Spectrum CE System
Operating Manual

Instructions for Use of Model Number CE1008

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All technical literature is available at: **www.promega.com/protocols/**

Visit the web site to verify that you are using the most current version of this Technical Manual.

E-mail Promega Technical Services if you have questions on use of this system: **genetic@promega.com**

Introduction 1

1.1   Instrument Description

The Spectrum CE System (Cat.# CE1008) is an automated 8-capillary electrophoresis instrument intended for separation and detection of fluorescently-labeled DNA fragments, including short tandem repeat (STR) markers. The Spectrum CE System is designed for use by laboratory professionals, including forensic laboratories. The CE instrument is compatible with existing five- and six-dye-labeled STR kits available from Promega and other commercial vendors. It is also compatible with the Promega 8-dye STR kits. The system supports automated analysis of up to four 96-well sample plates.
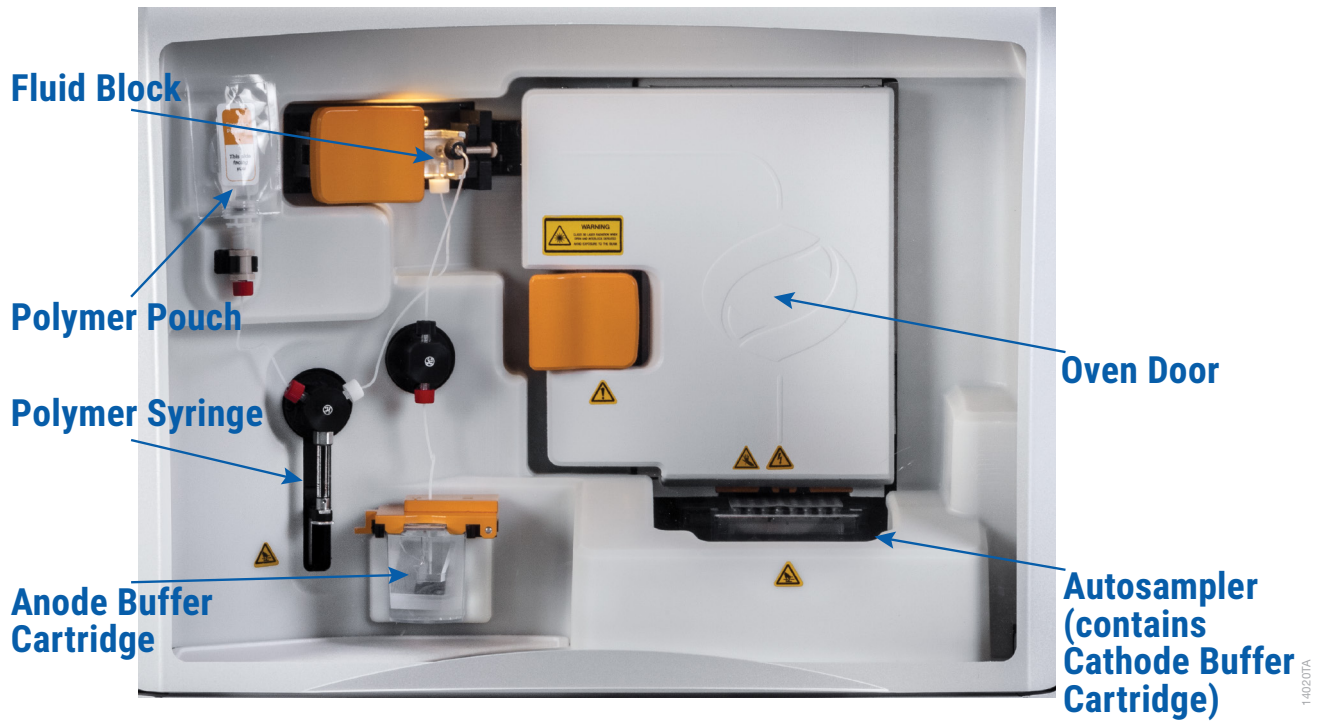
The system includes the capillary electrophoresis instrument, desktop computer, monitor and consumables. The instrument is controlled through a graphical user interface running on the system computer. The Spectrum Control Software (SCS) provides a simple user interface with a clear display of useful features including run setup, consumables usage information, and system maintenance reminders. The integrated RFID readers are used to capture RFID information on consumables for easy exchange and tracking of instrument consumables.

During a run, the system uses electrokinetic injection at the cathode end of each capillary to simultaneously inject nucleic acids from eight wells of a 96-well sample plate. Samples are then separated in the polymer-filled capillary array using electrophoresis. Sample detection is performed near the anode end of the capillary using laser-excitation of the sample and subsequent light capture by an integrated camera system. The system automatically replenishes polymer and injects and runs the next set of eight samples.

The system offers the ability to monitor run progress and view results while data collection is in progress. GeneMarker®HID Software for Spectrum CE Systems and HIDAuto for Spectrum CE Systems are installed on the system computer to assess data quality within SCS at the completion of each injection. Exported data files from five- and six-dye-labeled STR kits are compatible with commercially available data analysis software such as GeneMarker®HID Software for Spectrum CE Systems (GMHID-Spectrum) and GeneMapper® *ID*-X. Exported data files for the Promega eight-dye STR kits are only compatible with GMHID-Spectrum.

Power Button

Upper Door

Plate Drawer

The front of the Spectrum CE System has a power button, upper door, and plate drawer. A master power switch for the instrument is located in the back.

Fluid Block

Polymer Pouch

Polymer Syringe

Anode Buffer Cartridge

Oven Door

Autosampler (contains Cathode Buffer Cartridge)

The interior of the system provides access to key components. Instructions for maintaining these components are provided in Section 6, Performing Maintenance.

Component	Function
Oven	Maintains temperature around the capillary array during electrophoresis.
Capillary Array	Eight capillaries (36cm) that enable electrophoretic separation of fluorescently labeled DNA fragments.
Detection Window	Area where fluorescence is detected.
Anode Buffer Cartridge (ABC)	Contains running buffer for electrophoresis.
Cathode Buffer Cartridge (CBC)	Contains running buffer, wash and waste.
Polymer Pouch	Contains Spectrum Polymer4, which is pumped into the capillary array for separation of fragments.
Autosampler	Houses the Cathode Buffer Cartridge and adjusts its position during run cycles for proper injection and washes. Houses the sample plate during sample injection. **Note:** The sample plate is in a holding position away from the autosampler during electrophoresis and wash steps.
Plate Drawer	Houses sample plates. Allows the removal of previously run plates and addition of new sample plates for continuous operation of the instrument.
Wash Solution Pouch	Contains wash solution used to wash the polymer pump during a troubleshooting protocol and to take the place of the polymer pouch when the instrument is offline.
Fluid Block	Holds the anode end of the array.
Polymer Syringe	Pumps fluids (polymer or wash solution) through the fluidic system.
Radio Frequency Identification (RFID) Tags	RFID tags are attached to the following key consumables: • Anode Buffer Cartridge • Capillary Array • Cathode Buffer Cartridge • Polymer Pouch • Wash Solution Pouch The following information is tracked through these RFID tags: • Part Number • Lot Number • Initial Installation Date (date consumable was installed on the instrument) • Expiration Date • Injections (number of injections performed using the installed consumable) • Installation Count (number of times reagent has been installed on an instrument)

1.2   Common Safety Precautions

- Follow all precautions labeled on the instrument and described in this manual.

- Do not use this instrument for anything other than its designed purpose.

- Do not perform any operations and maintenance other than those described in this manual.

- Only perform the maintenance activities described in the manual. Contact Technical Service for further maintenance and repair.

- Preventive Maintenance, provided by Promega service, is strongly recommended to ensure the safety and performance of the instrument. Contact Technical Service for further information.

- Never modify the instrument.

- Do not use any parts that are not specified by Promega.

- For safety and to protect the system, a Promega representative must perform unpacking, installing and moving of the Spectrum CE System. Performing any of these activities by noncertified individuals may invalidate the product warranty or service contract terms.

- Keep in mind that the hazard warnings in the manuals or on the product cannot cover every possible case, as it is impossible to predict and evaluate all circumstances beforehand. Always be alert and use common sense.

- The guidance provided in this manual is intended to supplement, not supersede, the normal safety requirements prevailing in the user's country.

- Loading nonessential software programs on the computer supplied with Spectrum CE System is not recommended. Promega cannot guarantee compatibility of the Spectrum Control Software with other third-party software programs. Additional programs may also cause the application to slow down.

- Do not use any software other than the Spectrum Control Software to control the Spectrum CE System.

1.3   Safety Symbols and Markings

	Safety Symbols and Markings
⚠️	Warning. Risk of personal injury to the operator or a safety hazard to the instrument or surrounding area.
⚡	Danger. Hazardous voltage. Risk of electric shock.
♨️	Warning. Hot surface. Burn hazard.
✋	Warning. Sharp objects inside.
☢️	This label indicates laser radiation is present.
✊	Warning! Pinch point. Moving parts below; keep hands clear.

SYMBOLS KEY

Symbols	Explanation	Symbols	Explanation
REF	Catalog Number	**LOT**	Lot Number
SN	Serial Number	🏭	Manufacturer
🏭	Date of Manufacture (Year-Month-Day)	🗑️	Consult your local Promega Representative regarding instrument disposal WEEE Directive (European Community Directive 2012/19/EU on Waste Electrical and Electronic Equipment)

Symbols	Explanation	Symbols	Explanation
$C \epsilon$	CE Compliance Mark	FC	FCC Compliance Mark
(triangle symbol)	Regulatory Compliance Mark		

1.4   Location of Instrument Safety Symbols on Oven Door

Danger! Hazardous voltage. Risk of electric shock.

Do not remove instrument panels. Do not touch internal parts or circuits while the instrument power is turned on. This may cause death or serious injury due to electric shock.

1.5 Spectrum CE System Specifications

These specifications apply to the Spectrum CE Instrument, excluding the computer and monitor.

Processing Time:	35–60 minutes per injection (depending on protocol and data analysis requirements)
Number of Samples:	Up to four 96-well plates. Semi-continuous access to idle plate positions.
Weight:	230lb (100kg) est.
Dimensions (W × D × H):	26.0 × 26.0 × 30.7 in (66 × 66 × 78 cm)
Power Requirements:	AC
	100–120/200–240V; 6/3A; 50/60Hz; Class I
Fuse:	250V, 6.3A, 5 × 20mm, fast blow
Excitation Source:	Laser module (150mW at 505nm)
Connections (rear panel):	• USB port (instrument-computer communication to computer)
	• USB port (instrument-camera communication to computer)
	• C14 power connector
	• On/Off switch (extended shut down)

Leave at least 12 inches (31 cm) of space at the back and both sides of the instrument. At the front of the instrument allow 18 inches of space to allow sufficient clearance to raise the instrument door and extend the drawer.

Important! Power connectors

The Spectrum CE System is delivered with a detachable power cord that meets the power requirements listed above. In areas where the supplied power is subject to voltage fluctuations exceeding ±10% of the nominal value, a power line regulator may be required. High or low voltages can adversely affect the electronic components of the instrument.

We recommend the use of an uninterruptible power source (UPS) for the Spectrum CE System. At a minimum, the instrument should be connected through a surge suppressor.

Important! Camera connector

The instrument-camera communication cord must be connected to the dedicated USB port at the base of the system computer.

Danger! Hazardous voltage. Risk of electric shock.

Use properly configured and approved line cords for the voltage supply in your facility as specified by Promega. Incorrect connection of the power cord could result in fire or electrical shock.

Place instrument in a location so that the power cord is accessible and can be easily connected and disconnected.

Warning! Sharp objects inside.

The electrode-end of the capillary array can lead to piercing injury. To avoid injury, do not touch the tip of the capillary cartridge.

Warning! Physical injury hazard.

Do not touch moving parts while operating the instrument. Disconnect power before performing maintenance on the instrument.
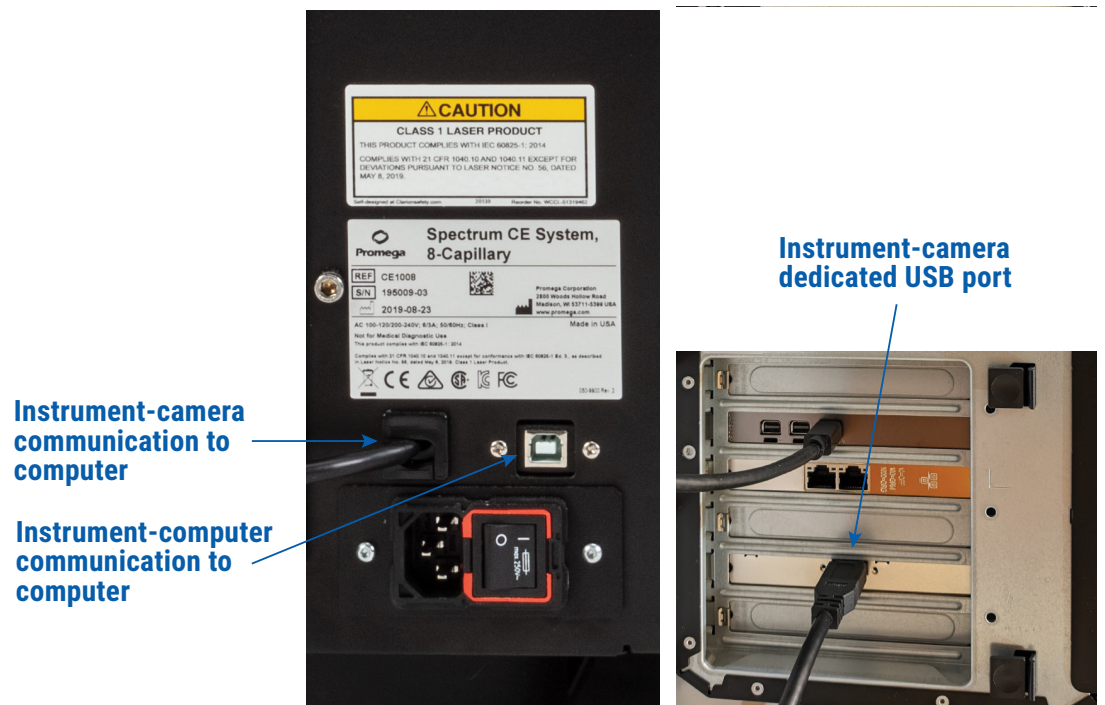
1.6   Product Components

PRODUCT	CAT.#
Spectrum CE System, 8-Capillary	CE1008

Includes:

- Spectrum CE System, 8-Capillary

- Spectrum Computer, Keyboard, Mouse, Power Cable

- Spectrum Monitor, Monitor Cable, Power Cable

- Accessories Kit (USB Cable, Power Cable)

- Spectrum Control Software

- GeneMarker®HID Software for Spectrum CE Systems, Instrument

- HIDAuto for Spectrum CE Systems

1.7   Reagents and Consumables

Reagent/Consumable		Part Number	Storage and Handling
Spectrum Buffer	Anode Buffer Cartridge	CE2001	Store at +2°C to +10°C. When stored at the recommended temperature, sealed buffer cartridges are stable until the expiration date printed on the label. Once the seal is removed, the buffer is stable for 14 days on the instrument or for the following number of injections: 240 injections on 8-capillary array (1,920 wells)
	Cathode Buffer Cartridge		
Spectrum Cathode Septa Mat		CE2002	Store at room temperature (+15°C to +30°C).
Spectrum Buffer and Cathode Septa Mat Bundle		CE2012	Consists of one Cat.# CE2001 and one Cat.# CE2002.
Spectrum Capillary Array, 8-Capillary		CE2008	Store at room temperature (+15°C to +30°C). Recommended 300 injections.
Spectrum Polymer4		CE2048 (384 wells)	Store at +2°C to +10°C. Each pouch contains sufficient polymer for the number of wells stated on the packaging (384 or 960), plus additional volume for performing a limited number of installations and maintenance-related wizards. See the table below for polymer usage by instrument process.
		CE2040 (960 wells)	
Spectrum Plate Base and Retainer, 96-Well		CE5004	Store at room temperature (+15°C to +30°C).
Septa Mat, 96-Well		CE2696	Store at room temperature (+15°C to +30°C).
Spectrum Wash Solution		CE2099	Store at +2°C to +10°C. One pouch of Spectrum Wash Solution contains sufficient volume for five uses. Ensure the storage cap is secured between uses and the pouch is returned to storage at +2°C to +10°C after each use. The pouch should be discarded after the fifth use.

⚠️ **Caution:** Use of expired reagents is not recommended. Application technical support is not available if expired reagents are used. Service coverage does not apply if instrument damage is caused by use of expired reagents.

Instrument Process	Number of Polymer Injections Used
Install All Wizard	62
Refill Capillary Array	1
Replace Capillary Array Wizard	8
Replace Polymer Wizard	15
Sample injection (8 wells)	1
Standard Bubble Purge	6
System Wash	60

Note: When the Instrument Process volume is not a multiple of one "Sample Injection (8 wells)", the number of counted injections is rounded up to the next higher number.

1.8   Laser Safety

The Spectrum CE System is a Class 1 laser product. The instrument has been tested and complies with standard IEC 60825-1 Second Edition (2007) and Third Edition (2014).

The Spectrum CE System uses a laser module categorized as a Class 3B laser beam.

The laser specifications are:

- Wavelength: 505nm
- Output power: 150mW

To ensure safe laser operation:

- Do not remove the instrument protective panels or safety labels.

- Do not disable safety interlocks.

- Never look directly into the laser beam.

- Remove reflective objects such as jewelry and wristwatches.

- Wear proper eye protection and post a laser warning sign at the entrance to the laboratory if panels are removed for service.

Warning! Laser hazard.

Use of controls or adjustments or performance of procedures other than those specified herein can result in hazardous radiation exposure.

Warning! This label indicates laser radiation is present.

Class 3B laser radiation when open and interlocks defeated. Avoid exposure to the beam.

1.9   Environmental Requirements

Power Requirements	AC 100–120/200–240V; 6/3A; 50/60Hz; Class I
Temperature During Transportation and Storage	4°C to 50°C
Temperature During Operation	15°C to 30°C with changes less than ±2°C/hour
Humidity During Transportation and Storage	≤80% RH
Humidity During Operation	20–70% RH noncondensing
Operating Altitude	<2,000m
Pollution Degree	2

The Spectrum CE System is intended for indoor use only. To avoid shortening the expected lifespan of the instrument, the Spectrum CE System must be installed in a location that meets the following criteria:

- Use a sturdy, level surface (no perceptible vibration).

- Avoid dusty areas.

- Choose a location that has good air circulation and is not exposed to direct sunlight.

- Use an uninterruptable power source (UPS) rated to support the power requirements above. Contact a Promega representative for a recommended UPS.

- Do not install in a location with large temperature variability or high humidity.

- Do not position the instrument so that it is difficult to unplug from the power source.

- Do not place next to heating or cooling sources.

- Do not use near flammable gases or liquids.

- Do not place near other electrically sensitive instruments.

- Do not use extension cords. Relocate the instrument, power receptacle and/or UPS to avoid using an extension cord.

1.10   Unpacking, Installing and Moving the Spectrum CE System

For safety and to protect the system, a Promega representative must unpack, install and move the Spectrum CE System. Performing any of these activities by noncertified individuals may invalidate the product warranty or service contract terms.

1.11   Special Instructions

The Spectrum CE System is designed to require minimal maintenance. If samples or reagents have been spilled, clean the instrument immediately to avoid damage. Always turn off and unplug the instrument before cleaning up spills.

- Wipe up spills immediately.

- Use caution when working with solvents, as they may damage the plastic case of the Spectrum CE System. Do not use bleach or abrasive cleaners.

- Never allow liquids to remain on the instrument surfaces for extended periods of time.

- Do not use a spray bottle to soak instrument surfaces with large volumes of liquid.

- Do not overfill plate wells, because this may lead to spills and/or instrument damage.

- Keep vents clear of dust.

- Clean the instrument surfaces with a lint-free wipe moistened with distilled water. Dry with a lint-free wipe.

- The Spectrum CE System contains sensitive optical components and precision-aligned mechanical assemblies. Handle with care. A Promega representative must move the Spectrum CE System.

- Do not expose the Spectrum CE System to temperatures outside the specified range (see Section 1.9), because damage to the unit may occur that will not be covered under warranty.

- Changes or modifications to the instrument not expressly approved by Promega could void the warranty.

- Do not use this Spectrum CE System for anything other than its intended use.

- Do not disassemble the Spectrum CE System other than as specified in this operating manual for routine instrument maintenance and use.

- If the equipment is used in a manner other than that specified by Promega, the protection provided by the equipment may be impaired.

- Restart the instrument and computer on a monthly basis (see Section 9.1).

- Not for Medical Diagnostic Use.

- Class 1 Laser Product.

1.12   Electromagnetic Compatibility (EMC) Safety

Spectrum CE System complies with the emission and immunity requirements prescribed by EMC standard IEC 61326-1:2012 (Group 1, class A, Basic environment).

If installed adjacent to other electrical and electronic equipment, they may adversely affect each other. Equipment operation and measurement results may be affected by noise from peripheral devices. Alternatively, noise from the device may affect the operation of peripheral devices and measurement results.

1.13   Chemical Safety

Caution! Chemical hazard

Formamide may be combustible at high temperature, and slightly flammable in presence of heat, sparks or open flames. Keep away from heat or sources of ignition. Refer to the Safety Data Sheet (SDS) provided by the manufacturer to handle the reagent.

Formamide is an irritant and a teratogen; avoid inhalation and contact with skin. Read the warning label, and take appropriate precautions when handling this substance. Always wear gloves and safety glasses when working with formamide.

Caution! Chemical hazard

Before handling any chemicals, refer to the Safety Data Sheet (SDS) provided by the manufacturer and observe all relevant precautions in handling each chemical.

Caution! Chemical hazard

All chemicals in the instrument, including liquid in the lines, are potentially hazardous. Always determine what chemicals have been used in the instrument before changing reagents or instrument components. Wear appropriate protective equipment (e.g., protective clothing, gloves) when working on the instrument.

1.14 Disposal of Waste Solution and/or Instrument

- To dispose of the instrument, follow the local environmental protection regulations.

- Do not dispose of this instrument as unsorted municipal waste. Follow local municipal waste ordinances for proper disposal provisions to reduce the environmental impact of waste electrical and electronic equipment (WEEE). For European Union customers, Contact Promega Service for equipment pick-up and recycling.

