Operator's Manual
SDG Elite
Synchronization and Delay Generator

COHERENT®
5100 Patrick Henry Drive
Santa Clara, CA.95054

Patents referenced in this manual are active when the manual is printed (see last page for the date). You are advised to check to see if the patents are still active **http://portal.uspto.gov/external/portal/pair**.

Every effort has been made to ensure that the data given in this document is accurate. The information, figures, tables, specifications, part numbers, and schematics contained herein are subject to change without notice. Coherent makes no warranty or representation, either expressed or implied, with respect to this document. In no event will Coherent be liable for any direct, indirect, special, incidental, or consequential damages resulting from any defects in its documentation.

Technical Support

In the U.S.:

Should you experience any difficulties with your laser or need any technical information, please visit our Web site **www.Coherent.com**. Should you need further assistance, please contact Coherent Technical Support via e-mail **Product.Support@Coherent.com** or telephone, 1-800-367-7890 (1-408-764-4557 outside the U.S.). Please be ready to provide model and laser head serial number of your laser system as well as the description of the problem and any corrective steps attempted to the support engineer responding to your request.

Telephone coverage is available Monday through Friday (except U.S. holidays and company shutdowns). Inquiries received outside normal office hours will be documented by our automatic answering system and will be promptly returned the next business day.

Outside the U.S.:

If you are located outside the U.S., please visit **www.Coherent.com** for technical assistance, or phone our local Service Representative. Service Representative phone numbers and addresses can be found on the Coherent web site.

Coherent provides telephone and web-based technical assistance as a service to its customers and assumes no liability thereby for any injury or damage that may occur contemporaneous with such services. Under no circumstances do these support services affect the terms of any warranty agreement between Coherent and the buyer. Operation of any Coherent laser with any of its interlocks defeated is always at the operator's own risk.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Signal Words and Symbols in this Manual

This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

Signal Words

Four signal words are used in this documentation: **DANGER**, **WARNING**, **CAUTION** and ***NOTICE***.

The signal words **DANGER**, **WARNING** and **CAUTION** designate the degree or level of hazard when there is the risk of injury:

DANGER!
Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING!
Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION!
Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

The signal word "***NOTICE***" is used when there is the risk of property damage:

NOTICE!
Indicates information considered important, but not hazard-related.

Messages relating to hazards that could result in both personal injury and property damage are considered safety messages and not property damage messages.

Symbols

The signal words **DANGER**, **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.

This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.

This symbol is intended to alert the operator to the presence of dangerous voltages within the product enclosure that may be of sufficient magnitude to constitute a risk of electric shock.

This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.

This symbol is intended to alert the operator to the danger of crushing injury.

This symbol is intended to alert the operator to the danger of a lifting hazard.

Preface

This document contains user information for the SDG Elite controller.

NOTICE!
Read this Operator's Manual carefully before operating the system for the first time. Special attention should be given to the material in Section One: Laser Safety.

WARNING!
Use of controls or adjustments or performance of procedures other than those specified in this Operator's Manual may result in hazardous radiation exposure.

WARNING!
Use of the system in a manner other than that described herein may impair the protection provided by the system.

U.S. Export Control Laws Compliance

It is the policy of Coherent to comply strictly with U.S. export control laws.

Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification should be obtained from Coherent or an appropriate U.S. Government agency.

SECTION ONE: SAFETY

WARNING!
The use of controls or adjustments or performance of procedures different from those specified in this manual can cause dangerous radiation exposure.

This safety section must be completely reviewed before SDG Elite operation. The Coherent SDG Elite is not a laser and is not a laser hazard. But, the SDG is for amplification of short laser pulses. The SDG therefore shows a laser exposure hazard. The user must know all aspects of laser safety. Read the safety section of all laser manuals supplied with the laser system.

Electrical Safety

WARNING!
Normal operation of the SDG Elite does not require access to the internal circuits. The cover removed will causes exposure to the user with possible lethal electrical hazards.

Recommended Precautions and Guidelines

The following precautions must be observed:

1. Disconnect main-power lines before working on any electrical equipment.
2. Do not short or ground the power supply output. Protection against possible hazards requires correct connection of the ground terminal on the power cable and a sufficient external ground. Check these connections at installation and at future intervals.
3. Never work on electrical equipment unless there is another qualified person near. This person must know the operation and hazards of the equipment and can assist.
4. Keep one hand away from the equipment to reduce the danger of electrical current flow through the body.

5. Always use approved, tools with insulation.
6. Special measurement procedures are required for this system. A technician must understand system operation and must select ground references for related electronics.

