

Reagent-Free Ion Chromatography Systems with Eluent Generation for IC *Without* Manually Prepared Eluents



Since the introduction of Reagent-Free™ ion chromatography (RFIC™) products in 1995, Dionex has continued to simplify IC while increasing the capabilities and power of ion analysis. RFIC systems with eluent generation (RFIC-EG™ systems) produce consistent, precisely controlled, high-purity eluents and regenerants electrolytically. Not only is the eluent preparation labor decreased, but reproducibility is increased. The ICS-2000 and ICS-3000 systems are integrated RFIC-EG systems. The RFC-30 Reagent-Free Controller can be used to convert most other Dionex IC systems into RFIC-EG systems.

Benefits of Eluent Generation

RFIC-EG systems generate high purity hydroxide, carbonate, or methanesulfonic acid (MSA) eluents electrolytically using EluGen® Eluent Generation Cartridges. Chemists no longer need to spend time manually preparing eluents as traditionally done using conventional IC systems. The required eluent is generated at the concentration required for your ion chromatography application. Eluents are purified on-line using Continuously Regenerated Trap Columns (CR-TC), and suppressed electrolytically before detection, without the need to prepare regenerants. The only requirement is a high-purity source of deionized water.

Key benefits:

- Improves analytical reproducibility, day-to-day, week-to-week, month-to-month
- Ensures system-to-system reproducibility and lab-to-lab consistency
- Achieves sensitive results with pure, uncontaminated eluent
- Eliminates errors and variability associated with manual eluent and regenerant preparation
- Achieves the power of hydroxide and MSA gradient separation with an isocratic pump
- Reduces operator exposure to hazardous chemicals
- Reduces pump maintenance because pump is exposed only to deionized (DI) water
- Simplifies operation; no need to prepare eluents or regenerants



Passion. Power. Productivity.

Simplify Operation with RFIC-EG Systems

RFIC-EG systems are very easy to operate. Simply install the eluent generator, attach a source of deionized water to your pump, and begin collecting data. The schematic diagram (Figure 1) illustrates just how easy operation is with RFIC-EG systems. The compatibility chart to the right shows what eluent generator cartridges are supported on each system.

Reproducibility of Eluent Generation

Electrolytic eluent generation produces amazingly consistent run-to-run eluent concentrations by eliminating errors associated with manual eluent preparation. Eluent concentration accuracy and precision translates into highly reproducible retention times and peak areas. Figure 2 shows an overlay of 100 chromatograms, illustrating the unmatched reproducibility provided by eluent generation.

Make Your Methods Portable

With RFIC-EG systems, your ability to transfer methods from one lab to another is simplified. Whether the lab is next door or in another country, RFIC eluent generators ensure that your analytical results are consistent and can be seamlessly transferred. RFIC eluent generators are so precise that you can expect to see less than 1% deviation from lab to lab under most analytical conditions.

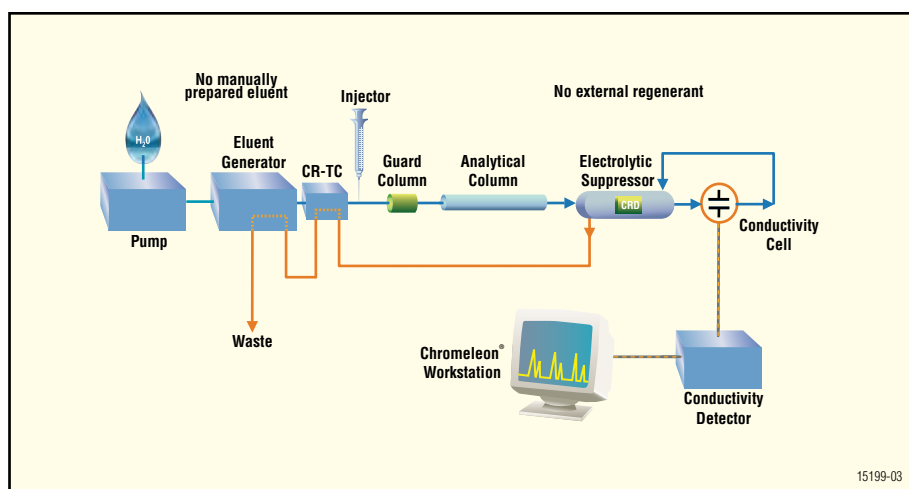


Figure 1. RFIC-EG systems schematic diagram.

