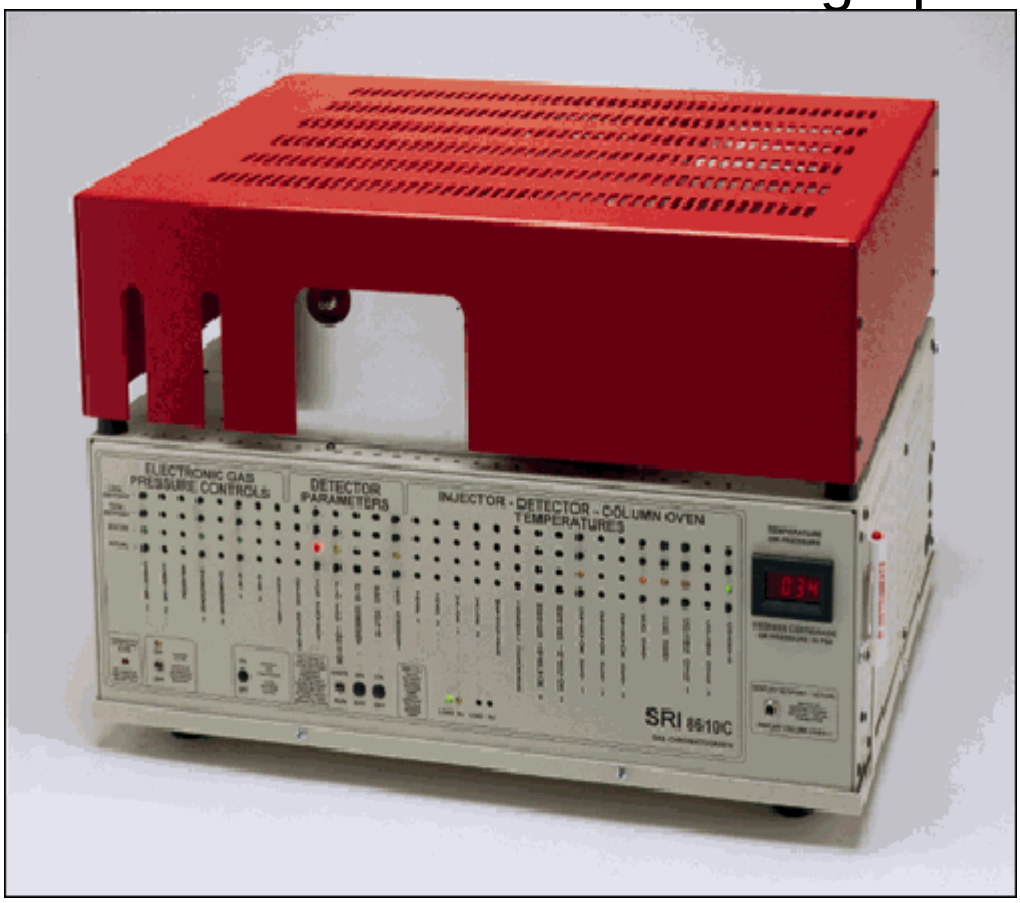
Model 8610C Gas Chromatograph

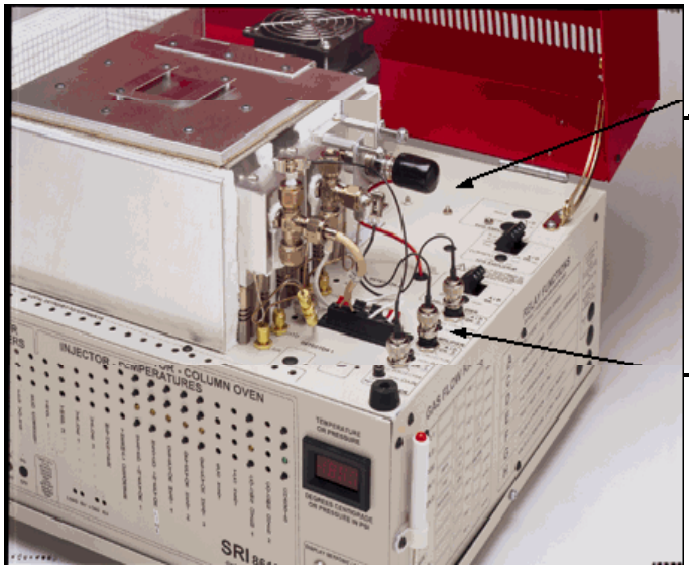


The Model 8610C Gas Chromatograph is our most popular model. While it is very compact compared to comparable laboratory GCs from other manufacturers, it is large enough and flexible enough to perform an amazing variety of applications. Up to 4 detectors, from a choice of 14, can be mounted simultaneously. Up to 5 injector types, from a choice of 15, can be installed at the same time. The 8610C can control up to 16 heated zones, 3 gas sampling valves, and 7 EPC gas pressures. Virtually any EPA or ASTM method can be implemented on the 8610C chassis, while still remaining small enough to ship as airline baggage or FedEx. The 8610C column oven is temperature programmable from ambient to 400°C with unlimited ramps and holds and fast cool-down. While smaller than full-sized lab GCs, the column oven still holds a standard 7 inch diameter megabore column cage, or multiple columns with smaller coil sizes. All gases, carrier and detector, are controlled by electronic pressure regulators (EPC) for maximum precision, and the carrier gas pressure is programmable. The PeakSimple data system is built in for easy serial port connection to your notebook or desktop PC.

8610-2203 Model 8610C chassis with Std. Equip. 220 volt AC

Standard equipment: Model 8610C chassis, ambient to 400ºC programmable column oven, on-column injector with carrier gas EPC, PeakSimple data system (with detector), "at a glance"
display of voltages, pressures and detector parameters, operator's manual, accessory kit, and heavy-duty re-useable shipping container. To completely configure a Model 8610C gas chromatograph, most users will need to specify one or more detectors, injectors, and column. Some users may also need an installation kit for each gas required for system operation (hydrogen, helium , etc.).