Sources of Additional Information

The following are some sources for additional information on laser safety standards and safety equipment and training.

Laser Safety Standards

Safe Use of Lasers (Z136.1)
American National Standards
Institute (ANSI)
1430 Broadway
New York, NY 10018
Tel: (212) 354-3300

Occupational Safety and Health Administration (OSHA)
U.S. Department of Labor
200 Constitution Avenue N.W.
Washington, DC 20210

A Guide for Control of Laser Hazards
American Conference of Governmental
and Industrial Hygienists (ACGIH)
6500 Glenway Avenue, Bldg. D-7
Cincinnati, OH 45211
Tel: (513) 661-7881

Laser Safety Guide
Laser Institute of America
12424 Research Parkway, Suite 130
Orlando, FL 32826
Tel: (407) 380-1553

Equipment and Training

Laser Focus Buyer's Guide
Laser Focus World
One Technology Park Drive
P.O. Box 989
Westford, MA 01886-9938
Tel: (508) 692-0700

Photonics Spectra Buyer's Guide
Photonics Spectra
Berkshire Common
Pittsfield, MA 01202-4949
Tel: (413) 499-0514

Lasers and Optronics Buyer's Guide
Lasers and Optronics
301 Gibraltar Dr.
P.O. Box 650
Morris Plains, NJ 07950-0650
Tel: (210) 292-5100

SECTION TWO: GENERAL DESCRIPTION

Overview

The Coherent SDG Elite™ gives digital control of the timing signals and high voltages required to operate a regenerative amplifier laser system. Primary features are shown below:

- Eight (8) trigger outputs, each with adjustable delays
- Two (2) adjustable high-voltage outputs
- Internal or external trigger input
- Continuous, Divided, Gated, or Single-Shot operation
- External safety interlock circuit
- Programmable memory slots to save and recall system configurations
- System control by front panel or remotely by the computer (RS-232 or USB connection and optional LabView interface)
- Rack-mountable controller (19-inch standard rack size)

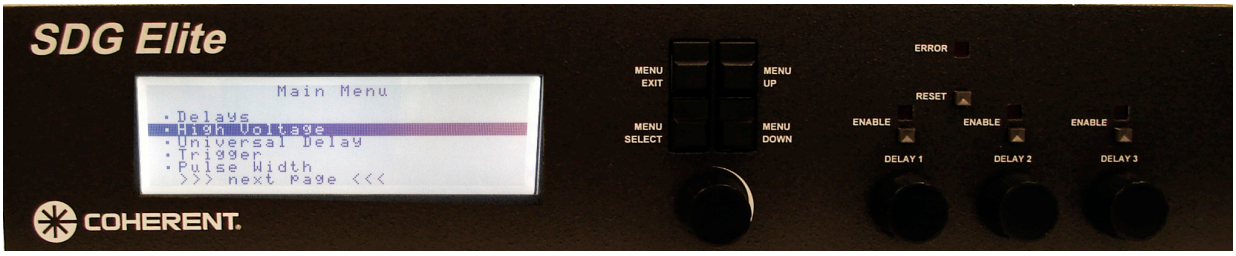

Figure 2-1. SDG Elite (Synchronization and Delay Generator)

Regenerative amplification depends on the precise control of the modelocked seed source, amplifier pump source and amplifier Pockels cells that control pulse injection and ejection. The SDG Elite accepts input from the seed laser and pump laser, and provides a trigger signal for each Pockels cell with an adjustable delay. Additional delay signals are supplied for synchronization with diagnostic equipment and other directions of a user test.

All delays can operate at the pump laser frequency or at an integral divisor. The system also includes a Gate input that is adjustable to each channel.

Refer to the amplifier Operator's Manual for more information about the Chirped Pulse Amplification scheme.

Dimensions

Refer to Figure 2-2 for the dimensions. The SDG Elite is mountable in a standard 19-inch rack.

