

DOCUMENT TITLE: **PDA FINAL TEST**

SYSTEM/ASSEMBLY NAME: **PDA FINAL TEST EQUIPMENT**

PART NUMBER AFFECTED **SEE TABLE ON PAGE 2**

TEST EQUIPMENT NAME: **PDA FINAL TEST EQUIPMENT**

TEST EQUIPMENT NUMBER: **TE82882, TE82969, TE83057**

TEST SOFTWARE:



(TE82882)



(TE82969)



(TE83057)

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DATE: **June 25, 2007**

REVISED BY: **MATT BRULE**

DATE: **May 20, 2019**

PART NUMBERS AFFECTED

186002998	2998 Photodiode Array Detector
186015026	ACQUITY UPLC PDA Detector
186015030	Assy., ACQUITY UPLC PDA eLambda Detector
186015032	ACQUITY UPLC PDA Detector
186015033	ACQUITY UPLC PDA eLambda Detector
186015034	ACQUITY UPC2 PDA Detector
186015053	ACQUITY PDA Detector w/TaperSlit
186017003	ACQUITY Arc 2998 PDA Detector
186017013	ACQUITY Arc Bio 2998 PDA Detector
186299800	2998 Photodiode Array Detector (blue)
279002655	ASSY, OPTICS BENCH, 2998
700002787	OPTICS BENCH, ACQUITY PDA
700003765	ASSY, OPTICS BENCH, 2998, CLASSIC
700004035	eLAMBDA OPTICS BENCH
700005424	OPTICS BENCH, ACQUITY PDA eLAMBDA
700005427	OPTICS BENCH, ACQUITY PDA
700009014	ASSY, OPTICS BENCH, SFC
700009328	ASSY, OPTICS BENCH, 2998
700009532	ASSY, OPTICS BENCH, PDA
700011650	ACQUITY PDA eLAMBDA, Optics Bench
700011652	ACQUITY PDA, Optics Bench
700011867	ASSEMBLY, OPTICS BENCH, 2998
700011868	ASSEMBLY, OPTICS BENCH, PDA TS
700011869	ASSY, OPTICS BENCH, 2998 UPC2
700012243	Assy, Optics Bench, 2998 (On-Semi)
700012245	Optics Bench, eLambda (On-Semi)
800000202	Refurbished AcQuity UPLC PDA Detector
800000244	Refurb. 2998 Photodiode Array Detector
800000245	Ref. AcQuity UPLC PDA eLambda Detector
800000304	Ref. AcQuity PDA Detector
800000305	Ref. AcQuity PDA eLambda Det.
800000397	Ref. 2998 PDA Detector
800000414	Ref. UPC2 PDA Detector
800000439	Refurb AcQuity PDA W/Taperslit
800000453	Refurb Acq ARC 2998 PDA Det.
800000476	Refurb Arc Bio 2998 PDA Detect
N2971013	Altus A-10 PDA Detector
N2971035	Altus A-30 PDA Detector

EQUIPMENT REQUIRED

Quantity	Part Number	Description
1	TE82882	PDA Final Test System
1	TE83057	Detector download/configure station
1	TE82969	PDA/2998 Linearity Test System

DISPOSABLES REQUIRED

Quantity	Part Number	Description
1	176000278	Linearity Cuvette Kit
1	205015007	AcQuity PDA Cuvette Holder (if AcQuity PDA or ELambda)
1	WAT042885	Cal Solution
1	700004155	2 Cuvette kit
1	289002226	Medium Shunt (if AcQuity PDA or eLambda)

REFERENCE DOCUMENTATION

Document #	Description
735001104	AcQuity PDA Performance Spec
735000898	2998 Performance Spec
735001637	eLambda Optics Performance Spec
735001638	eLambda Performance Spec
735000948	AcQuity PDA Flowcell Performance Spec