- To dispose of waste solutions, read and understand the Safety Data Sheets (SDSs) provided by the manufacturers of the chemicals in the waste container.

- Prior to instrument disposal, ensure that any important data has been archived.

- Contact your local Promega Representative for disposal of the instrument. Please follow your institutional and country-specific requirements to handle the disposal of accessories. Decontaminate the instrument prior to disposal by wiping all surfaces with a cloth dampened with 70% ethanol or with a detergent solution such as Steris LpH® following the manufacturer's instructions. Dispose of the cleaning materials used according to your institutional guidelines.

1.15 Thermal Safety

Warning! Hot surface. Burn hazard.

The inside surface of the oven can reach a temperature of 70°C. Ensure that the oven is off before replacing the capillary array.

Warning! Hot surface. Burn hazard.

The oven remains hot after the instrument stops.

1.16   Configuring the System Computer

The Spectrum CE System is controlled by Spectrum Control Software on a computer that is provided with the system. This section describes the setup and configuration options for the computer provided with the Spectrum CE System.

Your IT department or site Administrator should configure the computer according to the IT rules and IT procedures pertinent to your site. The following is a set of guidelines for your IT personnel or site Administrator.

We do not recommend loading additional programs onto the computer because these may interfere with the instrument operation.

Some institutions require antivirus software installed on computers within the institution. If installing an antivirus program please ensure it is set to manual, not automatic, update.

Antivirus scanning will slow the performance of the computer and may affect the performance of the Spectrum CE System while it is processing samples.

Additional recommendations:

- Disable automatic Windows® updates and virus scans.

- Disable Windows file system indexing.

- Disable automatic power off, sleep or hibernation settings.

- Disable "Fast Startup". Set the power button to Shut Down, not Sleep.

- Disable any other automatically or manually started software that would consume computer resources during operation.

- Ensure there are no domain policies that would overwrite any of the above settings.

Note: The computer that is provided with the Spectrum CE System is already configured for the settings listed above.

Depending on your institution's IT policy, you may or may not be able to configure or change the settings for the computer if it is connected to your site network domain.

Promega Corporation is not responsible for any loss or damage done to data or applications due to broken hardware.

Operating the System

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2.1　Turning on the Instrument and Computer

Follow These Steps

1. Confirm that the instrument is connected to an appropriate UPS and is on a protected circuit.

2. Verify that the Upper Door and the Plate Drawer are closed.

3. Verify the power switch on the back of the instrument is in the on position.

4. Turn on the instrument by pressing the power button on the front left side of the instrument.

5. Turn on the instrument computer and monitor.

6. Log on to the Windows® operating system.

7. Launch the Spectrum Control Software (SCS).

The instrument power button indicates five states:

State	Status
No light	Instrument is off.
Steady amber light	Power is on, but instrument is not connected to SCS.
Steady green light	Power is on and instrument is connected to SCS.
Blinking green light	Power is on and instrument is in use (calibration, electrophoresis, etc.)
Blinking amber light	An error has occured.

The plate drawer handle light indicates two states:

State	Status
Light on	Drawer is closed and unlocked.
Light off	Drawer is closed and locked.
Light is blinking	Drawer is open.

2.2   Navigating the Spectrum Software

Upon launching the Spectrum Control Software, the Home Menu will be displayed. The screen is divided into three sections: the header, Task Pane and Status Bar.

The header is fixed and remains available to the user throughout all navigation processes. This area contains the Workflow Menu, Run Time Indicator, Start Button, Message Center and Status Indicators. The header also shows the status of the plate positions within the Plate Drawer.
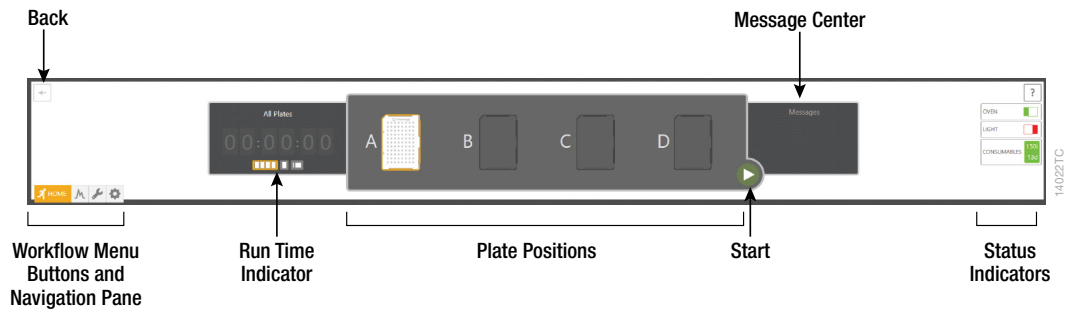
Each button in the Workflow Menu provides access to a list of workflow-specific functions. Workflow Buttons and the Navigation Pane are highlighted to indicate the user's current location within the Spectrum Control Software.
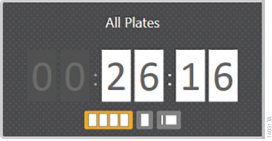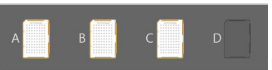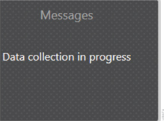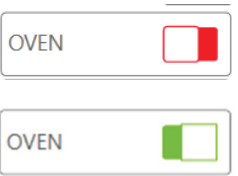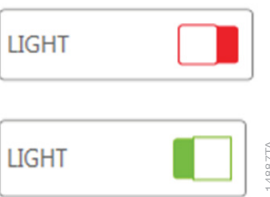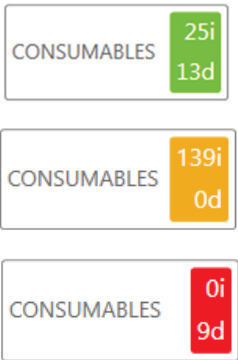
Icon	Button Name	Function
	Back	Navigates to the previous screen
	Start/stop	Starts or stops all currently scheduled plates (enabled when plates are linked for run and sufficient consumables are available)
	Help	Opens PDF of Spectrum CE System Operating Manual
	Home	Displays Home Menu
	Review Plates	Displays Review Plates Menu
	Maintenance	Displays Maintenance Menu
	Settings	Displays Settings Menu

In the example below, the **Maintenance** Button is highlighted, indicating the user is in the Maintenance Menu. The Navigation Pane below the workflow buttons indicates the user has navigated to the 'Consumables' page within the Maintenance Menu.
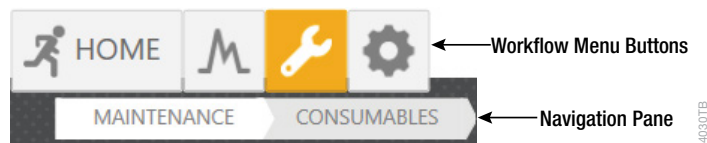
Sections 4–7 of this manual provide detailed descriptions of the contents and functions within the Home, Review, Maintenance and Settings Menus.

The Spectrum Control Software contains several indicators in the header. Each indicator provides information about a specific function or component.

Indicator	Type	Function
All Plates 0 0 2 6 1 6	Run Time Indicator	Shows the estimated remaining run time for all scheduled plates , currently running plate , or currently running injection .
A B C D	Plate Positions	Displays the four positions of the plate drawer (A–D) showing the presence or absence of a plate and its current status (e.g., draft, running, completed, aborted).
Messages Data collection in progress	Message Center	Displays messages indicating the state of the instrument and any warnings that require the user's attention.
OVEN OVEN	Oven Heater	On/off toggle controls oven state. Displays whether the oven heater is on or off. A message within the indicator will note when the oven is preheating. The oven will automatically turn off after 2 hours if a run is not started.
LIGHT LIGHT	Internal Task Light	On/off toggle controls internal task light.
CONSUMABLES 25i 13d CONSUMABLES 139i 0d CONSUMABLES 0i 9d	Consumables	Displays the status of consumables in injections (i) and days (d) remaining. This indicator also acts as a shortcut button to the Maintenance: Consumables screen (see page 65). Green Background: All consumables are up-to-date and in sufficient supply for the scheduled plates. Yellow Background: One or more consumables needs to be replaced or replenished. Red Background: The polymer pouch has reached its maximum injection count and must be replaced.

Indicator	Type	Function
STATUS WARNING	Status Warning	Displayed when and instrument status warning is detected. This indicator also acts as a button to open the Status errors window, which displays the logged error messages.
UNLOAD PLATE	Unload Plate	Displayed when a plate is in the upper portion of the instrument (i.e., on the autosampler or in the holding position) during a system disruption (e.g., run aborted, power failure, disconnection from control software). Selecting this indicator removes the plate from the upper portion of the instrument and returns it to its assigned position in the plate drawer.

The Task Pane displays the content windows of the selected workflow menu.

The Status Bar displays instrument conditions and information. In the default collapsed view, the Status Bar displays the oven temperature and the connection status of the instrument.

State	Status
Promega-146896	Software connected to named instrument.
Instrument Offline - Click to Connect	Software is not connected to a Spectrum instrument. If software does not automatically attempt to connect to the instrument, select **Click to Connect**.

You can select the ⌃ button on the left side of the bar to display the expanded view of the Status Bar.
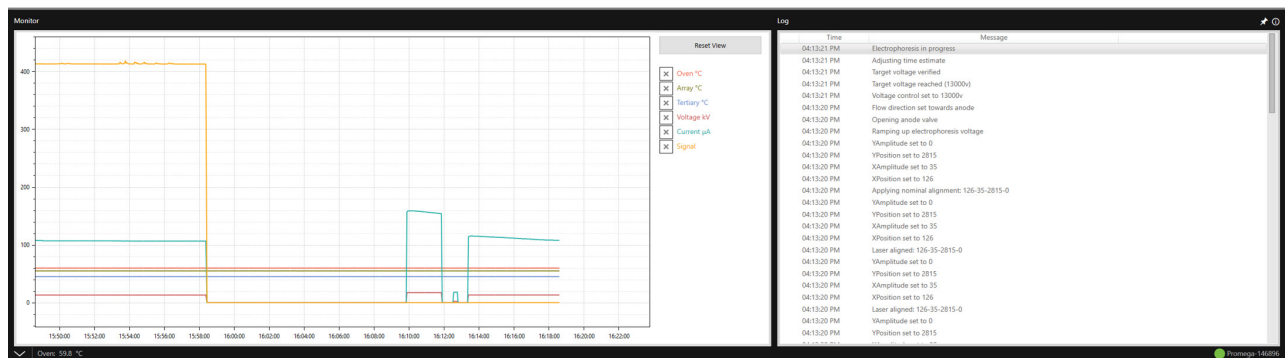
The Monitor side of the Status Bar displays plots for the following parameters in a single graph where the x axis corresponds to the time and the y axis corresponds to the units for each parameter:

Parameter	Description
Oven °C	Oven heater temperature in degrees Celsius
Array °C	Array heater temperature in degrees Celsius
Tertiary °C	Tertiary heater temperature in degrees Celsius
Voltage kV	Voltage applied in kilovolts
Current μA	Current applied through capillaries in microamperes
Signal	Camera signal level

The Log side of the Status Bar displays a list of system operations and error messages.

You can adjust the width of the Monitor and Log sections by hovering over the section divider until the double-ended horizontal arrow appears, then left-click and dragging the divider left or right to the desired position. You can adjust the height of the extended Status Bar by hovering over the divider between the Status Bar and the Task Pane until the double-ended vertical arrow appears, then left-clicking and dragging the divider up or down to the desired position. The Pin icon in the upper right corner of the Status Bar allows you to pin ⬈ or unpin ✖ the expanded Status Bar to the main program window. In the unpinned state, the extended Status Bar is displayed over the Task Pane. In the pinned state, the extended Status Bar is displayed as a separate section without obscuring the Task Pane.

You can use the extended Status Bar to monitor a run and review log messages (see Section 4.5).

To minimize the Status Bar, click the ⌄ button on the left side of the bar.

2.3   Checking Consumable Status

Before starting a run on the Spectrum CE System, ensure all consumables are installed and in sufficient supply. For the best quality results, use unexpired reagents that are within the recommended use range (see Section 1.7). Refer to the Consumables status indicator to determine if any consumables need to be replaced. To access the Consumables screen, select the Consumables status indicator in the header.

The Consumables screen displays information for the four RFID-tagged consumables on the instrument: the Polymer, Capillary Array, and Anode and Cathode Buffers.

POLYMER	**CAPILLARY ARRAY**	**ANODE BUFFER**	**CATHODE BUFFER**
164/164 Injections Remaining	288/300 Injections Remaining	228/240 Injections Remaining	228/240 Injections Remaining
11/14 Days Remaining		11/14 Days Remaining	11/14 Days Remaining

Status Bars

Part Number	CE204B		Part Number	CE200B		Part Number	CE200A		Part Number	CE200B
Lot Number	0000487193		Lot Number	0421-19		Lot Number	0000480162		Lot Number	0000480163
Initial Installation Date	2/27/2022		Initial Installation Date	2/27/2022		Initial Installation Date	2/27/2022		Initial Installation Date	2/27/2022
Expiration Date	7/21/2024		Expiration Date	7/21/2024		Expiration Date	7/21/2024		Expiration Date	7/21/2024
Injections	0		Injections	12		Injections	12		Injections	12
Installation Count	1		Installation Count	1		Installation Count	1		Installation Count	1

RFID Info

REPLACE...   REPLACE...   REPLACE...

Replace Wizards

14069TC

The following information is tracked through these tags:

- Part number
- Lot number
- Usage
- Dates (installation, expiration)
- Number of installations

For a more detailed description of the Consumables screen, refer to Section 6.1.

When a consumable needs to be replaced or replenished, click the **Replace** button below the appropriate consumable to launch the replacement wizard.

Note: The replacement of the anode and cathode buffers is combined in one wizard. We recommend replacing both cartridges at the same time.

For instructions on installing consumables after long-term shutdown of the instrument, refer to Section 8.2.

2.4   Preparing the Sample Plate

Samples prepared in a 96-well plate are assembled into the plate base and retainer, which is loaded into the plate drawer of the Spectrum CE System. Samples are injected in groups of eight such that one column of a 96-well plate comprises one injection.

Notes:

a.   Only use MicroAmp® Optical 96-Well Reaction Plates (0.2ml).

b.   Wear gloves when handling consumables and sample plate assembly. Prepare the sample plate for placement onto the instrument.

Follow These Steps

1.   Place a 96-well septa mat over the wells of the 96-well plate containing the samples + size standard in formamide. We recommend placing one allelic ladder every three injections.

Follow the instructions in the appropriate kit technical manual to prepare the sample loading cocktail. Ensure all eight wells of a column contain a minimum of 10µl of sample loading cocktail or formamide.

Notes:

a.   Be sure the samples are positioned at the bottom of each well and are free of bubbles. Briefly centrifuge the sample plate if needed.

b.   To prevent cross-contamination, do not reuse plate septa mats. Always use a new 96-well septa mat.

2. Place the 96-well plate into the Spectrum plate base, lining up the notch above well A12 with the notch on the base.

3. To complete the plate assembly, place the Spectrum plate retainer over the plate/base assembly, lining up the notch on the retainer with the notch on the plate and base. Verify that the retainer is locked in place on both sides of the plate, sitting evenly on top of the base.

Location to affix bar code
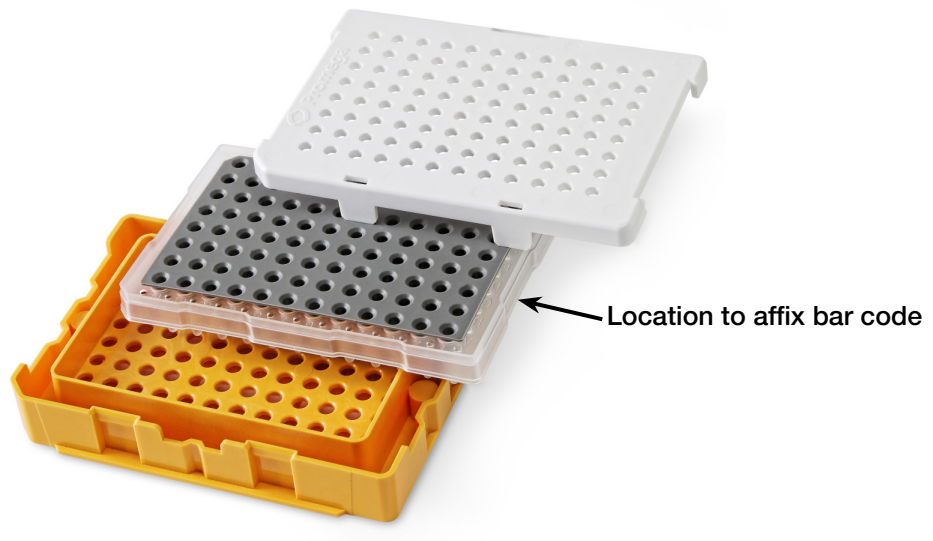
Note: If using bar coded plates intended for use with the auto plate import feature (Sections 4.4 and 7.3), ensure the bar code label is affixed to the center of the plate skirt along the side of column 1. If positioned correctly, the bar code is visible in the cutout of the plate base and retainer.

Calibration

3

A **spatial calibration** defines the position of each capillary on the camera image. A **spectral calibration** is required for each set of dyes that will be analyzed on the Spectrum CE System (e.g., spectral calibration of the PowerPlex® 6C Matrix Standard for analysis of the PowerPlex® Fusion 6C System). This calibration provides spectral deconvolution of individual dyes by the data collection software. Matrix standards are used to create spatial and spectral calibrations in a single calibration assay for each dye set. Fragments of the matrix standard are first used to create a spatial calibration of the array, then a spectral calibration of the dyes. You must perform a calibration after installing a capillary array. In addition, perform a calibration if the optics window has been opened, the instrument has been moved, or you observe poor spectral separation in the STR results. Criteria for passing spectral calibrations are set in the 'Calibration' tab of the Preferences submenu (see Section 7.3). The Spectrum Control Software contains pre-installed dye sets from which a calibration can be initiated.

3.1   Performing a Calibration

Follow These Steps

Before a calibration run is started, ensure all consumables are installed and in sufficient supply (see Section 2.3). For best quality results, use unexpired reagents that are within the recommended usage range (see Section 1.7). Toggle the Oven indicator in the header to the On position to preheat the oven to 60°C.

1. Follow the instructions in the appropriate Spectrum Calibration Manual to prepare the spectral calibration samples for Promega chemistries.

   Note: For spectral calibration of kits from other vendors, follow the manufacturer's instructions.

2. Add spectral calibration samples to wells A1–H1 of a 96-well plate.

3. Place a 96-well septa mat over the wells of the 96-well plate.

4. Place the 96-well plate into the Spectrum plate base, lining up the notch above well A12 with the notch on the base.

5. To complete the assembly, place the Spectrum plate retainer over the plate and base assembly, lining up the notch on the retainer with the notch on the plate and base. Verify that the retainer is locked in place.

6. Navigate to the Maintenance Menu and select **Calibration**. Select the desired manufacturer from the drop-down menu, then select the **Start** button next to the appropriate dye set to be calibrated. This will launch the Calibration wizard.

   Notes:

   a. If a run is in progress, the **Start** button is deactivated. A calibration run can only be started when all other runs are complete.

   b. No calibration date and time is displayed in the dye-set drop-down menu unless you have previously performed a calibration for that dye set. "(Uncalibrated)" is displayed after the dye set name.
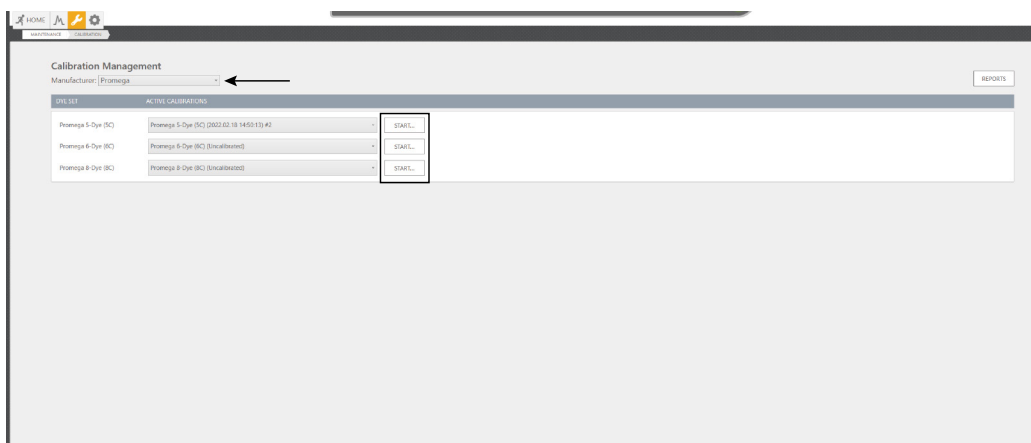
7. Check the Message Center to verify the drawer is not locked ("Drawer Locked" is not displayed in the Message Center.) Verify the drawer handle light is illuminated indicating the drawer is unlocked and ready for plate loading.

8. Open the plate drawer.

9. Follow the instructions in the Calibration wizard to load the plate in the drawer, then select the **Next** button to close the wizard and display the calibration run screen for the selected dye set.
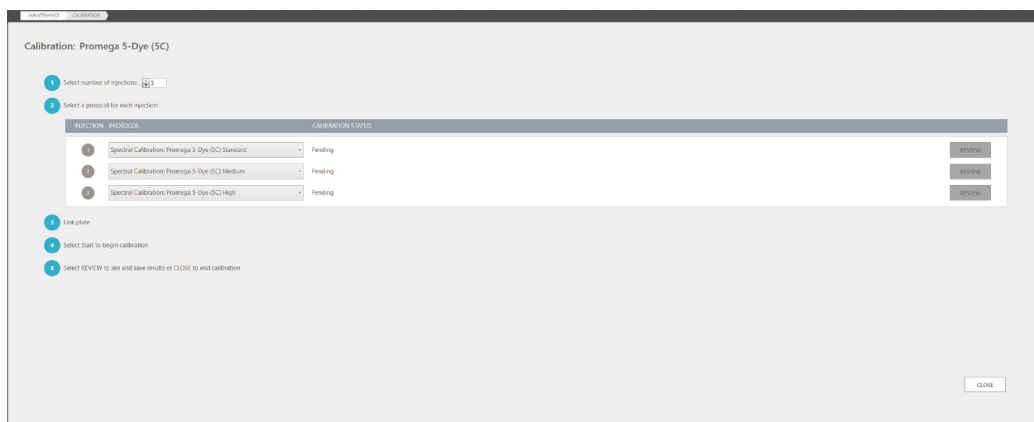
10. Select the number of injections to schedule for the calibration run. Up to three calibration injections can be run in succession.

