------|------------------|----------------|-------------|-------------------------------------|

Description: Causes the instrument to go to single shot energy measurement screen, irrespective of current status.

Parameters: None.

Returns: Nothing.

Limitations: None.

See also \$FP, \$FS, \$SK

\$FE Force to Energy screen (Remote control)

| | | | | |
|--|------------------|--|--|-----------------|
| | LaserStar | | | RP heads |
|--|------------------|--|--|-----------------|

Description: Causes the instrument to go to the specified energy measurement screen, irrespective of current status. If no parameter is sent, this command will force the instrument into the currently configured energy screen.

Parameters: 'S': Single Shot Energy.
'R': Relative Mode RP Energy.
'A': Absolute Mode RP Energy.

Returns: Nothing.

Limitations: None.

See also \$FP, \$FS, \$SK

\$FO Force Oscilloscope mode (Remote control)

| | | | | |
|-------------|------------------|----------------|-------------|-------------------------------|
| Nova | LaserStar | Nova-II | Vega | Pyroelectric, RP heads |
|-------------|------------------|----------------|-------------|-------------------------------|

Description: Forces device into Scope Mode screen.

Parameters: None.

Returns: ?NO HEAD CONNECTED if no head attached.

Limitations: ?THIS HEAD DOESN'T SUPPORT SCOPE MODE for Thermopile and Photodiode heads.

\$FP Force to Power screen**(Remote control)**

| | | | | |
|-------------|------------------|----------------|-------------|-------------------------------------|
| Nova | LaserStar | Nova-II | Vega | Thermopile, Pyroelectric |
|-------------|------------------|----------------|-------------|-------------------------------------|

Description: Causes the instrument to go to power measurement screen, irrespective of current status.

Parameters: None.

Returns: Nothing.

Limitations: None.

See also \$FE, \$FS, \$SK

\$FP Force to Power (illuminance) screen**(Remote control)**

| | | | | |
|-------------|------------------|----------------|-------------|--------------------------|
| Nova | LaserStar | Nova-II | Vega | Illuminance heads |
|-------------|------------------|----------------|-------------|--------------------------|

Description: Causes the instrument to go to a specified illuminance measurement screen, irrespective of current status. If no parameter is sent, this command will force the instrument into the currently configured illuminance screen.

Parameters: 'L': Lux.
'F': Footcandles.

Returns: Nothing.

Limitations: None.

See also \$FP, \$FS, \$SP

\$FQ Filter Query**(Remote control)**

| | | | | |
|--|------------------|----------------|-------------|-----------------------------|
| | LaserStar | Nova-II | Vega | Photodiode, RP heads |
|--|------------------|----------------|-------------|-----------------------------|

Description: Query and set the diffuser setting of the head.

Parameters: 0 for query (default if no parameter sent).
1 for Filter Out.
2 for Filter In.

Returns: String containing index of presently active filter setting as well as literal description of set of available filter settings.

Limitations: From LaserStar version 1.96. Nova-II and Vega support this command in all versions.

\$FS Force to Screen N**(Remote control)**

| Nova | LaserStar | Nova-II | Vega | All heads |
|------|-----------|---------|------|-----------|
|------|-----------|---------|------|-----------|

Description: Causes the instrument to go to the screen listed below irrespective of current status.

Parameters: N a digit 0...3.

Returns: Nothing.

Limitations: None.

See also \$FP, \$FE, \$SK

Other details: Will cause the following screen to appear, dependent upon the value of N

| Value of N | Screen that will appear |
|------------|----------------------------------------------------------------------------------------------------------|
| 0 | Main power measurement screen. |
| 1 | Energy screen. |
| 2 | The screen seen when soft-key "MORE" is pressed in the Nova; "MENU" screen in the LaserStar and Nova-II. |
| 3 | The screen seen when no head is connected. |

\$FX Force Exposure**(Remote control)**

| | LaserStar | Nova-II | Vega | Pyroelectric heads |
|--|-----------|---------|------|--------------------|
|--|-----------|---------|------|--------------------|

Description: Will force head into exposure measurement screen.

Parameters: None.

Returns: Nothing.

Limitations: LaserStar version 1.98 and higher. All Nova-II and Vega versions.

Error Messages: If the head cannot measure exposure; the instrument returns an appropriate error message.

\$FZ FreeZe updating the display (Remote control)

| | | | | |
|-------------|------------------|----------------|-------------|--|
| Nova | LaserStar | Nova-II | Vega | |
|-------------|------------------|----------------|-------------|--|

Description: Stops or restarts the instrument writing to the display.

Parameters: 1 (=Freeze), or 0 (= Unfreeze).

Returns: Nothing.

Limitations: None.

See also \$DI

Other details:

Use before and after dumping the pixel map of the LCD display by using the \$DI command.