DEFINITIONS AND ABBREVIATIONS

Term	Definition
λ	Lambda
CPU	Central Processing Unit (i.e. "computer")
FSD	Functional Specification, Design
L1	Lambda 1
L512	Lambda 512
LSL	Lower Spec Limit
MeOH	Methanol
PDA	Photo Diode Array
PRF	Performance Specification (SAP document type)
USL	Upper Spec Limit
UUT	Unit Under Test
SAP	S ystems, A pplications & P roducts in Data Processing (Enterprise Software)
PC	Personal Computer
LAN	Local Area Network
COM	Communications Port
AQL	Acceptable Quality Level
DHCP	Dynamic Host Allocation Protocol

NOTE: For specifications and test purposes, Altus-A10, AcQuity Arc PDA, Arc Bio = 2998 Refresh and Altus-A30 = eLambda

TEST SPECIFICATIONS AND TRACEABILITY MATRIX

Test #	Test Specification & Condition	Acceptance criteria	Reference
1	<i>Lambda 1</i>	$\leq 188.375 \text{ nM (AcqPDA)}$ $\leq 188 \text{ nM (2998, eLambda)}$	<i>PDA 735000913, sec 2.0</i> <i>(see Note 3)</i> <i>eLambda 735001637, sec. 2.0</i> <i>2998 - 735001637, sec. 2.0</i>
2	<i>Lambda 512</i>	$\geq 501.25 \text{ nM (AcqPDA)}$, $\geq 801.5 \text{ nM (2998, eLambda)}$	<i>PDA 735000913, sec. 2.0</i> <i>eLambda 735001637, sec. 2.0</i> <i>2998 - 735001637, sec. 2.0</i>
3	<i>Shunt/Flowcell energy at 5ms exposure</i>	<i>LSL = 80000 counts</i> <i>USL = 250000 counts</i>	<i>PSC see Note 2</i>
4	<i>Linearity %RSD</i>	$\leq 3.0 \text{ (AcqPDA)}$, $\leq 5.0 \text{ (2998, eLambda)}$	<i>PDA 721007611, sec 5.15.3</i> <i>eLambda 721013305, sec. 5.3.1</i> <i>2998 - 721013305, sec. 5.3.2</i>
5	<i>Noise</i>	$\leq 7 \text{ } \mu\text{Au (PDA, eLambda)}$, $\leq 8 \text{ } \mu\text{Au (2998)}$	<i>PDA 721013305, sec 5.14.1</i> <i>eLambda 721013305, sec. 5.14.2</i> <i>2998 - 721007611, sec. 5.15.2</i>
6	<i>Drift</i>	$\leq 1000 \text{ } \mu\text{Au}$	<i>PDA 721013305, sec 5.14.1</i> <i>eLambda 721013305, sec. 5.14.2</i> <i>2998 - 721007611, sec. 5.15.3</i>

Note 1: Note 1: Optics bench temperature is reported on the test report as with specs listed with LSL as 20°C and USL as 40°C. This is intended to automatically verify fan operation; however this is not a required test per FSD (SAP document type PRF) as operators check fan operation manually.

Note 2: Energy readings at the final test are to ensure the shunts and flow cells used are still functioning properly upon correct assembly as these energy readings are confirmed earlier in the process at the optics bench level mirror adjustment.

Note 3: On the AcQuity PDA, the performance spec allows for a maximum Lambda 1 of 188.75 so the 188.375 adheres to that spec with some additional margin. Associated models are tested to a tighter spec than required.

NOTE: For optics bench testing, proceed to section 5

1. FIRMWARE DOWNLOAD (MANUAL AND AUTOMATED) AND

1.1. If unit under test is an AcQuity PDA, Altus A-30, or an eLambda, install medium shunt (289002226), otherwise use flowcell (289007906 or equivalent).

1.2. Remove instrument cover.

1.3. Verify that the battery protector has been removed.

1.4. NOTE: if possible, use automated test system

1.4.1. Automated

1.4.1.1. Install 2 pin jumper across pin 8 and 16 (software jumpers) on personality PCB to enable serial communications on blank CPU.