11. Select a Spectral Calibration protocol defined in the Protocols submenu (see Section 7.1).

    Note: Preset Spectral Calibration Protocols for the selected dye set are assigned by default. You can use the drop-down menu to choose other available protocols for the dye set.

12. Link the calibration run to the plate position by selecting **LINK** under the plate icon in the Plate Position indicator.

13. Select the green **Start** button in the header to start the calibration run.

    During the calibration, the status of each injection is updated in the Calibration Status column. The Run Time indicator in the header shows the time remaining.

    Note: The calibration run can be aborted before it is completed. To abort the calibration run, select the **Stop** button in the header. Select **YES** in the 'Stop Execution' window to stop the calibration, then choose **OK** in the confirmation window. Data from any completed calibration injections are saved when the calibration run is aborted. Select **NO** in the 'Stop Execution' window to allow the calibration to continue.

When a calibration injection is completed, the software processes the spatial calibration data. If the spatial calibration passes, the spectral calibration data is processed. The Calibration Status column updates to reflect the calibration outcome. A chasing yellow line indicates a calibration in progress. A red line indicates a failed calibration. A green line indicates a passing calibration. If a calibration injection passes, any remaining injections are automatically canceled. If a calibration injection fails, the next scheduled injection begins, if applicable.
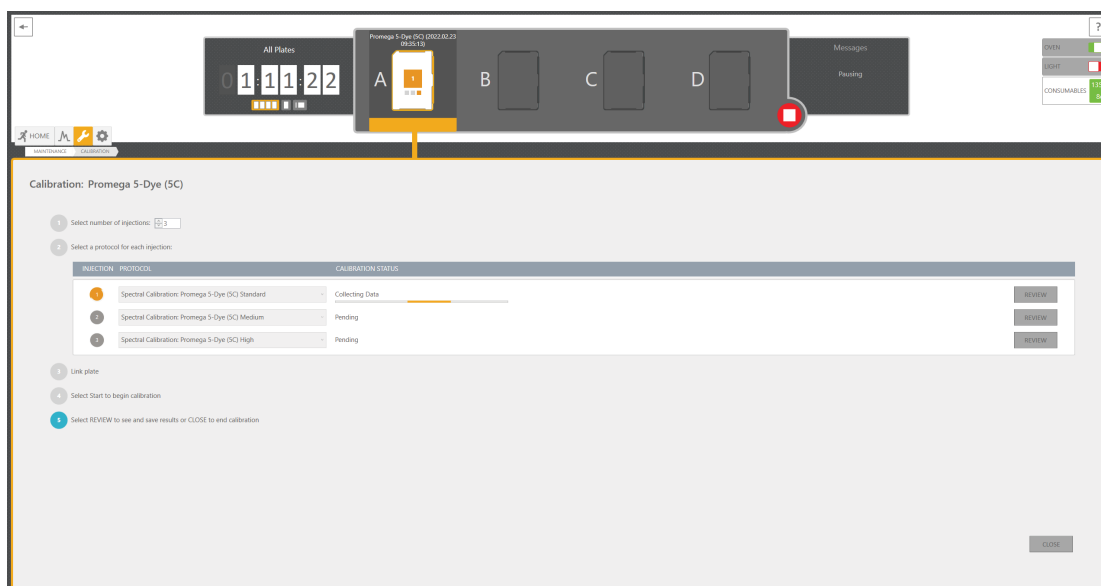
Calibration Status	Description
Spatial Calibration Failure – Insufficient data collected for spatial calibration	No frames were collected (see Section 9.2).
Spatial Calibration Failure – Failed to identify X capillaries (Y found)	Fewer than the expected number of capillaries were detected. Y is the number detected and X is the expected number (e.g., 8).
Spatial Calibration Failure – Capillary #X: Insufficient number of matrix peaks detected (Y found with signal over 12)	Fewer than expected number of matrix peaks detected. X is the number of the failed capillary. Y is the number of matrix peaks found.
Spectral Calibration Failure – Capillary #X: Invalid number of distinct emissions (Y found)	Insufficient number of distinct emission peaks detected. Y is the number detected. See Section 9.2.
Spectral Calibration Failure – Invalid calibration request	Corrupt calibration settings (see Section 9.2).
Spectral Calibration Failure – Corrupt or missing calibration data	Corrupt calibration procedure (see Section 9.2).
Spectral Calibration Failure – Insufficient spectral calibration data	Insufficient peaks. Peaks present for the matrix standard in the raw data but too low to generate a spectral calibration (less than 50RFU above the baseline).
Success	Spatial and spectral calibrations passed.

3.2 Reviewing Calibration Results

Completed calibrations are reviewed in the calibration review screen. Select the **REVIEW** button in the injection row to open the calibration review screen for that injection.

Note: You must review and activate passing results to activate a calibration.

The calibration review screen displays the overall calibration status and Max Spectral Bleedthrough value, as well as spectral quality flags, raw data and emission spectra for each capillary. The overall calibration status is the same as that displayed in the calibration run screen.
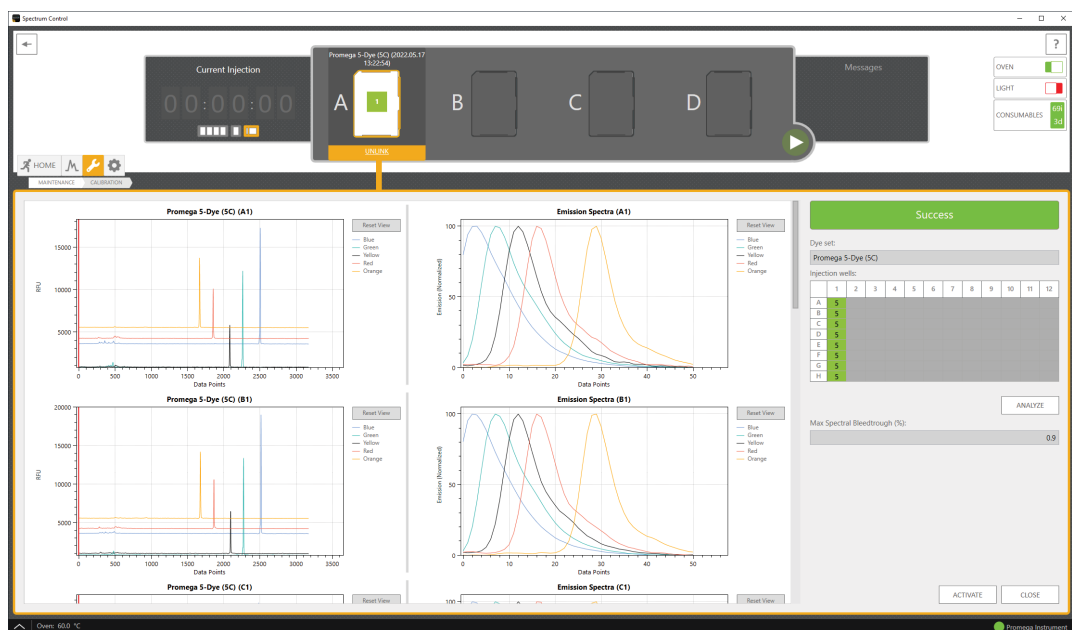
Each capillary must meet the passing criteria for distinct emission peaks. This number is determined by dye set (e.g., six peaks for a dye set comprised of six dyes). The number of distinct emission peaks is displayed through spectral quality flags that can be found in the plate layout of the calibration review screen. Minimum peak height for a dye-labeled fragment to be considered by the algorithm is 50 Relative Fluorescence Units (RFU) above the baseline. Capillaries with peak heights less than this value results in a failed spectral calibration on that capillary array. Also ensure that peaks are not saturating (Maximum RFU value for raw data is approximately 400,000RFU). If peaks are saturating, dilute spectral calibration standards before repeating the calibration. Other quality issues will fail the calibration data for the capillary and thus fail the calibration.

Spectral Calibration Quality Flags

Quality Flag	Result	Symbol	Color	Description
Success	Pass	N (e.g., N = 6 for a dye set of six dyes)	Green (pass)	The expected number of distinct emission peaks was detected.
Bubble detected	Fail	bu	Red (fail)	A bubble or spike was detected.
Insufficient data	Fail	0<	Red (fail)	Calibration data corrupt or not detected.
Insufficient peaks	Fail	N< (e.g., 5< if five peaks are detected in a dye set of six dyes)	Red (fail)	Insufficient number of distinct spectral peaks detected.
Overlapping peaks	Fail	No (e.g., ≤6 for a dye set of six dyes)	Red (fail)	Two peaks detected with the same emission.
Out of order	Fail	or	Red (fail)	Detected spectral peaks are out of order.

Each capillary must also meet the passing criteria for spectral bleedthrough set in the Calibration tab of the Preferences submenu (see Section 7.3). The default passing criteria for all dye sets in the software are set as follows:

Description	Minimum Spectral Bleedthrough (%)	Maximum Spectral Bleedthrough (%)
A measure of the confidence with which fluorescent signal from any given dye can be separated from that contributed by the other fluorescent dyes present. The optimal theoretical value is 0, with no signal from any given fluorescent dye contributing to signal from any of the other fluorescent dyes.	0	5

The Max Spectral Bleedthrough value is the highest bleedthrough percentage observed across the capillary array.

If the calibration passed, the calibration review screen displays the spectral calibration data for each capillary in the form of a deconvoluted raw data plot on the left and the emission spectra on the right of the plot area. You can review the data in these plots.

- To zoom in to a specific area along the y axis of the plot, hold down the left mouse button and drag across the area from left to right. The x axis will automatically rescale to the peak heights of the peaks within that area. Alternatively, hold down the **CTRL** key and scroll the mouse wheel up.

- To zoom back out, hold down the **CTRL** key and scroll the mouse wheel down.

- To move the plot left or right, hold down the right mouse button and drag the mouse left or right.

- To reset the view to the default settings, select the **Reset View** button.

- To apply these navigation actions to more than one capillary at a time, select the desired capillaries in the plate layout.

If the data of a single capillary has failed to meet the criteria, the calibration fails. Select **Failure Details…** below the calibration status to review the failure description and review the spectral quality flags for each capillary in the plate layout.

When a spatial calibration fails, only a temporal plot of the emission peaks is displayed.
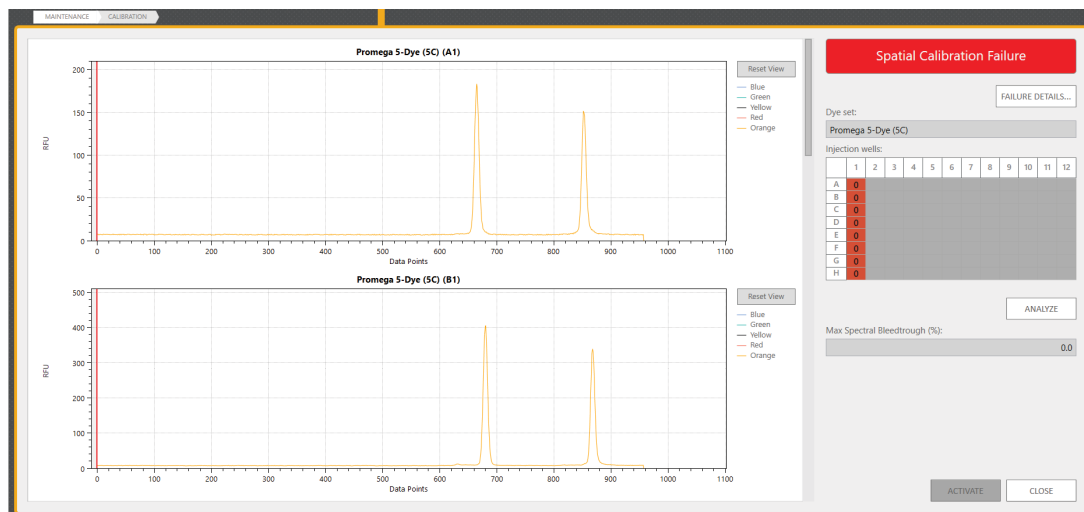
When a spectral calibration fails, the deconvoluted raw data plots and emission spectra plots are displayed, and the failed capillaries are flagged in the plate layout.
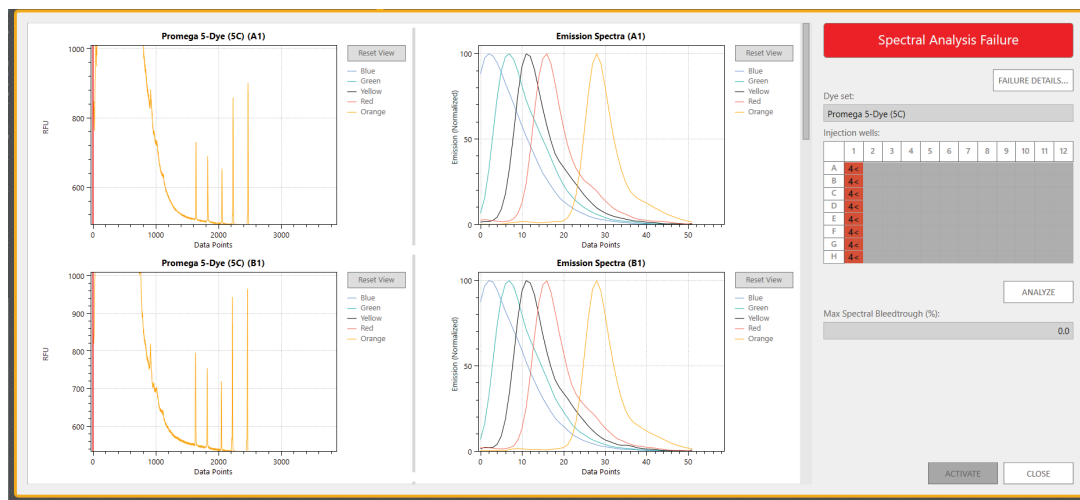
If the spectral calibration fails due to the presence of artifact peaks in the beginning of the run, adjusting the analysis start point and reanalyzing the data may recover the calibration and change the status to Success.

To adjust the analysis start point:

1. Select the well(s) to be reanalyzed from the plate view on the right. To reanalyze all wells, select the column header.

2. Left-click and hold the mouse pointer over the red bar at the beginning of the deconvoluted plot for an affected well. When the double-ended arrow appears, drag the bar to the desired start point. If more than one well is selected in the plate view, adjusting the red bar of one well will adjust the others simultaneously. With the desired start points adjusted, select the **ANALYZE** button on the right to reprocess the spectral data. The quality flags and metrics will update.

Note: When more than one well is selected, adjusting the analysis start point of one well adjusts the analysis start point for all selected wells.
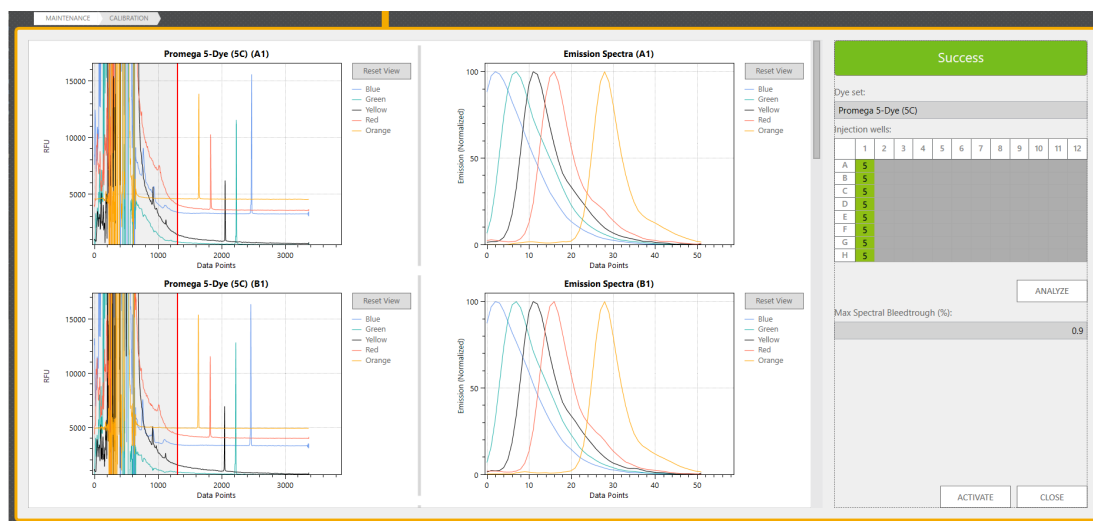
After reviewing the data for all capillaries, select **ACTIVATE** at the bottom of the calibration review screen to accept passing results and activate the calibration for the dye set. A confirmation window appears to verify the calibration is active. Select **OK** to close the window and return to the 'Calibration Management' screen. Alternatively, select **CLOSE** to return to the calibration run screen without activating the calibration.

Note: When calibrating a dye set for the first time, you must select **ACTIVATE** to save and activate a passing calibration. Selecting **CLOSE** in both the calibration review screen and the calibration run screen will discard the passing calibration, and the dye set will need to be calibrated again.

If all injections failed, select **CLOSE** in the calibration run screen to return to the 'Calibration Management' screen. Calibration reports for all injections are only generated once a calibration was either activated or closed. Calibration PDF files are saved in this file location: **C:\ProgramData\Promega\Spectrum\Calibration Reports**. Select the **REPORTS** button in the 'Calibration Management' screen to review calibration reports.

Notes:

a. The **ACTIVATE** button is not active if the calibration status is Fail.

b. You can activate the calibration if the calibration status of a failed injection is converted to Success after reanalysis. If another calibration is in progress when this calibration is activated, you must stop the run before activating the results. Any incomplete calibration injections are marked as aborted by the system when the run is stopped.

c. The C:\ProgramData folder is hidden under the default Windows® operating system settings. To navigate to this folder from the File Explorer, select **Hidden Items** from the View menu.

After returning to the 'Calibration Management' screen, the active passing calibration is displayed in the dye set drop-down menu by its run name and injection number [e.g., Promega 6-Dye (6C) (2022.01.12 13:58:26) #1]. Any additional passing calibrations are displayed in the drop-down menu. Selecting a calibration from the drop-down list sets it as the active calibration. A confirmation window is displayed. Select **OK** to close the window and return to the 'Calibration Management' screen.

Note: Passing calibrations remain in the drop-down list for the duration of an array's installation period on an instrument. All calibrations are cleared from the software when an array is uninstalled.
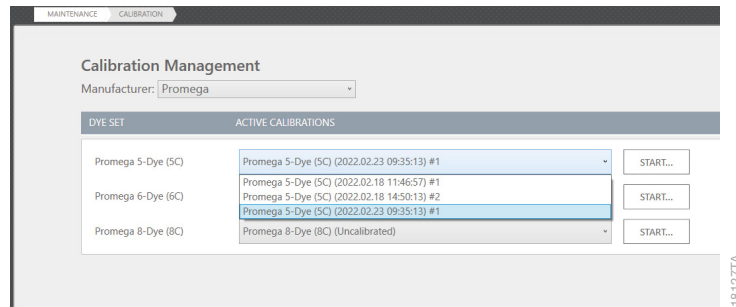
Starting a Run 4

4.1   Preparing the Instrument

Before starting a run, ensure all consumables are installed and in sufficient supply for the intended run (see Section 2.3). For the best quality results, use unexpired reagents that are within the recommended use range (see Section 1.7). Ensure that you have performed a calibration for the needed dye set (see Section 3). Preheat the oven by clicking the **Oven** indicator in the header. (Preheating takes about 20 minutes.) Inspect the fluid block, tubing, polymer syringe and polymer pouch for bubbles, and perform a bubble purge if necessary (see Section 6.2).

4.2   Preparing Run Documentation

You must create a plate record for each plate run. This record defines the Sample ID of each sample on a plate, the protocol to apply to each injection, and other user-defined items. There are four main methods for preparing a new plate record:

- Manual entry into a new plate record;

- Manually importing a plate record document;

- Automatically importing a plate record document through the barcoding process; and

- Duplicating information from a completed plate.

The Home menu provides buttons for two of the methods of assigning plate details: manual entry via the **New Plate** button and manual import via the **Import Plate** button. The third button available on the Home Menu screen is the **Draft Plates** button. This button opens a list of all plate records filtered to show only those in Draft status (i.e., not completed, not aborted, not running or not queued).

For a barcoded plate, a new plate record is automatically imported when the associated barcoded plate is scanned by the bar code reader in the plate drawer, if the auto-import file path is designated in the Preferences screen of the Settings Menu (see Section 7.3) and the associated bar code label is affixed to the center of the plate skirt on the column one side (see Section 2.4). Plate record files intended for auto-import should contain the same information and follow the same file format as described for manually imported plate record files (see "Creating a Plate Record from an Imported File via the Home Menu" on page 49). Initiating a new plate record via the duplication method is described in Section 5.4. All plate information brought into a new plate record through an import or duplication method can be verified and/or modified from the plate screen.

Note: The number on the bar code label and must be included in the file name of the plate record file (e.g., Sample Plate_A1234.xlsx for a bar code label with the number A1234). Systems that produce a bar code label number and a bar code read number that do not match are not compatible with this feature.

Assigning Plate Details to a New Plate Record

1. To create a new plate record for manual plate entry, select **New Plate** from the Home menu.
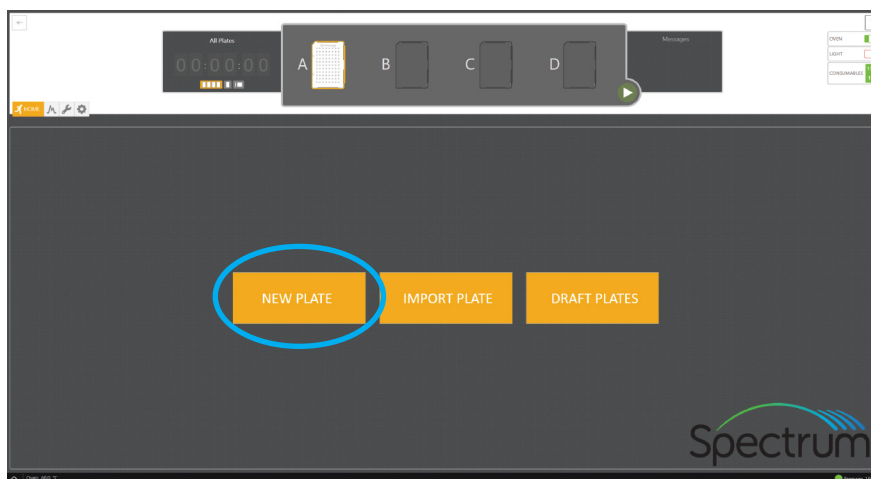
Note: The **New Plate** button will open a new plate screen that is divided into three sections: Plate Information, Sample Information and Injection Information.

