Using the Agilent Instrument Control Framework to control the Agilent 1290 Infinity LC through Waters Empower software

Instrument set up and performance

Technical Overview

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Abstract

The Agilent Instrument Control Framework (ICF) enables other providers of LC data acquisition and processing software to simplify the development of the control of Agilent LC instrumentation. In this Technical Overview we demonstrate how Agilent ICF facilitates enhanced control of the Agilent 1290 Infinity LC through Waters Empower chromatography data software versions 2 and 3. The combination of Agilent ICF and Waters Empower software provides easy access to advanced features of the 1290 Infinity LC such as priming and purging the pump, external needle wash, and acquisition of all eight MWD and DAD signals.

Agilent Technologies

Introduction

The Agilent Instrument Control Framework (ICF) is a software component that makes it easier and faster for software providers to implement control of Agilent LC equipment in their chromatographic data systems or workstations[1,2]. Based on new standard instrument drivers from Agilent, ICF eliminates much of the delay and effort of using low-level instrument control codes and the need of software developers to write their own native drivers.

In this Technical Overview we demonstrate:

- What prerequisites have to be fulfilled to ensure seamless interaction with Agilent 1290 Infinity LC systems, Waters Empower software and ICF
- Which modules and instrument features are supported
- How instruments are configured and methods are created for the Agilent 1290 Infinity LC system using Waters Empower software in combination with ICF
- That the performance of the Agilent 1290 Infinity LC system fulfills expectations using Waters Empower data acquisition and processing tools

Experimental

An Agilent 1290 Infinity Binary LC system with the following modules was used for the precision measurement:

- Agilent 1290 Infinity Binary Pump
- Agilent 1290 Infinity Thermosttated Column Compartment
- Agilent 1290 Infinity Diode Array Detector
- Agilent 1290 Infinity High Performance Autosampler
- Agilent ZORBAX RRHT Eclipse Plus C-18 column packed with 1.8-µm particles

Chromatographic conditions for precision measurement

Compounds:	Uracil, phenol, methyl-, ethyl-, butyl-, and heptyl-paraben, toluene, and n,n-diethyl-m-toluamide
Column:	Agilent ZORBAX Eclipse C18 RRHT, 3 × 100 mm, 1.8 µm
Mobile phases:	Water/acetonitrile
Gradient:	30% to 80% in 8 min, at 8.01 min 30%
Flow rate:	0.8 mL/min
Stop time:	11 min
Column temperature:	30 °C
Injection volume:	3 µL
DAD:	254/10 nm Ref. 360/100 nm, 20 Hz
Software:	Empower 2 Build 2154, Installed Service Packs: A-D, Installed Feature Releases: 1-4, with ICF version A.01.02 SP1

Prerequisites for the combination of Empower and ICF

- All Agilent LC modules must have firmware version A.06.32 or B.06.32 or B.06.41 or higher.
- All Agilent LC modules must have RC.Net drivers.
- Agilent Infinity LC ICS 1.0.0
- Empower 2, feature release 3 or higher or Empower 3 software[3]
- Windows XP with service pack 3 or higher[3]

Results and discussion

Agilent ICF facilitates access to advanced features of Agilent LC instruments that were previously not supported by earlier revisions of Empower with drivers provided by Waters. Now, all features are supported and available through the new *On Line* screen, which has been added to the familiar Empower screen, see Figure 1. A right-click on one of the module fields gives access to all control, method and other advanced features of the module. RFID tags can be seen if the cursor is moved over the label pictogram for the lamp and cell of the DAD module.

For supported modules and functions, refer to the Appendix.

Configuring the Agilent 1290 Infinity LC system

1. Set up the DHCP of the Empower node.
2. Set all DIP switches of the Agilent module to "0". This module is connected to the Empower node through LAN.
3. The LC receives an IP address from the DHCP server.
4. To connect the Agilent instrument, configure the DHCP server through *Properties* of the *Empower Nodes*. Note: For more details see Technical Overview in reference 4.
5. Use *Edit* to set the instrument type and a unique name.
6. Click *File* and *New chromatographic system* to make the new LC system accessible for data acquisition.

After this last configuration step, the Agilent 1290 Infinity LC system is *On Line* and ready for use.

These configuration steps have to be followed whenever a new module is added or removed. Previously, the old configuration had to be deleted from the DHCP server configuration. Then the Empower software had to be shut down and the LAN connection to the module had to be switched off and on again. When the LAN connection has been restored the new configuration procedure can be started.