\$HC Head Configuration (Remote Control)

| | | | | |
|--|------------------|----------------|-------------|------------------|
| | LaserStar | Nova-II | Vega | All heads |
|--|------------------|----------------|-------------|------------------|

Description: Save configuration of head Startup, Calibration, or Response settings.

Parameters: S (Startup), C (Calibration), R (Response).

Limitations: LaserStar version 2.00 and higher. All Nova-II and Vega versions.

Returns: *SAVED
*UNCHANGED
?FAILED

\$HI Head Information (Request for data)

| | | | | |
|-------------|------------------|----------------|-------------|------------------|
| Nova | LaserStar | Nova-II | Vega | All heads |
|-------------|------------------|----------------|-------------|------------------|

Description: Requests a string of general information.

Parameters: None.

Returns: Returns type, serial number, name, and measurement capabilities of head.

Examples:

- * XX 0 NOHEAD 00000000: If no head connected.
- * TH 12345 03AP 00000183: For Thermopile head that can measure power and energy.
- * TH 21212 Temperature 00040000: For Thermopile head that can measure temperature.
- * PY 22323 PE10 80000003: For Pyroelectric head.

Bit 0 is lit if head can measure power.

Bit 1 is lit if head can measure energy.

Bit 18 is lit if head can measure temperature.

Bit 31 is lit if head can measure frequency.

All other bits are reserved and are not guaranteed to be 0 or 1.

\$HT Head Type (Request for data)

| Nova | LaserStar | Nova-II | Vega | All heads |
|------|-----------|---------|------|-----------|
|------|-----------|---------|------|-----------|

Description: Requests code for type head.
 Parameters: None.
 Returns: Returns code for head type. LaserStar and Nova-II append the measurement mode as well (see SI command for details). Nova appends an "X".
 Limitations: Nova version 3.29 and higher. LaserStar version 2.42 and higher. Nova-II and Vega on all versions.

List of Head Type codes:

1. TH: Thermopile
2. BC: BC20
3. TP: Temperature Probe
4. SI: Photodiode
5. LX: CIE head
6. RP: RP head (LaserStar Only)
7. PY: Pyroelectric
8. NJ: nanoJoule meter
9. XX: No head connected

\$IC Instrument Configuration (Remote Control)

| | LaserStar | Nova-II | Vega | |
|--|-----------|---------|------|--|
|--|-----------|---------|------|--|

Description: Save instrument configuration.
 Parameters: None.
 Limitations: LaserStar version 1.96 and higher. All Nova-II and Vega versions
 Returns: *SAVED
 *UNCHANGED
 ?FAILED

\$II Instrument Information**(Request for data)**

| Nova | LaserStar | Nova-II | Vega | |
|------|-----------|---------|------|--|
|------|-----------|---------|------|--|

Description: Requests a string of information about the instrument.
Parameters: None.
Returns: Returns id, serial number, and name of instrument being queried.
Examples:

- * NOVA 22211 NOVA
- * LS-A 54545 LASERSTAR-S for a single-channel LaserStar
- * LS-A 23452 LASERSTAR-D for channel A of a dual-channel LaserStar
- * LS-B 23453 LASERSTAR-D for channel B of a dual-channel LaserStar
- * NV-2 565343 NOVA2
- * VEGA 556334 VEGA

\$KL Key Legends**(Request for data)**

| Nova | LaserStar | Nova-II | Vega | |
|------|-----------|---------|------|--|
|------|-----------|---------|------|--|

Description: Requests the legends visible for all the softkeys.
Parameters: None.
Returns: A string of up to 40 characters.
Limitations: None.

See also **\$SK**

Other Details:

The string returned contains the legends for each soft key delimited by the open quote character ". A tilde "~" character preceding a legend indicates an active highlighted key. On the NOVA, whenever a bargraph replaces the soft keys, a blank string is returned.

\$LC Log Choose

(Request for Data)

| | LaserStar | Nova-II | Vega | |
|--|-----------|---------|------|--|
|--|-----------|---------|------|--|

Description: Will set the pointer to the next datum to upload.
Format: \$LC <1-54000>
Returns
* <index>: for success.
* <max-index>: if parameter is greater than number of points stored.
? "point not in range": parameter greater than number of points stored.

\$LD Log Delete

(Request for Data)

| | LaserStar | Nova-II | Vega | |
|--|-----------|---------|------|--|
|--|-----------|---------|------|--|

Description: Will delete previously selected Log File.
Format: \$LD <filesize>: <filesize> must equal actual filesize. This is a security measure.
Returns:
* for success
? "no file chosen" if no file was chosen with the \$LF command

\$LF Log File

(Request for Data)

| | LaserStar | Nova-II | Vega | |
|--|-----------|---------|------|--|
|--|-----------|---------|------|--|

Description: Chooses which file to upload. No other Logging Command is legal until a legal File has been chosen.
format: \$LF <0-10>
where 0 represents the present logging session.
1 - 10 are the legal file values.
Response could be one of the following:
* <param>: <filesize> : for success
? "no such file" : for bad choice of file

| Nova | LaserStar | Nova-II | Vega | |
|------|-----------|---------|------|--|
|------|-----------|---------|------|--|

Description: Requests information about logged data.
Parameters: None.
Returns: A string up to 60 characters.
Limitations: Meaningless unless logged data are stored.
See also \$LR, \$LS

The format of the returned string is as follows

" " <exp> <min> <max> <points> <samples>

Where

" " is one or more spaces.