GC Detector Overview (14 types)



Up to four detectors can be mounted simultaneously along the right hand side of the GC's column oven.

The 8610C GC shown in the photo is equipped with NPD, FID, and PID detectors.

Amplifier and gain controls are located immediately adjacent to each detector.

Fourteen detector types

are available for mounting on the SRI Models 8610C, 310 and 110 mainframe chassis. Up to four detectors may be mounted and used simultaneously, although some rare combinations of detectors may conflict because of space limitations. Each detector is equipped with a thermostatted heater block for temperature stability, electronic pressure controlled (EPC) support gases, such as hydrogen and air for the FID, and internal amplifier electronics. Detector types are selected by the user depending on the particular measurement application, detection limit required, matrix interferences, and/or regulatory guidelines. All detectors require factory installation.

Detector types are:
1) CCD (catalytic combustion detector)
2) TCD (thermal conductivity detector)
3) FID (flame ionization detector)
4) FID/DELCD (combination FID and dry electrolytic conductivity detector)
5) HID (helium ionization detector)
6) NPD (nitrogen-phosphorus detector)
7) NPD/DELCD (combination NPD and dry electrolytic conductivity detector)
8) TID (thermionic ionization detector)
9) ECD (electron capture detector)
10) PID (photo ionization detector)
11) FPD (flame photometric detector)
12) FID/FPD (combination FID and FPD)
13) Dual FPD (dual wavelength FPD for both sulfur and phosphorus)
14) FID dual FPD (dual FPD plus FID combination)

Catalytic Combustion Detector (CCD)

