

Using High Dynamic Range (HDR) in Empower Environment

Technical Note

This is a technical guide for the configuration of the High Dynamic Range (HDR) option with two Agilent DADs in a Waters Empower 3 environment.

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Introduction

Waters Instrument Control Software (ICS) is Waters Corporation adoption of the Agilent Instrument Control Framework (ICF) for their data systems. This guide describes how to configure HDR using Agilent ICF in a Waters Empower environment.

Table 1 on page 2 lists the supported and unsupported configurations using HDR in Empower.

Waters Instrument Control Packages	Agilent ICF / LC Driver	HDR support in Waters Empower 3		
ICF Support v2.2 #667005584	A.02.04 A.02.14	HDR support using		
ICF Support v2.2 #667005449	A.02.03 DU2 A.02.13	• 2 x G4212A/B or 2 x G7117A/B		
ICF Support v2.1 HF1 #667005397	A.02.03 DU1 HF2 A.02.11SP1 HF2	• Firmware B.06.57 or higher		
ICF Support v2.1 HF1 #667004920	A.01.05 SP1 A.01.05 SP1			
ICF Support v2.1 HF1 #667004900	A.01.04 A.01.04	No HDR Support		
and any lower integration	and any lower integration			

 Table 1
 Supported and not supported configurations

Other Prerequisites:

- HDR requires HDR-DAD USB dongle (the USB dongle is part of the 1200 Infinity HDR-DAD Solution Kit, G2199AA), which contains a license to enable the HDR-DAD solution. Only one of the DADs requires a license.
- No other detectors are supported together with HDR.

NOTE

Ensure that all Agilent LC modules in the system *meet or exceed* the minimum firmware requirements specified by the 3rd-party CDS software vendor and Agilent's firmware set/firmware interoperability requirements. Agilent recommends using the latest available firmware set.

http://www.chem.agilent.com/_layouts/agilent/downloadFirmware.aspx?whid=79809

Set Up of HDR within the Agilent LC Instrument System

Software Requirements

The clustering option is directly provided by the Agilent LC driver. This driver is delivered along with the supporting ICS.

Ensure that all the components are installed correctly by checking in the operating systems Program and Features section. The Agilent components need to be listed among the Waters ICS component (Agilent LC).

🐹 Agilent Instrument Control Framework - LC Drivers A.02.14	Agilent Technologies	12.04.2017	111 MB	2.14.115
🔆 Agilent Instrument Control Framework A.02.04	Agilent Technologies	12.04.2017	47,0 MB	2.4.124
😒 Agilent LC	Waters Corporation	12.04.2017	15,6 MB	2.2.0.0

Figure 1 Required components

HDR Cluster – Instrument Set Up

- 1 Close the Empower CDS.
- 2 Switch off the Agilent LC Tower and connect both DADs to the LC system.
- **3** Connect a LAN cable to each DAD.
- **4** The Agilent DADs are delivered with the communication switches (dip switches) set to LAN communication mode *using default*. The default IP address 192.168.254.11 is the same for all modules.

Both detectors used for HDR require a unique IP address, which is in the same subnet range. Ensure that the correct connection type on the detectors is set by the dip-switches on the back of each module.

Following listed initiation modes are selectable. Fixed IP addresses are strongly recommended for this set up, hence the proposed set ups are marked in bold font. The hardware manual for the DAD outlines:

- Bootp
- Bootp and store
- Using stored (assignment via Instant Pilot or Telnet commands)
- Using default
- DHCP (assignment by DHCP server during reboot)

Using Stored	SW4	SW5	SW6	SW7	SW8
G4212A/B			OFF	ON	OFF
G7117A/B	OFF	ON	OFF	OFF	OFF

Refer to the DAD manual available on the Agilent webpage (www.agilent.com). Type the product number of the detector in question and review chapter *LAN configuration* for the assignment of the IP address.

- **5** Reboot the instrument to ensure IP assignment of the module.
- **6** Use the ping command to verify online communication. Both DADs must be accessible from the LAC/E.

NOTE

Note the IP address and the MAC Address for the DAD with the long and the short flow cell. Both parameters are required for the set up in Empower.

- 7 One detector used for HDR requires the HDR-USB dongle. Plug-in the USB dongle and turn the devices on. Wait until the HDR dongle stops blinking and power cycle the device. Afterwards the USB dongle can be removed from the device. The license remains on the device.
- 8 Connect both detectors to the Waters LAC/E box (HUB/switch required).
- 9 Connect the power plug and connect all modules using CAN cable.