<exp> is the exponent used for all stored data.

To convert the mantissa data <mant> returned by \$LI and this <exp> to a real power or energy in watts or joules, use the formula $RealPower = \langle mant \rangle * Antilog(\langle Exp \rangle - 3)$ where antilog (x) means 10 raised to the power of x.

<min> is the lowest mantissa in the memory.

<max> is the highest mantissa in the memory.

<points> is the number of data points stored.

<samples> is the time between samples in seconds multiplied by 30 for logged power data and 0 for logged energy data.

In the LaserStar, this command returns the following additional information (between <samples> and trailing CR).

<units> <corrupt> <checksum> <name> <max_in_range> <serial_number>

where:

<units> is units logged (J, W, V, A, K, etc.)

<corrupt> is 1 if data may have been corrupted, else 0.

<checksum> is the hexadecimal checksum word of the logged samples.

<name> is a NULL terminated string containing the name of the second head used to log the dual channel data. For single channel logs, it will contain the string "NONE".

<max_in_range> is the maximum value that is still properly within range for the second head. Contains 0 in single channel log.

<serial_no_b> is the serial number for the second head in dual channel log. Contains 0 in single channel log.

<missing_pulse> 1 if log contains missing pulses information (for RPheads), otherwise 0.

\$LL Log Last

| | | | | |
|--|------------------|----------------|-------------|--|
| | LaserStar | Nova-II | Vega | |
|--|------------------|----------------|-------------|--|

Will send the last bundle of data in the same format as \$LS command.

\$LR Reset Log buffer pointer (Remote control)

| | | | | |
|-------------|------------------|----------------|-------------|--|
| Nova | LaserStar | Nova-II | Vega | |
|-------------|------------------|----------------|-------------|--|

Description: Sets the next data point to be read using \$LS to be the first one in the memory

Parameters: None.

Returns: Nothing.

Limitations: Meaningless unless logged data are stored.

See also \$LI, \$LS

\$LS Logged data send block (Request for data)

| | | | | |
|-------------|------------------|----------------|-------------|--|
| Nova | LaserStar | Nova-II | Vega | |
|-------------|------------------|----------------|-------------|--|

Description: Requests for a block of logged data points.

Parameters: None.

Returns: A string up to 60 characters.

Limitations: Meaningless unless logged data are stored.

See also \$LI, \$LR

Other Details:

Since all data stored in data logging mode are collected in the same measurement range, there is no need transmit the exponent associated with each data point for each point, so this is read once using \$LI. When blocks of data are read from the memory using this \$LS command, only the mantissa is sent across the interface. The string returned contains ten mantissas in ASCII (text, not binary) form separated by spaces. If a block contains more points than were recorded, those points will have a mantissa of -9999.

In the LaserStar, Nova-II, and Vega, each datum takes on the form "+8888 ". That is 1 character for sign, 4 characters exactly for mantissa, and 1 space. This will allow the PC software to do format checking to verify that no characters have been lost in transmission.

Furthermore, in dual-channel files, the 10 points can be seen as 5 couples where the first of every couple is a datum for channel A and the second is a datum for channel B.

\$MF Max Frequency (Remote control)

| | | | | |
|--|------------------|----------------|-------------|-------------------------------|
| | LaserStar | Nova-II | Vega | Pyroelectric, RP heads |
|--|------------------|----------------|-------------|-------------------------------|

Description: Get maximum frequency for present pulse width setting
 Parameters: None.
 Returns: ?NO HEAD CONNECTED if no head attached.
 Limitations: Not for Thermopile and Photodiode heads.

\$NE Next Energy (Request for data)

| | | | | |
|--|------------------|----------------|-------------|-------------------------|
| | LaserStar | Nova-II | Vega | Thermopile heads |
|--|------------------|----------------|-------------|-------------------------|

Description: Request to send next energy reading.
 Parameters: None.
 Returns: Returns next energy reading (when available) instead of previous energy reading.
 Limitations: **In GPIB, when reading is available and LaserStar discerns that it is not Talk Addressed, the LaserStar will assert SRQ.**

\$PL Pulse Length (Remote control)

| | | | | |
|--|------------------|----------------|-------------|---------------------------|
| | LaserStar | Nova-II | Vega | Pyroelectric heads |
|--|------------------|----------------|-------------|---------------------------|

Description: Query and set maximum pulse-length (in time) that head is configured to measure.
 Parameters: 0 for query (default if no parameter sent).
 1 Set to Short Pulse mode
 2 Set to Long Pulse mode
 Returns: String containing index of presently active pulse width setting as well as literal description of set of available pulse width settings.
 Limitations: From LaserStar version 1.97. Nova-II and Vega support this command in all versions.