1.4.1.2. Connect UUT to power cord from power controller, serial cable to PC, and Ethernet cable to Instrument LAN in PC.

1.4.1.3. Make sure power switch is in the ON position. (NOTE: UUT will not turn on until power controller activates)

1.4.1.4. If applicable, connect leak test cable from event out connector on rear of UUT to leak detector cable connector on front of UUT.

1.4.1.5. If not logged into PC, log in.

1.4.1.6. If download-config application is not running, launch program by double clicking on the desktop icon.

1.4.1.7. Click **Start**, scan or type operator name (system will verify you are an approved operator – contact line supervisor if login error).

1.4.1.8. Enter serial number or scan folder serial number label with barcode scanner if available and click **Enter**.

1.4.1.9. Click **Download Firmware**. Verify fan operation and air flow (out of back of UUT). Wait until complete.

1.4.1.10. Click **Program Serial Number**.

1.4.1.11. Click **Verify**. System will check firmware version, serial number, and leak detector, if applicable

1.4.1.12. Collect print out, verify all tests pass, sign and place in DHR folder. Remove jumper from CPU board.

1.4.1.13. Click **Back To Main** to test another.

NOTE: You may also power on detector with power on switch on screen. Once detector completes power up cycle (30 sec), you can check serial number, version of firmware, and leak detector individually.

1.4.2. Manual

1.4.2.1. Plug UUT into available AC power. Connect Ethernet cable to Instrument LAN card in PC.

1.4.2.2. Power up UUT. Power light will turn green and lamp light will turn red. Verify fan operation and air flow (out of back of UUT).

1.4.2.3. Run loader software – this should be on desktop of PC, but it can be located in the **C:\Empower\Instruments\firmware** directory. Select **scan for instruments** box on first page, then **next**.

1.4.2.4. Program should find **Boot Loader** on the CPU. Click on this and then click **OK**.

- 1.4.2.5. Select the proper revision of the PDA firmware (see SPECIFICATIONS section above) from the **C:\Empower\Instruments\bin** directory. Click **next**.
- 1.4.2.6. Download should take a few minutes. Cycle power when done. Wait for two beeps or until lamp light is blinking green. Load serial number into unit. In loader, select **scan for instruments** box on first page. Click **next**. Highlight unit, right click select (set serial number). Enter serial number of unit. **OK**. Click **cancel** to exit serial number dialog, then **cancel** to exit the loader program.
- 1.4.2.7. If unit is not a standard PDA (186015032), continue to section 2.
PDA (186015032) Only
- 1.4.2.8. Connect UUT to an available COM port on the PC.
- 1.4.2.9. Open Hyperterminal session with settings 38400,8,n,1.
- 1.4.2.10. Power up instrument and monitor Hyperterminal session screen.
- 1.4.2.11. After instrument displays **lighting lamp**, type **setcalconstants 188 502 <enter>**.

1.5. Verify internal fans

- 1.5.1. If instrument is not powered up, turn on power. Press control button on power controller, if applicable, to power on.
- 1.5.2. Verify that both internal fans are blowing towards the front of the unit. The fans are under control by instrument firmware, the fans are turned on full during instrument initialization and then will slow down. this is normal.