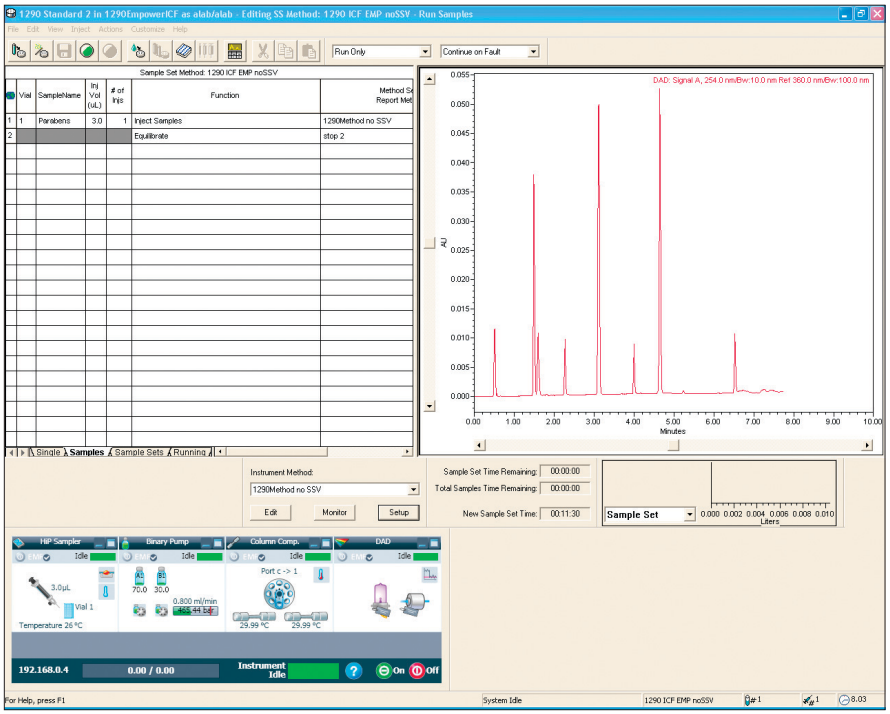


Figure 1
Agilent Instrument Status screen under Empower and ICF software.

Creating an instrument method and a method set

Having configured the instrument, the instrument method and the method set can be created in the *Empower Run Sample* screen. The Instrument method is set up through *Edit method.* The pump screen for setting appropriate parameters is shown in Figure 2. All parameters that are available in the Agilent ChemStation are now accessible in Empower.

To use Agilent well/vial plates, the dimensions of the plates have to be configured.

The created instrument method is saved and used to set up a method set. The method set can then be used to create sequences.

The *Agilent Instrument Status* screen implemented in the *Run Sample* screen of Empower is used to set up online methods, to switch the system on or off, to equilibrate columns, to view the status of single module, and to access special features. Control Tab functions such as purging and priming the pump and setting the minimum stroke are now available. See Figures 3 and 4.

The method parameters filled in here are not saved as an instrument method. Only the method created in the *Edit method* screens is saved.

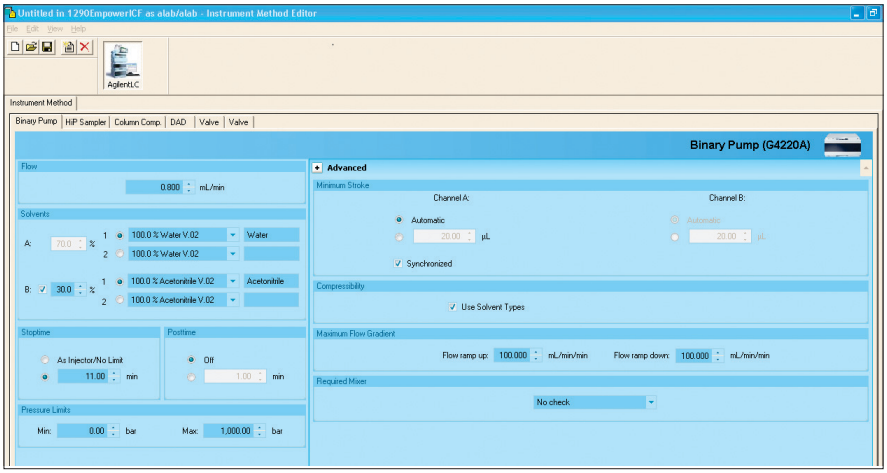


Figure 2
Parameter selection screen for the binary pump of the 1290 Infinty LC.