The Catalytic Combustion Detector (CCD) consists of a tiny coil of platinum wire embedded in a catalytic ceramic bead. A small electric current flows through the platinum coil heating the ceramic bead to about 500ºC. The CCD is maintained in an oxidative environment typically by using air as the carrier gas. When hydrogen or a hydrocarbon molecule impacts the hot bead it combusts on the surface raising the temperature and resistance of the platinum wire. The resistance change causes the detector output signal to change thus producing a peak. The CCD is about as sensitive as a TCD detector but has the hydrocarbon selectivity of an FID while operating on air alone. Because the CCD needs no high pressure cylinder gases such as hydrogen or helium to operate, just ambient air, it lends itself to use in SRI's unique Gas-less GCs where a built-in air compressor supplies the carrier gas. The CCD can also be used as a hydrocarbon monitor in non-chromatographic applications where the CCD senses the total hydrocarbon content of a flowing air stream, or as a hydrogen/hydrocarbon leak detector. The CCD detector bead is very rugged and can be expected to last a long time. A second bead is included in the detector housing at no extra cost thus providing a built-in replacement in the event the first bead becomes inoperable. Replacement bead sets install in minutes with no tools and are very economical, making this detector a good choice for academic settings where detectors may be damaged by inexperienced operators. The brass detector housing is mounted on a stainless steel bulkhead fitting which is secured directly to the wall of the GC column oven.

8690-2007 CCD detector mounted on SRI chassis
8670-2007 Replacement CCD detector bead (2 beads in one housing)

Four Filament Wheatstone Bridge Thermal Conductivity Detector (TCD)

The TCD consists of four tungsten-rhenium filaments in a Wheatstone bridge configuration. Electric current flows through the four filaments causing them to heat up. Carrier gas (typically helium which has very high thermal conductivity) flows across the filaments removing heat at a constant rate. When a sample molecule with lower thermal conductivity exits the column and flows across the two sample filaments, the temperature of the filaments increase unbalancing the Wheatstone bridge and generating a peak as the sample molecules transit through the detector. The TCD detector is useful because it detects all molecules, not just hydrocarbons, so it is commonly used for fixed gas analysis (O2, N2, CO, CO2, H2S, NO, NO2, etc.) where the target analytes do not respond well on other more sensitive detectors. The TCD is able to detect concentrations from 100% down to about 100 ppm, but not lower. Even 100 ppm is only possible where the chromatography permits a sharp peak on a flat baseline. Where the peak is broad or the baseline is not perfectly flat, detection limits of 300 ppm are more realistic. For lower detection limits, the HID detector may be more suitable for inorganics, and of course the FID provides 1 ppm detection for hydrocarbon species. The standard TCD detector may be thermostatically controlled up to a maximum temperature of 130ºC, which is suitable for most applications. A high temperature TCD detector is also available which can be operated up to 300ºC. Both the standard and high temperature TCDs use identical, easily replaceable filaments which allow user replacement in the event of a filament burnout. A filament protection circuit prevents filament damage by disabling the current if carrier gas pressure is not detected at the GC, but cannot prevent filament damage under all circumstances.

8690-0007 Standard TCD detector
8690-9007 Hi-temperature TCD detector

Flame Ionization Detector (FID)

The FID detector responds to any molecule with a carbon-hydrogen bond, but not at all, or poorly to compounds such as H2S, CCl4, or NH3. The carrier gas effluent from the GC column is mixed with hydrogen and then routed through an unbreakable stainless steel jet. The hydrogen supports a flame at the tip of the jet, ionizing the analyte molecules. A collector electrode attracts the negative ions to the electrometer amplifier producing an analog signal which is connected to the data system input. The FID is the most commonly used GC detector, responding linearly from its minimum detectable quantity of about 100 picograms to almost 100%. The FID response is very stable from day to day, and is not susceptible to contamination from dirty samples or column bleed. Unlike many other FID designs, the SRI FID employs a unique ceramic ignitor which can run hot continuously, thus totally preventing the flame from extinguishing even when presented with large water injections or pressure surges from column backflush. The FID is thermostatted in an aluminum block up to 375°C and is equipped with a electrometer amplifier which has high, hi-filtered (for extra noise immunity) and medium gain settings. Hydrogen and air gas flows are controlled using Electronic Pressure Control (EPC) for high precision. The optional built-in "whisper quiet" air compressor (part# 8690-0070) is often used to supply the air for the FID, eliminating the bulky air cylinder.