RFIC Eluent Generator (EG) Instrument Compatibility Chart*				
Instrument	Anions			Cations
	Gradient or Isocratic Hydroxide EG	Isocratic Carbonate EG	Isocratic Carbonate/Bicarbonate EG	Gradient or Isocratic MSA EG
ICS-2000	KOH, NaOH*, LiOH*	K ₂ CO ₃	K ₂ CO ₃ + EPM	MSA
ICS-3000	KOH, NaOH, LiOH	K ₂ CO ₃	K ₂ CO ₃ + EPM	MSA
RFC-30	KOH	not available	not available	MSA

*Contact your local Dionex representative for software requirements.

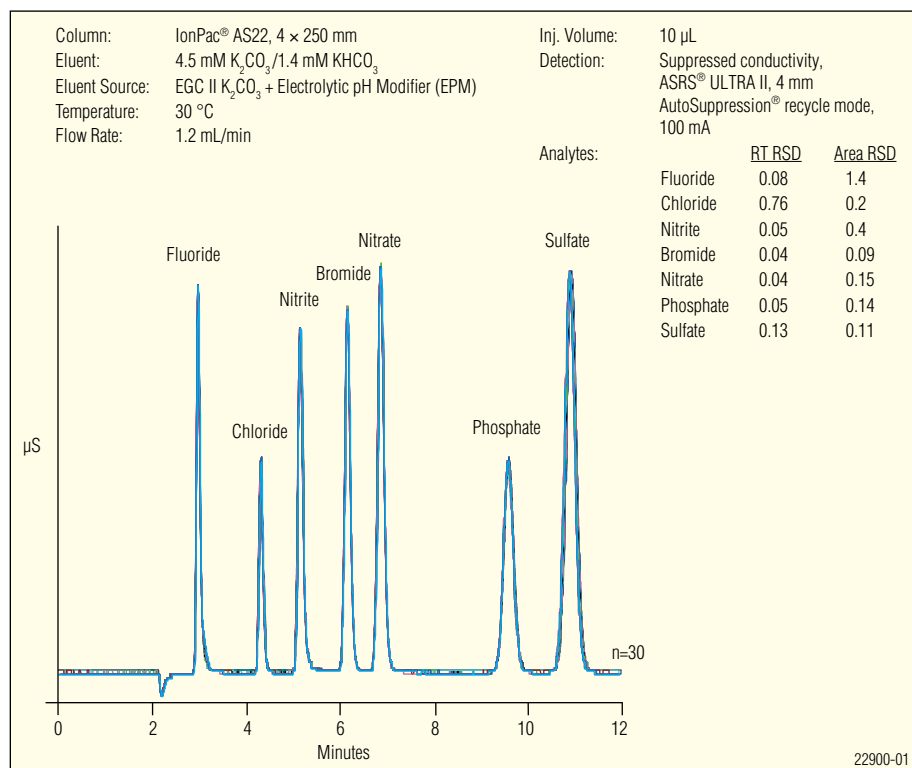


Figure 2. Systems using eluent generation produce extremely reproducible retention times and peak areas, as demonstrated with this overlay of 30 injections of an anion standard on an ICS-2000 RFIC-EG system using an electrolytically generated carbonate/bicarbonate eluent.