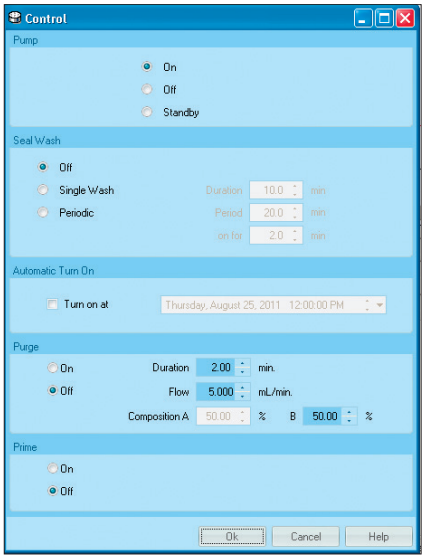


Figure 3
Control screen of Agilent 1290 Infinity Binary Pump.

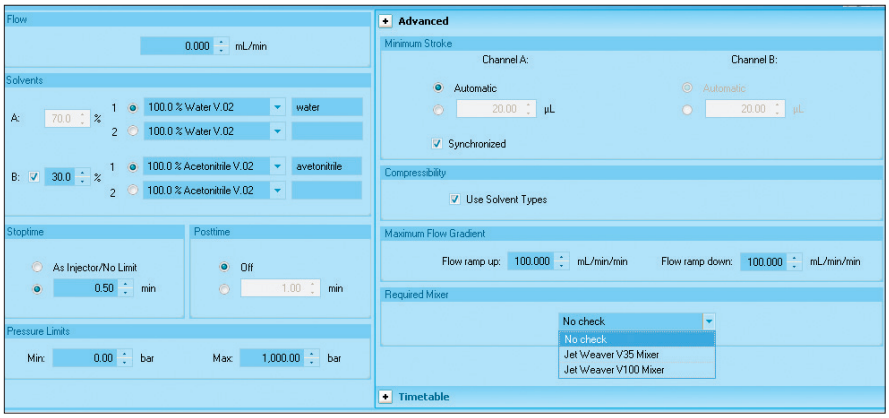


Figure 4
Method screen of the Agilent 1290 Infinity Pump selected from the new user interface.

Creating a sequence

Create a sequence by filling the sample set table with the sample name, position of vials, number of injection per vial, method set to be used, and so forth.

Performance of the Agilent LC systems using Waters Empower data processing tools

To demonstrate that the Agilent 1290 Infinity Binary LC fulfills the expected performance, the following tests were done using a paraben sample:

- Precision of retention time
- Precision of areas

Precision of retention time and areas

The chromatogram of the paraben sample is shown in Figure 5. Precision of retention times and areas for a 3-µL injection are combined in Table 1. Data were evaluated using *Empower Component summary report*. The precision for the retention times for six consecutive runs is < 0.11% RSD, for the area the precision is < 0.30% RSD.

Conclusion

The Agilent Instrument Control Framework (ICF) is a software component that makes it easier and faster for software providers to implement control of Agilent liquid chromatography systems in their chromatographic data systems or workstations. In our application example, ICF was used to control the Agilent 1290 Infinity Binary LC system in combination with Waters Empower software. The instrument was configured in Empower and data were acquired and processed. The combination of ICF and Empower software facilitates access to most available Agilent instrument features such as external needle wash, purging and priming of the pump, and acquisition of more than five signals. The Agilent Instrument Status screen is used to set up *On Line* methods, to switch the system on or off, to equilibrate columns, to view the status of single module, and to access special features using the *Control* function available for each Agilent LC module. As expected, the Agilent 1290 Infinity Binary LC system shows the same excellent performance for data acquired and processed using Empower and ICF.