2. WAVELENGTH CALIBRATION

- 2.1. If instrument is not powered up, turn on power. Press control button on power controller, if applicable, to power on.
- 2.2. Wait for UUT to complete initialization and lamp warm-up (about 4 minutes, or until lamp light is steady green).
- 2.3. Run **Stop AcQuity Processes** which should be on the desktop and in the **C:\Empower\Instruments\bin** directory.
- 2.4. If a Waters model, Run **AcQuity Console** which should be on the desktop and in the **C:\Empower\Instruments\bin** dir.
- 2.5. Click on **PDA Detector** from the top left of the console screen. Under **configuration, view module information** to verify serial number of unit under test. Before erbium calibration is performed, check to see if upper wavelength ($\lambda 512$) is correct. Under the **Troubleshoot** selection from the menu, select **service** mode, then enter **1147**, for a password, **OK**. Again, click on **Troubleshoot**, then **Calibration Values**. If the unit under test is an AcQuity PDA or equiv., set the $\lambda 512$ value to **510**, or set to **810** if an eLambda or 2998 or equiv. is being tested. Click on **Set**, then **Yes** when warned by a dialog that you are changing calibration values. Then click **Close**.
- 2.6. At this point, if this is a PDA to be tested, the lamp may have shut off due to a wavelength calibration error. Click on the lamp icon to turn the lamp back on. Also, reset PDA (click PDA Detector|Control|Reset PDA).

- 2.7. Under the **Troubleshoot** selection from the menu, select **Erbium Calibration** and click on the **Erbium Absorbance** radio button. Once the erbium screen appears, select **optimize exposure**.
- 2.8. Next, click **Start** to continuously acquire spectrum.
- 2.9. Click on **Stop**, then note the Lambda 1 and Lambda 512 values. They need to be green ($L1 \leq 188.375$ and $L512 \geq 501.25$ or ≥ 801.5 if 2998 or eLambda or equiv.). If not, the optics bench will need to be recalibrated. If green select **Save**, **OK**, then **OK** again. L1 and L512 are saved into memory of unit. Close screen.
- 2.10. **NOTE: 186002998, 186299800, 186015026, 186015030, 186017003, 186017013, N2971013 (and equivalent repair numbers) only - Enter Lamp Serial Number.** Select Maintain, Select Change Lamp, New Lamp, Enter serial number. (Serial number is on the Lamp cable). Select OK, Close. Close out of AcQuity Console.
- 2.11. Deactivate power controller, if applicable, by pressing control button on power controller. Unplug UUT, **leaving power switch on** and set up at final tester (TE82882).

3. FINAL TEST (NOISE AND DRIFT)

- 3.1. **NOTE: If you are switching from one model to another, follow 3.1.1- 3.1.7, if not, proceed to step 3.2.**
 - 3.1.1. Open Empower by double clicking on the Empower desktop icon or find it in the All Programs list using the start button.
 - 3.1.2. Login as system, pw: metsys.
 - 3.1.3. Select **Configure System** from the menu blocks.
 - 3.1.4. Click on **Systems**
 - 3.1.5. There are up to twenty systems configured for use with the test system, PDA 1 through PDA 4, 2998 1 through 2998 4, A10 1 through A104, A30 1 through A30 4, and ELAMBDA 1 through ELAMBDA 4. Only four of these systems can be online at a time so whatever slot on the test system you are using (1-4), the proper system needs to be on-line. To take a system off line, right click on the system name and select **take offline** from the menu. Then, right click on the system you would like to bring online and select **bring online**.
 - 3.1.6. The recommended configuration is to test all of one type at a time.
 - 3.1.7. Exit out of configuration manager by clicking on the small x in the top right corner of the window. Exit out of Empower by clicking on the small x on the block menu window. For extra stability, run the StopAcQuityProcesses.cmd from the desktop.
- 3.2. Connect UUT to final tester, selecting a position (1-4). Connect the power cable, the serial cable, and the Ethernet cable from that position – they are grouped together.
- 3.3. The power switch on the UUT should be in the ON position. The UUT will not power up, however, as it is software controlled by the tester.
- 3.4. Double click the PDA Final Test icon to start
- 3.5. Choose the loaded position and click **Run**. Enter the required information and follow all instructions on the screen. System will automatically launch Empower and run a noise and drift test.

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- 3.6. Upon finishing the test, click **Remove Unit**, and follow instructions on screen. A printout will print at the test station default printer.
 - 3.7. Final test system will indicate if a particular UUT is to be tested for linearity (AQL testing – one of every ten, serial numbers that end in zero).