8690-0010 FID detector with EPC gas controls
8690-0070 Optional 120 VAC 60 hz "whisper quiet" built-in air compressor
8690-2270 Optional 220 VAC 50 hz built-in air compressor

Flame Ionization/Dry Electrolytic Conductivity Detector (FID/DELCD)

The FID/DELCD detector is one of the most useful GC detector combinations because it allows the operator to reliably identify hydrocarbon peaks detected by the FID as halogenated or not. The DELCD actually measures the ClO2 present in the FID exhaust gas. Because the FID combusts the sample upstream of the DELCD, all hydrocarbons are converted to CO2 and H20 prior to the DELCD, completely preventing large hydrocarbon peaks from contaminating the DELCD. Because the DELCD operates at close to 1000°C, it can tolerate the water-saturated FID effluent and measure the chlorine or bromine content simultaneously with the FID measurement of the hydrocarbon content. This is especially beneficial for measuring chlorinated VOCs under a solvent peak as shown in the example chromatogram above, pesticides or in measuring PCB peaks obscured under large amounts of diesel fuel. While less sensitive than an ECD detector, the DELCD is much more selective than the ECD which can eliminate interferences which would complicate an ECD analysis. Sample preparation which might be required for ECD work is not required for the DELCD because of its total selectivity and because the FID pre-combusts any contaminants. In the high sensitivity mode (flame off, reduced airflow using dry tank air) the DELCD can detect down to the low picogram range as shown in the chromatogram above. The FID/DELCD is supplied with dual amplifiers for two simultaneous chromatograms and comes with a spare DELCD detector assembly.

8690-2026 FID/DELCD detector with dual amplifiers and EPC gas controls for H2 and air fuel gases

Nitrogen/Phosphorus Detector (NPD) NPD/DELCD Combination Detector

The Nitrogen Phosphorus Detector (NPD) is similar in design to the FID, except that the hydrogen flow rate is reduced to about 3 ml/min and an electrically heated thermionic bead (NPD bead) is positioned near the jet orifice. Nitrogen or phosphorus containing molecules exiting the column collide with the hot bead and undergo a catalytic surface chemistry reaction. The ions created in this reaction are attracted to a collector electrode, amplified, and output to the data system. The NPD is commonly used to detect pesticides, herbicides, and drugs of abuse because it responds to N-P compounds about 100,000 stronger than normal hydrocarbons, making it very selective. When combined with the chlorine/bromine selective DELCD, the combined detector is ideal for pesticide screening since the NPD selectively detects the organo-phosphate pesticides, while the DELCD detects only the chlorinated species. Together all pesticides can be detected, and the relative responses can help to identify pesticide species. The SRI ceramic NPD bead is exceptionally rugged and long-lasting, offering service from 100-1000 hours depending on operating conditions.

8690-0015 Nitrogen-Phosphorus detector (NPD) Includes: one NPD bead
8690-2615 NPD/DELCD combination detector Includes: one NPD bead and two DELCD detector assemblies

Electron Capture Detector (ECD)

The ECD detector consists of a sealed stainless steel cylinder containing radioactive Nickel-63. The Nickel-63 emits beta particles (electrons) which collide with the carrier gas molecules, ionizing them in the process. This forms a stable cloud of free electrons in the ECD cell. When electro-negative compounds (especially chlorinated, fluorinated or brominated molecules) such as carbon tetrachloride, bromoform, PCBs and pesticides such as DDT enter the cell, they immediately combine with some of the free electrons, temporarily reducing the number remaining in the electron cloud. The detector electronics which maintain a constant current (of about 1 nanoampere) through the electron cloud, are forced to pulse at a faster rate to compensate for the decreased number of free electrons. The pulse rate is converted to an analog output which is connected to the data system. The SRI ECD detector can be operated with either Nitrogen or Argon/5%Methane (P5) makeup gas, and Nitrogen, P5, or helium carrier as long as the helium flow is less than 10 ml/min. The ECD offers extreme sensitivity (parts per trillion for SF6). Because it contains 5 millicuries of Nickel-63, the ECD is covered by a "General License" requiring a periodic "wipe test" and the filing of a form with your state's Department of Health. In most states no annual fee is required. The ECD may be thermostatted from ambient to 375ºC

8690-0020 ECD detector (Nickel-63)

ECD vs. DELCD

Both the ECD and DELCD detectors are useful for halogenated analytes. The ECD detects fluorine while the DELCD does not. Both detectors detect chlorine and bromine. The DELCD is much more selective than the ECD, which detects electro-negative molecules like oxygen as well as halogens.
The selectivity of the DELCD can be exploited to reduce the amount of sample preparation required.
PCBs for example can be detected by the DELCD even in the presence of massive co-eluting hydrocarbons. On the other hand the DELCD is less sensitive than the ECD, so larger amounts must be extracted and injected on-column.