Achieve Sensitive Results

RFIC eluent generators make trace-level analysis routine. The ultra-pure eluent produced by our full line of eluent generator cartridges results in a stable baseline that makes peak integration more accurate and reliable. In addition to lower background, electrolytically generated gradients provide minimal baseline shifts compared to conventional gradients.

Accuracy of RFIC Eluent Generators

The eluent concentration generated by an RFIC-EG system is extremely accurate and reproducible. Dionex’s patented eluent generation technology follows Faraday’s Law. The eluent concentration is, therefore, directly proportional to the applied current from the eluent generator and inversely proportional to the eluent flow rate. Because both of these parameters can be precisely controlled, the resulting eluent concentrations are more precise than manually prepared eluents. This consistency is true from run to run, system to system, and lab to lab.

Eluent generation is fully supported by Dionex OQ/PQ validation tools to ensure that your laboratory meets even the most rigorous regulatory requirements.

Labor Savings

Labor savings alone justify the purchase of an EluGen cartridge. Manual eluent preparation usually consists of a long list of tasks that can include weighing or pipetting chemicals, diluting, filtering, mixing stock solutions, transferring, dispensing, priming, degassing, filling bottles, and so forth. This list does not take into consideration potential errors associated with eluent makeup or time required for system equilibration. Eluent generation simplifies IC by making the eluent for you. Simply add water to the system and begin collecting data. In addition, with an RFIC-EG system, no additional chemicals or reagents are needed for the suppressor, which saves even more time. Table 1 illustrates the potential labor savings of RFIC eluent generators.

Table 1. Labor Savings								
Cost of Manual Preparation*				Time to Start Up System for Life of Cartridge	Labor Savings with Eluent Generation			
Hourly Labor Rate	0.5 h (Hours spent per 5-day week preparing eluent. Calculations based on 50 weeks)	1.0 h	2.0 h	1 h	0.5 h	1.0 h	2.0 h	
\$15.00	\$375.00	\$750.00	\$1500.00	\$15.00	\$360.00	\$735.00	\$1485.00	
\$25.00	\$625.00	\$1250.00	\$2500.00	\$25.00	\$600.00	\$1225.00	\$2475.00	
\$35.00	\$875.00	\$1750.00	\$3500.00	\$35.00	\$840.00	\$1715.00	\$3465.00	
\$45.00	\$1125.00	\$2250.00	\$4500.00	\$45.00	\$1080.00	\$2205.00	\$4455.00	

*Quality Assurance Report conditions

RFIC EluGen Cartridge Lifetime

The life expectancy of an eluent generator cartridge is a function of a number of user-selectable parameters. Based on eluent concentration and flow rate, the number of expected operating hours for the cartridge can be determined. Table 2 shows some examples of calculations of EGC II KOH, EGC II K_2CO_3 , and EGC II MSA cartridge lifetimes based on different column applications.



EluGen cartridges provide months or even years of eluent generation, and give you the ability to run KOH or MSA gradients, and isocratic carbonate/bicarbonate eluents without the need to manually prepare eluents.

Table 2. EluGen Cartridge Life

Column*	Eluent	Flow (mL/min)	Conc. (mM)	I (current required)	Hours	Days (8 h/day)	Weeks (5 days/week)
AS23 (4 mm)	$K_2CO_3:KHCO_3$	1.0	4.5:0.8	17	2547	318	64
AS23 (2 mm)	$K_2CO_3:KHCO_3$	0.25	4.5:0.8	4.3	10190	1274	255
AS22 (4 mm)	$K_2CO_3:KHCO_3$	1.2	4.5:1.4	23	1906	238	48
AS22 (2 mm)	$K_2CO_3:KHCO_3$	0.3	4.5:1.4	5.7	7627	953	191
AS18 (4 mm)	KOH	1.0	39	62.7	1282	160	32
AS18 (2 mm)	KOH	0.25	39	15.7	5128	641	128
AS15 (3 mm)	KOH	0.5	40	32.2	2500	313	63
AS14 (4 mm)	$K_2CO_3:KHCO_3$	1.2	3.5:1.0	17	2500	313	63
AS9-HC (4 mm)	K_2CO_3	1.0	9.0	29	1500	188	38
CS12A (4 mm)	MSA	1.0	18	28.9	1389	174	35
CS16 (4 mm)	MSA	1.0	30	48.2	833	104	21
CS17 (2 mm)	MSA	0.25	6	2.4	16666	2083	420