10 Switch on all modules in the Agilent LC instrument system.

Configure HDR in Empower

Configure HDR in Empower

The configuration of HDR in Empower requires a PreConfiguration Utility.

Starting with ICF Support v. 2.1 HF1 with A.02.03 DU1 HF2 a PreConfiguration Utility is availabe. The PreConfiguration Utility is present at one of the following two locations:

- Using Empower installation on the LAC/E box, see "Using Empower installation on the LAC/E box" on page 5
- Via the Empower Configuration Manager (recommended for Client/Server configuration), see "Via the Empower Configuration Manager" on page 6

Using Empower installation on the LAC/E box

Software required ICF Support v2.1 HF1 with A.02.03 DU1 HF2

1 Double-click on the PreConfiguration Utility in C:\Empower\Instruments\AgilentLC (the main Windows driver character may differ depending on the installation path, e.g. in Citrix environment).

LCF Agilent.InstrumentControl.InstrumentPreConfigurator.exe

2 If an instrument is not present, click New to generate a new instrument.

Icf InstrumentPreConfigurator	
	Exit

Figure 2 InstrumentPreConfigurator on LAC/E

NOTE

Via the Empower Configuration Manager

Software required	ICF Support v2.2 (see "Waters" on page 20 for Waters support documentation TECN134936402)
	1 In the Empower Configuration Manager select Tools > Agilent PreConfiguration .
	🔒 System/Administrator - Configuration Manager
	File Edit View Records Tools Help
	🔊 🖫 💁 💉 💌 Empower Analytics Agilent PreConfiguration
	Figure 2 Configuration Managar
	rigure 5 Configuration Manager
	2 Enter IP address or host name of the LAC/E box which is connected to your instrument in the pop-up screen Configuration Directory and click Connect .
NOTE	Do not enter the IP address of the instrument here.

Enter IP address or host name of the LAC/E box where your instrument in the Configuration Directory. If you are connected, the status line above shows **Connected to...**.

See Example: IP 169.254.135.144, where is the IP of Empower LACE Node.

🗐 Configuration Directo	ory: Connected to	169.25 👝	• ×
IP Address / Host Name	169.254.135.144	Connect]
New Dele	ete Configu	re 🗌	Exit

Figure 4 IP address to connect

3 Once the IP address is connected, click **New** to open the PreConfiguration Utility.

Pre-Configuration of HDR for Empower

Regardless of which PreConfiguration Utility was chosen, continue the configuration using the following steps when the dialog box opens:

뗥 ConfigDlg		
⊕ - Agilent ELSD ⊕ - Agilent 1100/1200/1290/LC ⊕ - Agilent 1120/1220 LC Systems ⊕ - Agilent 7100 CE	Auto Configure Autoconfig se	elected package Agilent 1100/1200/1260/1290 LC
Help		OK Cancel

Figure 5 Configuration Dialog

1 Highlight Agilent 1100/1200/1260/1290 LC, select **Auto Configure** and enter the IP address of the DAD with the long flow cell.

Note the IP address of the DAD with the long flow cell. The same IP address is used later in the Empower Configuration Manager.

2 Click OK.

If the system offers cluster possibilities, the Cluster option screen appears.

Otherwise the currently connected online modules appear on the right-hand side and no cluster options are displayed.

3 In the following **Edit automatic configuration** screen all available cluster options are shown in a highlighted blue box. As HDR is the clustering of two DADs (example shown for G7117A/B), select the option **Configure HDR-DAD Cluster**.

If all prerequisites are met, the Cluster Configuration screen opens.



Figure 6 Automatic configuration offering cluster options

NOTE

Ensure that all hardware requirements (firmware, long flow cell 1st detector and short flow cell 2nd detector) are fullfilled. Please refer to the HDR manual.

- 4 The HDR-Cluster Configuration screen shows the automatically clustered detectors.
- **5** Highlight the 2nd DAD (short flow cell) and select **Configure**.

HDR-DAD Cluster	Configuration (auto	configuration part)			
Liuster					
Device name H	IDR-DAD Cluster]			
Detectors					
Module Type	Serial number	Firmware revision	Cell length [mm] 🛛 🗸	Additional Connection	
G7117B	DEBAW00140	D.07.10 [0004]	60		
▶ G7117B	DEBAW00141	D.07.01 [0005]	3.7		
				Configure	
Options					
	Delay Volume bet	ween detectors	11.00 🛟	μ	
		Linked Pump G712	DA:DEBAY00131	~	
					Ok Cancel

Figure 7HDR - Cluster configuration screen

Empower requires only one IP address to connect to the LC System. The IP address of the detector with the long flow cell is to be used as connection point. In addition the second DAD requires a LAN card connection to ensure sufficient bandwidth to transmit the delivered data (especially spectra data) in the required time.