To adjust the height of the Plate Information and Injection Information, hover the mouse pointer in the space between the two sections on the far left side of the screen. When the double-headed arrow appears, left-click and drag to the desired position. To adjust the width of the Plate Information, Injection Information and Sample Information sections, hover the mouse pointer in the space to the left of the Sample Information. When the double-headed arrow appears, left-click and drag to the desired position.

Plate Information

Sample Information

Injection Information
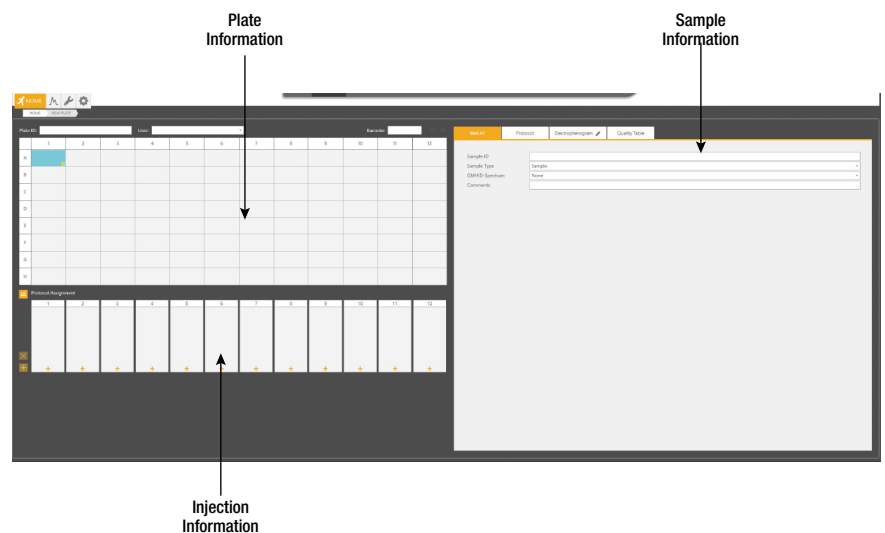
2.   Accept or enter a unique Plate ID.

A unique Plate ID is automatically generated in the Plate Information section and a Draft plate record is automatically saved when a new plate document is created. Alternatively, you can define a Plate ID via an imported plate record file (see "Creating a Plate from an Imported File via the Home Menu" on page 49) or you can rename the Plate ID in this screen.

Note: 1 to 50 characters are allowed in any editable field. Any characters are allowed; however, if an invalid character is used in a field that is used in the exported data file name (see Section 7.3), that character will be automatically replaced with an underscore upon export.

3.   Enter a User (optional).

The User field is a user-defined section that you can search or filter to find previously created or completed plates (see Section 5.1 for information on reviewing plate records). Information previously entered into this section will be available for future use via the drop-down option on the right side of the field. To clear this list, right-click on the drop-down arrow and select **Clear List**.
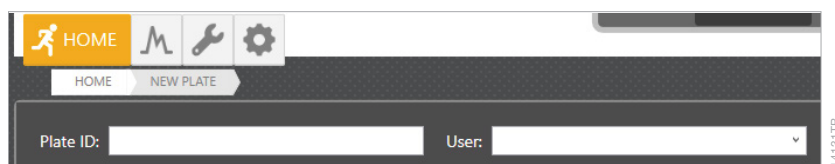
4.   Enter Sample IDs (sample names) for each sample on the plate.

You can enter a Sample ID directly in the cells of the plate map area of the Plate Information section by clicking on the appropriate well(s) and entering the ID information. Right-clicking a sample well provides editing options: Cut, Copy, Paste and Clear. You can use the following keyboard shortcuts to aid in editing:

Keyboard Shortcut	Function
Ctrl + X	Cut
Ctrl + C	Copy
Ctrl + V	Paste
Ctrl + Z	Undo

There are also **Undo** and **Redo** shortcut buttons to the right of the Barcode field.

Additionally, you can use the green box in the lower right corner of a sample well to fill other wells with the same information by left-clicking and dragging.

Select and drag to fill other wells with the same information
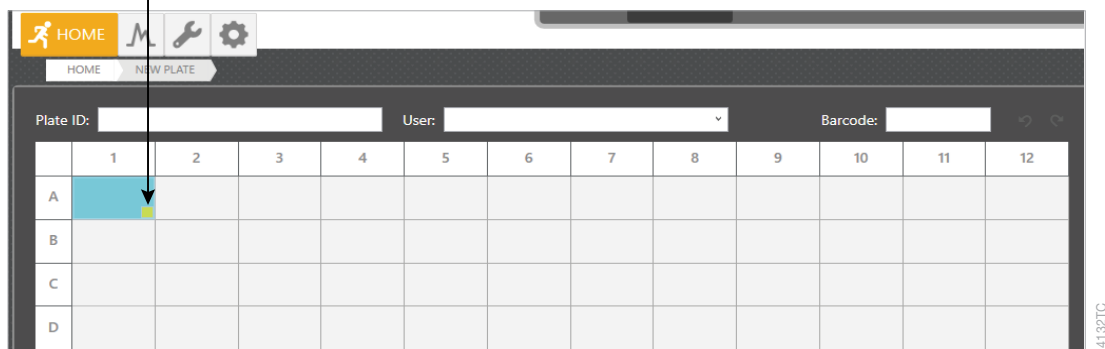
You can also enter Sample IDs in the 'Sample' tab of the Sample Information section. This section also allows you to enter additional sample information (Comments, Sample Type or GMHID-Spectrum Run Wizard template).

Note: The use of the Quality Table feature (see Section 4.5) requires the selection of the appropriate GMHID-Spectrum Run Wizard template. These templates are created within the GeneMarker®HID Software for Spectrum CE Systems (GMHID-Spectrum). Ensure that your laboratory's Run Wizard templates are present in the Spectrum CE System workstation's copy of GMHID-Spectrum. Ensure the sample type for all ladder and control samples is appropriately designated.
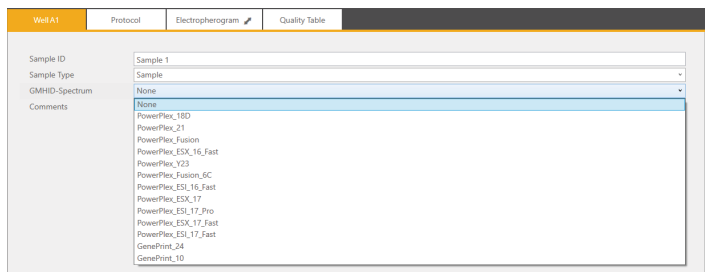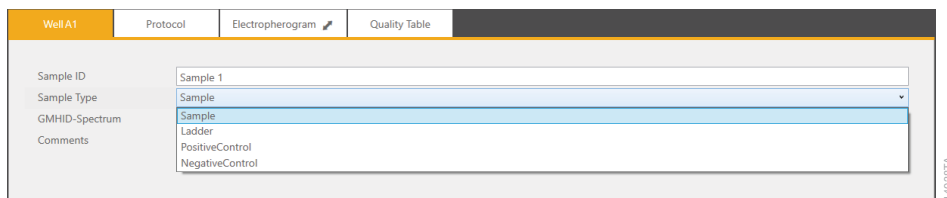
You can assign 'Sample' tab information to multiple samples at the same time by highlighting the desired wells in the plate map before entering or selecting the information.

5.   Assign run protocol(s) to samples.

Protocols define the instrument settings to be applied during a run. This includes: injection conditions, electrophoresis conditions and dye set. The Spectrum Control Software includes preloaded run protocols for use with Promega chemistries, as well as select Applied Biosystems chemistries. To create a new protocol or modify an existing protocol, see Section 7.1.

The Injection Information section of the plate screen has two views: the Protocol Assignment view and the Protocol Queue view. To switch between the two views, use the expand/collapse button in the upper left corner of the injection information section.

The Protocol Assignment view is the default view of a plate record and is used to assign run protocol(s) to samples.
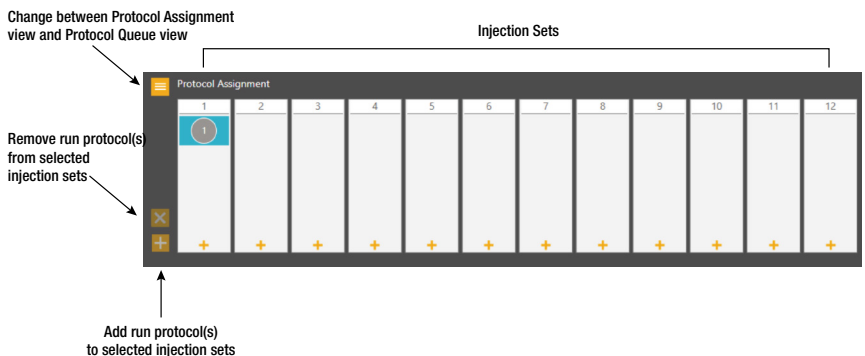
You can assign run protocols to selected samples, individual injection sets, or multiple injection sets.

Notes:

a. Injection sets represent the sample wells processed during a single injection of the Spectrum CE System. In the 8-capillary system, each injection set consists of one column (A–H) of samples.

b. A sample ID must be present in at least one well of an injection set with an assigned run protocol for the run to proceed.

(!) You can add run protocols to a plate in the following status: draft, queued and running. You can add multiple run protocols to the same plate. You cannot add run protocols to completed or aborted plates. See Section 5.1 for complete descriptions of plate status.

• To add a run protocol to selected samples, highlight the desired wells (Ctrl + left-click or drag with the mouse), then right-click, mouse over **Add Injection to Selected Wells**, and select the desired run protocol from the pop-out menu. A maximum of four run protocols can be assigned to a single injection set.

• To add a run protocol to individual injections, select the **+** button at the bottom of the box for that injection set and select the desired run protocol from the list.

• To add a run protocol to multiple injections, highlight the desired injections in the plate map (click-drag, Ctrl + left-click, or click the upper left cell), then select the **+** button on the left side of the injection information section and choose the desired run protocol.
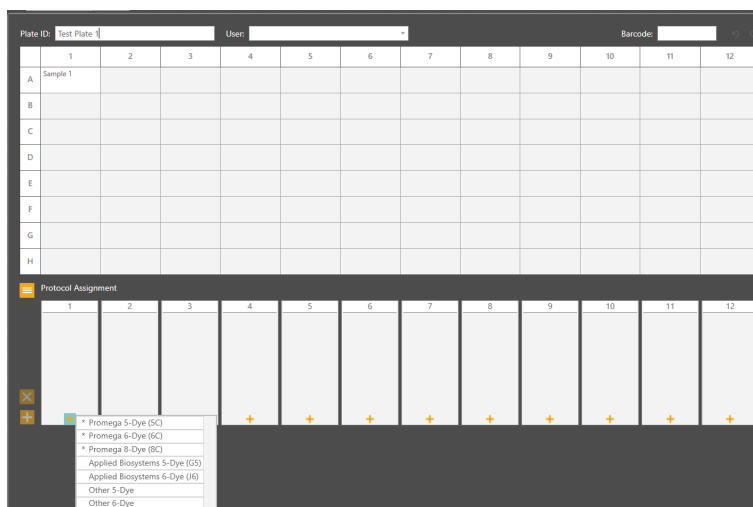
Note: You must select one or more injection sets to activate the **Add Protocol to Multiple Injections** (**+**) button.

When a run protocol has been assigned to an injection set, an injection number will be assigned and displayed in a circle within the injection set box.

You can reorder or remove injections from the plate. To change the scheduled order of an injection or remove an injection, right-click the injection number requiring the change and select the appropriate command: **Remove**, **Skip**, **Prioritize as First**, **Promote**, **Demote**, or **Deprioritize as Last**. To remove all injections from the plate, highlight all the wells of the plate and select the **X** button on the left side of the injection information section.

Note: Skip is only available when the injection status is "Injecting" and the injection protocol has passed the data collection phase.
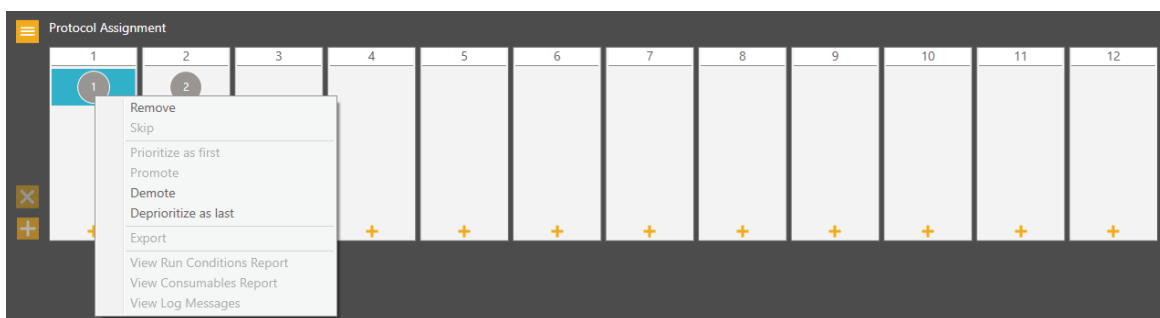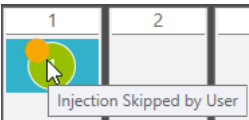
The Protocol Queue view displays a list of all injections with their remaining injection time, status, column(s), and assigned run protocol.

The status of injections within a plate will update in the Injection Information section of a 'Plate' screen. The injection status indicators are as follows:

Icon	Status
	Ready—a run protocol is assigned to the injection set and it is ready for injection.
	Injecting—the assigned run protocol is currently running on the instrument.
	Completed—the assigned run protocol is complete.
	Aborted—the assigned run protocol was aborted.

Icon	Status
	Skipped by system—the assigned run protocol was skipped by the system due to an error, refer to the event log (Section 4.5) for details. See Section 9.1 for troubleshooting.
	Skipped by user—the assigned run protocol was skipped by the user.

6. Verify the assigned run protocols.

To verify the parameters of the assigned run protocol(s), click on the injection number or select a sample well in the plate map and navigate to the 'Protocol' tab of the Sample Information section. The information in this tab is read-only. To edit the parameters of a run protocol, see Section 7.1.

Creating a Plate from an Imported File via the Home Menu

You can import plate details (Plate ID, Sample IDs, Sample Type designation, Protocols and GMHID-Spectrum Run Wizard templates) from an Excel file (created elsewhere) or from a Spectrum Control Software plate record. Import files will be accepted in the following formats: .csv, .txt, .xls, .pla. Instructions for how to create a plate record import file are found in [Section 10.1 Creating a Plate Record Import File]. An example Microsoft Excel® template is available in the C:\Plates folder.

Note: Microsoft Excel® software is not installed on the system computer. You can transfer the template file to a computer running Excel.

To import a previously defined plate record file:

Follow These Steps

1. Select **Import Plate** from the Home Menu.
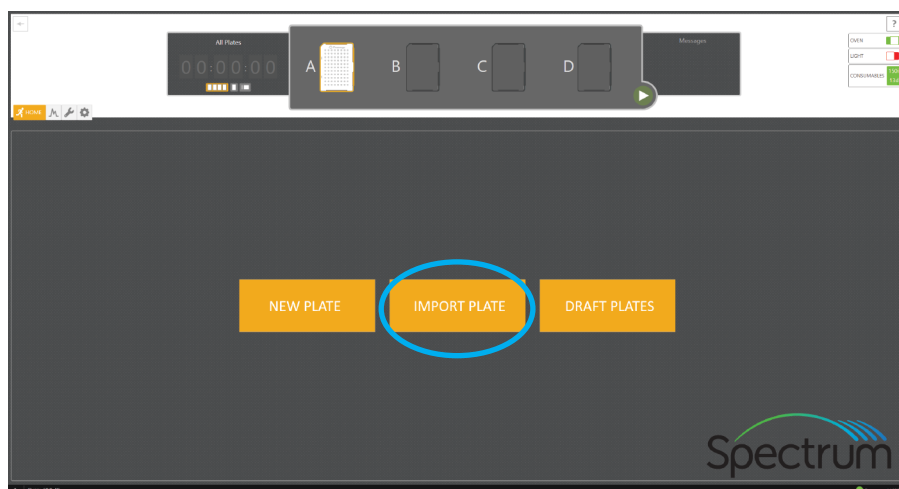
2. The Import Plate link will open a browsing window.

3. Navigate to the location of the plate record file, select the file, then select **Open**.

This location will be preserved for subsequent imports. You can specify a default location for manual import plate record files in the Settings Menu (see Section 7.1).

Upon successful import, the 'Plate' screen will be displayed showing the imported plate layout information (Sample IDs, Protocols, etc.).

Accessing Draft Plates

A plate record remains in Draft status until it is linked to a plate position at which time its status becomes Queued. If a linked plate is unlinked before being processed, it will revert back to Draft status. To access a list of all plates in the Draft status, select the **Draft Plates** button from the Home Menu.
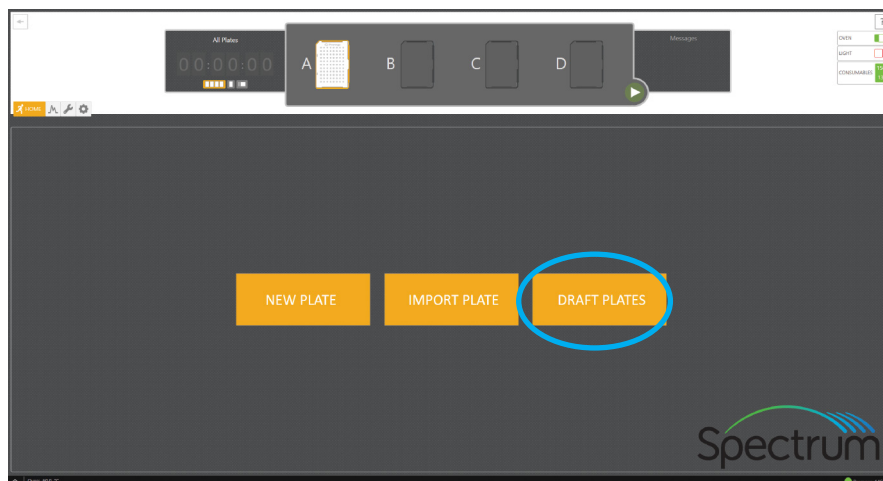
This Plates List view is also available through the Review Plates menu filtered by Draft status (see Section 5.1).

Note: Plate, sample, and injection information can only be modified while a plate record is in Draft status. This information cannot be modified in Queued, Running, Completed and Aborted plates.

4.3   Loading a Plate

Samples prepared in a 96-well plate are assembled into the plate base and retainer that is loaded into the plate drawer of the Spectrum CE System (see Section 2.4). To load a plate into the plate drawer:

Follow These Steps

1. Check the Message Center to verify that the drawer is not locked ("Drawer Locked" is not displayed in the Message Center). Verify that the drawer handle light is illuminated, indicating that the drawer is unlocked and ready for plate loading.

2. Open the plate drawer. The Message Center will display the "Drawer Open" message.

3. Check the Plate Positions indicator to note which of the four plate positions (A, B, C or D) is open and does not already contain a plate (see Step 3 in Section 4.4).

    Note: If you place a new plate into the plate drawer while a plate is being processed in the autosampler, the software will flag an error if the new plate occupies the position reserved for the return of the plate being processed.

4. Place the plate assembly in an open plate position with the notched corner of the plate base and retainer in the upper left corner of the plate position. When the plate is seated properly, the Plate Positions indicator will update that position to **Occupied**, but not Linked (see Step 3 in Section 4.4).

5. Close the plate drawer. The Plate Drawer Status indicator will change from **Open** to **Closed**.

4.4   Linking a Plate for a Run

Once you have placed a plate assembly into the plate drawer, you must link a plate record to the plate before adding it to the run queue.

> **Note:** If you use bar coded plates, the integrated bar code scanner will scan the bar code label after the plate drawer is closed. If **Activate Auto Plate Import from Barcode** is selected in the 'Plate Import' tab of the Preferences submenu and the associated plate record import file is located in the designated file path (see Section 7.3), a dialog box will appear asking if the found plate record should be imported and linked to the bar coded plate. Select **Import and Link** to link the plate record to the bar coded plate. The number on the bar code label must be included in the file name of the plate record file (e.g., Sample Plate_A1234.xlsx for a bar code label with the number A1234). Bar coding systems that produce a bar code number and a bar code read number that do not match are not compatible with this feature. See Creating a Plate Record Import File (see Section 10.1).

Follow These Steps

1. With the Plate Screen for the appropriate plate open, select **Link** in the Plate Position indicator under the position where the plate was placed (see the table under Step 3 on page 52). Once the plate is successfully linked, the text under the position will change status to Unlink and the Plate ID will appear above the position.

2. If a plate is linked to a plate position when there are no runs in progress, you must select the **Start** button in the header. If a plate is linked to a plate position while there is a run in progress, the newly linked plate will automatically enter into the run queue.

    Note: The status of all linked plates will update in the Plate Positions indicator throughout the run.
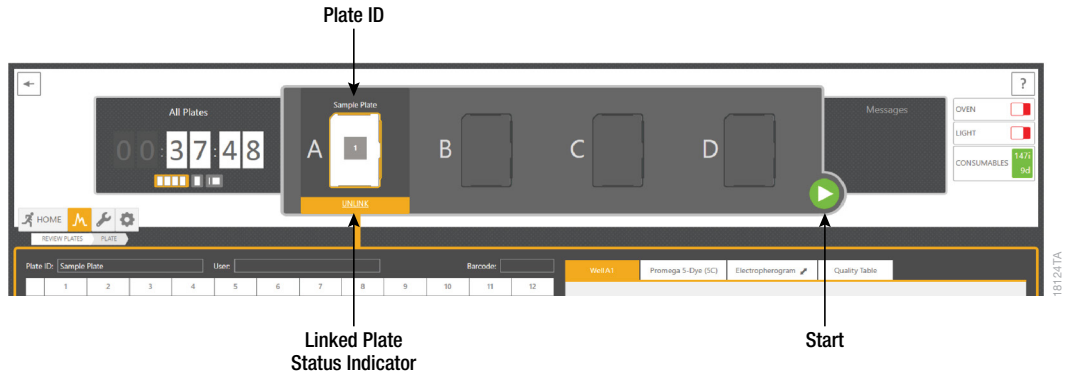
3. To access the plate screen for linked plates, click the plate image in the Plate Positions indicator. The Plate Status options visible in the Plate Indicator are as follows:

Icon	Status
	No plate is detected in plate drawer.
	The plate is detected in the plate drawer. No plate record is linked. Clicking a plate icon in this state opens the Review Plates screen with the Draft filter applied. See Section 5.1.
	The plate record is linked to the plate in the designated position and is scheduled to run. The run name is displayed. The number inside the square indicates the order of the plate in the run queue (i.e., 1, 2, 3 or 4).
	The plate is linked and currently running on the instrument.