*Quality Assurance Report conditions

Unparalleled Gradient Flexibility

In addition to saving time preparing reagents, you can speed methods development by adding hydroxide and MSA gradient capability to your existing isocratic system. Electrolytically generated gradient separations are as effortless as isocratic separations. Not only is eluent preparation eliminated, but also straightforward software control creates gradient profiles on demand. A change in eluent concentration is accomplished through the software, not manual eluent preparation from a chemical stock. Furthermore, on-line eluent generation eliminates eluent contaminants that cause gradient baseline shifts by electronically generating high-purity, contamination-free eluent. This eluent generation results in higher sensitivity, improved resolution, lower baseline drift, and accurate peak integration.

RFIC-30: Upgrade IC Systems to RFIC-EG Systems

The Reagent-Free Controller (RFC-30) is an economical way to upgrade an existing DX-120, DX-320, DX-500, DX-600, or ICS-2500 ion chromatography system to an RFIC-EG system. The RFC-30 is a stand-alone eluent generation system that does not require software. This stand-alone controller and EluGen cartridge can deliver isocratic or simple gradient eluents. The RFC-30 includes an eluent generator, an electrolytic suppressor controller (AES[®] and SRS[®] 300), and control for the Continuously Regenerated Trap Columns (CR-TC).

RFIC-EG COMPONENT SPECIFICATIONS

EluGen Cartridge Specifications

<i>Cartridge Dimensions (h × w × d):</i>	23 × 7 × 10 cm (9 × 2.75 × 4 in.)
<i>Cartridge Weight:</i>	1.6 kg (3.5 lb)
<i>Concentration Range:</i>	0.1-100 mM (0.1-80 mM EGC-LiOH)
<i>Flow Rate:</i>	0.01-3.00 mL/min.
<i>Max. Operating Pressure:</i>	21 MPa (3000 psi)
<i>Max. Solvent Concentration:</i>	EGC II KOH—25% methanol EGC II MSA—no solvents EGC II K ₂ CO ₃ —no solvents

RFIC CR-ATC and CR-CTC Specifications

<i>Dimensions (h × w × l):</i>	5.1 cm × 5.5 cm × 8.4 cm (2.0 in × 2.15 in × 3.3 in)
<i>Weight:</i>	60 g (0.13 lb)
<i>Current Output:</i>	<125 mA
<i>Void Volume:</i>	<100 µL
<i>Constant Voltage:</i>	24 V dc

RFIC Suppressor Specifications

ASRS 300

<i>Dimensions:</i>	16.8 × 4.5 × 5.2 cm (6.6 × 1.8 × 2.1 in.)
<i>Void Volume:</i>	4 mm: <50 µL 2 mm: <15 µL
<i>Weight:</i>	630 g (1.4 lb)
<i>Current Range:</i>	0–500 mA

CSRS® 300

<i>Dimensions:</i>	16.8 × 4.5 × 5.2 cm (6.6 × 1.8 × 2.1 in.)
<i>Void Volume:</i>	4 mm: <50 µL 2 mm: <15 µL
<i>Weight:</i>	630 g (1.4 lb)
<i>Current Range:</i>	0-150 mA

AAES

<i>Dimensions:</i>	4.9 × 4.4 × 10.2 cm (1.9 × 1.8 × 4.0 in.)
<i>Void Volume:</i>	<35 µL
<i>Weight:</i>	120 g (0.3 lb)

CAES

<i>Dimensions:</i>	4.9 × 4.4 × 10.2 cm (1.9 × 1.8 × 4.0 in.)
<i>Void Volume:</i>	<35 µL
<i>Weight:</i>	120 g (0.3 lb)

RFIC-30 REAGENT-FREE CONTROLLER SPECIFICATIONS

TTL Inputs:

Two independent 0–5 V
0V = On, 5V = Off; ac control

Dimensions (h × w × d):

12.4 × 16.2 × 28.8 cm
(4.9 × 6.4 × 11.3 in.)