6 Click Additional Connection....

🖳 Dad Configuration	- • ×
Module	
Type ID G7117B 👻	
Serial number DEBAW00141	
Firmware revision D.07.01 [0005]	
Additional connection	
Options	
Cell length 3.7 🔹	mm
[mmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	0.1
<u> </u>	Cancel

Figure 8 Second DAD LAN configuration

7 In the pop-up screen Auxiliary connection settings select Use auxiliary connection to enable the communication settings and enter the IP of the 2nd DAD (short flow cell).

HDR- Cluste De	-DAD Cluster Co er evice name HD	onfiguratio R-DAD Clus	n (auto co ter	onfiguration part)						
Dete	ctors										
Mod	lule Type	Serial nu	umber	Firmware revision		Cell leng	th [mm]	Additional	Connection		
0	G7117B	DEBAW	00140	D.07.10 [0004]		60					
•	G7117B	DEBAW	00141	D.07.01 [0005]		3.7			Δ		
	🖳 Dad Config Module	uration					23	Γ			
Op		Type ID	G7117B	•			Auxiliary	connection	settings	ĺ	×
	Ser	ial number	DEBAW0	0141			Conn	ection setting	s		
	Firmwa	re revision	D.07.01 [0 Additiona	0005] al connection			0	IP Address Hostname	192.168. 0. 4		
	Options										
		Cell length		3.7 🛟	mm			ΟΚ	Cancel	Help	
				OK		Cancel				Ok	Cancel

Figure 9 Communication of 2nd DAD – flow cell

- 8 Click OK to close the Auxiliary connection settings window.
- 9 Click OK to close the Dad Configuration window.

In the configuration screen, the 2 clustered DADs are listed.

Configure HDR in Empower Pre-Configuration of HDR for Empower

HDR-DAD Cluster	Configuration (auto c	onfiguration part)				
Device name H	IDR-DAD Cluster					
Detectors						
Module Type	Serial number	Firmware revision	Cell length [mm] 🛛 🗸	Additional C	onnection	
G7117B	DEBAW00140	D.07.10 [0004]	60			
▶ G7117B	DEBAW00141	D.07.01 [0005]	3.7	192.168.0.4		
					Configure	
Options						
	Delay Volume betv	veen detectors	11.00 📫	μL		
		Linked Pump G7120	A:DEBAY00131	•		
						Ok Cance

Figure 10 HDR - DAD Cluster Configuration

NOTE	If the LC system connection would be hosted by another module, two IP addresses need to show up in this screen – one for each DAD module.
	10 Ensure that the HDR modules are in the correct order:
	• First: the long cell (60 mm)
	• Second: the small cell (3.7 mm)
	11 Fill in the Delay volume between detectors in μL .
NOTE	Agilent provides the G2199AA 1200 Infinity HDR-DAD Solution Kit, which includes capillaries ensuring to have a delay volume of 11.00 μL. The package includes the HDR user manual G2199-90001 documenting the calculation of the delay volume.
NOTE	Please contact Agilent Support if you need to measure the delay volume in case there are changes in kit used, or if the retention time is not the same as expected.

12 Click OK to close the HDR - DAD Cluster Configuration window.

13 If you need to perform additional cluster configuration, proceed with the cluster configuration. Otherwise close the window by clicking the red X in the upper right corner or click **Close**.



Figure 11 Cluster option window

The just configured Cluster (HDR-DAD Cluster) is present in the right-hand side of the configuration editor.

🖳 Instrument Configuration (modified)		- • ×
	Bin. Pump (G7120A:DEBAY00131) Column Comp. (G7116B:DEBA200123) HiP Sampler (G7167B:DEBAQ00217) HDR-Dad Cluster (HDR-DAD Cluster)	
	Up Down Config	ire Clear
Audit Trail Report Help Export	OK	Cancel

Figure 12 Final Instrument Configuration window

14 Click **OK** to close the configuration editor.

In the **InstrumentPreConfigurator** the newly created instrument appears with the assigned IP number.

ICF InstrumentPreConfigurator						
192,168.0.3						
New Delete Configure						

Figure 13 Final Screen of PreConfiguration

15 Click **Exit** to close the PreConfiguration Utility.

Set Up of LC System with HDR in Empower

Refer to the Waters Empower documentation for installation and configuration of an LC system in Empower.

1 Open Waters DHCP Server Configuration window by entering to C:\Empower\ Instruments\Waters DHCP Server Configuration.exe.