\$RE REset instrument (Remote control)

| | | | | |
|-------------|------------------|----------------|-------------|--|
| Nova | LaserStar | Nova-II | Vega | |
|-------------|------------------|----------------|-------------|--|

Description: Has same action switching instrument off and on again.
 Parameters: None.
 Returns: Nothing.
 Limitations: None.

\$RN Range Now (Request for data)

| | | | | |
|-------------|------------------|----------------|-------------|------------------|
| Nova | LaserStar | Nova-II | Vega | All heads |
|-------------|------------------|----------------|-------------|------------------|

Description: Requests the measurement range that the instrument is now using.
 Parameters: None.
 Returns: A number in the range -2 to 6.
See also: \$WN

The number returned should be interpreted as follows:
 0: The highest power or energy measurement range for this head.
 1: The second to highest measurement range.
 2: etc: The next highest range.
 -1: Auto-ranging.
 -2: dBm autoranging for photodiodes.

\$SB Send Both readings (Request for data)

| | | | | |
|--|-------------------------|--|--|------------------|
| | LaserStar (Dual) | | | All heads |
|--|-------------------------|--|--|------------------|

Description: Requests dual-channel data currently detected.
 Parameters: None.
 Returns: Two readings as an ASCII string in scientific notation.
 Limitations: Dual-channel LaserStar only. Both heads should be plugged in and measure.

Other Details:
 Either one or both readings can be replaced with the “N” sign in the case when a LaserStar does not have new readings since the last \$SB command.

\$SE Send Energy

(Request for data)

| | | | | |
|--|------------------|----------------|-------------|-------------------------------------|
| | LaserStar | Nova-II | Vega | Thermopile, Pyroelectric |
|--|------------------|----------------|-------------|-------------------------------------|

Description: Requests single pulse energy currently measured.
Parameters: None.
Returns: Energy in Joules as an ASCII string in scientific notation.
Limitations: Must be measuring single shot energy.

Other Details:

Will return the energy of the last pulse whose measurement cycle is complete. Will return energy of one pulse more than once if request is repeated. Use with \$EF to ensure reading each pulse only once.

Errors reported

?HEAD NOT MEASURING ENERGY if head isn't measuring energy.

See also \$ER, \$EF, \$FE

\$SE Send Energy

(Request for data)

| | | | | |
|-------------|--|--|--|---------------------------|
| Nova | | | | Pyroelectric heads |
|-------------|--|--|--|---------------------------|

Description: Requests next energy pulse to be measured.
Parameters: Timeout in hundreds of milliseconds.
Returns: Energy in Joules as an ASCII string in scientific notation.
Limitations: Must be measuring power.

Other Details:

Timeout is an optional parameter. If left out, the Nova will wait until it has a new reading to report. If new energy reading is available, returns immediately. Otherwise will return the next energy reading measured.

Errors reported

?PARAM ERROR bad operand
?TIMEOUT: NO PULSE when the requested time period elapsed w/o pulse coming in.

See also \$FE

\$SE Send Energy

(Request for data)

| | | | | |
|-------------|--|--|--|-------------------------|
| Nova | | | | Thermopile heads |
|-------------|--|--|--|-------------------------|

Description: Requests single pulse energy of reading currently displayed.
Parameters: None.
Returns: Energy in Joules as an ASCII string in scientific notation.
Limitations: Must be measuring single shot energy.

Other Details:

Will return the energy of the last pulse whose measurement cycle is complete. Will return energy of one pulse more than once if request is repeated. Use with \$EF to ensure reading each pulse only once.

Errors reported:

?NOT IN MAIN ENERGY SCREEN if not measuring energy.

See also \$ER, \$EF, \$FE

\$SF Send Frequency

(Request for data)

| | | | | |
|-------------|------------------|----------------|-------------|-------------------------------|
| Nova | LaserStar | Nova-II | Vega | Pyroelectric, RP heads |
|-------------|------------------|----------------|-------------|-------------------------------|

Description: Requests the pulse frequency detected.
Parameters: None.
Returns: Frequency in Hertz as an ASCII string in scientific notation.
Limitations: NOVA: ROM versions 2.40 and higher.

See also \$SP, \$SE

\$SG Send average

(Request for data)

| | | | | |
|--|------------------|--|--|------------------|
| | LaserStar | | | All heads |
|--|------------------|--|--|------------------|

Description: Requests most recent average calculated by the instrument.
Parameters: None.
Returns: Power or Energy average as an ASCII string in scientific notation.
Limitations: Does not average Energy for Thermopile heads.
From LaserStar version 2.50.

