Operating the System Using the Serial Interface

Pinout/Wiring

The RS-232 serial port on the power supply accepts a standard 9-pin D-sub male/female extension cable for hookup. Only three of the pins are actually used:

Pin Numbers	Usage
2	transmit data (*Mai Tai* out)
3	receive data (*Mai Tai* in)
5	signal ground

Communications Parameters

Communications must be set to 8 data bits, no parity, one stop bit, using the XON/XOFF protocol (do not use the hardware RTS/CTS setting in your communications software). The baud rate is set to 9600 at power up.

Command/Query/Response Format

In the interest of standardization, the RS-232 commands and queries used on the *Mai Tai* system follow the SCPI protocol (Standardized Commands for Programmable Instruments). The following rules apply:

- All commands and responses are in ASCII format.
- Commands to the *Mai Tai* are terminated by an ASCII carriage return <CR>, line feed, or both.
- Responses from the *Mai Tai* are terminated by an ASCII line feed <LF>.
- All queries end with a question mark (?). If a query has no command associated with it, it is preceded with READ.
- The *Mai Tai* will not generate any signals on the RS-232 unless a query command is received first.
- Parameters are separated from commands by spaces.
- Commands have both a "short" and "long" form.

  Example:

  Long form: SHUTTER1
  Short form: SHUT1

  In this document, the short form portion of the command is written in capital letters and the balance of the long form is in lower case (e.g., SHUTter1).

- Several commands have variations or subcommands which are separated by colons (:). Short and long forms of the various commands and subcommands may be freely mixed. For example, all of the following are equivalent:

  READ:PLAS:DIOD1:CURR?
  READ:PLASER:DIODE1:CURRENT?
  READ:PLAS:DIODE1:CURR?

Commands and Queries

Typical Command Usage

1. Turn on the system, then wait approximately 45 seconds for the computers to initialize.

2. Wait approximately 30 minutes until the *Model J40/J80* diode laser warmup sequence has completed. Verify that warm-up is complete by issuing a series of READ:PCTWarmedup? queries until you receive a "100" response, indicating the system is 100% warmed up.

3. Turn on the laser by issuing the ON command. The unit will come up in Green Power mode to the factory target value for IR Power.

4. Open the shutter by issuing the SHUTter1 command.

Quick Reference

The following *Mai Tai* commands and queries list is provided as a reference guide and are described in the next section.

ON
OFF

WAVE?
BANDwidth [OEM ONLY]
WAVE xxx

CONTrol:PDITher
CONTrol:PDITher 2

ECHO0
ECHO1
ECHO2

MODE?
MODE:PCURrent
MODE:POWer
MODE:PPOWer

PLASer:AHIStory?
PLASer:ERRCode?
PLASer:HIStory?
PLASer:PCURrent?
PLASer:PCURrent
PLASer:POWer?
PLASer:POWer
PLASer:SHG?
POWer?

READ:AHIStory?
READ:MILLennia:SNUM?
READ:PCORrection?
READ:PCTWarmedup?
READ:PDITher?
READ:PLASer:DIODe(n):CURRent?
READ:PLASer:DIODe(n):HOURs?
READ:PLASer:DIODe(n):SNUM?
READ:PLASer:DIODe(n):TEMPerature?
READ:PLASer:PCURrent?
READ:PLASer:POWer?
READ:PLASer:SHGStatus?
READ:PLASer:SNUM?
READ:POINTing?
READ:POWer?
READ:PZTX(n)?
READ:PZTY(n)?
READ:QUADCELLX?
READ:QUADCELLY?
READ:QUADCELLSUM?
READ:SNUM?
READ:TEMPerature:BODY?
READ:TEMPerature:CONTrol?
READ:TEMPerature:RF?
READ:TEMPerature:TOWer?
READ:WAVelength?

SAVE

SHUTter (n)
SHUTter?

SYSTem:COMMunications:SERial:BAUD (nnnn)
SYSTem:ERRor?

TIMer:WATChdog (n)

*IDN?

*STB?

This section explains the commands and queries in detail. The form of the command is followed by the form of the associated query (if it exists), which is followed by an explanation of each.

⚠️ **Caution!** ✋ This is a partial list of the RS-232 command and query set for the *Mai Tai* system. The complete set was developed for features not applicable to the *Mai Tai Laser* system. Issuing one of these invalid commands or queries could have unpredictable and possibly damaging consequences for this system.

ON

Turns on the pump laser *if* the system has reached 100% warm-up, otherwise it is ignored.

Unless overridden by the MODE and/or PLASer:POWer commands, the laser will turn on in GRN Power mode at the pump power level set at the factory and operate at the last set Wavelength.

The shutter is not automatically opened when the ON command is issued.

Use the READ:PCTWarmedup? query to determine the progress of the warm-up cycle. When the response to that query reaches 100, the laser can be started. Do not issue the ON command while the response to READ:PCTWarmedup? is 1 through 99.

If the response to READ:PCTWarmedup? is...	The response to ON is...
0	to begin diode laser temperature stabilization. (approximately 2 minutes)
1 to 99	an execution error. (The EXE_ERR bit in the status byte is set.)
100	the diode lasers turn on, and the system output ramps to the most recently set power/current.