Icon	Status
	The plate is linked and all injections on the plate have completed.
	The plate is linked and the run was aborted.
	The new plate in is a position linked to the plate currently running on the instrument. You must remove the plate from the position.

Caution! Any plates present in the plate drawer and linked to a plate position will be unlinked when the software is closed and/or the instrument is turned off. If either of these actions occurs while a plate is running, the run will be aborted and marked as such upon restart. Plates will also be unlinked when removed from the plate drawer.

You can reorder or unlink plates in the run queue that are not being injected. To change the scheduled order of a plate or remove a plate from the queue, right-click the plate number requiring the change and select the appropriate command: **Order Up**, **Order Down**, **Order First**, **Order Last**. To unlink a plate from a plate position, select Unlink in the Plate Position indicator under the position where the plate was placed. To abort a run, select the **Stop** button in the header. This will abort the current run and clear the plate queue.
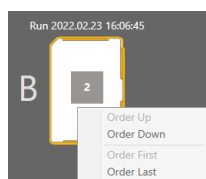
4.5   Monitoring a Run

You can monitor the status of a plate from the Plate Positions indicator as described in Step 3 of Section 4.4. You can obtain a detailed view of the data being collected from a particular sample(s) in progress or completed from the 'Electropherogram' tab of the Sample Information section of the 'Plate' screen. To access the 'Plate' screen of a linked plate, select the associated plate icon in the Plate Positions indicator. To access the plate screen of a completed plate that is no longer on the instrument, see Section 5.1.

The 'Electropherogram' tab displays the raw data electropherogram of the selected well(s). This tab is the default view of the Sample Information section of the 'Plate' screen for plates that are currently being processed or those that are completed. Each electropherogram is labeled by the well position of the selected sample(s) followed by the injection number [e.g., A1 (1)]. If a sample is injected multiple times, choose the injection number, then select the sample(s) to review the electropherogram. Electropherogram data from multiple samples run together in the same injection can be displayed together in the 'Electropherogram' tab. Electropherogram data from different injections cannot be displayed together.

- To change the dye channels displayed, check or uncheck the box next to the dye channel.

- To zoom into a specific area along the y axis of the electropherogram, hold down the left mouse button and drag a box from left to right around the area. The x axis will automatically rescale to the peak heights of the peaks within that area. Alternatively, hold down the **CTRL** key and scroll the wheel of the mouse up.

- To zoom back out, hold down the **CTRL** key and scroll the wheel of the mouse down.

- To move the electropherogram left or right, hold down the right mouse button and drag the mouse left or right.

- To reset the view to the default settings, click the **Reset View** button. If multiple wells are selected, a scroll bar will appear to the right allowing you to scroll through the electropherograms of the selected wells.

The ⬛ button in the 'Electropherogram' tab allows you to move the electropherogram screen either in its default position next to the 'Protocol' tab or below the Injection Information section of the 'Plate' screen.

The Quality Table will populate with GMHID-Spectrum quality flags if a GeneMarker®HID template was selected when the plate record was created (see Section 4.2). The quality table lists samples in order by well position with allelic ladders and controls sorted to the bottom. This table displays the size score for each sample as well as a flag for each quality reason detected in the sample. Eight quality metrics defined by GMHID-Spectrum are checked for each sample:

- Size Quality (SQ)

- Off Ladder (OL)

- Out of Bin (OB)

- Saturation Detected (SD)

- Saturated Pull-up (SP)

- High Intensity (HI)

- Low Intensity (LO)

- Bin Conflict (BC).

See the *GeneMarker®HID Software for Spectrum CE Systems User Manual* #TM555 for further definitions. If no GMHID-Spectrum template is selected when a plate record is created, the Quality Table will not be populated with sample quality information.

Well	Sample ID	Injection	Size Score	SQ	OL	OB	SD	SP	HI	LO	BC
C1	6C 1 ng Amp 1	1	96	■	■	■					
D1	6C 1 ng Amp 2	1	--	■							
E1	6C 1 ng Amp 3	1	78	■	■	■					
F1	6C 1 ng Amp 4	1	95	■	■	■			■		
G1	6C AL 1	1	96	■			■				
H1	6C AL 2	1	96	■			■				
A1	6C NTC 1	1	96	■	■	■					
B1	6C NTC 2	1	96	■	■	■					

Re-analyze

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If you determine samples require reinjection under the same or a different protocol, you can add injections to the run while it remains in the Running state (see Section 4.2). You cannot add injections to the run if the plate is in the Completed state (see Section 5.1). To schedule re-injections of samples on a completed plate, follow the steps in Section 5.4, Duplicating Plate Details.

To monitor the run conditions and log for a current run, expand the Status Bar by selecting the ⌃ button at the bottom left of the screen.
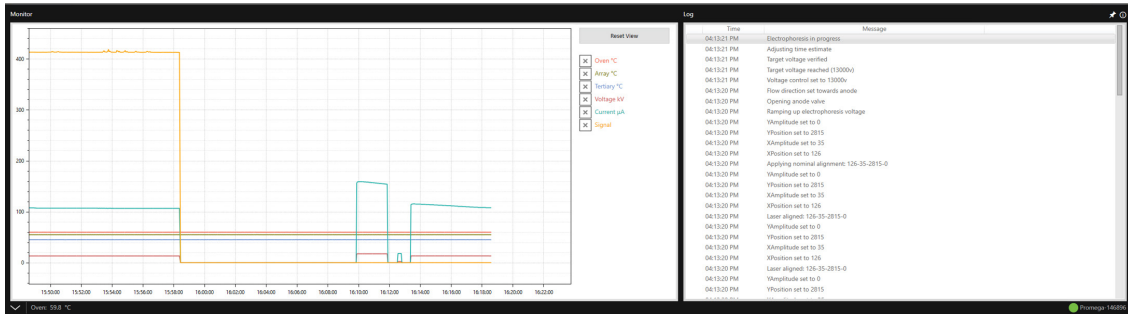
To change the parameters displayed in the monitor graph, check or uncheck the box next to the parameter: Oven, Array, Tertiary, Voltage, Current and Signal. Refer to the table in Section 2.2 for a description of these parameters. You can zoom in on the monitor graph by hovering the mouse pointer over the area and scrolling up the mouse wheel. To zoom back out, scroll the mouse wheel down. To move the monitor graph left or right, hold down the right mouse button and drag the mouse left or right. To reset the view, select the **Zoom All** button.

You can use the scroll bar on the right of the log list to review the system operations and error messages recorded throughout the run. To copy this list to the clipboard, right-click in the list and select **Copy All to Clipboard**.
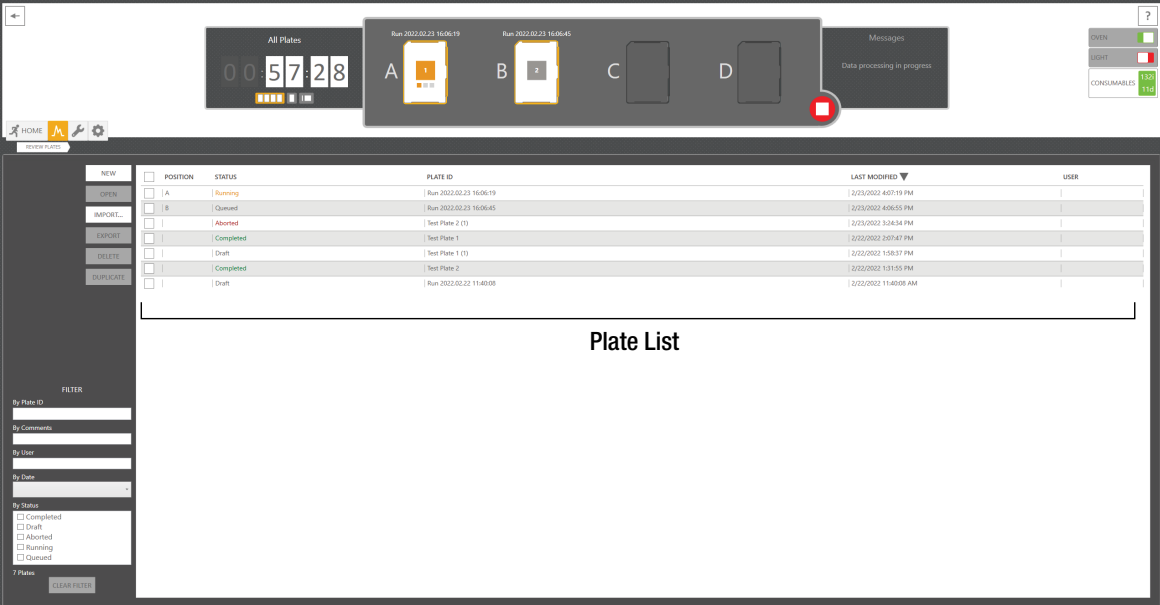
To minimize the Status Bar, select the ⌄ button at the bottom left of the screen.

Reviewing Plates

<div style="text-align: right">5</div>

The Review Plates menu provides a list of all plates saved to the Spectrum Control Software.

5.1 Navigating the 'Review Plates List' Screen

Click the **Review Plates** button 〽 in the Workflow Menu to open the 'Review Plates' screen. The 'Review Plates' screen is divided into three main sections: Plate Record Management, Plate List and Filters.

The Plate Record Management section provides five options:

Command	Function
New	Creates a new plate record and opens a new, unpopulated plate screen (see Step "4. Enter Sample IDs (sample names) for each sample on the plate." on page 42).
Open	Opens the selected plate record. Only one plate record can be open at a time.
Import	Opens a browsing window to locate a plate import file (see "Creating a Plate from an Imported File via the Home Menu" on page 48).
Export	Exports the selected plate record to the designated file export location. **Note:** These files are only read by Spectrum Control Software.
Delete	Deletes the selected plate records.
Duplicate	Duplicates the plate layout information (Sample IDs, protocols, etc.) from the selected plate into a new plate record.

The Open, Delete and Duplicate options are not active unless you have selected the check box next to at least one plate record.

The Plate List section provides a list of all saved plate records. Each entry for a plate contains five potential fields of information. Each field is sortable by an up/down arrow to the right of the category name.

Field	Information	
Position	Displays the plate drawer position of a linked plate record (i.e., A, B, C or D).	
Status	Displays the status of the plate record:	
	Completed	All scheduled injections on the plate have been completed.
	Aborted	One or more injections on the plate were aborted before completion.
	Draft	A plate record has been created, but injections have not been started or placed into the queue.
	Running	The plate is currently being processed in the autosampler.
	Queued	The plate has been linked and is in the queue to be run.
Plate ID	Displays the unique plate ID assigned to the plate record.	
Last Modified	Displays the last date the plate record was modified.	
User	Displays the user-defined section assigned when the plate record was created (if any).	

The Filter section displays five options for filtering the list of plate records.

Filter Option	Applied Filter
By Plate ID	Displays a list of plate records containing the specified plate ID.
By Comments	Displays a list of plate records containing the specified comments entry.
By User	Displays a list of plate records containing the specified user entry.
By Date	Displays a list of plate records created or modified within the specified time frame: Today, 7 Days, 30 Days, 3 Months, 6 Months, 1 Year, All or Custom (which allows you to specify a date range).
By Status	Displays a list of plate records with the specified status: Draft, Queued, Aborted, Completed or Running.

The **Clear Filter** button at the bottom of the screen will become active after a filter is applied. Clicking this button will clear all applied filters and show all saved plate records.

To open a plate record, choose the row for the record. Alternatively, select the box to the left of the plate record, then choose the **Open** button in the Plate Record Management section. To delete or duplicate a plate record, you must check the box to the left of the plate record for those buttons to be active (see Section 5.4).

5.2   Reviewing Completed Runs

Once all scheduled injections on a plate are completed, the plate record status will change from Running to Completed, and the plate icon will change to the Completed status. The plate record remains linked to the plate position until the plate is unlinked in the Plate Positions indicator or removed from the drawer. You can review linked, completed plates by clicking the corresponding plate icon. Injections cannot be added to a completed plate. To schedule reinjections of samples on a completed plate, follow the steps in Section 5.4, Duplicating Plate Details.

Follow These Steps

1. To review completed plates, either click the plate icon if the plate is still linked to a plate position (then skip Step 3), or navigate to the Review Plates menu and select the **Completed** check box in the Filter by Status section.
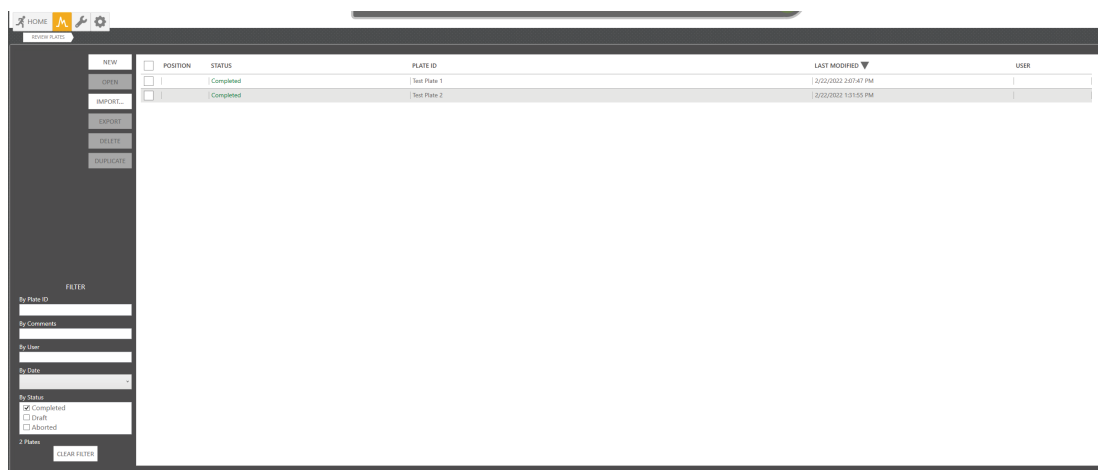
2. Scroll to find the completed plate needing review.

To simplify a search, you can sort plates by any of the five fields by clicking the arrow in each column header.

Alternatively, you can use plate record information to filter the list further. Enter the appropriate plate record information into the Filter section of the screen (Plate ID, Comments, User or Date).

3. Select the row for the desired completed plate to open its plate screen.

From this screen, you can access information about the run, including raw data electropherograms, run conditions, and consumable records.

The 'Electropherogram' tab in the Sample Information section displays the raw data electropherogram of the completed run for selected well(s) or injection(s) (see Section 4.5). The 'Quality Table' tab displays the quality flags for each sample in the completed run.

Note: You must wait for injection data to load, as indicated by a solid green injection status indicator, before reviewing data.

To review run conditions, information on the consumables used in each injection or the log messages recorded during the run, right-click the injection in the Injection Information section and select **View Run Conditions Report, View Consumables Report** or **Log Messages**.

The Run Conditions Report displays the run conditions collected during the injection. This screen functions the same as the Monitor side of the Status Bar (see Section 4.5). To close the Run Conditions Report screen, select the **Close** button in the bottom right corner.
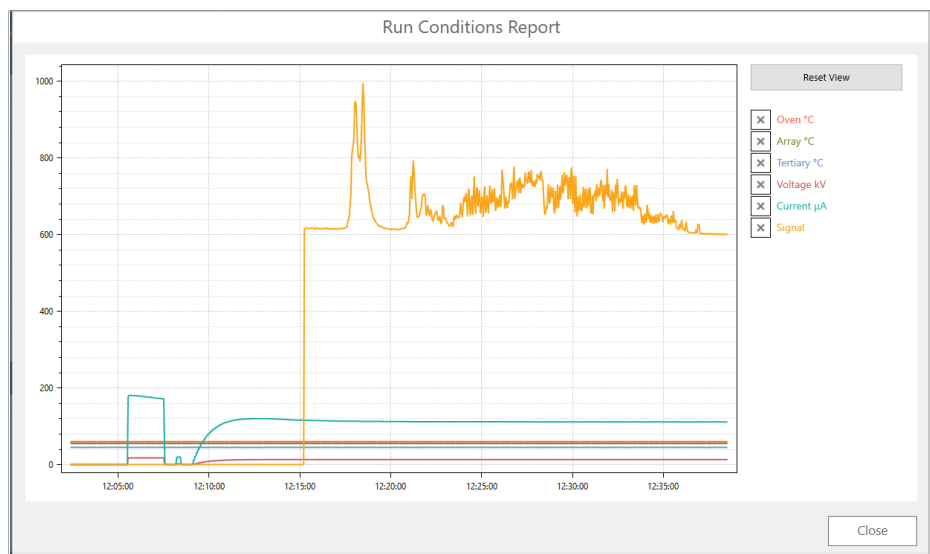
The Consumables Report displays the status of the consumables as they were during the injection (for more information regarding consumable status, see Section 6.1). To close the 'Consumables Report' screen, select the **Close** button in the bottom right corner.

The 'Log Messages' window displays a list of all system operations and error messages recorded during the run. To close the 'Log Messages' window, select **Close** in the bottom right corner of the window.
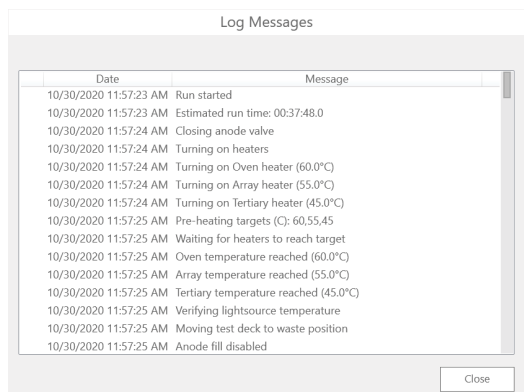
5.3   Exporting Plate Data

Data collected are exported automatically to a defined file location and file format (either .promega only or .promega and .fsa) that is specified in the Settings menu (see Section 7.3).

After reviewing data within the Spectrum Control Software, you can export data for individual samples or groups of samples using the following methods. Data are exported in the data format and the Export File Path designated in the 'Data Export' tab of the Settings → Preferences menu (see Section 7.3).

Follow These Steps

1. Within the plate record screen for the completed plate, highlight the wells to be exported, right-click, and select **Export**. When export is completed, you will be given the option to open the export folder. Select **Yes** to open the folder or **No** to close the Export window.
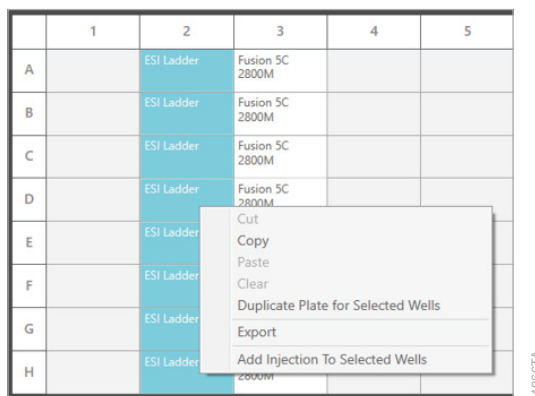
2. Alternatively, data can be exported by injection set. Right-click on an injection number in the Injection Information section of the plate record and select **Export** (see top figure on page 61). The export folder will open when the data export is complete.

   Note: You must wait for injection data to load, as indicated by a solid green injection status indicator, before exporting data.

5.4   Duplicating Plate Details

Duplicating Plates from the Review Plates Menu

Plate information contained in a plate record can be duplicated to a new plate record (with a new Plate ID). You can do this for a whole plate from the Review Plates menu or for selected samples from within the plate screen of the selected plate record.

Follow These Steps

1. Locate the desired plate record from the plate list of the Review Plates menu.

2. Check the box to the left of the plate record, and select the **Duplicate** button in the Plate Record Management section. This will open a new plate screen for the duplicated plate record.

3. By default, the Plate ID will be the original plate record's Plate ID followed by the sequential number of duplication in parenthesis [e.g., (1)]. The duplicated cells will retain their well positions, Sample IDs, Sample Types and assigned protocols (as well as any assigned GMHID-Spectrum Run Wizard Templates and Comments). Since this is a new plate record, all fields are editable.

4. Make the desired edits to the plate record.

5. When you have completed all edits, you can link the plate record to the appropriate plate position.

Duplicating Plate Details from a Plate Screen

Follow These Steps

1. Locate the desired plate record from the plate list of the Review Plates menu, and double-click the row to open the plate screen.

2. Highlight the desired wells to be duplicated by holding down the **Ctrl** key and either clicking the wells or dragging across them.

3. With the desired wells selected, right-click and select **Duplicate Plate for Selected Wells**. This will open a new plate screen for the duplicated cells. By default, the Plate ID will be the original plate record's Plate ID followed by the sequential number of duplication in parenthesis [e.g., (1)]. The duplicated cells will retain their well positions, Sample IDs, Sample Types, and assigned protocols (as well as any assigned GMHID-Spectrum Run Wizard Templates and Comments). Since this is a new plate record, all fields are editable.

4.   Make the desired edits to the plate record.

5.   When you have completed all edits, you can link the plate record to the appropriate plate position.

Performing Maintenance

<div style="text-align: right; font-size: 3em;">6</div>

The Maintenance menu contains three buttons for performing various maintenance functions: Calibration, Consumables and Utilities. The **Consumables** button opens the 'Consumables' screen and displays the current status of the four RFID tag-tracked consumables. The **Calibration** button opens the calibration screen (see Section 3.1). The **Utilities** button provides additional maintenance functions.