Photo Ionization Detector (PID)

The PID detector consists of a special UV lamp mounted on a thermostatted low volume flow-through cell. The temperature is adjustable from ambient to 250ºC. The 10.6 electron volt UV lamp emits energy at a wavelength of 120 nanometers, which is sufficient to ionize most aromatics (benzene, toluene, xylene, etc.) and many other molecules (H2S, hexane, ethanol) whose ionization potential is below 10.6 ev. Methanol and water, for instance, have ionization potentials greater than 10.6 ev and do not respond on the PID. Unlike other PID designs, the lamp on the SRI PID can be removed easily without tools for periodic cleaning of the lamp window. Lamps last far longer on the SRI PID because only the lamp window is heated, not the entire body of the lamp. Detection limits for aromatics are in the low picogram range (ppb) and because the PID is non-destructive, it is often run in series with another detector (FID/DELCD) for multiple chromatograms from a single injection. Use of the PID is mandated in several EPA methods (8021, TO-14 etc.) because of its sensitivity and selectivity. The PID is also able to run on air carrier, which can be useful in situations where no gas (helium, hydrogen, nitrogen) is available, or stream monitoring applications where no column is used to separate compounds but rather the entire stream of sample is directed through the detector.

8690-0040 PID detector with 10.6 ev lamp

Flame Photometric Detector (FPD) Dual FPD, FPD/FID

The FPD detector is similar to the FID except that the detector body is completely light tight and a second flow of hydrogen purges the optical path between the photomultiplier tube (PMT) and the hydrogen-rich flame. A bandpass filter at 393nm. for sulfur or 525nm. for phosphorus mounts in front of the PMT so only the emissions from sulfur or phosphorus are detected while other wavelengths are rejected. While not 100% selective, the FPD is 100,000 times more sensitive for S-P compounds than for hydrocarbons. Sulfur compounds such as H2S or SO2 can be detected down to about 200 ppb and phosphorus to 10ppb. The phosphorus response is linear, but the sulfur response is exponential (twice the sulfur yields four times the peak area). The dual FPD detector is equipped with two PMTs which allow simultaneous detection of sulfur and phosphorus. Either the single or dual FPD can be equipped with an FID collector electrode and electrometer which will detect the hydrocarbon peaks at the same time as the PMTs are responding to the S-P compounds. The FID response is not as sensitive as a pure FID because the hydrogen-rich flame required for optimum S-P detection is not optimum for best hydrocarbon response. Users can easily optimize S-P response versus hydrocarbons response by simply adjusting the hydrogen/air mixture using the included EPC gas controls.

8690-0080 Single FPD detector with EPC gas controls
8690-1080 Single FPD as above with FID collector electrode and dual amplifiers
8690-0085 Dual FPD with EPC gas controls, dual amplifiers and PMTs
8690-2085 Dual FPD as above with FID probe and three amplifiers

GC Injector Overview (10 types)