OFF

Turns off the pump diode lasers, but SHG crystal oven temperature is maintained to reduce warm-up time. The shutter is not automatically closed.

WAVE?

Returns the last wavelength commanded as "xxx.xnm."

BANDwidth [OEM ONLY]

Sets the system to Bandwidth mode if the system is in Wavelength mode, otherwise it is ignored.

WAVe xxx.x

Sets the wavelength in 10 nm increments.

CONTrol:PDITher—Enable (1) or disable (0) the "dither for power."

This loop dithers mirror P_2 (see Chapter 3 for a description of this function) and can be turned off during a measurement. The loop will move the lasers in an "auto-seek" pattern if the pump laser power is >95% of the calibrated pump power and there is <130 mW of output from the *Mai Tai*.

Note: It is also possible to send CONTrol:PDITher 2<CR>, which enables the dither loop but disables the "auto-seek" feature. Disabling the auto-seek is useful to factory technicians.

ECHO

> **ECHO 0**—returns a response to queries only, not to commands (*Mai Tai* default).

> **ECHO 1**—returns a "\n" (ASCII line feed character) after receiving a command. The response to queries remains unchanged.

> **ECHO 2**—returns the complete command or query, then (if appropriate) responds to a query.

MODE? Queries the Millennia operating mode.
MODE

Switches the system mode as follows. The query returns the status.

> **LIFESAVER [OEM ONLY]**—moves the pump beam off its normal operating locationin the Ti:sapphire rod to reduce time-related degradation. When the mode is changed back using MODE POW<CR>, normal beam position is restored within 20 seconds.

> **PCURrent**—maintains constant "percentage current" in the pump laser.

> **PPOWer**—maintains constant "green output power" of the pump laser.

> **POWer [OEM ONLY]**—maintains constant IR output power (*Mai Tai* default) .POW mode operates the *Millennia* in green power mode and adjusts the pump power into the ultrafast laser side of the *Mai Tai*.

> Proper syntax for this command is MODE POW<CR> (without a colon). This is because POW, PPOW, and PCUR are parameters of the mode command, rather than complete commands.

PLASer (commands and queries related to the *Millennia* Pump Laser)

> **:AHIStory?**—returns the contents of the history buffer in the form of a 16 decimal integer separated by a space. The history buffer contains the most recent status codes listed first. This query only returns codes that are generated by the *Model J40/J80* power supply. (To read the status codes from the *Mai Tai* laser head, use READ:AHIS?.) The list of status and error codes is given in Appendix A.

> **:ERRCode?**—returns the pump laser error code.
> See Table 5-1,": Query Errors for PLAS:ERRC" on page 5-34 and Table 5-2, ": Error Return List for PLAS:ERRC" on page 5-34.

:POWer
:POWer?

Sets the pump laser output power. This is useful only when the mode is set to MODE:PPOWer. The query returns the most recent pump laser output power setting, in Watts. To see actual output power, use the query READ**:**PLASer:POWer?.

:PCURrent
:PCURrent?

Sets the pump laser percentage of available current. This is only useful when the mode is set to MODE:PCURrent.

The query returns the most recent pump laser current percentage setting. To see actual diode current, use the query READ**:**PLA-Ser:PCURrent?

:SHG
:SHG?

This command only addresses the "fine" SHG control setting, which is measured in "counts" with a range of ±127 counts.

The query returns the most recent SHG fine setting as a "count."

POWer [OEM version]—controls *Mai Tai* output power in POW mode.

READ

:AHIStory?—returns the contents of the history buffer in the form of a 16 decimal integer separated by a space. The history buffer lists the most recent status codes first. This query only returns codes that are generated by the *Mai Tai* laser head. To read status codes from the *Model J40/J80* power supply, use PLAS**:**AHIS?. Appendix A lists the status and error codes.

:MILLennia:SNUM?—returns the *Millennia* pump laser serial number.

:PCORrection? [OEM version ONLY]—reads the *Millennia* %Green Correction output as a percentage of total headroom power (i.e., amount of room left before reaching the *Millennia* upper power limit). The total headroom power is set at 900 mW. The lower the %Green Correction value, the more of this headroom remains. For example, a %Green Correction value of 30% means that 70% x 900 mW = 630 mW of headroom remains available.

:PCTWarmedup?—returns the percentage of warm-up time elapsed.

:PLASer—returns information about the *Millennia* pump laser.

:POWer?—returns actual *Millennia* output power

:PCURrent?—returns actual diode current

:SHGStatus?—heating, cooling and stability

:SNUM—serial number of the *Model J80* power supply

:DIODe(n) n: (where n = 1,2)

:CURRent?—returns the present diode current setting

:HOURs?—returns the number of hours on the diode

:SNUM?—returns the serial number of diode laser module (n)

:TEMPerature?—returns the diode temperature

:POINting?—returns the status of the POINTING Servo loop. The values returned are servos active (1) or inactive(0). The logic is:

451 = M3 switch = off: servo always inactive
452 = M3 switch = on: if output power < 130 mW, servo is inactive
453 = M3 switch = on: if output power > 150 mW, servo is active
(Note that these commands are not the same as those used for the enable/disable function, which are controlled by the CONTrol commands).