Other Details:

Returns most recent Average Reading calculated by the instrument. Will return the same Average more than once if the request is repeated before a new Average has been prepared. Use with \$AF to ensure reading each Average only once.

Errors reported

?HEAD NOT MEASURING POWER if thermopile head is measuring energy

See also \$AF, \$AQ

\$SI Send units

(Request for data)

| | | | | |
|-------------|------------------|----------------|-------------|------------------|
| Nova | LaserStar | Nova-II | Vega | All heads |
|-------------|------------------|----------------|-------------|------------------|

Description: Requests units of measurement.
Parameters: None.
Returns: Responds with one character to describe what the head is measuring (Amps, Joules, Volts, Watts, Lux, Footcandles) Responds with X if head isn't measuring anything.
Limitations: None.

Note:

For photodiode heads in dBm mode, will return "d". Relate to this as if the response was "W".

Note:

For Photometer, will return "l" when measuring LUX and "c" when measuring Footcandles.

\$SK Simulate Key-press**(Remote control)**

| | | | | |
|-------------|------------------|----------------|-------------|--|
| Nova | LaserStar | Nova-II | Vega | |
|-------------|------------------|----------------|-------------|--|

Description: Has same action as pressing a softkey.
Parameters: One digit, 0-4 for LaserStar; 0-3 for NOVA; 0-8 for Nova-II and Vega).
Returns: Nothing.
Limitations: None.
Example: \$SK 2 (equivalent to pressing second key from left).
See also \$KL, \$FP, \$FE, \$FT, \$FS

\$SL Set Lock**(Remote control)**

| | | | | |
|-------------|--|--|--|--------------------------------|
| Nova | | | | Heads with lock feature |
|-------------|--|--|--|--------------------------------|

Description: Locks and unlocks calibration capability.
Parameters: One digit, 0 or 1.
Returns: LOCKED or UNLOCKED.
Limitations: For heads with EEROM locking feature only.
Operation: \$SL 0. Turns off EEROM locking. A head with the EEROM Locking feature can have its parameters changed permanently. Returns "*UNLOCKED" \$SL 1. Turns on EEROM locking. A head with the EEROM Locking can have none of its parameters changed permanently. Returns "*LOCKED".

\$SP Send Power**(Request for data)**

| | | | | |
|--|------------------|----------------|-------------|---------------------------|
| | LaserStar | Nova-II | Vega | Pyroelectric heads |
|--|------------------|----------------|-------------|---------------------------|

Description: Requests present power reading.
Parameters: None.
Returns: Power in Watts as an ASCII string in scientific notation.
Limitations: Must be measuring power.

Other Details:

Will return the last power measurement made. Will return power more than once if request is repeated. Use with \$EF to ensure reading each power measurement only once.

Errors reported:

?HEAD NOT MEASURING POWER if head isn't measuring energy.

See also \$EF, \$FP

\$SP Send Power (Request for data)

| | | | | |
|-------------|------------------|----------------|-------------|-------------------------------|
| Nova | LaserStar | Nova-II | Vega | Non-Pyroelectric heads |
|-------------|------------------|----------------|-------------|-------------------------------|

Description: Requests next power reading.
Parameters: None.
Returns: Power in watts as an ASCII string in scientific notation.
Limitations: Must be measuring power (for Photometer may be measuring Lux or Footcandles).

Other Details:
Will never return more than 15 results per second; if requests are sent rapidly enough, results will synchronize to exactly 15 times per second.

errors reported:
?HEAD NOT MEASURING POWER in LaserStar
?NOT IN MAIN POWER SCREEN in Nova

See also FP

\$SP Send Power (Request for data)

| | | | | |
|-------------|--|--|--|---------------------------|
| Nova | | | | Pyroelectric heads |
|-------------|--|--|--|---------------------------|

Description: Requests next power measurement.
Parameters: Timeout (in hundreds of milliseconds).
Returns: Power in watts as an ASCII string in scientific notation.
Limitations: Must be measuring power.

Other Details:
Timeout is an optional parameter. If left out, the Nova will wait until it has a new reading to report. If new power reading is available, returns immediately. Otherwise will return the next power reading measured.

Errors reported:
?PARAM ERROR bad operand.
?TIMEOUT: NO PULSE when the requested time period elapsed w/o pulse coming in.

See also FP\$

\$SX Send Max**(Request for data)**

| | | | | |
|--|------------------|----------------|-------------|------------------|
| | LaserStar | Nova-II | Vega | All heads |
|--|------------------|----------------|-------------|------------------|

Description: Requests for the maximum allowable reading on present scale.
Parameters: None.
Returns: Returns Max allowable reading for present range in scientific notation or AUTO if in autoranging.
Examples: *AUTO if head is in autoranging.
*3.000E-2 if head is in 30mW range.