4. LINEARITY (ONE UNIT OUT OF 10)

- 4.1. Use PDA Linearity Test Station (TE82969).
- 4.2. Plug in UUT AC Cord, Ethernet cable, and serial cable if instrument level.
- 4.3. If unit is light guided, install cuvette holder.
- 4.4. Power up detector with MeOH cuvette (marked "0") inside.
- 4.5. When lamp light stops blinking and is steady green, run Linearity test program (if not already running) and press START and fill in all required information and select appropriate report mode (Production for standard production and Repair for service). Note: make sure "Launch Console" switch on computer screen is in the ON position (default).
- 4.6. Wait 3-4 seconds (do not click start again), and the program will launch the console application.
- 4.7. Click on PDA – top left corner of screen. Graphs should appear on screen with information on detector.
- 4.8. Click on Troubleshoot|Service Mode
- 4.9. Enter 1147 as password, **OK**.
- 4.10. Click Maintain|Read Energy
- 4.11. Click the **Continuous Read** button to select it. Set wavelength to 240 nm. Type in an exposure of 12.00, and then click **Read**. Note the peak height at around 240nm. Stop (Click the Read button again which is now labeled Stop) and start (Click Read) reading energy, adjusting exposure time until peak between 170,000 and 220,000 counts.
- 4.12. After determining the correct exposure, click **Stop**. Click the **Continuous Read** button to select it.
- 4.13. Click on the close shutter box. Click **Read** once to take a scan. Click **Read**, click **Capture**. Repeat Read-Capture two more times for a total of 3. Make sure screen shows Captures:3.
- 4.14. Press **Save**. A dialog box will open, looking for a filename. Name File C:\PDA Linearity\TestData\darkxxx.txt where xxx is the last 3 numbers in the serial number (before the factory specific letter). If an optics bench, use the entire optics bench serial number as xxx. Click **Save**.
- 4.15. Open the shutter. Make sure exposure is the same as the last capture.
- 4.16. Click **Read** once to take a scan. Click **Read**, click **Capture**. Repeat Read-Capture two more times for a total of 3. Make sure screen shows Captures 3 then stop.
- 4.17. Press **Save**. Name File C:\Program Files\PDA Linearity\TestData\meohxxx.txt where xxx is the last 3 numbers in the serial number (before the factory specific letter). If an optics bench, use the entire optics bench serial number as xxx. Click **Save**.
- 4.18. Repeat Steps 17 and 18 for 5mg, 10mg, 15mg, 20mg, and 25mg cuvettes, also using a 30mg cuvette for extended wavelength detectors, naming the text file 5mgxxx.txt, 10mgxxx.txt etc. If an optics bench, use the entire optics bench serial number as xxx. Exit Read Energy.
- 4.19. Exit Console. Graph will show and print linearity points and %RSD. If %RSD is over 3.0(std) or 5.0(extended wavelength) retest. If linearity does not go below 3.0(std) or 5.0(extended wavelength) within three retests, contact engineering. Insert passing printout into file.

5. SPARE OPTICS BENCH TESTING

- 5.1. Install bench into a new or tested chassis which has appropriate firmware. Follow test procedure from Step 2.1, using the download station to run the console application (to get erbium cal data), and then run final test, section 3.
- 5.2. The chassis will be left with the last serial number tested in its static RAM, but when the chassis is used for a shippable unit, the correct serial number will be programmed in.