OR

Access Empower Configuration manager window, select **Node** on the right-hand side, right-click and select **Properties**.

2 Select the Configure DHCP tab and click on Configure DHCP.

The set up can be performed in two different ways:

- manually (see "Manual Set Up Using Fixed Addresses" on page 13)
- using the *scan instrument* functionality (see "Set Up Using the Scan Functionality" on page 15)

Manual Set Up Using Fixed Addresses

Preparations

IP assignment: Using stored or Bootp and Store

1 Add the IP/MAC manually just for the DAD with the *long* flow cell.

2	🚜 Waters DHCP Server Configuration 📃 🗖 📼 💌								
File Server Help									
Γ,		1	1	1					
	IP Address	MAC Address	Туре	Name					
	192.168.0.3	00-30-DX-XX-XX-XE	AgilentLC	AgilentHDR					
	4								
	Add Edit Remove OK								

Figure 14 Set up of detector with long flow cell

2 Select Instrument Type: AgilentLC and click OK to leave the screen.

3 Access the **Nodes Properties** in the Empower Configuration Manager and check if the Instrument is **OK**?.

Node 'Ic-ep3fr2-b1' Properties									
General Instruments Serial Ports Configure DHCP Access									
	Type Address OK ? Serial Number L								
	1	AgilentLC	AgilentLC#AgilentHDR	Yes					
	<u> </u>								
	•				4				
	Scan Instruments Remove Instrument								
	OK Cancel Help								

Figure 15 Node Properties

4 Generate a new Chromatographic System with the newly configured instrument. Due to the manual set up, only the instrument with the long flow cell should be listed.



Figure 16 Create new chromatographic system after manual set up

Set Up Using the Scan Functionality

Preparations

IP assignment: DCHP.

Note that the recommended set up is working with fixed IP addresses.

- **1** Select the **Instrument** tab and click on **Scan Instruments**
- 2 The online instruments, including both detectors are listed. Ensure that the type for the 1^{st} DAD with the long flow cell is **AgilentLC**. Ignore the other DAD entry for the 2^{nd} DAD with the short flow cell.

船 Waters DHCP S File Server He	ierver Configuration Ip		
IP Address	MAC Address	Туре	Name
192.168.0.3 192.168.0.4	00-30-D3-2E-FB-42 00-30-D3-2E-EF-9E	AgilentLC AgilentLC	0030D32EFB42 0030D32EEF9E
•	m	lit Remov	re OK

Figure 17 DHCP detects all online instruments

- **3** Access the **Nodes Properties** in the Empower Configuration Manager and check if the Instrument is **OK**?.
- **4** Generate a new Chromatographic System with the newly configured instrument. Use the instrument with the long flow cell.



Figure 18 Generate HDR Chromatographic system – ensure to select instrument with long flow cell

NOTE

Ignore the other DAD entry for the 2nd DAD with the short flow cell.

Method Set Up of HDR in Empower

- 1 Start Empower and open the **Run Sample** screen.
- **2** The LC Status window automatically displays all available online modules including the HDR-DAD Cluster.

Multisampler		Binary Pump)	Column Comp.	HD	R-DAE) Clu	
	Idle		Idle	Idle				Idle
	EMF		EMF	EMF⊘				EMF⊘
δ 28 °C [25 °C]		100,00 0,00 0 0000 0,00 0	0,000 mL/min	25,24°C 24,79°C Position 1 (Port 1 -> 1') Nucleosil		<u>,</u>		<u> </u>
0,00 / 0,00				Instrument	Idle	i	() On	⊖ Off

Figure 19 LC Status Window

3 Loading the **instrument method**, the system requests the user to update the given method configuration with the new instrument configuration.