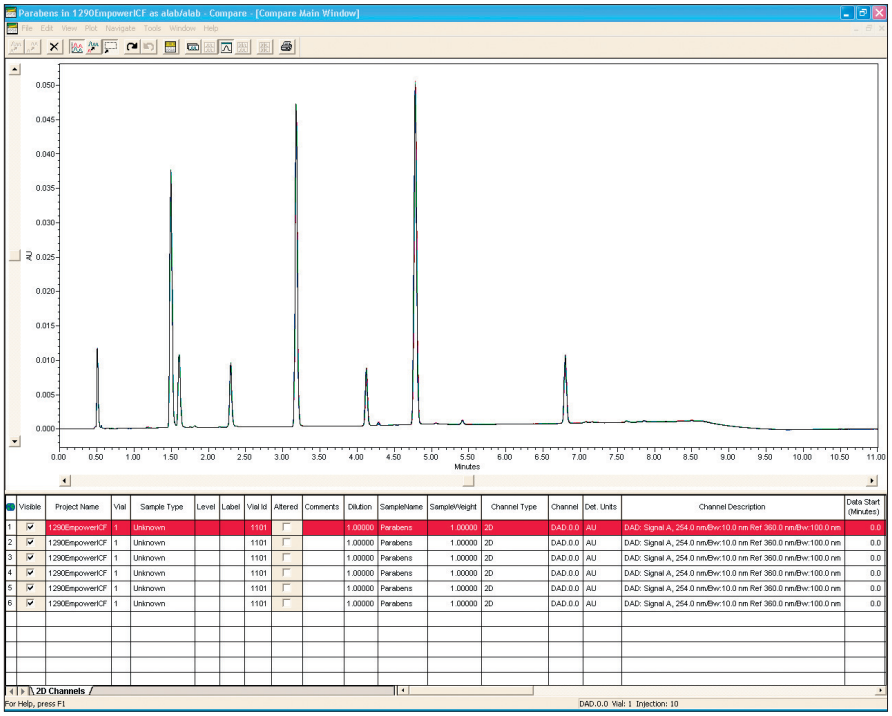


Figure 5
Overlay of six chromatograms of paraben sample for evaluation of retention time and area precision.

Peak name	RSD RT (%)	RSD Area (%) (3 µL injection volume)
Phenol	0.108	0.125
Methyl-	0.108	0.227
Ethyl-	0.090	0.148
Toluamid	0.059	0.159
Butyl-	0.068	0.142
Toluene	0.060	0.278
Heptylparaben	0.036	0.197

Table 1
Precision of retention times and areas for six consecutive runs.

References

1.
"The Agilent Technologies Instrument Control Framework", Technical Overview, Publication number 5990-6504EN, November 2010.

2.
"The Agilent Technologies Instrument Control Framework" Short overview, Publication number 5990-5756EN, June 2010.

3.
"Agilent Infinity LC Instrument Component software Version 1.0 for Empower software" Waters Installation note, Publication number 716003453 Rev.A, August 2011.

4.
"Using the Agilent Instrument Control Framework to control the Agilent 1260 Infinity LC through Waters Empower software- Instrument set up and performance", Agilent Publication, Publication number 5990-9092EN, November 2011.

Appendix

See Table 2 for supported and tested Agilent modules.

See Table 3 for supported and not yet supported functions and instrument features.

				Tested by Waters	Tested by Agilent
Agilent 1290	Pumps	Binary pump	G4220A	OK	OK
		Binary pump VL	G4220B	OK	
	Sampler	1290 HiP	G4226A	OK	OK
	TCC	TCC	G1316C	OK	OK
		2-pos/6-port valve	G4231A/B		OK
		6 column selection valve	G4234A/B		OK
		8-pos/9-port valve	G4230A/B		OK
		2-pos/10-port valve	G4232A/B		OK
	Detector	DAD	G4212A	OK	OK
		VWD	G1314E	OK	

Table 2
Supported and tested Agilent LC Modules.

The following configurations and tasks are now accessible by Empower with ICF as tested in the application lab in Waldbronn, Germany.	Features not yet supported in the current version used for this Technical Overview
• System with second pump, for instance for alternating column regeneration • Dual detector application is possible to configure and run (this functionality is not officially supported by Waters) • 2-pos/10-port, 2-pos/6-port, 8-pos/9-port, and 6 column selector valve built in column compartment, valve-heads • Switching of these valve is possible • External needle wash • All eight signals for acquisition on a DAD or MWD are supported • Early Maintenance Feddback (EMF) can be set up in the Agilent Lab Adviser. Warnings and limits are displayed in the Agilent System UI in Empower • Overlapped injections • RFID tags: Lamp and detector cell tags and column tags can be accessed in the *Agilent Instrument Status* screen by clicking on the label pictograms • *None* or *All spectra* can be selected for DADs Module control functions • Pump bottle filling	• Configurations such as UIs needed for clustering of pumps and column compartments are not yet available • Creation of additional compressibility curves by the user not yet available • Manual injection as single sample run; i.e. Empower always requires a sequence when Agilent LC instruments are used • Fraction collector • Purge kit (G1373A) • DAD data recovery card • Clustered column compartments • New external valve drives (G1170A) • Clustered pump with Solvent Selection Valve • Injector programming • Post time available in the pump set up screen of Agilent pumps