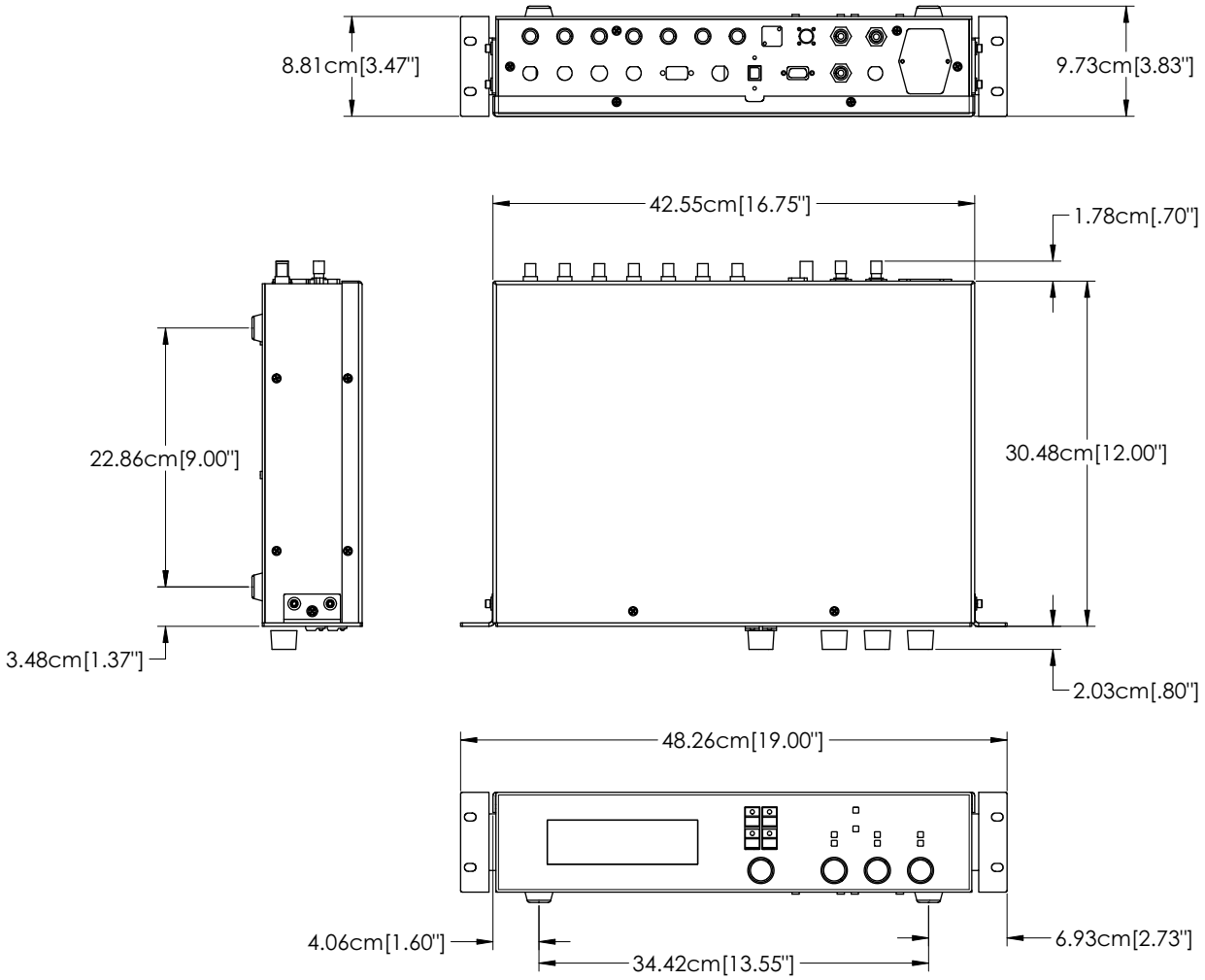

Figure 2-2. Dimensions

Specifications

Specifications for all Coherent products can be found at www.Coherent.com.

SECTION THREE: CONTROLS, INDICATORS, AND FEATURES

Inputs, Outputs, and Features

Figures 3-1 and 3-2, and Tables 3-1 and 3-2 identify and describe SDG Elite features.