:PDITher?—returns the status of the DITHERING servo loop. The values returned are servos active (1) or inactive(0). The logic is:

441 = P2 switch = off: servo always inactive
442 = P2 switch = Autoseek: if output power < ~130 mW, servo is inactive
443 = P2 switch = Autoseek: if output power > ~ 150 mW, servo is active

(Note that these commands are not the same as those used for the enable/disable function, which are controlled by the CONTrol commands).

:POWer?—*Mai Tai* output power, in Watts

:PZTX(n)? (n = 1 for P_2, n = 2 for M_3)—returns the percentage (0 to 100%) of full-scale voltage sent to the relevant PZT x-axis.

:PZTY(n)? (n = 1 for P_2, n = 2 for M_3)—returns the percentage (0 to 100%) of full-scale voltage sent to the relevant PZT y-axis.

:QUADCELLX? or QUADCELLY?—returns the x-axis or y-axis position of the output beam in the POINTING loop (0 to 100%).

:QUADCELLSUM?—returns the total power measured on the output quad cell, in ADC counts.

:SNUM?—returns the serial number of the *Mai Tai*.

:TEMPerature—returns the temperature of the following components:

:BODY?—inside the *Mai Tai* laser head, at the *Millennia* laser

:CONTrol?—the Control pc board in the *Mai Tai* head

:RF?—the RF pc board in the *Mai Tai* laser head

:TOWer?—temperature of the cooling water in the pump laser

:WAV?—returns actual wavelength.

SAVE

Saves the *Mai Tai* status. Use this before turning off the AC power in order to return to the present mode the next time the unit is turned on.

SHUTter (n)

SHUTter 1 opens the shutter.
SHUTter 0 closes the shutter.

SHUTter?

Reads and returns the shutter status.

Note: It is normal for SHUTter? to return a "0" approximately 1 second after issuing the SHUTter 1 command or a "1" after issuing the SHUTter 0 command.

SYSTem

:COMMunicate:SERial:BAUD

Sets the baud rate to 300, 600, 1200, 4800, 19200, 38400, or 57600 baud. The system always powers up at 9600 baud.

Note: the XON/XOFF protocol is used regardless of baud rate. Hardware handshaking is not used.

TIMer

:WATChdog—sets the number of seconds before issuing the "diode lasers off" command once RS-232 communications have stopped. This is a useful safety feature in the event the computer controller fails. A value of zero (the default) disables this feature.

:STANdby—sets the number of minutes the diode lasers are off before entering "power down standby" (or sleep) mode.

*IDN?

Returns a system identification string that contains 4 fields separated by commas, as follows:

Spectra-Physics,MaiTai,xxxxx/yyyyyy/zzzzz,0454-8270T/6.00/0456-9100A. [Current revision]

- the laser was made by Spectra-Physics
- the model name (*Mai Tai*)
- the *Mai Tai, Millennia* and *Model J40/J80* serial numbers
- the software revision beginning with Mai Tai In Product software 0454-8270 revision / Reserved for Eprom version for T40 power supply / and power supply software 0456-9100 revision.

*STB?

Returns the product status byte:

bit	description
0	1 = emission
	0 = no emission possible
	(this indication is the same as the light on the front of the laser)
1	1 = *Mai Tai* is pulsing (modelocked)
	0 = *Mai Tai* is not pulsing (modelocked)
2–7	reserved

Table 5-1: Query Errors for PLAS:ERRC

Binary Digit	Decimal Value	Name	Error Code	Interpretation
0	1	CMD_ERR	CE	Command error. Something was wrong with the command format, the command was not understood
1	2	EXE_ERR	EE	Execution Error A command was properly formatted, but could not be executed. For example, a power command of P:0<CR> was sent, when the minimum allowed power is 0.2 Watts.
2	4	(reserved)		
3	8	(reserved)		
4	16	(reserved)		
5	32	SYS_ERR	SE	Any "system" error (an open interlock, or an internal diagnostic).
6	64	LASER_ON	LO	Indicates that laser emission is possible.
7	128	ANY_ERR	AE	Any of the error bits are set.

Table 5-2: Error Return List for PLAS:ERRC

Binary DigitS	Decimal Value	Errors Returned
0100 0000	64	LO
1000 0001	129	CE + AE
1000 0010	130	EE + AE
1000 0011	131	CE + EE + AE
1010 0000	160	SE + AE
1010 0001	161	CE + SE + AE
1010 0010	162	EE + SE + AE
1010 0011	163	CE + SE + EE + AE
1100 0001	193	CE + LO + AE
1100 0010	194	EE + LO + AE
1100 0011	195	CE + EE + LO + AE
1110 0000	224	SE + LO + AE
1110 0001	225	CE + SE + LO + AE
1110 0010	226	EE + SE + LO + AE
1110 0011	227	CE + EE + SE + LO + AE