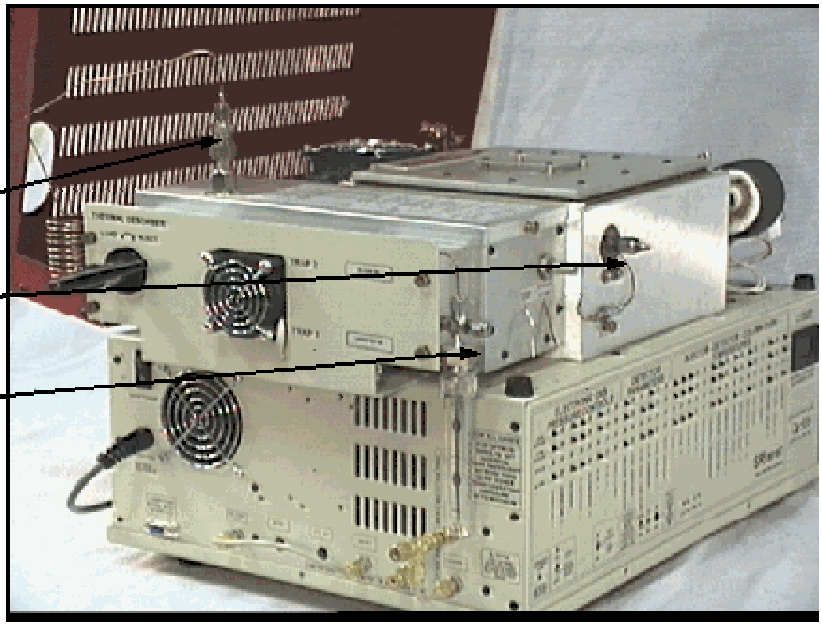
Up to five injector types can be mounted on an 8610C GC simultaneously. The GC shown is equipped with:

1) Thermal Desorber

2) Heated Split/ Splitless Injector

3) Purge & Trap

Each carrier gas flow is protected by a molesieve contaminant filter which can be baked out by simply throwing a switch on the front panel.

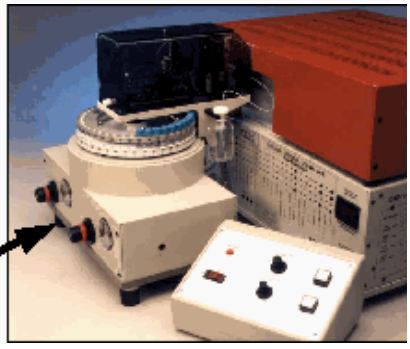


Ten injector types are available for mounting on SRI Gas Chromatographs. Up to five injectors may be mounted simultaneously on the Model 8610C, but only a single On-column, Heated Flash Vaporization or Heated Split/Splitless injector will fit on the smaller model 310. For solids, choose the Thermal Desorber or the Heated Static Headspace injector. For liquids, choose the On-column, Heated Flash Vaporization, Heated Split/Splitless, Heated Static Headspace, or Purge & Trap. For gases, choose the 10-port Gas Sampling Valve or Air Concentrator. For SPME fibers, choose the Heated Flash Vaporization or Split/Splitless injector with low volume SPME liner. To add automation, select the Method 5030 Purge & Trap Autosampler or the 20-vial Liquid Autosampler. Injector types are selected by the user depending on the particular measurement application, detection limit required, and regulatory requirements. All injectors require factory installation.

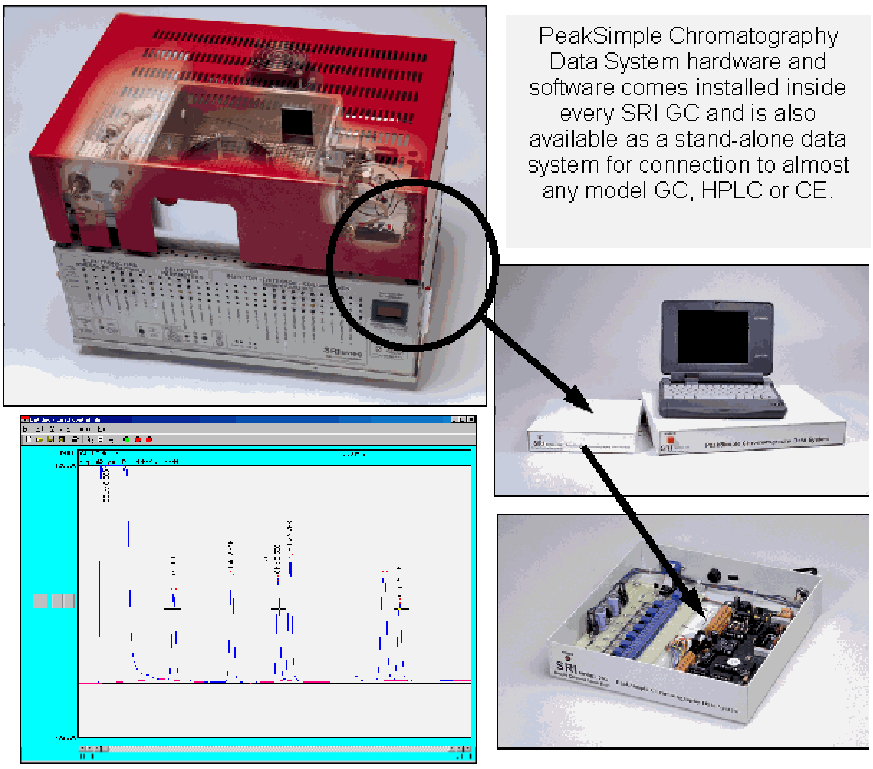
Injector types are:

1) On-column (for .53mm wide-bore capillary or 1/8inch packed columns)
2) Heated flash vaporization (SPME fiber injections)
3) Heated Split/Splitless injector (for narrow bore capillary columns)
4) 10 port Gas Sampling Valves and Stream Selector valves
5) Heated Static Headspace injector
7) Thermal Desorber (for semi-volatiles in solids)
8) Method 5030/5035 Compliant built-in Purge & Trap
9) Method 5030 10 sample Purge & Trap Autosampler
10) 20 and 42 vial Liquid Autosamplers

42 vial Liquid Autosampler



PeakSimple Chromatography Data Systems Overview



PeakSimple Chromatography Data System consists of hardware and software which is supplied as standard equipment with every SRI GC and HPLC. The same hardware and software is available as a stand-alone data system for connection to any make or model GC, HPLC or CE system. The A/D hardware comes in two versions, the single channel model 203 and the four channel model 202. The software is the same for both the model 203 and 202. When built-inside an SRI GC or HPLC the detector signals are factory connected inside the chassis to the A/D board.

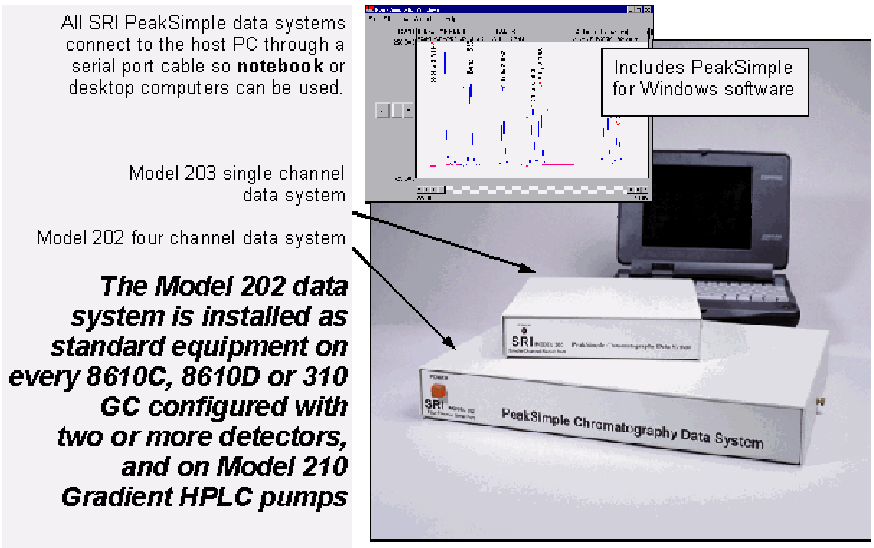
Model 203 Single Channel Data System

The Model 203 Chromatography Data System consists of PeakSimple for Windows/Windows 95 software plus a single channel 20-bit high resolution A/D board. The 203 system can be mounted inside the Model 8610C or 310 GC, or it can be mounted in a separate box for connection to other vendor's GC or HPLC detectors. When mounted in an SRI GC, the 203 controls the temperature program of the column oven and the pressure program of the carrier gas electronic pressure
controller (EPC). The eight available TTL outputs are connected internally within the GC to control functions such as valve rotation, gas solenoid actuation, autosampler injection, etc. When mounted in a separate box, the temperature and pressure control outputs are available for use, but not connected to anything, and the eight TTL outputs can optionally be wired to a bank of eight
single-pole, dual-throw mechanical relays with screw terminals (part# 8600-1056) for easy connection to any user device which operates from a contact closure. A remote start input allows run initiation from the user's GC or HPLC system. Data can be acquired at rates up to 50 Hz. Windows 95 computers with two available serial ports (bus mouse installed) can operate dual 203 systems, or a 203 and a 202 simultaneously. The 220 volt system is supplied with a UL, CSA, and CE/VDE approved universal voltage input power supply which will operate on any

AC voltage from 100-250 volts.

8600-1255 Model 203 Chromatography Data System with Peaksimple for Windows/Windows 95 software mounted in a sturdy low-profile chassis (220VAC)
8600-1056 Optional eight position, single-pole dual-throw (SPDT) relay board with screw terminals for interfacing with auto-samplers, valves and other devices which require a contact closure rather than a TTL signal

Model 202 Four Channel Data System



The Model 202 Chromatography Data System consists of PeakSimple for Windows software plus a four channel 24 bit high resolution A/D board. The 202 system can be mounted inside the Model 8610C or 310 GC, or Model 210 Gradient HPLC pump, or it can be mounted in a separate box for connection to other vendor's GC or HPLC detectors. When mounted in an SRI GC, the 202 controls the temperature program of the column oven and the pressure program of the carrier gas electronic pressure controller