\$TM Turbo Mode**(Remote Control)**

| | | | | |
|--|-----------------------------|--------------------------|-----------------------|---------------------------|
| | LaserStar (GPIB) | Nova-II (USB) | Vega (USB) | Pyroelectric heads |
|--|-----------------------------|--------------------------|-----------------------|---------------------------|

\$TM [0 - 65535] (Turbo Mode)

Description:

This is a GPIB (USB) specific command. It puts the LaserStar (Nova-II) into Turbo Mode calculations. Absolutely everything is closed down except pulse measurement and transmission of result on the GPIB (USB). The device screen shows "LaserStar is in Turbo Mode on Channel B". There is no analog output, battery check, response to backlight switch, or response to keypad. The optional parameter allows the user to inform the device of the expected frequency. If left out, the device will do Turbo Mode measurements without applying any corrections based on frequency.

Details:

The LaserStar (Nova-II or Vega) returns one of the following return codes:

| | |
|-----------------------------------------|---------------------------------------------------------|
| ? 'TM' IS A GPIB SPECIFIC COMMAND used. | if RS232 communications are being used. |
| ?NO HEAD CONNECTED | if no head is connected. |
| ?HEAD CAN'T WORK IN TURBO MODE | for photodiode and thermopile heads. |
| ?FREQUENCY TOO HIGH | if expected frequency is beyond the head's capability. |
| ?HEAD NOT IN SHORT PULSE MODE | for head presently configured to work with long pulses. |
| ?FAILED TO START TURBO MODE Mode. | if didn't succeed in setting up Turbo Mode. |
| *TURBO MODE STARTED | on successful configuration of Turbo Mode. |

After responding *TURBO MODE STARTED, the device configures itself to transmit pulses in compressed format (see \$CS command). However, it does not append a '*' at the beginning or a <LF> (linefeed) at the end. This way it is just pumping out a datastream.

Limitations:

Turbo Mode is exited upon receipt of a new message. The device turns off its datastream and puts itself back into normal functionality.

Serial Poll, Parallel Poll, and being unTalked temporarily suspend Turbo Mode.

SDC (Selective Device Clear), DCL (Device Clear), IFC (Interface Clear) turn off Turbo Mode.

\$VE VErision of ROM (Request for data)

| Nova | LaserStar | Nova-II | Vega | |
|------|-----------|---------|------|--|
|------|-----------|---------|------|--|

Description: Requests version number of ROM software.
Parameters: None.
Returns: String up to 10 characters; may contain non-numeric characters.
Limitations: None.

\$WD Wavelength add - Continuous (Remote control)

| | LaserStar | Nova-II | Vega | See limitations below |
|--|-----------|---------|------|-----------------------|
|--|-----------|---------|------|-----------------------|

Description: Add a wavelength to list of favorite wavelengths that the head is configured to work with.
Parameters: Index: Location in list of wavelengths in which to insert the wavelength selected (must be between an unused value between 1 and 6 as returned by the \$AW command).
 Wavelength: New favorite wavelength (must be between the lower and upper wavelength limits as returned by the \$AW command).
Returns: Nothing.
Example: \$WD 4 633 (set wavelength stored in index 4 to 633nm).
Limitations: Can only be used with heads that have continuous wavelength correction curves, i.e. photodiode heads and some pyroelectric and thermopile heads.
 See also: \$AW \$WE \$WI \$WL

\$WE Wavelength Erase - Continuous (Remote control)

| | | | | |
|--|------------------|----------------|-------------|------------------------------|
| | LaserStar | Nova-II | Vega | See limitations below |
|--|------------------|----------------|-------------|------------------------------|

Description: Delete from list of favorite wavelengths the wavelength at location <Index>. Index must be between 1 and 6 and not the presently active index.

Parameters: Index in list of wavelength to delete.

Returns: Nothing.

Example: \$WE 4 (erase wavelength at index 4).

Limitations: Can only be used with heads that have continuous wavelength correction curves, i.e. photodiode heads and some pyroelectric and thermopile heads.

See also: \$AW, \$WD, \$WI, \$WL

\$WI Wavelength Index (Remote control)

| | | | | |
|--|------------------|----------------|-------------|------------------|
| | LaserStar | Nova-II | Vega | All Heads |
|--|------------------|----------------|-------------|------------------|

Description: Configure head to work with wavelength at location <Index> in list of favorite wavelengths.

Parameters: Index of selected wavelength.

Returns: Nothing.

Example: \$WI 4 (set head to work with wavelength at index 4).

Limitations: None.

See also: \$AW, \$WD, \$WE, \$WL, \$WW

\$WL Set WaveLength - Continuous (Remote control)

| | | | | |
|-------------|------------------|----------------|-------------|------------------------------|
| Nova | LaserStar | Nova-II | Vega | See limitations below |
|-------------|------------------|----------------|-------------|------------------------------|

Description: Sets the wavelength setting. This is especially useful for automated spectral scans or with tunable lasers.

Parameters: Wavelength as an integer in nanometers.

Returns: Nothing.