6. TROUBLESHOOTING

- 6.1. If the system has trouble launching console or Empower, run Waters DHCP Server Configuration.exe and verify there are less than 255 IP addresses, serial numbers in list. If not, delete them all. If you cannot locate the program do a search of ***DHCP*** with the XP search function.
- 6.2. You may also need to run "Stop AcQuity Processes.cmd" if you are having connection problems or, if all else fails, re-boot system.
- 6.3. Verify the proper systems are on-line (4.1.1-4.1.7).
- 6.4. To verify a connection to a single system
 - 6.4.1. Plug AC into a regular power outlet and power up
 - 6.4.2. Open HyperTerminal and connect to the appropriate serial port (COM15 for Station 1, COM16 for station 2 etc.) with 38400 baud, 8, n,1.
 - 6.4.3.** Change the serial number of the unit to 1-4 for AcqPda, position 1-4, 5-8 for 2998, position 1-4, or 9-12 for eLambda, position 1-4, 13-16 for A10, 17-20 for A30. eg. 2998 in position 2 would be **setserialnumber 6** <enter>.
 - 6.4.4.** Type **setipflags N F** <enter>.
 - 6.4.5.** Type **setipaddress 192 168 0 x** <enter> where x = 5-8 for AcqPda 1-4, x=9-12 for 2998 1-4, and x=13-16 for eLambda 1-4. So, for an eLambda in position 2, you would type **setipaddress 192 168 0 14** <enter>.
 - 6.4.6.** Power cycle UUT.
 - 6.4.7.** Plug Ethernet cable directly into switcher, or card in PC.
 - 6.4.8.** Launch empower and login as system pw:metsys. Click **Configure System**.
 - 6.4.9.** Select **Empower Nodes** and right click on the empower node on the right. Select **properties** from the drop-down list.
 - 6.4.10.** Select Instruments and check to see if the instrument in question is "OK". You may run scan instruments to see if it helps. If not, call TE. Sometimes these steps "awaken" Empower to now recognize the UUT.
- 6.5. To troubleshoot **Lost Comm** errors:
 - 6.5.1.** In the list of instruments, there should only be up to 20 systems (Address ACQ-PDA#1 through #4, and #9 through #12, W2998#5 through #8, A10#13-16, A30#17-20). If there are any other systems listed with typical serial numbers (A09UPD011M) or 'serial number uninitialized', click **remove**.

- 6.5.2. Click on the **Configure DHCP** tab. Click on the **Configure DHCP** button. If there are any instruments listed in the Waters DHCP server configuration list, highlight them and remove them. Click **OK**.
- 6.5.3. Click **OK**, then use the X in the top corner of the Configuration Manager window and then the Empower Pro window to exit.
- 6.5.4. Put any removed cabling back and try running application again.
- 6.5.5. If problems persist, reboot system.
- 6.5.6. To minimize Lost Comm errors, only run the same model detectors at the same time.
- 6.5.7. If condition still persists, exit application and click on **Stop AcQuity Processes**.
- 6.5.8. Click on Start|Run and type in net stop "Waters DHCP Server".
- 6.5.9. After service stops, delete C:\Empower\ Instruments\DHCP.xml.
- 6.5.10. Restart test program.
- 6.5.11. If you are still facing connection issues, try the following:
 - 6.5.11.1. Start the test program and start the test on any position with a unit attached.
 - 6.5.11.2. When the test software displays "Powering Up", click on the X in the top right corner of the test software window to close the program. This will leave the Ethernet connected and the power on.
 - 6.5.11.3. Restart PC.
 - 6.5.11.4. Try running Loader.exe (C:\Empower\Instruments\Firmware folder). Check the scan for instruments box and click OK. Sometimes this establishes a connection which you will see in the information box. Click cancel and exit loader.
 - 6.5.11.5. To verify connection at this point, launch Empower, user tester, no password.
 - 6.5.11.6. Click on Configure System.
 - 6.5.11.7. Choose Empower Nodes from tree.
 - 6.5.11.8. Right click on the node name and select Properties...
 - 6.5.11.9. Select the Instrument tab and look to see if the instrument connected shows Yes in the OK? column.
 - 6.5.11.10. If yes, close Empower and restart the test program, which will power off the instrument. You must power up the instrument again and reset the serial number before testing.

END OF DATA