(EPC). When mounted in the Model 210 HPLC pump, the 202 controls the pump speed, gradient profile, and displays the column pressure. The eight available TTL outputs are connected internally within the GC/HPLC to control functions such as valve rotation, gas solenoid actuation, autosampler injection, etc. When mounted in a separate box, the temperature, pressure and gradient control outputs are available for use but not connected to anything, and the eight TTL outputs are wired to a bank of eight single-pole, dual-throw mechanical relays with screw terminals for easy connection to any user device which operates from a contact closure. Two remote start inputs allow run initiation from the user's GC or HPLC system. In addition, two optional AC outlets permit 110/220 volt devices (line powered solenoid valves, vacuum pumps, lights etc.) to be powered on/off under PeakSimple software control. The four channels of data can be randomly assigned to one of two time bases which allows independent start and stop times for two entirely separate instruments. Data can be acquired at rates up to 50 Hz with one channel active, 10 Hz for two channels, or 5 Hz with all four channels activated and acquiring data. Windows computers with two available serial ports can operate dual 202 systems for a total of eight data channels and four time-bases from a single PC platform.
8600-4255 Model 202 Chromatography Data System with PeakSimple for Windows software mounted in a sturdy low-profile chassis (220VAC)
8600-4056 Optional factory installed AC power outlet 2A max

PeakSimple for Windows Software Features Overview

PeakSimple chromatography software combines quick learning, ease of use, and convenient powerful features for GC and HPLC and CE**. PeakSimple is included in the price of every SRI Gas Chromatograph, HPLC and Data System.** PeakSimple's intuitive graphical functions and features are so user-friendly most operators can produce results almost immediately and without specific training. PeakSimple is packed with state of the art features like drag-able retention time windows, seldom found in other data system software packages costing much more.

With PeakSimple, **no hardware** is installed in your computer, so you can use a small portable
notebook instead of a full-sized computer. If you travel with your system or have limited bench space you will appreciate this. Multiple users can also connect their individual computers to the chromatograph without moving the data system hardware from computer to computer.

PeakSimple even includes built-in **data validation**, an extra-cost option on other systems. This allows you to replay and re-acquire a stored chromatogram over and over, to determine the
reproducibility and precision of the entire system.

Of course, PeakSimple includes baseline subtraction, chromatogram overlay, DDE links, peak alarms, report generation, multi-level calibrations, data merge across channels, autosampler queue, batch reprocessing, and many other convenient features (see following pages).