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1. PURPOSE

The purpose of this Test Instruction is to detail how to perform the required tests in a safe and consistent manner.

2. SCOPE

The scope of this Test Instruction is to cover all activities relating to the testing of Electrical Assemblies detailed in the Title above.

3. DEFINITIONS AND ABBREVIATIONS

Term	Definition / Abbreviation
QMS	Quality Management System
ATE	Automated Test Equipment
UUT	Unit Under Test

4. ROLES AND RESPONSIBILITIES

Roles	Responsibilities
Operator	Ensure all aspects of this test instruction are adhered to and all equipment required to complete these tasks are within calibration.
Quality	Ensure that any records being generated by this document are retained for 15 years.

5. FORMS

Doc No:	Document Title
N/A	Not Applicable

6. RECORDS

Ref No:	Doc No:	Document Title	Location
QMS1	N/A	Test Results Database	Waters Servers

7. HEALTH & SAFETY

High Voltages (1500VDC) Present During ATE Test.

8. TESTING

8.1. Optical Inspection

8.1.1. Inspection

Tasks/Instructions

Full Automated Optical Inspection/Visual Inspection must be carried out.

*The *AOI program/Visual Inspection Documents are under the control of the supplier and can be changed as they require without informing Waters of these changes.*

8.2. In Circuit Testing

8.2.1. ICT Test

This section can not be started unless the Optical Inspection section detailed within this document has been completed satisfactorily.

Tasks/Instructions

*Full In Circuit Testing by *Bed of Nails must be carried out.*

*The*BON program is under the control of the supplier and can be changed as they require without informing Waters of these changes.*

8.3. Functional Testing – Programming Firmware

8.3.1. Functional Test 1 (FCT1)

This section can not be started unless the AOI and ICT sections detailed within this document have been completed satisfactorily.

8.3.1.1. Equipment Required

Equipment Number:	Equipment Description
	PC + Monitor – Set up and provided by Waters with additional keyboard (EPC keyboard)
	PSU – 24V (=>2A)
	PICKit3 Programmer – Provided by Waters
	Converter Communication Module PROTO-0712-29 – Waters part 210000947
	Terminal Application for serial communication – e.g. Tera Term or Hyper Terminal using COMx (designated serial port)
	Serial communication cables 2 off
	Ethernet Cat 5e patch cable
	USB flash drive – Provided by Waters
	Software + Firmware – Provided by Waters

8.3.1.2. Connecting the Equipment

Tasks/Instructions

Connect +24VDC from the bench top power supply to 24V_RAW and Ground to GND_RTN of the UUT (do not turn power ON until instructed to do so).

Link the two mounting holes (one near J10 and the other near J18) using the provided grounding lead.

Connect the PicKit3 to one of the PC's USB ports.

Required Times are Approximate.

8.3.1.3. Directing WatersFileService Services

Tasks/Instructions

Run the batch file **WDHCP_Restart_RegUpdate.bat** from location; C:\#Waters_Test_Programs\Kestrel\Firmware\

It is necessary to do this at least once for this particular batch run, regardless.

(Time required: 1 minute)

8.3.1.4. Downloading Firmware to U13

Tasks/Instructions

Run the batch file **Program U13_bootloader_D.bat** from location;

C:\#Waters_Test_Programs\Kestrel\Firmware\pic_binary\ and follow the on screen instructions.

(Time required: 1 minute)

8.3.1.5. Downloading Firmware to U62

Tasks/Instructions

Run the batch file **Program U62_poweronoff_D.bat** from location;

C:\#Waters_Test_Programs\Kestrel\Firmware\pic_binary\ and follow the on screen instructions.

(Time required: 1 minute)

8.3.1.6. Downloading Firmware to FPGA

Tasks/Instructions

Run the batch file **FPGA_failsafe_H.bat** from location; C:\#Waters_Test_Programs\Kestrel\Firmware\fpga_binary\ and follow the on screen instructions.

Note: - This will take a few minutes to complete. Make sure that "Image Sent Successfully" message appears on the console window at the end of the download.

