The SRS-ULTRA Self-Regenerating Suppressor utilizes AutoSuppression® technology to enhance analyte conductivity while suppressing eluent conductivity. This results in a dramatic improvement in analyte detection limits. The ions required for eluent suppression are generated by the continuous electrolysis of water. This means that there are no regenerant solutions to make and no need for off-line regeneration of the suppressor. The SRS-ULTRA delivers ultra-low backgrounds and noise levels for true trace-level, parts-per-trillion performance, together with rugged construction for extended lifetimes. The SRS-ULTRA is designed to operate with the entire line of Dionex ion chromatography equipment. When combined with the revolutionary EG40 Eluent Generator, it delivers truly automated, minimal-maintenance ion chromatography.

The Suppressor Advantage
Dionex introduced chemical suppression in 1975, thereby bringing ion chromatography to the forefront of modern analytical techniques for inorganic analysis. Chemical suppression greatly enhances signal-to-noise ratio (see Figure 1) by:

- Decreasing background eluent conductivity
- Increasing analyte conductivity compared with nonsuppressed
- Eliminating sample counterions

A New Era in Suppression
The SRS-ULTRA is the latest embodiment of AutoSuppression, a technique that goes beyond the power of classical chemical suppression to combine high performance with unparalleled ease of use. The SRS-ULTRA offers:

- Superior performance with low background conductivity, low noise, and excellent baseline stability
- High suppression capacity; compatibility with gradient chromatography
- Economical, effortless, and maintenance-free operation
- Fast equilibration and start-up
Economical, Easy to Use, and Maintenance-Free

The self-contained SRS-ULTRA operates reliably without routine maintenance or operator intervention. In the AutoSuppression Recycle Mode the SRS-ULTRA uses no chemical regenerants, eliminating preparation time and the handling of corrosive reagents.

Rapid Start-up and Equilibration

The SRS-ULTRA equilibrates rapidly, thus ensuring fast start-ups and rapid re-equilibration after changing eluents.

True Trace-Level Analysis

In the AutoSuppression mode, the SRS-ULTRA operates with low noise, drift, and background conductivity. The result is low parts-per-billion detection limits for anions and cations without preconcentration (Figure 2).

For the highest sensitivity, the SRS-ULTRA should be combined with the EG40 Eluent Generator, which provides contaminant-free eluents for ion chromatography and therefore lower background conductivity.

Figure 1. In this example of anion chromatography, the SRS-ULTRA removes sodium ions (and other cations) from the eluent and replaces them with hydronium ions from the water regenerant. These hydronium ions combine with the hydroxyl ions from the eluent to form water, which has very low conductivity compared with the sodium hydroxide eluent. Analyte conductivity is enhanced because the analyte anions associate with the highly conductive hydronium ions.

Figure 2. The SRS-ULTRA is the perfect complement to the EG40 Eluent Generator. The ASRS-ULTRA provides highly efficient suppression of the potassium hydroxide eluent in this example of low parts-per-billion anion analysis.
The Perfect Complement for AutoElution™

The SRS-ULTRA and the EG40 Eluent Generator are the perfect combination for ultratrace analysis. The EG40 converts water into ultra-pure eluents for ion chromatography. The EG40 combined with the SRS-ULTRA permits gradient chromatography for parts-per-trillion analysis with almost no baseline drift and maximum signal-to-noise ratio (Figure 3).

High Efficiency

The internal volume of the SRS-ULTRA is exceptionally low (< 50 µL for the 4-mm suppressor). Because of this, the suppressor maintains the efficiency of high-performance IC columns with minimal peak dispersion.

High Capacity

The high suppression capacity of the SRS-ULTRA allows the use of high eluent concentrations with high-capacity columns. High-capacity columns can tolerate a much higher analyte load without deterioration of peak shape or loss of resolution. In addition, the linear working range of analyte concentrations is expanded beyond that available without suppression, thus permitting analysis of samples with widely disparate analyte concentrations.

Gradient Compatibility

The dynamic suppression capacity of the SRS-ULTRA accommodates rapidly increasing eluent gradients, thus maintaining low background conductance with minimal baseline shift.

Rugged Design

The internal construction of the SRS-ULTRA is shown in Figure 4. The SRS-ULTRA consists of alternating layers of high-capacity ion-exchange screens and ion-exchange membranes separating two electrodes. The screens create a convoluted low-volume path for the eluent and provide an ion transport path for the ion-exchange process. Together, the membranes and screens form a rugged, self-contained device that eliminates down-time and maintenance.
Flexibility

The SRS-ULTRA is designed for maximum flexibility. Use of the SRS-ULTRA does not restrict the user to one or two columns and eluents. The SRS-ULTRA is compatible with the full range of Dionex ion-exchange columns, gradients, and eluents.