沾 Untitled in test as System/Administrator - Instrument Method Editor 🕞 🕞 💌								
File Edit View Help								
Instrument Method Pretreatment Method Auxiliary Channels General Instrument Co	onfiguration							
Quat. Pump Binary Pump Valve Column Comp. Multisampler HDR-DAD Cluster	81							
	HDR-DAD Cluster (HDR-DAD Cluster)							
Signals	Advanced							
Acquire Wave Band Reference Reference	Spectrum							
Signal A 2 540 : 1 3 60 : 1 1000 : 1 mm Signal A 2 210 : 2 40 : 2 3 800 : 1 1000 : 1 mm Signal A 2 210 : 2 40 : 2 3 800 : 1 1000 : 1 mm Signal C 2 210 : 2 40 : 2 3 800 : 1 1000 : 1 mm Signal C 2 230 : 2 40 : 2 3 800 : 1 1000 : 1 mm Signal F 2 230 : 2 40 : 2 3 800 : 1 1000 : 1 mm Signal F 2 250 : 2 40 : 2 3 800 : 1 1000 : 1 mm Signal H 2 50 : 2 40 : 3 3 800 : 1 1000 : 1 mm Signal H 2 50 : 2 40 : 3 3 800 : 1 1000 : 1 mm Signal H 2 50 : 2 40 : 3 3 800 : 1 1000 : 1 mm Signal H 2 50 : 2 40 : 3 3 800 : 1 1000 : 1 mm > 0.0031 min (0.063 s response time) (80 Hz)	Store: M Parge from: 190.0 : to 400.0 : mm Step: 2.0 : mm Analog Output Zero Offset: 5 : % Attenuation: 1000 • mAU Margin for negative Absorbance 100 : mAU 4 • mm							
Totalio	Autobalance Lamps on required for acquisition							
As Pump/Injector Off 1.00 : min 1.00 : min								

Figure 20 HDR Method Screen

Instrument Configuration Tab

In the **instrument configuration** tab the LC system configuration is present. All settings in this dialog are already defined using the PreConfiguration Utility. Changes in this section of the method are not applied to the system. Any changes like e.g. modifying the cell length need to be handled in the PreConfiguration Utility.

Instrument Method Tab

The **instrument method** tab provides access to all method parameters of the LC system, again one tab per module. Select the HDR –DAD Cluster tab to enter the method parameters. For details on the parameters refer to the online help and the HDR user manual.

Using HDR in Empower

Executing HDR- DAD Cluster the data systems treats the signal like any other detector signal. The combined signal can be seen in the online plot or viewed as part of sample sets in the projects. It is also possible to view the separated signals building the HDR signal.



Figure 21 Online channel plots HDR

F	File Edit View Tools Database Help								
E									
Γ									
F	Filter By: Default Edit View Update Max Rows: 1000								
4	Sample Se	ts]Ir	njections	Channels Meth	ods Result Sets Results	Peaks	ractions Sign Offs Curves View Filters Custom Fields		
ľ.	SampleName	Vial	Injection	Sample Type	Date Acquired	Channel	Channel Description		
1	HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.0	HDR-DAD Cluster: Signal A, 254 nm/Bw:4 nm Ref 360 nm/Bw:100 nm		
2	HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.1	HDR-DAD Cluster: Signal B, 210 nm/Bw:4 nm Ref 360 nm/Bw:100 nm		
3	HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.2	HDR-DAD Cluster: Signal C, 214 nm/Bw:4 nm Ref 360 nm/Bw:100 nm		
4	HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.8	HDR-DAD Cluster: LNG Signal A, 254 nm/Bw:4 nm Ref 360 nm/Bw:100 nm		
5	HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.9	HDR-DAD Cluster: LNG Signal B, 210 nm/Bw:4 nm Ref 360 nm/Bw:100 nm		
6	HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.10	HDR-DAD Cluster: LNG Signal C, 214 nm/Bw:4 nm Ref 360 nm/Bw:100 nm		
7	HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.16	HDR-DAD Cluster: SHT Signal A, 254 nm/Bw:4 nm Ref 360 nm/Bw:100 nm		
8	HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.17	HDR-DAD Cluster: SHT Signal B, 210 nm/Bw:4 nm Ref 360 nm/Bw:100 nm		
9	HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.18	HDR-DAD Cluster: SHT Signal C, 214 nm/Bw:4 nm Ref 360 nm/Bw:100 nm		
1	0 HDRSample01	1	1	Unknown	1/23/2015 10:16:48 AM CET	HDR.0.0.S	HDR-DAD Cluster: Spectrum		

Figure 22 HDR signals in Data Analysis

De-clustering HDR

In case the HDR set up is no longer required and the DADs are planned to be used as single modules a new autoconfiguration is required. Perform a new auto-configuration without selection of the HDR Cluster option. The DADs will appear as single modules as the de-clustering is performed by the driver in the background.

Additional Information

Agilent Technologies

Additional information on prerequisites, cabling, configuration and use of HDR can be found in the HDR user manual (Part Number G2190-90001) delivered along with the HDR-DAD USB dongle or on the Agilent Webpage http://www.agilent.com/cs/library/usermanuals/public/HDR_USR_EN.pdf.

Waters

Additional information on the PreConfiguration Utility is provided on the Waters Support Webpage http://www.waters.com/waters/support.htm?lid=134936402&cid=511442&type=TECN.

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