(Time required: 20 minutes)

8.3.1.7. Formatting the Flash Drive

Tasks/Instructions

Make sure the UUT is switched off

- Connect a USB keyboard and the supplied USB flash drive with format utility to J3 of the UUT
- Connect COMx from the PC to J18 of the UUT.
- Fit a jumper link between pins 1 & 2 of J2
- Open TeraTerm from the desktop (Make sure that the application is set-up as below:
Port - COMx, Baud - 9600, Data - 8bit, Parity - none, Stop - 1bit, Flow Control - none)
- Switch on power to the UUT
- D61 on the UUT will start to flash RED/GREEN for approximately 30 seconds

❖ If the board is already programmed, use the F11 key method below to boot into USB flash drive in J3

- **JUST BEFORE D61 STOPS FLASHING RED/GREEN (approx. 23 seconds), PRESS AND HOLD THE F11 KEY ON THE USB KEYBOARD ATTACHED TO J3. HOLD F11 KEY DOWN UNTIL KEYBOARD "NUM" LED LIGHTS.**
- **WAIT 2 SECONDS AND RELEASE F11 KEY, WAIT 3 SECONDS AND PRESS ↓ KEY AND THEN IMMEDIATELY AFTER ↵ KEY.**
- **WAIT A FEW SECONDS AND THE FOLLOWING MENU WILL APPEAR IN THE TERATERM WINDOW.**

❖ If the board is NOT previously programmed, then the following boot menu should appear after approximately 35 seconds

- This line should appear on the serial console.

- USB boot of FreeDOS.

-

- Welcome to FreeDOS. -

- Welcome to Waters EPC Configuration -

- 4325801PD REV E

-

- Please choose your assembly

- 4. Kestrel EPC

- 3. 279002568 - SnowNet EPC
 - 2. 279002658 - Vulcan/Spitfire : ADlink ATOM EPC
 - 1. Exit to DOS
 [1,2,3,4]? **4**
 Press 4 on PC keyboard to select Kestrel EPC
 This batch file is designed to configure a Kestrel board
 Do not use to configure other assemblies unless explicitly
 instructed to by Waters.
 Main Menu
 1 = Partition onboard drive
 2 = Configure D: with VxWorks
 3 = Update BIOS
 4 = Reboot
 5 = Exit to DOS
 [1,2,3,4,5]? **1**
 Press 1 to select Partition onboard drive ...

Checking existing disk format.

Verifying 488.22M

Format complete.

Volume has no label

511,664,128 bytes total disk space

511,664,128 bytes available on disk

8,192 bytes in each allocation unit

62,459 available allocation units on disk

Volume Serial Number is 1616-07D5

Partition	Status	Type	Volume Label	Mbytes	System	Usage
D: 1	*CREATED*	PRIMARY		488.2	FAT16	99%

D: 1	A	PRIMARY		488.2	FAT16	99%
------	---	---------	--	-------	-------	-----

Partition	Status	Type	Volume Label	Mbytes	System	Usage
D: 1	A	PRIMARY		488.2	FAT16	99%

D: 1	A	PRIMARY		488.2	FAT16	99%
------	---	---------	--	-------	-------	-----

Hardware restart board before copying

VxWorks across to drive

Main Menu

1 = Partition onboard drive

2 = Configure D: with VxWorks

3 = Update BIOS

4 = Reboot

5 = Exit to DOS

[1,2,3,4,5]?

- *Power DOWN board and then power UP*
- *D61 on the UUT will start to flash RED/GREEN for approximately 30 seconds*
- *After approximately 35 seconds press any key on the PC keyboard to obtain the following menu*

- This line should appear on the serial console.

- USB boot of FreeDOS.

-

- Welcome to FreeDOS. -

- Welcome to Waters EPC Configuration -

- 4325801PD REV E

-

- Please choose your assembly

- 4. Kestrel EPC

- 3. 279002568 - SnowNet EPC

- 2. 279002658 - Vulcan/Spitfire : ADlink ATOM EPC

- 1. Exit to DOS

[1,2,3,4]? 4

Press 4 on PC keyboard to select Kestrel EPC

This batch file is designed to configure a Kestrel board

Do not use to configure other assemblies unless explicitly

instructed to by Waters.