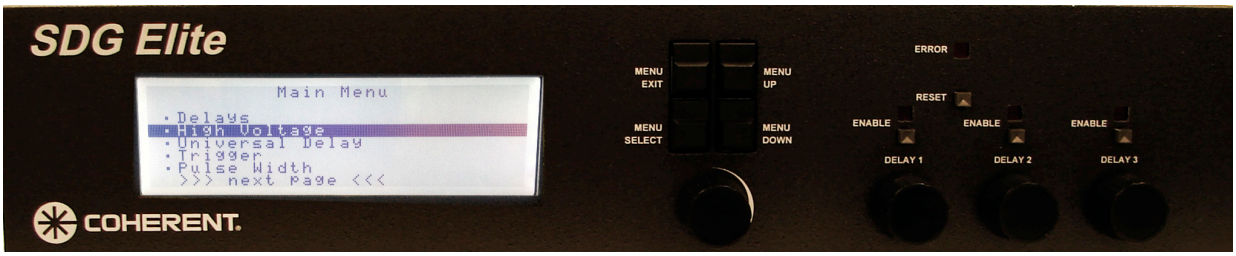

Figure 3-1. SDG Elite Front Panel

Table 3-1. SDG Elite Front Panel

FEATURE	DESCRIPTION
MENU EXIT MENU SELECT, MENU UP MENU DOWN pushbuttons	These keys provide navigation through the software menus. From the System Status screen, press MENU SELECT to access the Main Menu. From the Main Menu, use MENU UP and MENU DOWN to highlight the submenus, and press MENU SELECT to access a highlighted submenu. From a submenu, press MENU EXIT to return to the Main Menu. From the Main Menu, press MENU EXIT to return to the System Status screen. Note: The display will automatically return to the System Status screen if no controls are adjusted for one minute.
Main control knob	This knob provides adjustment of many parameters in the software. Note that most changes take effect immediately, i.e., the adjustments are made in real time as the knob is turned. Refer to Table 3-3 on page 3-6 for the available delay increments.
ERROR LED	This LED indicates an error in the system. Refer to Table 4-3 on page 4-3 for a list of possible errors. Solid ON: active fault Blinking: fault has been cleared but RESET button must be pushed to resume operation.
RESET pushbutton	This button resets a fault condition. Pushing the RESET button will silence the audible alarm, whether the fault has been cleared or not (the system will start beeping again if a new fault occurs). The RESET button must be pressed following a power cycle, or whenever the Bandwidth Interlock circuit is tripped or defeated.
ENABLE pushbuttons and LEDs	These three pushbuttons toggle the Delay 1, Delay 2, and Delay 3 outputs on and off. When a Delay is enabled, the LED lights red.
DELAY 1 DELAY 2 DELAY 3 control knobs	These knobs adjust the values of Delays 1, 2, and 3. This is equivalent to setting Delays 1, 2, and 3 in the Delays menu. Refer to Table 3-3 on page 3-6 for the available delay increments.

Figure 3-2. SDG Elite Rear Panel

Table 3-2. SDG Elite Rear Panel

FEATURE	DESCRIPTION
Power Switch and Plug	Provide main power to the unit
DELAY 1 through 8	The 8 individually adjustable Delay outputs, characterized below: 1-5 µs pulse duration (selectable from the PULSEWIDTH menu) 3.3 V into high impedance, 1.65 V into 50 Ω Positive or negative amplitude (leading edge rising or falling), as selected in the software
H.V. 1 and H.V. 2	High-Voltage outputs to drive the Pockels cells. Voltage level is adjustable in the software. Two additional outputs (H.V. 3 and 4) are included with some units, see Appendix A: High-Repetition Rate Systems.
RS-232 Serial Port	Provides a connection for RS-232 control. See Section Four: Computer Control for more information.
USB Port	Provides a USB interface. See Section Four: Computer Control for more information.
BWD Connector	Accepts the signals from the bandwidth interlock photodiodes. This circuit may be enabled or disabled in the software, although Coherent strongly recommends that this circuit be enabled. All Delay outputs selected in the Interlock submenu are disabled if this circuit is open (and enabled). Signal levels may be monitored in the software.
RF OUT	Provides a buffered monitor for the RF IN signal.
INTLK	Provides a connection for a user-supplied interlock circuit. This circuit may be enabled or disabled in the software. All Delay outputs selected in the Interlock submenu are disabled if this circuit is open (and enabled).
GATE IN*	Accepts a Gate input, which may be applied individually to each channel in the software. Channels may be set active HIGH or active LOW. See "Trigger" on page 3-8 for more information.
TRIG IN*	This connector accepts the pump laser trigger signal. The Delay outputs are set relative to this signal (when the system is set to External trigger).
RF IN*	This connector accepts the RF source which serves as the system master clock. Typically this signal is from a photodiode which monitors the seed laser pulse train. Signal must be 0 to 100 MHz, >100 mV into 50 Ω.
*The SDG Elite includes jumpers to set the impedance of the GATE IN (jumper J12), TRIG IN (jumper J11), and RF IN (jumper J1) inputs. When the jumper is in place the impedance is 50 Ω, when removed the impedance is high. Factory default is 50 Ω for TRIG IN and RF IN, high for GATE IN.	

Changing the Delay Increment

Several increments are available when changing the Delays. See Table 3-3.