6.1   Maintaining Instrument Consumables
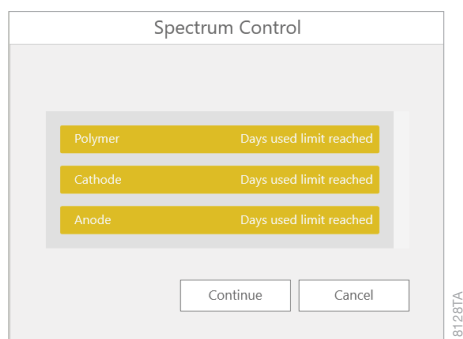
The software will check the status of the consumables on instrument start-up as well as any time the consumables screen is accessed, a plate is linked or any time before a consumable will be deployed for an instrument process (e.g., prior to starting a run or prior to starting a bubble purge). The Consumables status indicator in the header will display a yellow background when a consumable needs to be replaced or replenished. To view the specific details of the consumables status, select the indicator to access the Maintenance: Consumables screen shown on page 66. Alternatively, you can select the Maintenance Menu from the Workflow menu buttons, followed by the **Consumables** button.
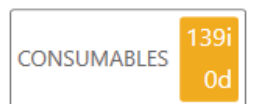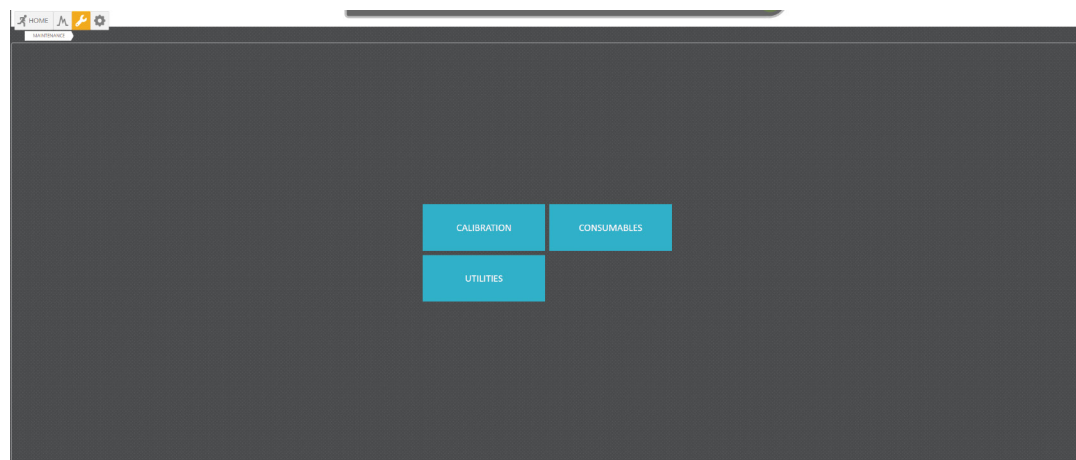
The 'Consumables' screen displays the current status of the four RFID tag-tracked consumables: Polymer, Capillary Array, Anode Buffer and Cathode Buffer. The progress bars indicate the remaining injections and/or days on the instrument for each consumable. The status of each consumable is updated every time this screen is visited.

The RFID section tracks the following information from each consumable:

- Part Number

- Lot Number

- Initial Installation Date (date consumable was first installed on an instrument)

- Expiration Date (valid through 11:59pm of the expiry date)

- Injections (number of injections performed using the installed consumable)

- Installation Count (number of times reagent has been installed on an instrument)

The expiration date, maximum injections remaining and maximum days remaining correspond to the recommended usage for each installed consumable. The status bars will adjust, changing from green to light gray with a dark gray line through it when the recommended limit is surpassed. The only hard stop for the system is injections remaining for the polymer. The software will not allow a run to proceed if the scheduled number of injections exceeds the remaining injections of the polymer, as this would lead to damage of the system. The injection field in the Polymer RFID Info table displays a red warning when maximum injection count has been reached. All other consumable warnings, indicated as yellow warnings, are advisory in nature and will not stop a run.

The **Replace** button under each consumable opens the wizard for replacing that consumable.

Note: The replacement of the anode and cathode buffers is combined in one wizard. We recommend replacing both buffer cartridges at the same time.

Maintenance Schedule for Consumables

Reagent/Consumable		Part Number	Maintenance
Spectrum Buffer	Anode Buffer Cartridge	CE2001	Once the seal is removed, the buffer is stable for 14 days on the instrument: 240 injections or until expiry date, whichever comes first.
	Cathode Buffer Cartridge		
Spectrum Capillary Array, 8-Capillary		CE2008 (8-capillary, 36cm)	300 injections or until expiry date, whichever comes first.
Spectrum Polymer4		CE2048 (384 wells)	14 days, when an insufficient amount remains to perform the scheduled injection(s) or until expiry date, whichever comes first.
		CE2040 (960 wells)	
Spectrum Wash Solution		CE2099	One pouch of Spectrum Wash Solution contains sufficient volume for five uses or until expiry date, whichever comes first. Ensure the storage cap is secured tightly between uses and the pouch is returned to storage at +2°C to +10°C after each use. The pouch should be discarded after the fifth use.

Changing the Anode and Cathode Buffers

Change the anode and cathode buffers every 14 days or 240 injections to ensure optimal analysis results.

Both the anode and cathode buffers should be warmed to room temperature before installing on the Spectrum CE System. To begin the anode and cathode buffer cartridge replacement process, select the **Replace** button under the Anode and Cathode Buffer section of the Consumables screen. This will open the Anode and Cathode Buffer replacement wizard. Follow the instructions in the wizard. At the completion of the wizard, the 'Consumables' screen will be updated with the information of the new anode and cathode buffer cartridges. We recommend using a new Cathode Septa Mat with each new buffer change.

Changing the Polymer Pouch

Change the polymer pouch every 14 days to ensure optimal results.

Before beginning polymer pouch replacement, warm to room temperature before use. If you observe a precipitate, gently warm the polymer pouch to dissolve the precipitate before use. If you observe precipitate crystals in the pouch collar, replace the cap, then flick the pouch while holding from the cap end to move the crystals into the pouch.

To begin the polymer pouch replacement process, select the **Replace** button under the Polymer section of the 'Consumables' screen. This will open the Polymer Replacement wizard. Follow the instructions in the wizard. At the completion of the wizard, the 'Consumables' screen will be updated with the information of the polymer pouch.

Note: We recommend checking for polymer leaks during polymer pouch replacement. If you notice crystal formation at the array port or syringe head, clean these components with a lint-free cloth moistened with distilled water, and then dry them with a lint-free cloth. If you suspect a polymer leak, please contact Promega Technical Service (**genetic@promega.com**).

Changing the Capillary Array

Change the capillary array every 300 injections to ensure optimal results.

To begin the capillary array replacement process, select the **Replace** button under the Capillary Array section of the 'Consumables' screen. This will open the Capillary Replacement wizard. Follow the instructions in the wizard. After the capillary array is installed, the wizard performs a laser alignment to align the laser to the detection window. If the laser alignment fails, refer to Section 9.1. At the completion of the wizard, the 'Consumables' screen will be updated with the information of the capillary array.

6.2   Navigating the Utilities Screen

The **Utilities** button opens a screen with four tabs: the 'Manual Controls' tab, 'Wash' tab, 'Troubleshooting' tab and 'Administrative Log' tab.

The 'Manual Controls' Tab

The 'Manual Controls' tab contains four sections of commands: Autosampler, Plate, Capillary Array and General.
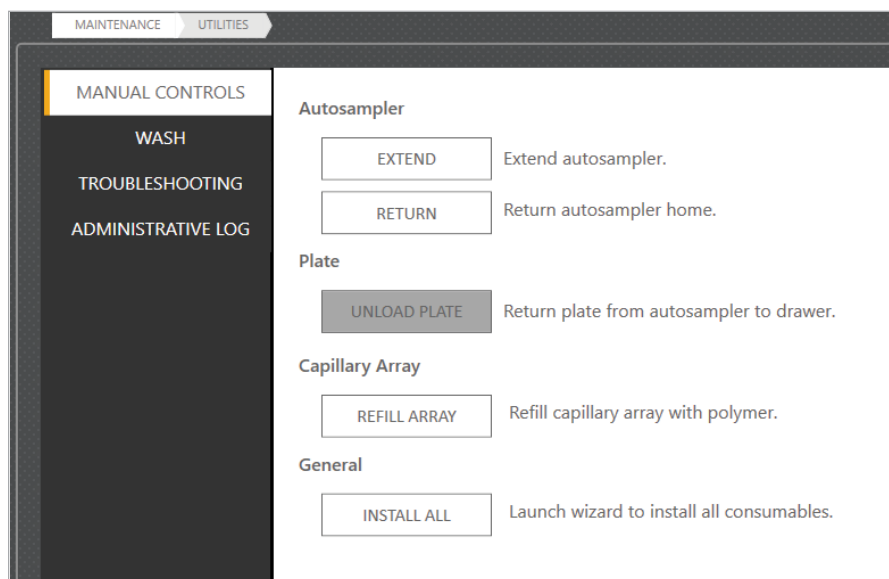
These three sections provide the following functions:

Section	Command	Function
Autosampler	Extend	Moves the autosampler out from underneath the array. This step is needed to access the cathode buffer cartridge during buffer change (see "Changing the Anode and Cathode Buffers" on page 68) or to gain access to the capillary array during an array change (see "Changing the Capillary Array" on page 69).
	Return	Moves the autosampler back under the array.
Plate	Unload Plate	Removes the plate from the upper portion of the instrument (i.e., on the autosampler or in the holding position) and returns it to its assigned position in the plate drawer. This function is needed if the instrument is interrupted in any fashion while a plate is in the upper portion of the instrument (e.g., run aborted, power failure, disconnection from control software). This command is only available when a plate is in the upper portion of the instrument.

Section	Command	Function
Capillary Array	Refill Capillary Array	Refills the capillary array with polymer. **Note:** The oven temperature must reach at least 58°C before an array fill can be performed.
General	Install All	Launches the Install All wizard to guide you through the process of installing all consumables at the same time for the first use of the instrument or after long-term shutdown of the instrument. You can make subsequent replacements in the order they are needed using the replacement wizards (see Section 6.1, page 65).

The 'Wash' Tab

The 'Wash' tab contains the System Wash wizard.
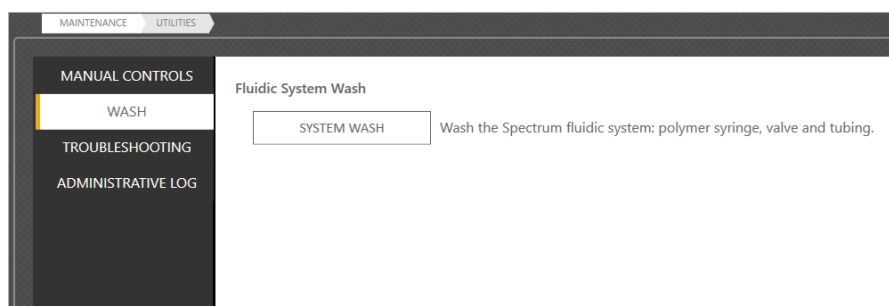
A system wash pushes Wash Solution through the fluidic system which includes the polymer syringe, valve and tubing. A system wash may be performed when suggested as part of a troubleshooting protocol.

Before beginning the wash process, warm a Wash Solution pouch to room temperature. Select **System Wash** to start the System Wash wizard. Follow the instructions in the wizard.

Note: Each Wash Solution pouch contains adequate volume for five separate uses. The number of remaining uses will be displayed during the wash procedure.

The 'Troubleshooting' Tab

The 'Troubleshooting' tab contains three sections of commands: Bubble Purge, Replace Syringe and Light Scatter Image.
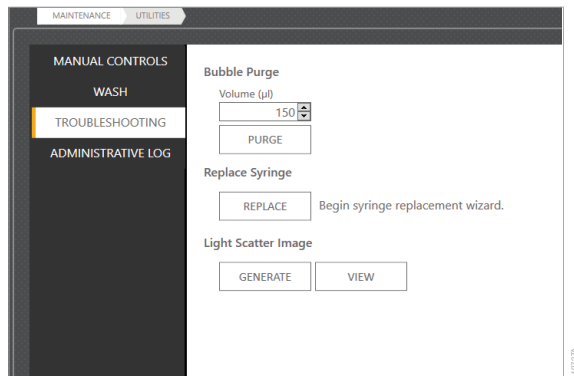
The Bubble Purge section provides a wizard for performing a bubble purge. You should perform a bubble purge when bubbles are present in the tubing, polymer, syringe or block. An option to perform a bubble purge is incorporated in the Polymer Replacement, Capillary Array Replacement and System Wash wizards.

To perform a bubble purge separately from these wizards, use the Purge command in the 'Troubleshooting' tab. Before beginning the bubble purge, ensure that the correct polymer purge volume based on the location of the bubble(s) (see the table below) is set in the provided field, then select **Purge** to open the Bubble Purge wizard. Follow the instructions in the wizard. When the wizard is complete, the Consumables screen will refresh with the updated remaining volume of polymer.

Bubble Location	Recommended Purge Volume
Before or inside fluid block	150µl
In tubing after fluid block	10µl

The Replace Syringe section provides a wizard for replacing the polymer syringe. The polymer syringe should be replaced every year. Contact Promega Technical Services at **genetic@promega.com** for replacement options.

The Light Scatter Image section provides a diagnostic troubleshooting tool. When requested by Promega Technical Services, select **Generate** to create an image to send to: **genetic@promega.com**.

Administrative Log

The 'Administrative Log' tab displays a list of all user actions.
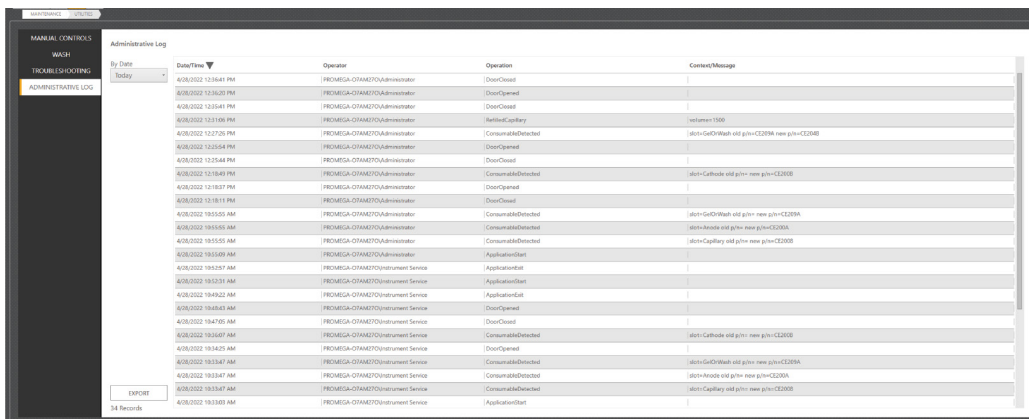
Each entry for a user action contains four categories of information:

Category	Information
Date/Time	Displays the date and time the action was executed. The arrow allows documents to be sorted in ascending or descending order.
Operator	Displays the name of the user logged in when the action was executed.
Operation	Displays the type of operation executed.
Context/Message	Displays the context or message recorded in the event log at the time the action was executed.

The action list can be filtered by date (Today, 7 Days, 30 Days, 3 Months, 6 Months, 1 Year) to limit the number of actions to review. Clicking an action displays an Audit Message dialog box describing the details of the action, if any exist. You can export administrative log records as a text file to a specified location using the **Export** button to the left of the list.

Managing Instrument Settings

7

The Settings menu contains four buttons for setting and managing various instrument features: Protocols, System Information, Preferences and Export Logs.
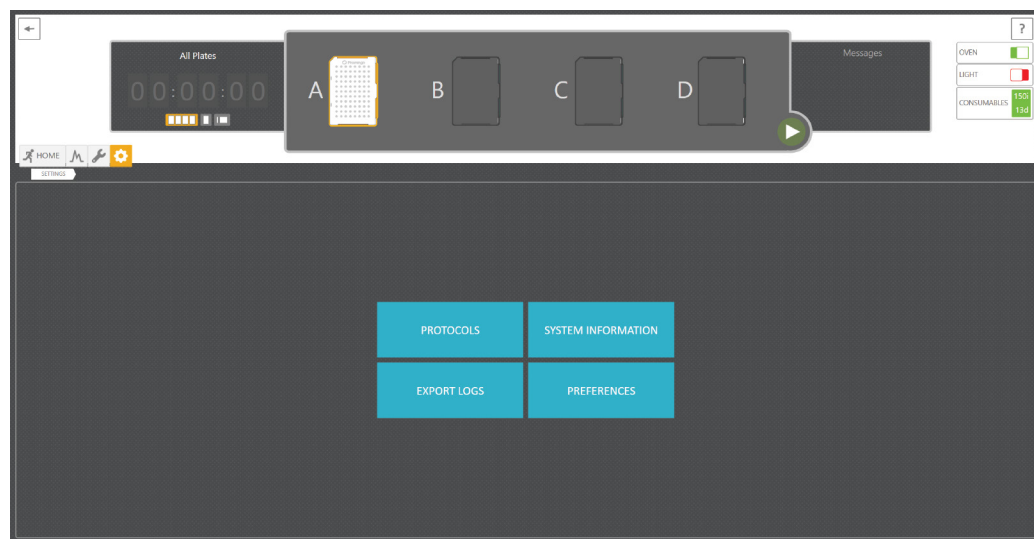
7.1   Managing Protocols

The **Protocols** button will open the Protocols screen and display all protocols that are saved in the software. The Protocols screen is divided into four main sections: Protocol Document Management, Filters, Protocol List and Protocol Parameters.
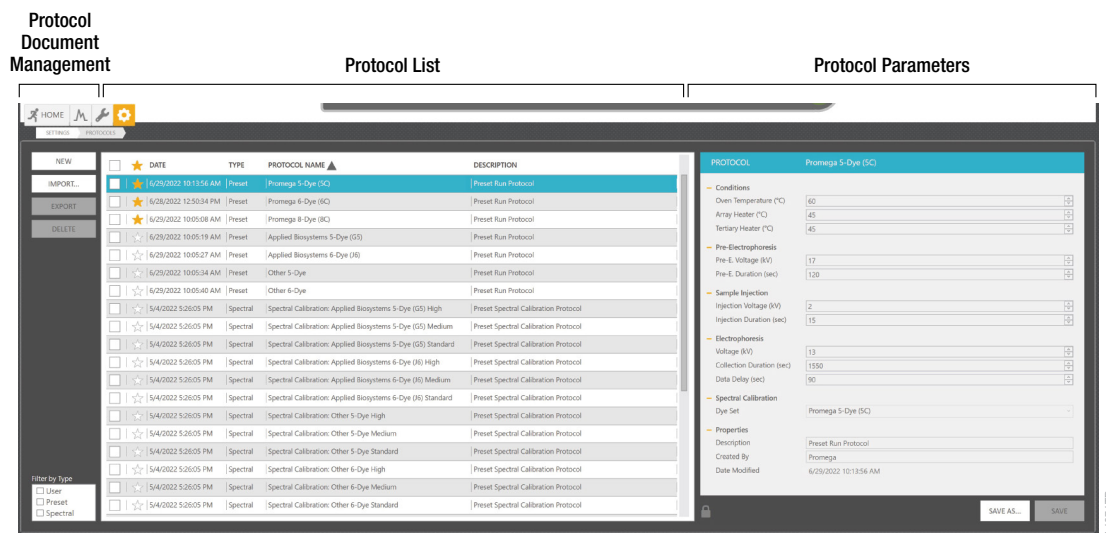
The Protocol Document Management section provides four options:

Command	Function
New	Creates a new protocol document in the Protocol Parameters section.
Import	Opens a browsing window to locate and import an existing protocol file in the Promega Protocol (.protocols or .pro) file format.
Export	Opens a browsing window to export the selected protocol file to the desired location in the Promega Protocol (.protocols or .pro) file format. **Note:** These files are only read by Spectrum Control Software.
Delete	Deletes selected protocol document(s).

The Filter section displays four options for filtering the list of protocols based on protocol type: User, Preset and Spectral.

The Protocol List section provides a list of all saved protocol documents. Each entry for a protocol contains six potential categories of information:

Category	Information
Selection Checkbox	Checking this box in the header selects all protocols in the list. Checking a box in front of a single protocol selects only that protocol.
Favorite ⭐	Selecting the star to the right of the check box for a protocol marks the protocol as a favorite.
Date	Displays the date and time the protocol was created.
Type	Displays the type of protocol: Preset, User or Spectral.
Protocol Name	Displays the name of the protocol. The arrow allows documents to be sorted in ascending or descending alphabetical order.
Description	Displays the type of protocol that the document contains. This field is defined by the user unless the protocol is a manufacturer's preset protocol. There are two types of preset protocols:
	Preset Run Protocol — Run protocol preset by the manufacturer. These protocols cannot be modified without saving as a new document.
	Preset Spectral Calibration — Spectral calibration protocol preset by the manufacturer. These protocols cannot be modified without saving as a new document.

The Protocol Parameters section displays the detailed parameters of the protocol. There are six parameter sections:

Parameter		Information	Minimum Value Allowed	Maximum Value Allowed
Conditions	Oven Temperature (°C)	Defines the target oven temperature setting for the protocol	60	70
	Array Heater (°C)	Defines the target array heater temperature setting for the protocol	0	70
	Array Heater (°C)	Defines the target tertiary heater temperature setting for the protocol	0	70
Pre-electrophoresis	Pre-E. Voltage (kV)	Defines the voltage applied during pre-electrophoresis	0	20

Parameter		Information	Minimum Value Allowed	Maximum Value Allowed
Pre-electrophoresis	Pre-E. Duration (sec)	Defines the duration of the during pre-electrophoresis	0	3,600
Sample Injection	Injection Voltage (kV)	Defines the voltage applied during sample injection	0	20
	Injection Duration (sec)	Defines the duration of the sample injection	0	3,600
Electrophoresis	Voltage (kV)	Defines the voltage applied during electrophoresis	0	20
	Collection Duration (sec)	The time needed to complete the run and collect data from all labeled fragments.	0	3,600
	Data Delay (sec)	The time to delay data collection while	0	3,600
Spectral Calibration	Dye Set	Defines the dye set to apply to the collected data.	Assigned using the drop-down menu	Assigned using the drop-down menu
Properties	Description	Defines the type of protocol. This is optional for a user-defined protocol and prepopulated for preset protocols	1 Character	50 Characters
	Created By	Defines the creator of the protocol. This is optional for a user-defined protocol and prepopulated for preset protocols	1 Character	50 Characters
	Date Modified	Displays the last modified date. This field is not editable.	N/A	N/A

N/A = Not applicable.