Most applications for anion or cation exchange use the economical and easy-to-use AutoSuppression Recycle Mode (Figure 5). The AutoSuppression Recycle Mode can be enhanced with the use of the Gas Assisted Regeneration Kit. This mode reduces the noise for trace-level analysis without the need for external water regenerant. In this mode, gas is added to the conductivity cell effluent before it enters the SRS’s Regen In port (Figure 6).

Figure 5. Eluent flow in the AutoSuppression Recycle Mode. After eluent passes through the flow cell to the detector, it is recycled back to the suppressor to be used as regenerant.

Figure 6. Eluent flow in the AutoSuppression Gas Assisted Recycle Mode. Gas is added to the conductivity cell effluent before it goes into the SRS’s Regen In port, significantly reducing the noise for trace-level analysis.
Eluents containing up to 40% organic solvent are suppressed using the AutoSuppression External Water Mode. In this mode the water for electrolysis is supplied from an external source (see Figure 7). The External Water Mode also can be enhanced with the use of the Gas Assisted Mode, which reduces the regenerant flow rate and lowers noise. Figure 8 shows the operation of the SRS in Gas Assisted External Water Mode.

The SRS-ULTRA should be operated in the Chemical Suppression Mode (Figure 9) for eluents containing greater than 40% solvent.

SRS-ULTRA suppressors can also be used to suppress eluents for Mobile Phase Ion Chromatography (MPIC®) when the organic solvent content of the eluent remains below 40%.

Figure 7. Eluent flow in the AutoSuppression External Water Mode. The deionized water used for the electrolysis process is supplied from a constant pressure source. This mode is ideal for high-sensitivity operation.

Figure 8. Eluent flow in the AutoSuppression Gas Assisted External Water Mode. Gas is added to the external water, which is pumped through the SRS at a consistent flow rate between 2–3 mL/min.

Figure 9. Eluent flow in the Chemical Suppression Mode. The SRS-ULTRA can be operated as a chemical suppressor by using a chemical regenerant. No current is supplied to the SRS.
Anion and Cation Suppressors—Microbore and Standard Bore

Two versions of the SRS-ULTRA are available—the Anion Self-Regenerating Suppressor (ASRS®-ULTRA) for the determination of anions and the Cation Self-Regenerating Suppressor (CSRS®-ULTRA) for the determination of cations.

Both the ASRS-ULTRA and the CSRS-ULTRA are available in formats optimized for use with standard bore (4-mm) or microbore (3-mm or 2-mm) analytical columns. The reduced internal volume of the 2-mm version is essential for maximum performance with microbore IC systems using 3-mm or 2-mm i.d. columns.

Figures 10 through 18 show analyses using the ASRS-ULTRA and the CSRS-ULTRA in 4- and 2-mm configurations.

**Figure 10.** The IonPac AS14A column is ideal for interference-free determination of inorganic anions, including fluoride in drinking water. The ASRS-ULTRA is ideal for suppressing carbonate/bicarbonate eluents to a low background conductivity.

**Figure 11.** The CSRS-ULTRA is used in Recycle Mode together with the EG40 for the separation of the common cations. This application requires only DI water for the chromatograph, eliminating corrosive eluents and regenerants.

**Figure 12.** The CSRS-ULTRA is used in the External Water Mode to suppress an eluent containing organic solvent. This separation permits the determination of trace-level ammonium in a wastewater sample containing a high concentration of sodium.
Figure 13. This analysis of cooling water uses simultaneous gradients of acid and acetonitrile at 35 °C. The CSRS-ULTRA is used in the External Water Mode to suppress this complex eluent to a stable background.

Figure 14. The ASRS-ULTRA suppresses the potassium hydroxide used for this separation of 29 anions. Together with the EG40 Eluent Generator, the ASRS-ULTRA delivers a very stable, noise-free background.
Figure 15. The ASRS-ULTRA suppresses the aggressive potassium hydroxide gradient used to separate these polyphosphates, which are found in a wide variety of consumer products.

Figure 16. The ASRS-ULTRA in the External Water Mode is compatible with eluents containing up to 40% methanol.

Multiple Operational Modes

The simplest way to operate the SRS-ULTRA is in the AutoSuppression Recycle Mode (Figure 5).

As the eluent passes through the suppressor to the detector, it is converted to its weakly ionized form. For example, sodium hydroxide is suppressed to water. After passing through the conductivity detector flow cell, the effluent is recycled to the regenerant inlet of the SRS-ULTRA, supplying the SRS-ULTRA with clean water for electrolysis. This mode requires the least day-to-day maintenance and is the operational mode of choice.