Table 3-3. Variable Delay Increments

ACTION	DELAY INCREMENT (ns PER "CLICK")
Turn Main Control knob	0.25
Turn Main Control knob while pushing in Main Control knob	10
Turn Main Control knob while pushing in Main Control knob and Delay 1 knob	100
Turn Main Control knob while pushing in Main Control knob and Delay 2 knob	1000
Turn Main Control knob while pushing in Main Control knob and Delay 3 knob	10,000
Turn DELAY 1, DELAY 2, or DELAY 3 knob	0.25
Turn DELAY 1, DELAY 2, or DELAY 3 knob while pushing in DELAY 1, DELAY 2, or DELAY 3 knob	10

Software Menu Structure

After the software has initialized, the System Status screen is displayed. The System Status screen is also displayed if there is no adjustment longer than one minute.

Press MENU DOWN to highlight "Main Menu," and then press MENU SELECT to open the SDG Elite menu structure. From the Main Menu press MENU EXIT to return to the System Status screen.

The menu structure is described in detail below. Use the MENU UP and MENU DOWN keys to navigate within a menu. Press MENU SELECT to access a given submenu, and MENU EXIT to return to the top level.

Delays

Delays 1 through 8 can be individually controlled. All changes take effect immediately.

- Delay range 0 to approximately 818000 ns (~0.8 ms) in 0.25-ns increments (select with Main control knob). Note: This for an 80 MHz RF input. If the RF input is greater than 80 MHz, the range decrease.
- Push MENU SELECT to toggle through the following states:

  ON Rise (positive pulse, i.e. leading edge rising)

  OFF Rise

  ON Fall (negative pulse, i.e. leading edge falling)

  OFF Fall

High Voltage

This menu includes a monitor and control for outputs HV1 and HV2. All changes take effect immediately.

- Voltage ranges 0 up to 4 kV. If the monitor shows 5 mA and a voltage much less than the set point voltage, a "HV ERROR" may occur. This can happen if the HSD is damaged and drawing excessive current.
- **See Appendix A: High-Repetition Rate Systems for systems with more than 2 high-voltage outputs.**

Universal Delay

All 8 delays are displayed in this menu. Turning the Main control knob introduces an offset to all 8 delays, effective immediately.Refer to Table 3-3 to see how to change the delay in large steps.

Trigger

The Trigger menu includes some settings as shown below. Use MENU UP and MENU DOWN to highlight a parameter, and press MENU SELECT to toggle between the available values. All changes take effect immediately.

Trigger Internal / External

When External trigger is displayed, the SDG Elite uses the TRIG IN input as the starting point (delay = 0) for the Delay outputs. This is the typical mode of operation, with the pump laser Trigger Out connected to TRIG IN on the SDG Elite.

When Internal trigger is displayed, the SDG Elite ignores the TRIG IN input. In this case the software divides (i.e. counts down) the RF IN signal by the RF Divisor, which causes the internal trigger repetition rate. The RF Divisor can be set to any integer in the range 2 to 131072. For an 80 MHz RF source, this agrees to a frequency range of 40 MHz to 610 Hz. The RF Divider can be changed in large steps using the Delay 1-3 knobs (similar to the delay adjustment actions shown in Table 3-3).

Trigger Normal / Invert

When set to the NORMAL position, the system triggers on the rising edge of a HIGH signal at the TRIG IN input. Setting to Invert causes the system to trigger on the falling edge of a LOW signal.

Trigger Divide

The trigger frequency (internal or external, depending on the trigger mode) can be divided from 1 to 1023 for output on selected channels. Those channels not selected will continue to output at the undivided trigger frequency. Channel selection is made by toggling between "DIV" and "OFF" next to the channel number.

The Trigger Divisor activates the Delay outputs at an integral divisor of the TRIG IN input repetition rate.

For example:

Trigger frequency	1 kHz
Trigger Divide	10
SDG Elite output rep rate	100 Hz (selected channels) 1 kHz (channels not selected)

Use the control knob to set the Trigger Divide parameter.

Gated / No Gate

When Gated is displayed, all Delay outputs are subject to the GATE IN input. When No Gate is displayed, the system ignores the GATE IN input. Channels can be gated individually through the Gate Override menu.

Gated Normal / Invert

When Normal is displayed, the system produces output when the GATE IN signal is HIGH. When Invert is displayed, the system produces output when the GATE IN signal is LOW.

Continuous / Single Shot

When Continuous running is displayed, the SDG Elite causes Delayed outputs continuously.

When Single Shot Fire is displayed, the SDG Elite can output one pulse on the same channels selected for trigger frequency divide. Those channels not selected will fire continuously at the undivided trigger frequency. To produce one pulse, highlight "Fire" and press MENU SELECT or send the "man:trig" RS-232 command.

Pulse width

The pulse width for each channel can be set from 1.0 to 5.0 µs with 0.1 ms resolution.