Creating or Modifying Protocols

You can create a new run protocol by clicking the **New** button in the Protocol Document Management section. This opens the 'New Protocol' window.

1. Enter the desired name for the new protocol, then select **OK**. The new protocol is now listed in the Protocol List with the default settings displayed in the Protocol Parameters section.

2. Verify or change the desired settings in the Protocol Parameters section.

3. Select **Save** to keep the parameters of the new protocol.

Alternatively, you can modify an existing run protocol.

1. Locate and select the desired protocol in the Protocol List.

2. Edit the desired settings in the Protocol Parameters section.

3. Select **Save** to overwrite the existing run protocol or **Save As** to save as a new protocol.

   Notes:

   a. If the protocol you wish to modify is a Preset Run Protocol, select **Save As** to first save the modified protocol as a new protocol. Preset Run Protocols cannot be overwritten.

   b. User-defined protocols are locked for editing after they are created. To unlock a user-defined protocol, select the **Locked** button at the bottom of the Protocol Parameters section. The button changes to "Unlocked", indicating the protocol is open for editing. To lock the protocol again, select the **Unlocked** button.

7.2   Viewing System Information

The **System Information** button displays a dialog box containing information about the instrument and software (e.g., revisions, serial numbers, instrument name). None of these fields are editable. To change the name of the instrument, refer to Setting Instrument Preferences.

7.3   Setting Instrument Preferences

The **Preferences** button opens a screen with seven tabs: Temperature, Plate Import, Data Export, Archive, Instrument, Notifications and Calibration.
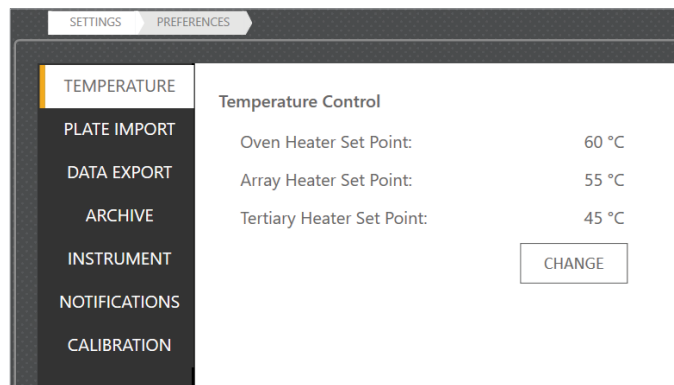
Oven and Heater Temperatures

The 'Temperature' tab displays the the set points for the oven, array and tertiary heaters. Each of these can be adjusted to the desired temperature by clicking the **Change** button, which opens the Oven window. The settings here are applied when the oven is set to preheat. Once a protocol is started, the oven, array, and tertiary heater settings for the protocol are applied.

Plate Import File Paths

The 'Plate Import' tab allows you to specify the file path where plate record files for both automatic import (via a barcoded label) and manual import (via the **Import Plate** button) are located. The default file path for both is **C:\Plates.** To change either file path, choose the **Select Folder** button and browse to the desired folder location. The "Activate Auto Plate Import" box must be checked to use the automatic import from barcode feature. For more information on importing plate documents via barcoded labels or manual import, see "Creating a Plate from an Imported File via the Home Menu" on page 48 and Section 4.2.
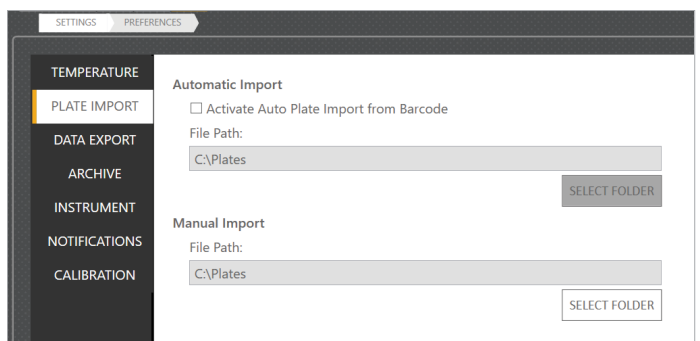
Data Export

The 'Data Export' tab allows you to define data export settings. In the Export section, the File Path field defines where the .promega data files are exported. **Note:** A new folder is created in this file path for each completed run based on the Plate ID (Section 4.2) . The default file path is C:/Export. To change the file path, choose the **Select Folder** button and browse to the desired folder location.

The Exported Filename section provides options for including or excluding information fields to the exported filename.
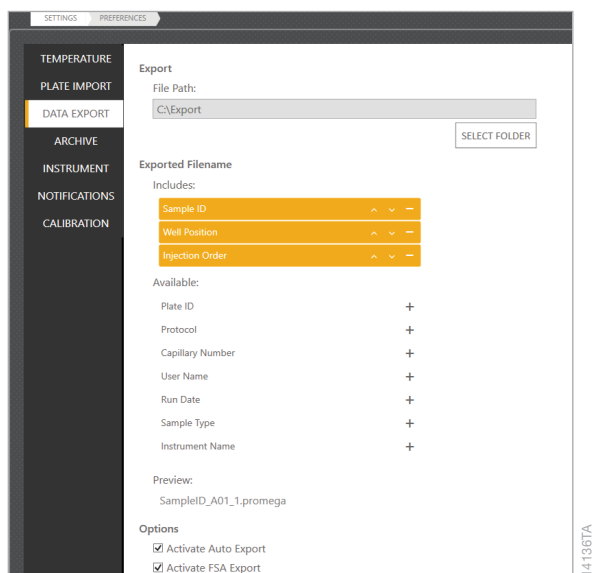
To add file name fields to the sample file name structure, select [**+**] button next to the desired field(s) from the Available section. Selected fields will be listed in the Includes section and their order within the name can be sorted by using the up and down arrows. To remove a field from the selection, click the [**-**] button. An example of the filename is displayed in the Preview section.

Note: If an invalid character is used in a field that is part of the exported data filename, that character will be automatically replaced with an underscore when exported.

There are two check boxes in the Options section: Activate Auto Export and Activate FSA Export. Selecting Activate Auto Export automatically exports .promega data files to the designated Export File Path at the completion of an injection. Selecting Activate FSA Export exports .fsa data files in addition to the .promega data files. Data files are saved in a folder named for the Plate ID with the suffix "-Promega" for .promega files and "-FSA" for .fsa files.

Note: Promega eight-dye STR kits are only compatible with the .promega file format.

Data Archives

The 'Archive' tab allows you to archive .promega data files of completed plates.
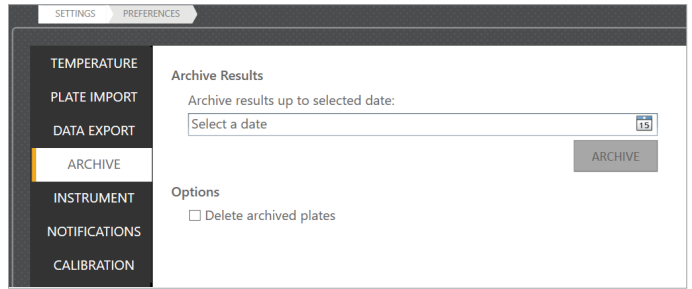
To archive data, enter or select a date in the provided space. Plates older than the date entered will be archived in the specified folder. Selecting the "Delete archived plates" check box deletes the archived plate records from the Spectrum software. This feature allows you to save space in the software and limit the number of results shown in the Review Plates List.

Caution! This step is irreversible. Deleted plates cannot be imported back into the Spectrum software.

Instrument Name

The 'Instrument' tab displays an area to specify the Instrument Name. You can change the name of the instrument by typing in the field and selecting **Assign**.

Note: 1 to 50 characters are allowed. Any characters are allowed; however, if an invalid character is used and the instrument name is part of the exported data filename (see Data Export), that character will be automatically replaced with an underscore during export. A name change will not be applied until the software is closed and restarted.
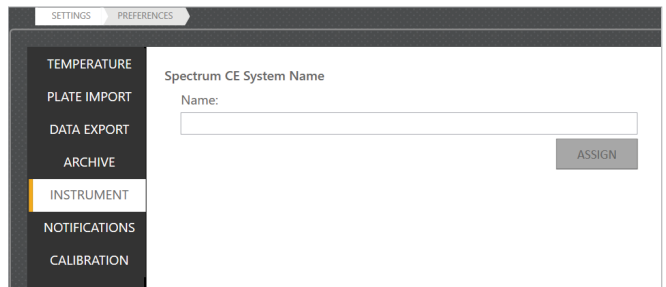
Notifications

The 'Notifications' tab allows you to set up system notifications to be sent to specified e-mail recipients through an SMTP server. The instrument computer must have network access to the email server to use this feature.

To set up notifications:

1. Enter the appropriate information in the Email Gateway Account section.

2. Enter the name of the user for the email account from which notifications will be sent in the Name field.

3. Enter the e-mail address from which notifications will be sent in the Account field.

4. Enter the password for the e-mail address in the Password field.

5. Enter the SMTP Server associated with the e-mail address in the SMTP Server field.

6. Enter the appropriate port number in the Port field by typing in the field or using the Up or Down arrows on the right side of the field.

7. Check the "Use SSL encryption" box if the email account uses an SSL encrypted connection.

Note: Contact your IT department to provide the information required to complete the Email Gateway Account settings.

To specify notification recipients and conditions for sending notifications, enter and select the appropriate information in the Notifications section:

1. Enter the e-mail address(es) of the notification recipient(s). Separate individual email addresses by a space.

2. Check "Notify on Completion" to send a notification when a run is complete.

3. Check "Notify on Error" to send a notification if a system error occurs during a run.

After completing the Email Gateway Account and Notifications sections, select **Test** at the bottom of the window. SCS will attempt to send a test e-mail to the designated e-mail recipients. A message indicating the success or failure of the test e-mail is displayed above the **Test** button. If the test e-mail failed, verify the account settings and e-mail address with your IT department.

7.4   Export Logs

The **Export Logs** button exports a compressed folder of log files that can be sent to Promega Technical Services. To export log files:

1. The **Export Logs** button will open a browsing window.

2. Navigate to the location to save the files, then select **OK**.

3. A confirmation window is displayed after the files are exported. Select **DONE** to close the window or **OPEN** to open saved folder location.

Shutting Down the Instrument

<div style="text-align: right; font-size: 3em;">8</div>

There are two levels of shutdown for the Spectrum CE System:

- Short-term shutdown, such as during a reboot of the system
- Long-term shutdown

8.1   Short-Term Shutdown

Follow These Steps

1. Confirm that the instrument is not currently in use (blinking green light).

2. Verify that the autosampler is positioned under the oven.

3. Close the Spectrum Control Software by selecting the [**x**] button in the upper right corner.

4. Turn off the instrument by pressing the power button on the front left side of the instrument for 5 seconds. All lights on the power button will go out.

⚠ **Caution!** Any plates present in the plate drawer and linked to a plate position will be unlinked when the software is closed or the instrument is turned off. If either of these actions occur while a plate is running, the run will be aborted and marked as such upon restart.

8.2   Long-Term Shutdown

The long-term shutdown procedure should be performed if the instrument will be out of use for more than 2 weeks.

Follow These Steps

1. Use the System Wash wizard in the 'Wash' tab of the 'Utilities' screen in the Maintenance menu (see Section 6.2) to fill the fluidic path with Wash Solution.

2. Select **NO** at the end of the wizard when asked if you would like to install a polymer pouch.

3. Keep the installed anode and cathode buffers in place.

4. Confirm that the instrument is not currently in use (blinking green light).

5. Verify that the autosampler is positioned under the oven.

6. Close the Spectrum application by selecting the [**x**] button in the upper right corner.

7. Turn off the instrument by pressing the power button on the front left side of the instrument for 5 seconds. All lights on the power button will go out.

8. Monitor the buffer levels while the instrument is in this state. If the cathode electrodes are no longer submerged in the buffer, start the system (see Section 2.1), and replace the anode and cathode buffers using the buffer replace wizard on the 'Consumables' screen of the Maintenance menu.

   Note: Do not store the array off the instrument.

Restarting the system after a long-term shutdown:

1. Turn on the instrument and computer as described in Section 2.1.

2. Use the System Wash wizard in the 'Wash' tab of the 'Utilities' screen in the Maintenance menu (see Section 6.2).

3. Select **YES** at the end of the wizard when asked if you would like to install a polymer pouch.

4. Replace the anode and cathode buffers using the buffer replace wizard on the 'Consumables' screen of the Maintenance menu.

Troubleshooting

<div style="text-align: right; font-size: 3em;">9</div>

For questions not addressed here, contact your local Promega Branch Office or Distributor.
Contact information available at: **www.promega.com**
E-mail: **genetic@promega.com**

9.1   Instrument

Symptom	Causes and Comments
Power failure during a run	In the event of a power failure, turn off the instrument, using the main power switch on the back of the instrument, and the system computer. When power has returned, turn the instrument and computer back on. If prompted, unload the plate (see Section 6.2).
	We recommend connecting the instrument and computer to a UPS to account for inconsistent or loss of power (see Section 1.5).
The instrument does not respond	Power button light is off. Verify the power cords are securely connected to the computer, monitor and instrument. Verify the instrument is turned on and connected to the PC.
	Power button light is amber. Verify the USB cable is securely connected between the computer and the instrument.
	Power button light is amber. Attempt to connect instrument using the **Instrument Offline – Click to Connect** button in the bottom right of the software (see Section 2.2).
	Power button light is steady green or blinking green. Restart the system as described in Section 9.5. Launch the Spectrum Control Software. If the issue is not resolved, contact Promega Technical Services for further assistance.

Symptom	Causes and Comments
Plate dropped inside the instrument, behind drawer	Failed to load or unload the plate. **Caution!** You must turn off the instrument using the main power switch on the back of the instrument, then unplug the instrument. With instrument unplugged, hold the instrument power button for 10 seconds.
	Verify no light is emitting from the power button before retrieving the plate from the interior of the instrument. Once the plate is retrieved, then plug in the instrument, turn it on and connect it to the software (see Sections 2.1 and 2.2). If the plate cannot be retrieved, contact Promega Technical Services.
Plate drawer does not open	Instrument is turned off. Confirm that the instrument is turned on and connected to the software (see Sections 2.1 and 2.2).
	The plate drawer is locked, Drawer Lock is displayed in the Message Center. The instrument may be accessing the plates in the drawer. The drawer will unlock when the task is finished. If the drawer remains locked, restart the system as described in Section 9.5.
Open plate drawer detected during the end of a run	Plate drawer was opened during the run and the instrument attempted to access the drawer. The run will be aborted.
Open upper door detected during a run	Upper door was opened during the run. The software will abort the run after 10 seconds if the door is not closed.
Cannot add an injection	A sample ID must be present in at least one well of an injection set for a run protocol to be assigned to the set.
	The maximum number of four injections has already been assigned to the set.
Plate not shown in the Plate Position Indicator	Verify the plate is seated properly in one of the drawer plate positions.
	Plate is already linked to another plate record. Unlink the plate from the other record to link to a new record.
	Verify the instrument is connected to the software.
Unable to start a run	Verify a plate has been linked in the software.
	Verify the instrument is connected to the software.
	Verify the upper door and plate drawer are closed.
	The dye set for one or more of the injections on the plate is not calibrated. Please calibrate all required dye sets before starting the run.

Symptom	Causes and Comments
System-based aborted runs	Two automatic bubble purges triggered during a run. Inspect the fluidic system for the presence of bubbles. Inspect the capillary array for signs of damage.
	Maximum injections of polymer reached during the run due to automatic bubble purges being triggered.
	Disk space low. Clear up disk space or remove archived data.
Cannot read RFID tag on consumables. RFID mismatch	Verify RFID tag is present on consumables.
	Verify consumables have been installed correctly.
	Verify the correct consumables are installed (e.g., Wash Solution pouch is installed for System Wash or Polymer pouch is installed for electrophoresis).
	Faulty RFID tag. Install a new consumable.
Unstable current. Multiple bubble purges during or between successive injections.	Inspect the fluidic system for the presence of bubbles. If bubbles are present in the tubing, polymer syringe or fluidic block, execute a bubble purge as described in Section 6.2.
	Cathode end of the capillary array are not completely submerged due to evaporation of buffers during a prolonged period of nonuse of the Spectrum CE System. Replace the anode and cathode buffer cartridges using the buffer replace wizard.
High run current	Old polymer (on the instrument for more than 2 weeks) or expired polymer can have higher than normal current during electrophoresis and longer run times, especially for larger fragments. Replace with a Spectrum Polymer Pouch that is within its expiration date.
Changing baseline during electrophoresis	Contaminants present in electrophoretic system. Replace with new Spectrum Capillary Array, Polymer Pouch, ABC and CBC.

Symptom	Causes and Comments
Poor quality data on Spectrum Capillary Array with less than 300 injections	Damage to a capillary or capillaries may result in polymer leakage. Check the Spectrum Capillary Array for evidence of polymer leakage (white crystals appearing somewhere along the length of capillary). If damage is detected, replace the Spectrum Capillary Array.
	Old polymer (on instrument for more than 2 weeks), expired polymer or both was used. Install a fresh Spectrum Polymer Pouch and reinject samples. Other symptoms of old polymer include higher than normal current during electrophoresis and longer run times, especially for larger fragments.
	Cathode end of the capillary array are not completely submerged due to evaporation of buffers during a prolonged period of non-use of the Spectrum CE System. Replace the anode and cathode buffer cartridges using the replace wizard. If instrument will not be used for an extended period (>2 weeks), run the System Wash wizard (see Section 6.2) leaving the Wash Solution pouch installed.
	Poor-quality formamide used with high conductivity. Prepare sample with fresh Hi-Di™ formamide.
Spikes in data	Ensure that the Spectrum Polymer Pouch is within the expiration date. If expired, replace with a fresh Spectrum Polymer Pouch.
	Inspect the fluidic system for the presence of bubbles. If bubbles are present in the tubing, polymer syringe, or fluidic block, execute a bubble purge as described in Section 6.2.
	Contaminants or crystals in Spectrum polymer pouch. Warm to room temperature before use. If you observe precipitate crystals in the pouch collar, replace the cap, then flick the pouch while holding from the cap end to move the crystals into the pouch. If you observe a precipitate, gently warm the Spectrum polymer pouch to dissolve the precipitate before use. For other contaminants, replace with a new Spectrum polymer pouch.
Sharp peaks in the same size range across an entire injection	Dropped camera frames. Do not run virus scans or other software during a run. Refer to Section 1.16 for proper system computer configuration.

Symptom	Causes and Comments
Failed laser alignment	Spectrum Capillary Array not installed correctly. Reinstall capillary array using the replace wizard. Confirm that the detection window is seated on the instrument. Replace wizard performs laser alignment to the array.
	Dust or dirt on capillary array window. Inspect capillary array window for dust or dirt. Gently remove dust with a bulb blower pointing away from the optics window. Reinstall and repeat capillary array replace wizard.
	Incomplete polymer fill. Repeat laser alignment using capillary array replace wizard. If issue persists, inspect the fluidic path for leaks. If leaks are observed, contact Promega Technical Services.
	Damaged Spectrum Capillary Array. Inspect capillary array for damage or defects. If damage is observed, replace with a new Spectrum Capillary Array.
	Signal not found. Reseat the array detection window and ensure the detection window cover is securely fastened. Repeat the capillary array replace wizard.

9.2   Calibration

Symptom	Causes and Comments
Spatial calibration failure	Insufficient data collected for spatial calibration. No frames collected. Check that the instrument-camera cable is connected to the computer.
	Failed to identify X capillaries (Y found). Incorrect preparation of matrix standard. Confirm that the matrix standard was prepared correctly. Check the matrix standard, reagent expiration date and storage conditions. Refer to the appropriate manufacturer's instructions for use of the matrix standard for additional troubleshooting suggestions.
	Capillary #X: Insufficient number of matrix peaks detected (Y found). Incorrect injection conditions. Adjust the injection protocol as needed (e.g., data delay, collection duration, injection duration).
	Spectral Calibration Failure – Capillary #X: Invalid number of distinct emissions (Y found). • Incorrect matrix standard used for dye set. Confirm that the correct matrix standard was run with the correct dye set. • Peaks observed that migrate before the matrix standard peaks. Adjust the analysis start point and re-analyze (see Section 3.2). • Unexpected peaks that migrate before the matrix standard peaks may indicate carryover from a previous injection. Replace Spectrum ABC and CBC and the Spectrum Cathode Septa Mat to eliminate any potential sources of contamination from a previous injection.

Symptom	Causes and Comments
No peaks detected in any capillary or abnormal peak morphology for each capillary resulting in failing spatial calibration	Incomplete polymer fill or poor electrophoresis conditions. Repeat calibration.
	Spectrum Capillary Array not installed correctly. Reinstall capillary array using the replace wizard. Confirm that the detection window is seated on the instrument. Replace wizard performs laser alignment to the array.
	Damaged Spectrum Capillary Array. Inspect capillary array for damage or defects. If damage is observed, replace with a new Spectrum Capillary Array.
	Dust or dirt on capillary array window. Inspect capillary array window for dust or dirt. Gently remove dust with a bulb blower pointing away from the optics window. Reinstall and repeat calibration.
No peaks detected in one or more dye channels for matrix standards	Incorrect matrix standard used for dye set. Confirm that the correct matrix standard was run with the correct dye set.
	Bubbles in the sample well. Centrifuge 96-well plate to remove air bubbles and repeat calibration per Section 3.
	Confirm that eight wells of 96-well plate containing matrix standard have been loaded into wells A1 through H1. If matrix standard-containing wells are not in these positions, they will not be injected and no peaks will be detected.
	Poor-quality formamide used with high conductivity. Prepare sample with fresh Hi-Di™ formamide.
	The cathode end of the Spectrum Capillary Array did not enter the sample, preventing electrokinetic injection of the matrix standard. Check the sample volumes. Volumes as low as 10µl result in successful injection, but lower volumes will increase the likelihood for injection failures. If insufficient volume is present, increase the volume to >10µl and repeat calibration. If volume is sufficient and no peaks are detected, contact Promega Technical Services.
	Confirm that the matrix standard was prepared correctly. Check the matrix standard, reagent expiration date and storage conditions. Refer to the appropriate manufacturer's instructions for use of the matrix standard for additional troubleshooting suggestions.