Example: \$WL 633 (set wavelength to 633nm).

Limitations: Can only be used with heads that have continuous wavelength correction curves, i.e. photodiode heads and some pyroelectric and thermopile heads. Do not enter wavelengths outside the head measurement range.

See also: \$AW \$WD \$WE \$WI

\$WN Write raNge**(Remote Control)**

| | | | | |
|-------------|------------------|----------------|-------------|------------------|
| Nova | LaserStar | Nova-II | Vega | All heads |
|-------------|------------------|----------------|-------------|------------------|

Description: Configure head to measure in a specific range.
Parameters: A number in the range -2 to 6.
Returns: None.

The number returned should be interpreted as follows:

- 0 : The highest power or energy measurement range for this head.
- 1 : The second to highest measurement range.
- 2 : etc: The next highest range.
- 1: Auto-ranging.
- 2: dBm autoranging (for heads that support this capability).

See also: \$RN, \$AR

\$WW Set WaveLength – Discrete**(Remote control)**

| | | | | |
|-------------|------------------|----------------|-------------|------------------------------|
| Nova | LaserStar | Nova-II | Vega | See limitations below |
|-------------|------------------|----------------|-------------|------------------------------|

Description: Configure head to work with laser as defined in <wavelength-string> (must be a string as returned by the AW command).
Parameters: Laser legend as a string.
Returns: Nothing.
Example: \$WW YAG (set laser wavelength to YAG setting).

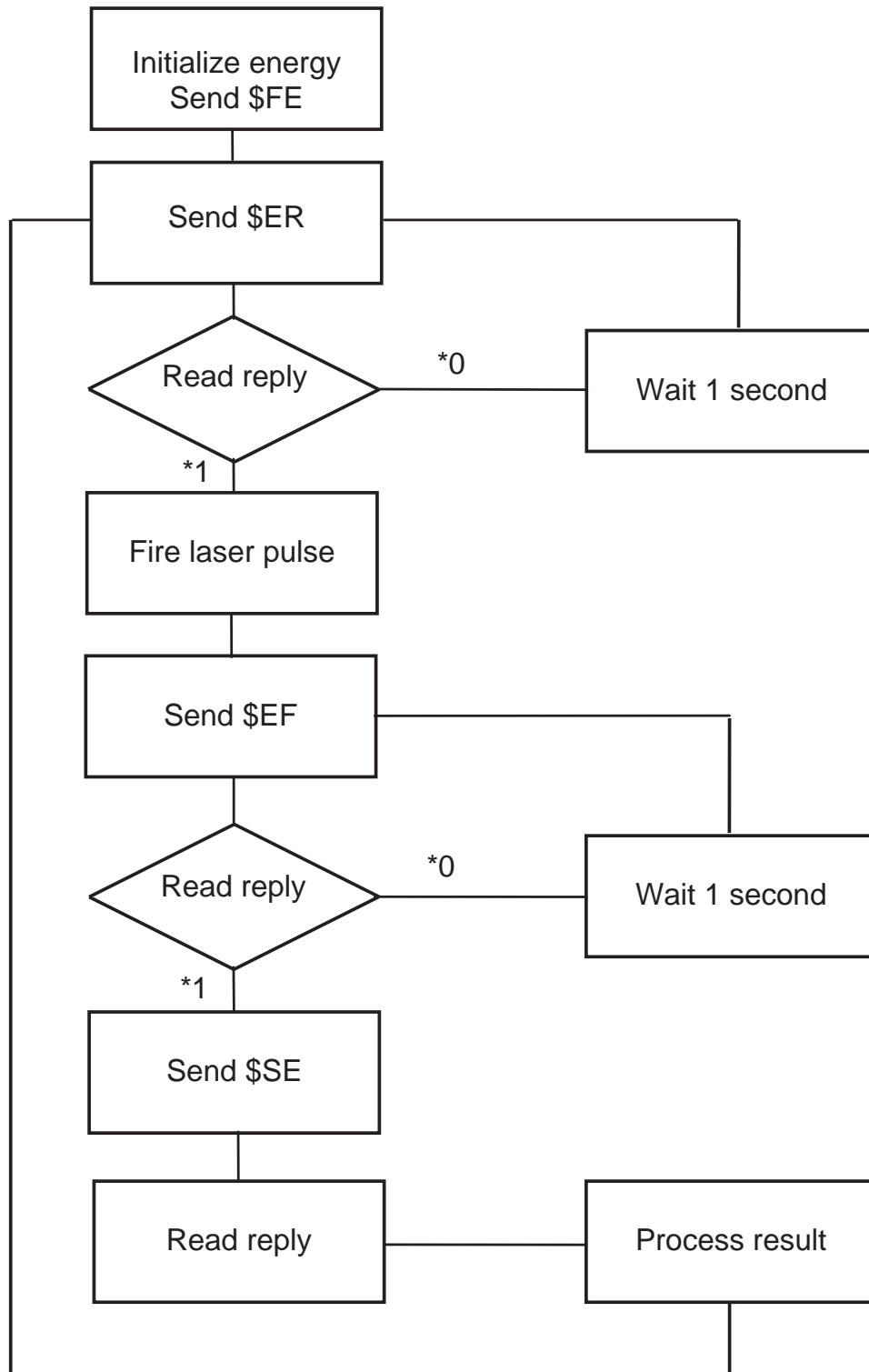
See also: \$AW

Limitations: Can only be used with heads that have discrete wavelength correction factors (thermopile, RP, and some pyroelectric heads).
Not available in NOVA with ROM versions prior to 2.40.