Gate Override

Gated or Not Gated is individually selectable for each delay. When Gated is displayed, the delay output responds to the GATE IN signal on the rear panel. When Not Gated is displayed, the delay output ignores the GATE IN signal.

BWD

The Bandwidth interlock circuit monitors two photodiodes, which are typically located inside the stretcher compartment of the regenerative amplifier. A strong signal from each photodiode indicates that the seed laser spectrum has sufficient bandwidth to avoid damaging the amplifier. This menu displays the signal level of each photodiode.

If the signal level of either photodiode falls below threshold, the Bandwidth Interlock circuit will trip. This disables all outputs selected in the Interlock submenu and lights the ERROR LED on the front panel. After correction, the system must be reset (by pushing the RESET button or sending the reset command) to re-enable output.

Press MENU SELECT to toggle between 2Channel and Disabled. When Disabled is displayed, the system ignores the bandwidth interlock circuit. Coherent does not recommend operation in this state.

RF

The SDG Elite includes an amplifier for the RF IN input signal. The gain of this circuit may be set from -8 to 15 dB. Press MENU SELECT to toggle Invert ON and Invert OFF.

The RF frequency is displayed, and "Input Clipping" is displayed when the internal circuitry is attenuating the input signal (when gain is negative).

Interlock

The system also provides an external interlock circuit through the INTLK connector on the rear panel. Press MENU SELECT to toggle through Ignore, Normal, or Invert.

When Ignore is displayed, the system ignores the external interlock circuit.

When Normal is displayed, the system operates only when the interlock circuit is closed.

When Invert is displayed, the system operates only when the interlock circuit is open.

The user can select one or more channels to continue to output pulses during a BWD or other fault by toggling between Use and Ignore next to the channel number.

Recall/Save Setup

Up to 255 system configurations can be saved.

To save a configuration:

1. Use the primary control knob to select an index, from 1 to 255.
2. Use the MENU UP and MENU DOWN keys to highlight Save.
3. Press MENU SELECT.

To recall a configuration:

1. Use the primary control knob to select an index, from 1 to 255.
2. Use the MENU UP and MENU DOWN keys to highlight Recall.

3. Press MENU SELECT.

NOITICE!
Recalling a different system configuration will immediately change all system parameters.

LCD/LED

This menu provides control over LED and display settings as listed below:

LCD Contrast	150 to 250
LCD Brightness	0 to 100
LED Brightness	1 to 16

SECTION FOUR: COMPUTER CONTROL

Remote Computer Interface

The SDG Elite may be externally controlled with a computer. The command syntax is to replicate the functions on the front panel. The system includes both RS-232 and USB connection.

LabView Interface

A LabView control program is sent with the system. Refer to the program control panel for additional information.

USB Connection

To connect by USB, drivers must be installed on the computer for the USB-to-serial adapter included in the system. All other use is not changed for USB and RS-232 connections.

RS-232 Connection

The RS-232 port accepts a standard 9-pin D-sub male/female extension cable for connection to a computer serial port. Only three pins are for communication as shown in Table 4-1.

Table 4-1. RS-232 Connector Wiring

PIN NUMBER	FUNCTION
2	SDG transmit data, computer receive data
3	SDG receive data, computer transmit data
5	Signal ground

RS-232 Communication Standards

The SDG Elite uses the following communication standards that is set in the communications program (for example Hyper Terminal) for remote control.

Table 4-2. RS-232 Communication Standards

SETTING	VALUE
Baud Rate	19200 bps
Data bits	8
Parity	None
Stop Bits	1
Flow Control	None

NOTICE!
Check the Baud Rate setting if there are communication issues at start-up.

Command/ Query/ Response Format

All RS-232 commands, queries and responses are in ASCII format. Each command or query must be stopped with a carriage return <CR>. Commands that have a numerical argument must be sent with all of the digits, preceded with zeros if necessary. Commands must be sent in all lowercase. All queries end with a question mark (?). Valid queries return data followed by a carriage return <CR>. Valid commands return the string "OK". Invalid commands or queries return the string "Bad".

Command Descriptions

Table 4-3 on page 4-3 provides a description of all commands.