The amount of deionized water required to operate an SRS suppressor in external water mode can be very expensive and labor-intensive. The SRS is typically operated in this mode when using solvents in eluents and to achieve lowest noise levels. The Gas Assisted Recycle Mode is a new method of SRS operation that replaces the External Water Mode for aqueous eluents when ultra-low noise levels are required. When using the Gas Assisted Regeneration Kit with aqueous eluents, the SRS is operated in Recycle Mode. Gas is added to the conductivity cell effluent before it goes into the SRS’s Regen In port. As shown in Figure 18, the SRS Gas Assisted Mode provides the benefit of low noise without the need for external water, significantly reducing water usage and waste. Gas Assisted Recycle Mode reduces peak-to-peak noise from an SRS by a factor of 4 to 10 for anion determinations and a factor of 2 for cations while using the eluent as the source for regenerant. The SRS can still be operated in normal Recycle Mode without replumbing.

The SRS Gas Assisted Kit is easy to install as shown in Figure 6. The effluent from the conductivity cell (which is normally connected to the Regen In port under standard conditions) is now connected to a mixing tee. The cell effluent is mixed with gas (nitrogen or helium) at a set pressure of 10 psi in the tee. This generates a gas flow rate of approximately 100 mL/min.
A check valve in the gas line ensures no leakage of liquid back into the gas line. When the gas pressure is turned off, the SRS is automatically operated in normal Recycle Mode.

The **AutoSuppression External Water Mode** (Figure 7) is used for applications requiring organic solvents in the eluent.

In this mode, a constant external source of deionized water supplies the water for the electrolysis process. The detector cell effluent is directed to waste. This is the most efficient AutoSuppression mode and also should be used for applications using high concentrations of eluent and to enhance signal-to-noise ratios for trace-level analyses.

The External Water Mode can be enhanced with the use of the Gas Assisted Kit. The **Gas Assisted External Water Mode** is for eluents containing solvent. A pump is used to deliver the external water regenerant at a consistent flow rate between 2–3 mL/min. A flow diagram for this mode of operation is shown in Figure 8.

Table 1 shows the typical benefits of operating a CSRS-ULTRA in both the Gas Assisted Recycle and Gas Assisted External Water Modes. The background noise when using the Gas Assisted Recycle Mode is reduced from 0.5 nS/cm to 0.2 nS/cm. For the Gas Assisted External Water Mode, the deionized water usage is reduced from 14.4 L/24 hours to 3.6 L/24 hours.

AutoSuppression is not recommended for eluents containing more than 40% solvent.

The **Chemical Suppression Mode** (Figure 9) requires the use of caustic or acidic regenerants. This mode delivers the maximum signal-to-noise ratio and is required for eluents containing high concentrations of organic solvent.

In this mode, a chemical regenerant is pumped through the suppressor either from a pressurized regenerant reservoir (supplied in the MMS™/SRS External Regenerant Installation Kit) or from the optional AutoRegen® delivery system.

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**Table 1: Benefits of CSRS-ULTRA Gas Assisted Regeneration Modes**

<table>
<thead>
<tr>
<th>Eluent</th>
<th>Eluent Flow Rate (mL/min)</th>
<th>Regenerant Flow Rate (mL/min)</th>
<th>Gas Pressure (psi)</th>
<th>Noise (nS/cm)</th>
<th>Regenerant Water Usage (L/24 hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 mN H₂SO₄</td>
<td>1.2 mL/min</td>
<td>0.0 (Recycle)</td>
<td>0.0</td>
<td>0.5</td>
<td>—</td>
</tr>
<tr>
<td>22 mN H₂SO₄</td>
<td>1.2 mL/min</td>
<td>0.0 (Recycle)</td>
<td>20</td>
<td>0.2</td>
<td>—</td>
</tr>
<tr>
<td>10 mN H₂SO₄/9% ACN</td>
<td>1.2 mL/min</td>
<td>10 mL/min</td>
<td>0.0</td>
<td>1.5</td>
<td>14.4</td>
</tr>
<tr>
<td>10 mN H₂SO₄/9% ACN</td>
<td>1.2 mL/min</td>
<td>2.5 mL/min</td>
<td>20</td>
<td>1.5</td>
<td>3.6</td>
</tr>
</tbody>
</table>

*Figure 18. The EG40 combined with the SRS Gas Assisted Recycle Mode reduces noise levels, allowing µg/L (ppb) detection of common anions.*
Ordering Information
To order in the U.S., call 1-800-346-6390 or contact the Dionex regional office nearest you. Outside the U.S., order through your local Dionex office or distributor. Refer to the following part numbers:

SRS Self-Regenerating Suppressors
ASRS-ULTRA (4 mm) Anion Self-Regenerating Suppressor
Replaces the ASRS-I (P/N 43189) and the ASRS-II (P/N 46081). For use with 4-mm anion-exchange columns ................. P/N 53946

ASRS-ULTRA (2 mm) Anion Self-Regenerating Suppressor
Replaces the ASRS-I (P/N 43187) and the ASRS-II (P/N 46078). For use with 2-mm microbore anion-exchange columns .............. P/N 53947

CSRS-ULTRA (4 mm) Cation Self-Regenerating Suppressor
Replaces the CSRS-I (P/N 43190) and the CSRS-II (P/N 46079). For use with 4-mm cation-exchange columns ................ P/N 53948

CSRS-ULTRA (2 mm) Cation Self-Regenerating Suppressor
Replaces the CSRS-I (P/N 43188) and the CSRS-II (P/N 46080). For use with 2-mm microbore cation-exchange columns .......... P/N 53949

SRS-ULTRA Suppressors for Mobile Phase Ion Chromatography (MPIC)
For ASRS-MPIC:
Order the ASRS-ULTRA.
Note: The AMMS®-ICE Anion MicroMembrane™ Suppressor cannot be used for Anion MPIC.
For CSRS-MPIC:
Order the CSRS-ULTRA.

MMS/SRS External Regenerant Installation Kit
Required for initial installation of the AutoSuppression External Water Mode and the Chemical Suppression Mode. Includes one 4-L pressurizable regenerant reservoir, one pressure regulator (0–30 psi/0–210 kPa), and all tubing and fittings required to install the SRS-ULTRA for operation in these modes.
................................................. P/N 38018

SRS Gas Assisted Regeneration Kit
Required for the initial installation of the Gas Assisted Recycle Mode or Gas Assisted External Water Mode. Contains one pressure regulator (0-30 psi/0-210 kPa), 1/4-28 mixing tee, one check valve, and all tubing and fittings required to install the SRS-ULTRA for operation in these modes.
.............................................. P/N 056886

Upgrading Older Dionex IC Systems with the SRS Controller Module
All DX-600, DX-500, and DX-320 detectors, CDM-3 and PED-2 detectors, DX-100 (model DX 1-03), and DX-120 IC systems contain built-in control and power supplies for the SRS-ULTRA.

Earlier Dionex systems can accommodate SRS-ULTRA operation with the stand-alone SRS Controller Module. When ordering, please indicate that you are upgrading your Dionex system for SRS-ULTRA operation, and order the following module:

SRS Controller Module (SRC-1)
115/220 V. SRS control must be provided by a stand-alone SRS Controller Module for any CDM-1, CDM-2, PED-1, or DX-100 IC system without built-in SRS control .................. P/N 43177

SRS-ULTRA Spare Parts
Backpressure Loop, 1 each
For 4-mm system .......... P/N 45877
For 2-mm system ........ P/N 45878

Syringe, 1.0 mL, disposable
For flushing the SRS-ULTRA at start-up ...................... P/N 16388

Syringe Adapter, female Luer lock,
1/4–28 threads ............. P/N 24305

SRC-1 Ship Kit
Contains all fittings, tubing, and a gas-separator waste tube required for installation of a second SRS-ULTRA on a system .... P/N 45720

SRS Extension Cable, 2.1 m (7 ft)
For remote placement of the SRS unit ......................... P/N 45343
SRS-ULTRA

**Void Volume:**
- SRS (4 mm) < 50 µL
- SRS (2 mm) < 12.5 µL

**Dimensions (h x w x d):**
- 16 cm x 3.5 cm x 3.5 cm
  (6.6 in. x 1.8 in. x 1.7 in.)

**Weight:**
- 0.4 kg (1 lb)

**SRS Controller Module**

**Approximate Current Output Levels:**
- Level 1: 50 mA
- Level 2: 100 mA
- Level 3: 300 mA
- Level 4: 500 mA

**Status LEDs:**
- Green—Normal operation
- Red—Power shut off
  by self-diagnostic circuitry

**Power Requirement:**
- 85–265 V ac, 50/60 Hz

**Temperature Requirements:**
- 10–40 °C (50–104 °F)

**Dimensions (h x w x d):**
- 12.9 cm x 5.7 cm x 13.3 cm
  (5 in. x 2.3 in. x 5.25 in.)

**Weight:**
- 0.8 kg (1.7 lb)