Symptom	Causes and Comments
Spectral calibration failure	Check the raw data of the failed capillaries. Look for signs of low peak heights, incorrect dye order for matrix standard (may indicate incompatible dye set used for matrix standard), high baseline noise, spikes or unexpected additional peaks that migrate before the matrix standard peaks. Adjust the analysis start point and re-analyze (see Section 3.2).
	Incorrect matrix standard used for dye set. Confirm that the correct matrix standard was run with the correct dye set. Possible failure messages: Insufficient peak count, Distinct emission mismatch, Out of order peaks.
	Insufficient spectral calibration data. Insufficient peaks. Peaks present for matrix standard in raw data but too low to generate a spectral calibration (less than 50RFU above the baseline). Check the matrix standard, reagent expiration date and storage conditions. Refer to the appropriate manufacturer's instructions for use of the matrix standard for additional troubleshooting suggestions.
	Collection duration too short. Adjust the injection protocol.
	Poor-quality formamide used with high conductivity. Prepare sample with fresh Hi-Di™ formamide.
	Unexpected peaks that migrate before the matrix standard peaks may indicate carryover from a previous injection. Adjust the analysis start point and re-analyze (see Section 3.2). Replace Spectrum ABC and CBC and the Spectrum Cathode Septa Mat to eliminate any potential sources of contamination from a previous injection.
	Confirm that the matrix standard was prepared correctly. Check the matrix standard, reagent expiration date and storage conditions. Refer to the appropriate manufacturer's instructions for use of the matrix standard for additional troubleshooting suggestions.
	Invalid calibration request. Corrupt calibration settings. Contact Promega Technical Services.
	Corrupt or missing calibration data. Corrupt calibration procedure. Check available system disk space and memory. Restart the system.

Symptom	Causes and Comments
Elevated spectral bleedthrough in one or more capillaries	If elevated spectral bleedthrough is observed in one or more capillaries after installing a new capillary array, reinstall the capillary array using the replace wizard. Confirm that the detection window is seated on the instrument correctly. **Note:** After uninstalling and reinstalling the capillary array, perform a new calibration before running samples.
Spectral calibration history does not display previously run calibration	Calibrations are reset on array replacement.

9.3   Fragment Analysis

Symptom	Causes and Comments
No peaks	Poor-quality formamide was used with high conductivity. Prepare sample with fresh Hi-Di™ formamide.
	Bubbles in the sample well. Centrifuge 96-well plate to remove air bubbles and reinject the samples.
	If peaks are detected at the expected height for your internal lane standard, this indicates that injection is performing as expected, and the absence of sample peaks may be due to poor amplification with the fragment analysis kit. Refer to the amplification troubleshooting section of the manual of the fragment analysis kit being used.
	Damaged Spectrum Capillary Array. Inspect capillary array for any damage or defects. If damage is observed, replace with an undamaged Spectrum Capillary Array.
	The cathode end of the Spectrum Capillary Array did not enter the sample, preventing electrokinetic injection of the matrix standard. Check the volume of samples. Volumes of sample as low as 10µl result in successful injection, but lower volumes will increase the likelihood for injection failures. If insufficient volume is present, increase the volume to >10µl and repeat calibration. If volume is sufficient and no peaks are detected, contact Promega Technical Services.

Symptom	Causes and Comments
Peak intensity too high	If peaks are detected at expected height for your internal lane standard, this indicates that injection is performing as expected, but the high intensity peaks in your sample may be a result of over-amplification of template DNA with the fragment analysis kit. Refer to the amplification troubleshooting section of the manual of the fragment analysis kit being used.
	If internal lane standard peaks are of higher signal intensity than expected as well as those in your sample, then the injection voltage and/or time may be too high and/or that the volume of internal lane standard in the loading cocktail is too high. Ensure that the correct volume of internal lane standard and sample was added to the loading cocktail and reduce if volumes are too high. If volumes of internal lane standard and sample are correct, repeat injection with a reduced injection time.
Peak intensity too low	Poor-quality formamide was used with high conductivity. Prepare sample with fresh Hi-Di™ formamide.
	Salt from the amplification reaction can compete with amplified DNA for electrokinetic injection. Adding too much volume of amplification reaction to the sample loading cocktail can reduce peak heights. If higher signal is desired, either reamplify your sample with more DNA (refer to the amplification troubleshooting of the fragment analysis kit being used) or repeat injection with an increased injection time.

Symptom	Causes and Comments
Poor resolution	Samples were over-injected. If sample peak heights are too high, use less sample volume and/or reduce injection time. Alternatively, reamplify with less DNA (refer to the amplification troubleshooting section of the manual of the fragment analysis kit being used).
	Old polymer (on instrument for more than 2 weeks), expired polymer or both was used. Install a fresh Spectrum Polymer Pouch and reinject samples. Other symptoms of old polymer include higher than normal current during electrophoresis and longer run times, especially for larger fragments.
	Spectrum Capillary Array with more than 300 injections was used. Greater than 300 injections may result in poor resolution. Replace Spectrum Capillary Array and reinject samples.
Poor signal and/or capillary-to-capillary signal variation	If low signal and/or high variation in signal from capillary to capillary is observed after installing a new capillary array, reinstall the capillary array. Completely remove the capillary array and reinstall using the replace wizard. Confirm that the detection window is seated on the instrument correctly. **Note:** It is necessary after uninstalling and reinstalling the Capillary array to perform a calibration before running samples.

9.4   System Error Codes

System error codes are displayed in the following format: <Command Error Code> - <Proxy Error Code> - <Firmware Error Code>

9.4.1   Command and Proxy Error Codes

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Drawer and Door	100	-	Failed to lock drawer	Firmware-lock interface failure. Restart the system. If the error persists, contact Promega Technical Services.
		6001		Drawer not closed. Ensure the plate drawer is closed. If error reoccurs, restart the system. If the error persists, contact Promega Technical Services.
		6008		Drawer not locked. Restart the system. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Drawer and Door (continued)	101	-	Failed to unlock drawer	Restart the system. If the error persists, contact Promega Technical Services.
		6010		Drawer unlock timeout. Restart the system. If the error persists, contact Promega Technical Services.
	102	-	Failed to read lock sensors	Component failure or operation timed out. Ensure the plate drawer is closed. Check the placement of plates in the drawer to ensure proper position. If error reoccurs, restart the system. If the error persists, contact Promega Technical Services.
	103	-	Failed to read drawer plate sensors	
	104	-	Failed to read drawer open sensor	
	105	-	Failed to read barcodes	Defective barcode reader or communication failure. Check the placement of plates in the drawer to ensure proper position. If error reoccurs, restart the system. If the error persists, contact Promega Technical Services.
	106	-	Failed to read door sensor	Defective door sensor or communication failure. Ensure the instrument door is closed. If the error reoccurs, restart the system. If error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Heater and Oven	200	-	Failed to turn heater on	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		4000		Target heater temperature out of range. Restart the system. If the error persists, contact Promega Technical Services.
	201	-	Failed to turn heater off	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	202	-	Failed to read heater temperature	
	203	-	Failed to turn fan on	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		4001		Target fan speed out of range. Restart the system. If the error persists, contact Promega Technical Services.
	204	-	Failed to turn fan off	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	205	-	Failed to read oven door sensor	Defective oven door sensor or communication failure. Restart the system. If the error persists, contact Promega Technical Services.
	206	-	Failed to read oven door sticky flag	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	207	-	Failed to reset oven door sticky flag	

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Heater and Oven (continued)	208	-	Oven fan speed is out of range	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		4005		Oven fan speed is out of range. Restart the system. If the error persists, contact Promega Technical Services.
Initialization	300	-	Failed to initialize instrument	Initialization failure due to mandatory component failure, timeout, or incomplete self-test. Restart the system. If the error persists, contact Promega Technical Services.
		6001	Failed to initialize, please make sure the drawer is closed.	Drawer not closed. Ensure the plate drawer is closed. If error reoccurs, restart the system. If the error persists, contact Promega Technical Services.
		6002	Failed to initialize, please make sure the current slot is not occupied.	Check drawer for plate. Select **Unload Plate** from the header or the 'Troubleshooting' tab of the Utilities submenu. Restart the system. If the error persists, contact Promega Technical Services.
	301	-	Firmware incompatible	Software-firmware incompatibility detected. Restart the system. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
High Voltage	400	-	Failed to turn voltage on	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		9000		Cannot verify voltage reached. Restart the system. If the error persists, contact Promega Technical Services.
		9003		Voltage calibration missing. Restart the system. If the error persists, contact Promega Technical Services.
	401	-	Failed to turn voltage off	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		9003		Voltage calibration missing. Restart the system. If the error persists, contact Promega Technical Services.
	402	-	Failed to read voltage	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	403	-	Failed to read current	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		9001		Injection current failure. Restart the system. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
High Voltage (continued)	405	-	Failed to calibrate high voltage	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		9000		Failed to verify target voltage. Restart the system. If the error persists, contact Promega Technical Services.
Pump and Valve	500	-	Failed to initialize pump	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	501	-	Failed to inject	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		5000		Aspirate flow rate out of range. Restart the system. If the error persists, contact Promega Technical Services.
		5001		Dispense flow rate out of range. Restart the system. If the error persists, contact Promega Technical Services.
		5005		Pump operation aborted. Restart the system. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Pump and Valve (continued)	502	-	Failed to aspirate	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		5000		Aspirate flow rate out of range. Restart the system. If the error persists, contact Promega Technical Services.
		5003		Cannot aspirate more volume. Restart the system. If the error persists, contact Promega Technical Services.
	503	-	Failed to dispense	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		5001		Dispense flow rate out of range. Restart the system. If the error persists, contact Promega Technical Services.
		5004		Cannot dispense more volume. Restart the system. If the error persists, contact Promega Technical Services.
	504	-	Failed to initialize valve	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	505	-	Failed to turn valve to capillary	
	506	-	Failed to turn valve to anode buffer	

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Pump and Valve (continued)	507	-	Failed to auto bubble purge	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		5003		Cannot aspirate more volume. Restart the system. If the error persists, contact Promega Technical Services.
Motion	600	-	Failed to set motion current	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	601	-	Failed to read motion opto-interruptors	
	604	-	Failed to initialize test deck	
	605	-	Failed to initialize transfer arm	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		6007		All drawer plate positions are occupied. Remove all plates. Restart the system. If the error persists, contact Promega Technical Services.
		6002		Intended plate position is occupied. Remove all plates from the plate drawer. Restart the system. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Plate Loading	700 or 701	-	Failed to load plate	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		6000		Transfer arm not at home position. Restart the system. If the error persists, contact Promega Technical Services.
		6001	Failed to load plate, please make sure the drawer is closed.	Cannot load plate when drawer is open. Run will be aborted. Close the plate drawer and restart the run.
		6003	Failed to load plate	Autosampler plate sensor is on. Check the plate drawer and autosampler to verify the plate position. If the plate is not in the plate drawer, select **Unload Plate** from the header or the 'Troubleshooting' tab of the Utilities submenu. If error reoccurs, restart the system. If the error persists, contact Promega Technical Services.
		6005	Failed to unload plate, please make sure the slot is empty.	Cannot unload the plate when the return plate position in the drawer is occupied. Ensure the position is empty.
		6006	Failed to unload plate	Remove all plates from the plate drawer. Restart the system. If the error persists, contact Promega Technical Services.
		6007	Failed to unload plate	Remove all plates from the plate drawer. Restart the system. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Plate Loading (continued)	702	-	Failed to clamp plate	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	703	-	Failed to partially clamp plate	
	704	-	Failed to unclamp plate	
	705	-	Failed to read autosampler plate sensor	
	706	-	Failed autosampler motion	
	707	-	Failed transfer arm plate load motion	
		6007	Failed to move plate, please make sure all slots are not occupied.	Remove all plates from the plate drawer. Restart the system. If the error persists, contact Promega Technical Services.
	708	-	Failed transfer arm plate unload motion	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		7002		Optical interrupter not in correct state. Restart the system. If the error persists, contact Promega Technical Services.
	709	-	Failed transfer arm return	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		7002		Optical interrupter not in correct state. Restart the system. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Light Source	800	-	Failed to turn on laser	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	801	-	Failed to turn off laser	
	804	-	Failed to read laser TEC voltage	
	805	-	Failed to read laser door sticky flag	
	806	-	Failed to reset laser door sticky flag	
	811	-	Failed to read laser temperature control probe #1	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	813	-	Failed to read laser temperature control probe #3	
	814	-	Laser temperature is out of range	
		4002		Light Source Temperature Out of Range. Restart the system. If the error persists, contact Promega Technical Services.
	850	-	Failed to turn on internal light	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
	851	-	Failed to turn off internal light	

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
RFID	900	-	Failed to write to RFID tag	RFID tag may be out of range of RFID antenna. Reseat consumable and refresh the Consumables screen. If the error persists, contact Promega Technical Services.
	901	-	Failed to read RFID tag	
Camera	1000	-	Image capture initialization failure	Check the camera cable connection from the instrument to the computer. Ensure the cable is properly secured into the controller board of the computer. If error reoccurs, restart the system. If the error persists, contact Promega Technical Services.
	1001	-	Image capture self-test failure	
		8001		
	1002	-	Image capture failure	
		8002		Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		8003		
Data Processing	1100	-	Data processing failure	Restart the system. If the error persists, contact Promega Technical Services.
		8100		Data collection timeout: may indicate a slow or malfunctioning computer, or memory limitations. Avoid running virus scanners, indexing or system updates while operational. Restart the system. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Injection Current	1200	-	Injection current monitor failure	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		9001		Injection current failure. Ensure no bubbles are present in the fluid path, buffers are not evaporated and sample plate has a minimum volume of 10µl in each well. Reinject samples. If the error persists, contact Promega Technical Services.
		9002	Injection current profile failure	Check system for bubbles and if present, perform a bubble purge. Reinject samples. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Laser Alignment and Control	1300	-	Failed to initialize laser alignment	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		8020		Alignment X-amplitude out of range. See "Failed laser alignment" in Section 9.1. If the error persists, contact Promega Technical Services.
		8021		Alignment X-position out of range. See "Failed laser alignment" in Section 9.1. If the error persists, contact Promega Technical Services.
Laser Alignment and Control (continued)	1300 (continued)	8022	Failed to initialize laser alignment	Alignment Y-amplitude out of range. See "Failed laser alignment" in Section 9.1. If the error persists, contact Promega Technical Services.
		8023		Alignment Y-position out of range. See "Failed laser alignment" in Section 9.1. If the error persists, contact Promega Technical Services.
	1301	-	Failed to initialize laser	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		8030		Laser power out of range. Restart the system. If the error persists, contact Promega Technical Services.

Section	Command Error Code	Proxy Error Code	Error Message	Proxy Error Code Causes and Comments
Calibration	1400	-	Calibration failure	Component failure or operation timed out. Restart the system. If the error persists, contact Promega Technical Services.
		10000	Calibration data is missing or invalid.	Calibration run was interrupted before data was received. See "Spectral calibration failure" in Section 9.2.
		10001	Calibration data did not meet minimum requirements.	
Miscellaneous	1500	6011	Main Door Left Open During Run	Upper door open during a run. Run will about after 10 seconds if door is not closed. Close the door and restart the run.
		11000	Polymer has been depleted, please install new polymer pouch.	Polymer has reached maximum injection count. Install new polymer pouch.

9.4.2   Firmware Error Codes

Firmware Error Code	Firmware Error Message
101	OperationAbortedByHost
102	WriteToReadOnlyParameter
103	ResultQueueOverflow
104	OpenDoorDetected
105	PreviousSessionTimeout
106	UnrecognizedParameter
107	BrownoutDetected
108	OperationTerminated
109	AttemptToResumeActiveTask
110	SessionAborted
111	UnexpectedTaskEvent
112	SIDAccessFailure
113	InterlockFailure

Firmware Error Code	Firmware Error Message
201	ReferencePositionLoss
202	MotionControllerMessageboxFull
203	MotionControllerStopForced
204	ReferencePositionLossUnderrun
205	AxisAlreadyInMotion
207	DriftDetect
208	StallDetect
301	FirmwareReadOperationTimeout
302	FirmwareWriteOperationTimeout
303	FPGACorrupt
304	ADCStatusInvalid
401	HeadLoopbackFailure
501	TouchSensorInterlockFailure
507	LaserFault
601	RequestedADCSamplesTooLow
602	RequestedADCSamplesTooHigh
603	InvalidAcquisitionChannel
604	BadCapitalLetter
605	CPSTooHighForPPR
606	InvalidStitchSetting

9.5 Restarting the System

1. Close the Spectrum Control Software by selecting the [x] button in the upper right corner, then select **YES** in the confirmation window.

2. Shutdown the computer.

3. Turn off the instrument by pressing the **On/Off** button on the front left side of the instrument for 5 seconds. All lights on the power button will go out.

⚠ **Caution!** Any plates present in the plate drawer and linked to a plate position will be unlinked when the software is closed and/or the instrument is turned off. If either of these actions occurs while a plate is running, the run will be aborted and marked as such upon restart.

4. Turn on the instrument by pressing the power button on the front left side of the instrument.

5. Turn on the instrument computer.

6. Log on to the Windows® operating system.

7. Launch the Spectrum Control Software.

Appendix

<div style="text-align: right; font-size: large;">10</div>

10.1 Creating a Plate Record Import File

Plate record files in the .csv, .txt, or .xls file format must have plate information listed under headers for all plate elements to be imported into SCS. The following headers must be included in the plate record file for successful import: Plate ID, Well, Sample ID, Sample Type, Comments and Protocol 1. Unrecognized fields will be listed in the Imported Fields section of the Well tab of the Plate screen for the imported plate record. We recommend entering plate information into a Microsoft Excel® spreadsheet or another spreadsheet program. An example Microsoft Excel® template is available in the C:\Plates folder.

Allowable plate information headers:

Header	Notes
Plate ID*	Enter a unique name for your plate
User	Enter user information
Barcode	Enter corresponding plate barcode number if applicable
Well*	Enter the sample well position in the plate. A1 and A01 formats are acceptable.
Sample ID*	Enter a Sample ID (sample names)
Sample Type*	Enter a sample type (i.e., sample, ladder, positive control, negative control)
GeneMarker HID	Enter a GMHID-Spectrum Run Wizard template saved in the Spectrum CE System installation of GMHID-Spectrum
Comments*	Enter any comment(s) about the sample. Note: While the Comments header is required for plate record file import, a sample comment is not required.
Priority	Enter the injection order priority (e.g., 1 for 1st injection, 2 for 2nd injection)
Protocol 1*	Enter a Spectrum run protocol. Additional protocols can be added by creating successive protocol headers (e.g., Protocol 2, Protocol 3)

* indicates a required header

Notes:

1. Any characters are allowed in the plate record file; however, if an invalid character is used in a field that is included in the exported data file name (see Section 7.3), that character will be automatically replaced with an underscore upon export.

2. If a Plate ID is not entered, a unique Plate ID will be automatically generated by the software.

3. The number on the bar code label must be included in the file name of the plate record file (e.g., Sample Plate_A1234.xlsx for a bar code label with the number A1234). Bar coding systems that produce a bar code label number and a bar code read number that do not match are not compatible with this feature.

4. Well numbers can be denoted in either the A1 or A01 format.

5. Information entered under the GeneMarker HID and Protocol columns must exactly match the corresponding options saved in SCS for successful import of this information (e.g., a protocol saved as "Promega 6-Dye (6C)" in SCS must be entered into the plate record file as "Promega 6-Dye (6C)". If a matching run protocol or GMHID-Spectrum Run Wizard template is not found in SCS, those fields will be left blank in the imported plate record.

	A	B	C	D	E	F	G	H	I	J
1	Spectrum Sample Import									
2										
3	Plate ID	User	Barcode							
4	Spectrum Import	Promega	BC123456							
5										
6	Well	Sample ID	Sample Type	GeneMarker HID	Comments	Priority	Protocol 1	Protocol 2	Protocol 3	Protocol 4
7	A01	Sample 1	Sample	PowerPlex_Fusion_6C			1 Promega 6-Dye (6C)			
8	B01	Sample 2	Sample	PowerPlex_Fusion_6C			1 Promega 6-Dye (6C)			
9	C01	Sample 3	Sample	PowerPlex_Fusion_6C			1 Promega 6-Dye (6C)			
10	D01	Sample 4	Sample	PowerPlex_Fusion_6C			1 Promega 6-Dye (6C)			
11	E01	Sample 5	Sample	PowerPlex_Fusion_6C			1 Promega 6-Dye (6C)			
12	G01	Sample 6	Sample	PowerPlex_Fusion_6C			1 Promega 6-Dye (6C)			
13	H01	AmpPos	Positive	PowerPlex_Fusion_6C			1 Promega 6-Dye (6C)			
14	G02	AmpNeg	Negative	PowerPlex_Fusion_6C			1 Promega 6-Dye (6C)			
15	H02	Ladder	Ladder	PowerPlex_Fusion_6C			1 Promega 6-Dye (6C)			
16										
17										
18										

18126TA

10.2   Related Products

STR Systems

PRODUCT	SIZE	CAT.#
PowerPlex® Fusion 6C System	50 reactions	DC2705
	200 reactions	DC2720
	800 reactions	DC2780
PowerPlex® Fusion System	200 reactions	DC2402
	800 reactions	DC2408
PowerPlex® Y23 System	50 reactions	DC2305
	200 reactions	DC2320
PowerPlex® 21 System	200 reactions	DC8902
	4 × 200 reactions	DC8942
PowerPlex® 18D System	200 reactions	DC1802
	800 reactions	DC1808
PowerPlex® ESX 16 Fast System	100 reactions	DC1611
	400 reactions	DC1610
PowerPlex® ESX 17 Fast System	100 reactions	DC1711
	400 reactions	DC1710
PowerPlex® ESI 16 Fast System	100 reactions	DC1621
	400 reactions	DC1620
PowerPlex® ESI 17 Fast System	100 reactions	DC1721
	400 reactions	DC1720

Not for Medical Diagnostic Use.

Matrix Standards

PRODUCT	SIZE	CAT.#
PowerPlex® 5C Matrix Standard	5 preps	DG4850
PowerPlex® 6C Matrix Standard	5 preps	DG4900

Analysis Software

PRODUCT	SIZE	CAT.#
GeneMarker®HID Software for Spectrum CE Systems, Local	1 seat	CE3001
GeneMarker®HID Software for Spectrum CE Systems, Network	1 seat	CE3010
GeneMarker®HID Software for Spectrum CE Systems, Client	1 seat	CE3011

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