Table 4-3. Command Reference List (Sheet 1 of 3)

COMMAND OR QUERY	DESCRIPTION
?	Returns the product name, version, serial number, and list of commands
man:trig	Manually triggers the SDG Elite when in single-shot mode
read:bwd?	Returns the state of the Bandwidth Interlock circuit 1 = Bandwidth Interlock error
read:cN?	Returns two integers for the enabled and inversion status of channel N. 1 < N < 8 0 = off or normal 1 = enabled or inverted
read:del:cN?	Returns the delay for channel N in nanoseconds (ns)
read:mode?	Returns the state of the trigger mode. 0 = Continuous 1 = Single Shot
read:rate?	Returns the trigger divisor and the RF divisor
read:sta:bwd?	Returns the state of the BWD photodiodes 0 = signal below threshold 1 = signal above threshold
reset	Resets the BWD interlock. There is a small delay (< 10 ms) before the reset occurs.
set:cN x	Enable (x=1) or disable (x=0) output on channel N
set:del:cN x	Sets the delay for channel N in nanoseconds $0 \le x < 817611.25$ in increments of 0.25
set:div:rf x	Sets the RF divisor $2 \le x < 131071$ in integer steps
set:div:tr x	Sets the trigger divisor $1 \le x < 127$ in integer steps
set:bwd:lv x	Sets the Bandwidth Interlock threshold level in %. The Main menu must be active to change the BW level. $0 \le x < 100$
set:bwd:md x	Enable (x=1) or disable (x=0) the Bandwidth Interlock circuit
set:mode x	Sets the trigger mode to continuous (x=0) or single-shot (x=1)

Table 4-3. Command Reference List (Sheet 2 of 3)

COMMAND OR QUERY	DESCRIPTION
set:ser:bd x	Changes the host port baud rate, effective immediately x = 1200, 2400, 4800, 9600, 19200 (default), or 38400
set:ser:hs x	Sets RS-232 handshaking x = 0 for no handshaking x = 1 for RTS / CTS handshaking
set:ser:nl x	Sets newlines to host x = 0 for none x = 1 to send newline
set:ser:pr x	Sets RS-232 prompt x = 0 for none x = 1 for ">"

Table 4-3. Command Reference List (Sheet 3 of 3)

COMMAND OR QUERY	DESCRIPTION
status?	Returns a comma-delimited string of numbers in the following order: On / Off status for each Delay channel (8 integers) Value for each Delay (8 floating point numbers) Trigger Divisor RF Divisor (countdown divisor) Error status (integer from 0 to 255, as defined by the 8 bits below) 0 Power error 1 Save / recall error 2 Bandwidth Interlock error 3 External Interlock error 4 HV error 5 RF error 6 No active faults but waiting for RESET 7 New error (alarm is beeping) HV1 voltage (V) HV1 current (mA) HV2 voltage (V) HV2 current (mA) BWD error status BWD photodiode levels (0 to 100) Current RF frequency Last captured RF frequency Current Trigger frequency Trigger source (0 = External, 1 = Internal) Run mode (0 = Continuous, 1 = Single Shot) Gating (0 = No Gate, 1 = Gated) BWD mode BWD signal level (0 to 100) Firmware version (8-bit hex number)

Typical Command Usage

The following list shows a simple control flow for the SDG Elite using RS-232 commands.

1. Turn on main power, and wait at least 5 seconds for the system to initialize.
2. Issue a “status?” command to determine the state of the SDG.
3. Set the required delay values with the “set:del:cN” commands.

4. If all interlocks are cleared, send a "reset" command to enable output.
5. Monitor the system at intervals with a "status?" command.

APPENDIX A: HIGH-REPETITION RATE SYSTEMS

Additional High Voltage Outputs

Some amplifier models may use more than two high-voltage sources. The SDG Elite can provide two additional outputs for a total of four.

Standard 10 kHz Configuration (2 SHV and 2 MHV Outputs)

In the standard 10 kHz configuration, each High-Speed Driver (HSD) accepts two voltage inputs from the SDG Elite, as indicated in Table A-1.

Table A-1. Standard 10 kHz High Voltage Connections

COMPONENT	VOLTAGE OUTPUT (SDG ELITE REAR PANEL)
HSD1	
MHV connection	HV1
SHV connection	HV3
HSD2	
MHV connection	HV2
SHV connection	HV4

Custom Configurations (four MHV Outputs)

When all four voltage outputs are MHV, outputs HV1 and HV2 are adjusted in the software, as shown in “High Voltage” on page 3-7.

***NOTICE*!**
High Voltage outputs HV3 and HV4 are to be serviced or adjusted by trained personnel only.

WARRANTY

Coherent, Inc. warrants to the original purchaser (the Buyer) only, that the laser system, that is the subject of this sale, (a) conforms to Coherent's published specifications and (b) is free from defects in materials and workmanship.