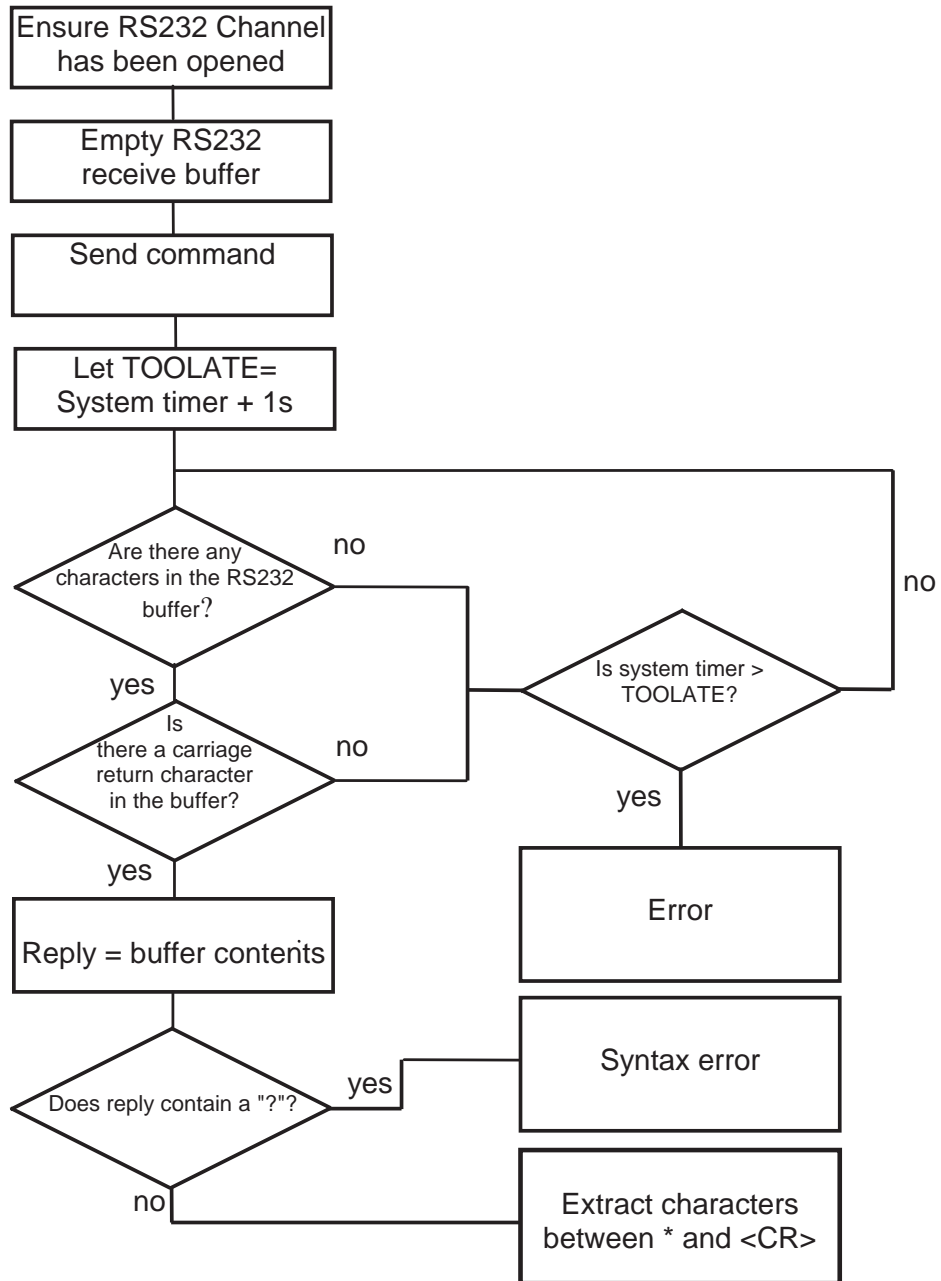
Other Details:

Leading and trailing spaces and letter case are ignored, thus "\$WW yag" has the same effect as "\$ww YAG".

A6 Flow Charts



Flow Chart 1
Measuring Several Energy Pulses



Flow Chart 2

Low Level Sending an RS232 instruction with time-out and error handling.