Weight:

2.5 kg (5.5 lb)

Power Requirements:

Consumption, 500 VA max.;
voltage, 100–240 V ac;
frequency, 50/60 Hz

Operating Temperature Range:

4–40 °C

Operating Humidity Range:

5–95% relative, noncondensing

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.

EluGen Cartridges	Part Number
EluGen II KOH Cartridge	058900
EluGen II MSA Cartridge	058902
EluGen II K ₂ CO ₃ Cartridge	058904
EPM Electrolytic pH Modifier	063175
(needed to generate K ₂ CO ₃ /KHCO ₃ eluent)	
Carbonate mixer kit (2 mm)	063443
Carbonate mixer kit (4 mm)	061686
EluGen II NaOH Cartridge	058908
EluGen II LiOH Cartridge	058906
Splitter/Mixer (used to operate EGC II NaOH and	063049
EGC II LiOH in dual-mode for Cryptand A1 column chemistry)	

Electrolytic Suppressors	Part Number
ASRS 300 (2 mm) Anion Self-Regenerating Suppressor	064555
ASRS 300 (4 mm) Anion Self-Regenerating Suppressor	064554
CSRS 300 (2 mm) Anion Self-Regenerating Suppressor	064557
CSRS 300 (4 mm) Anion Self-Regenerating Suppressor	064556
Anion Atlas Electrolytic Suppressor (AAES).....	056116
Cation Atlas Electrolytic Suppressor (CAES)	056118

Eluent Purification	Part Number
CR-ATC Continuously Regenerated Anion Trap Column.....	060477
CR-CTC Continuously Regenerated Cation Trap Column.....	060478

Sample Purifications	Part Number
<i>For Hydroxide Eluents:</i>	
CRD 200 (4 mm) Carbonate Removal Device	062983
CRD 200 (2 mm) Carbonate Removal Device	062986
<i>For Carbonate Eluents:</i>	
CRD 300 (4 mm) Carbonate Removal Device	064637
CRD 300 (2 mm) Carbonate Removal Device	064638

Reagent-Free Controller	Part Number
RFC-30 Reagent-Free Controller (EGC II KOH, CR-ATC).....	060667
RFC-30 Reagent-Free Controller (EGC II MSA, CR-CTC)	060668
RFC-30 (MSA, CR-CTC, CTS-10) for DX-120 Only	061414
RFC-30 (KOH, CR-ATC, CTS-10) for DX-120 Only.....	061413

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Dionex Corporation
1228 Titan Way
P.O. Box 3603
Sunnyvale, CA
94088-3603
(408) 737-0700

North America
U.S. (847) 295-7500
Canada (905) 844-9650
South America
Brazil (55) 11 3731 5140

Europe
Austria (43) 1 616 51 25 Benelux (31) 20 683 9768; (32) 3 353 4294
Denmark (45) 36 36 90 90 France (33) 1 39 30 01 10 Germany (49) 6126 991 0
Ireland (353) 1 644 0064 Italy (39) 02 51 62 1267 Switzerland (41) 62 205 9966
United Kingdom (44) 1276 691722

Asia Pacific
Australia (61) 2 9420 5233 China (852) 2428 3282 India (91) 22 2764 2735
Japan (81) 6 6885 1213 Korea (82) 2 2653 2580 Singapore (65) 6289 1190
Taiwan (886) 2 8751 6655

www.dionex.com