Laser systems are warranted to conform to Coherent's published specifications and to be free from defects in materials and workmanship for a period of twelve (12) months. This warranty covers travel expenses for the first ninety (90) days. For systems that include installation in the purchase price, this warranty begins at installation or thirty (30) days from shipment, whichever occurs first. For systems which do not include installation, this warranty begins at date of shipment.

Optical Products

Coherent optical products are unconditionally warranted to be free of defects in materials and workmanship. Discrepancies must be reported to Coherent within thirty (30) days of receipt, and returned to Coherent within ninety (90) days. Adjustment is limited to replacement, refund or repair at Coherent's option.

Conditions of Warranty

On-site warranty services are provided only at the installation point. If products eligible for on-site warranty and installation services are moved from the original installation point, the warranty will remain in effect only if the Buyer purchases additional inspection or installation services at the new site.

For warranty service requiring the return of any product to Coherent, the product must be returned to a service facility designated by Coherent. The Buyer is responsible for all shipping charges, taxes and duties covered under warranty service.

Parts replaced under warranty shall become the property of Coherent and must be returned to Coherent, Inc., Santa Clara, or to a facility designated by Coherent. The Buyer will be obligated to issue a purchase order for the value of the replaced parts and Coherent will issue credit when the parts are received.

Other Products

Other products not specifically listed above are warranted to (a) conform to Coherent's published specifications and (b) be free from defects in materials and workmanship. This warranty covers parts and labor and is for a period of twelve (12) months from the date of shipment.

Responsibilities of the Buyer

The Buyer must provide the appropriate utilities and operating environment outlined in the product literature and/or the Pre-installation manual. Damage to the laser system caused by failure of Buyer's utilities or the Buyer's failure to maintain an appropriate operating environment is solely the responsibility of the Buyer and is specifically excluded from any warranty, warranty extension, or service agreement.

The Buyer is responsible for prompt notification to Coherent of any claims made under warranty. In no event will Coherent be responsible for warranty claims later than seven (7) days after the expiration of the warranty.

Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from:

1. Components or accessories with separate warranties manufactured by companies other than Coherent.
2. Improper or inadequate maintenance by Buyer.
3. Buyer-supplied interfacing.
4. Operation outside the environmental specifications of the product.
5. Improper site preparation and maintenance.
6. Unauthorized modification or misuse.

Coherent assumes no responsibility for customer-supplied material.

The obligations of Coherent are limited to repairing or replacing, without charge, equipment which proves to be defective during the warranty period. Repaired or replaced parts are warranted for the duration of the original warranty period only. This warranty does not cover damage due to misuse, negligence or accidents, or damage due to installations, repairs or adjustments not specifically authorized by Coherent.

This warranty applies only to the original Buyer at the initial installation point in the country of purchase, unless otherwise specified in the sales contract. Warranty is transferable to another location or to another Buyer only by special agreement which will include additional inspection or installation at the new site.

THE WARRANTY SET FORTH ABOVE IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTY, WHETHER WRITTEN, ORAL OR IMPLIED, AND DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL LOSS. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

GLOSSARY

°C	Degrees centigrade or Celsius
°F	Degrees Fahrenheit
µ	Microns
µrad	Microradian(s)
µsec	Microsecond(s)
$1/e^2$	Beam diameter parameter
AC	Alternating current
AGC	Automatic gain control
Amp	Amperes
BPF	Band pass filter
BWD	Bandwidth
CDRH	Center for Devices and Radiological Health
cm	Centimeter(s)
CW	Continuous wave
DC	Direct current
EMC	Electromagnetic compliance
GHz	Gigahertz
Hz	Hertz
HV	High Voltage
IR	Infrared
Intlk	Interlock
kg	Kilogram(s)
kHz	Kilohertz
LCD	Liquid crystal display
LED	Light emitting diode
LVD	Low voltage directive
m	Meter(s)
mAmp	Milliampere(s)
MHz	Megahertz
MHV	Miniature high voltage (connector type)
mm	Millimeter(s)
mrad	Milliradian(s)
msec	Millisecond(s)
mV	Millivolt(s)
mW	Milliwatt(s)
Nd:YAG	Neodymium doped yttrium aluminum garnet
nm	Nanometer(s)

OEM	Original equipment manufacturer
PZT	piezo-electric transducer
RF	Radio frequency
rms	Root mean square
Rx	Receive
SDG	Synchronization and delay generator
SHV	Safe high voltage (connector type)
TEM	Transverse electromagnetic (cross-sectional laser beam mode)
Tx	Transmit
VAC	Volts, alternating current
VDC	Volts, direct current
W	Watt(s)

INDEX

SDG Elite Operator's Manual

Part No. 1172968, Rev AC