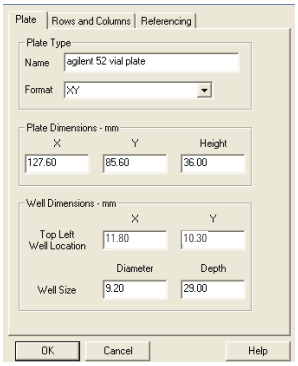
Table 3
Supported and not yet supported instrument features.

Configuring Agilent vial and well plates

In Empower, go to *Create New Plate Type* and enter the dimensions in Table 4 for the Agilent vial/well plate types.

Agilent 54 vial plate

Tab: PLATE



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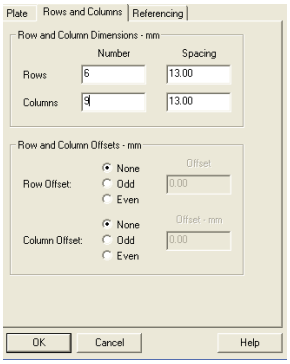

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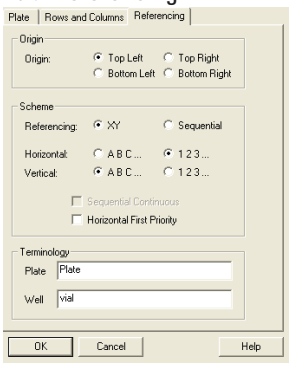
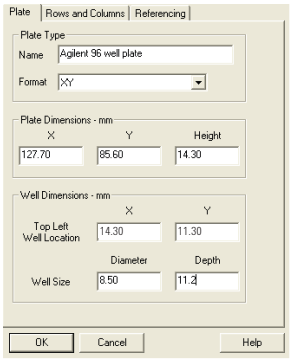


Agilent 96 well plate

Tab: PLATE



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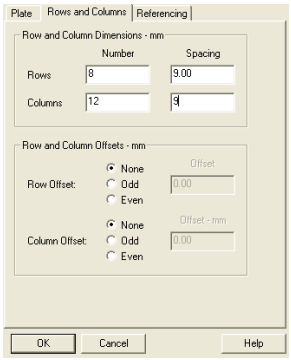

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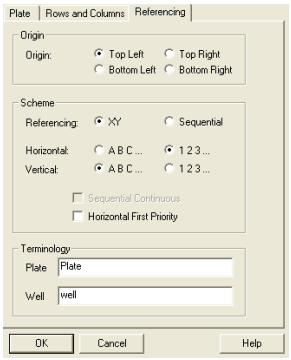
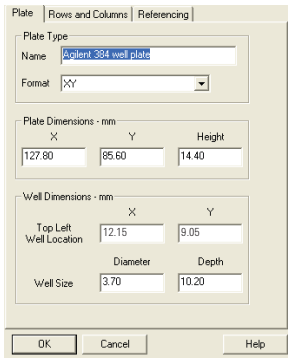


Agilent 384 well plate

Tab: PLATE



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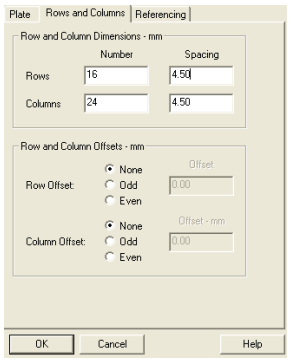

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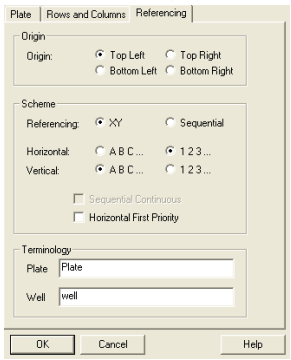

Table 4
Configuration of Agilent well/vial plate types in Empower.

www.agilent.com/chem/icf

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