Main Menu

1 = Partition onboard drive

2 = Configure D: with VxWorks

3 = Update BIOS

4 = Reboot

5 = Exit to DOS

[1,2,3,4,5]? 3

Press 3 on PC keyboard to select Update BIOS...

```
+-----+
|          AMI Firmware Update Utility Ver.4.15          |
| Copyright (C)2007 American Megatrends Inc. All Rights Reserved. |
+-----+
```

```
- Bootblock checksum .... ok
- Module checksums ..... ok
- Erasing flash ..... done
- Writing flash ..... done
- Verifying flash ..... done
- Erasing NVRAM ..... done
- Writing NVRAM ..... done
- Verifying NVRAM ..... done
- Erasing Bootblock ..... done
- Writing Bootblock ..... done
- Verifying Bootblock ... done
- CMOS checksum destroyed
- Program ended normally.
```

Now configuring the BIOS ...

CMOS Data Setup Tool --- Version 1.4

(C) Copyright 1998-2004

Reading CMOS data from file . . . Done

Writing CMOS data to EEPROM . . . Done

CMOS Data Setup Tool --- Version 1.4

(C) Copyright 1998-2004

Cleaning CMOS data in RTC . . . Done

Done.

Main Menu

1 = Partition onboard drive

2 = Configure D: with VxWorks

3 = Update BIOS

4 = Reboot

5 = Exit to DOS

[1,2,3,4,5]? 2

Press 2 on PC keyboard to select Configure D: with VxWorks...

WARNING: ALL DATA ON NON-REMOVABLE DISK

DRIVE D: WILL BE LOST! PLEASE CONFIRM!

Proceed with format (YES/NO)? **YES**

Type YES

Disk size: 488 Mbytes, FAT16. ***

Please enter volume label (max. 11 chars): **VXWORKS**

Type VXWORKS as the label

QuickFormatting (only flushing metadata)

Warning: Resets bad cluster marks if any.

Preparing FAT area...

100 percent completed.

QuickFormat complete.

511,934,976 bytes total disk space (disk size)

511,664,128 bytes available on disk (free clusters)

8,192 bytes in each allocation unit.

62,459 allocation units on disk.

```

Volume Serial Number is 1F4C-07DA
VxSys 1.6 (c) Wind River 1993-2002
That's a hard disk! Are you sure (y/n)? y
Press y

Boot sector installed OK.
\FLASH\VXWORKS\bootrom.sys => D:\bootrom.sys
\FLASH\VXWORKS\vxworks => D:\vxworks
Main Menu
1 = Partition onboard drive
2 = Configure D: with VxWorks
3 = Update BIOS
4 = Reboot
5 = Exit to DOS
[1,2,3,4,5]?

• Turn the power off to the UUT

(Time required: 15 minutes)
    
```

8.3.1.8. Rebooting to USB

Tasks/Instructions

```

Switch power OFF to the UUT
• Make sure there is a jumper link fitted on pins 1 & 2 of J2 of the UUT
• Switch power ON to the UUT.
• Wait for UUT to boot up with D61 flashing RED/GREEN and ensure the following menu is displayed after approx. 35 seconds:

- This line should appear on the serial console.
- USB boot of FreeDOS.
-
-----
- Welcome to FreeDOS. -
-----
-----
- Welcome to Waters EPC Configuration -
    
```

```

-----
-----
-      4325801PD REV E
-----
-
- Please choose your assembly
- 4. Kestrel EPC
- 3. 279002568 - SnowNet EPC
- 2. 279002658 - Vulcan/Spitfire : ADlink ATOM EPC
- 1. Exit to DOS
[1,2,3,4]?

•      Switch power OFF to the UUT

(Time required: 1 minutes)

```

8.3.1.9. Booting to VxWorks

Tasks/Instructions

Switch power OFF to the UUT

- Make sure there is a jumper link fitted on pins 1 & 2 of J2 of the UUT
- Remove USB flash drive and keyboard from J3 of UUT
- Connect the network port from the PC to J3 of the UUT
- Switch power ON to the UUT.
- Wait for UUT to boot up with D61 flashing RED/GREEN and make sure that the UUT has booted up to the prompt "->" in the TeraTerm window

Note:- The network connection may connect/disconnect a few times before any text will appear on the TeraTerm window. At the end of boot up, if the "->" prompt doesn't appear on TeraTerm window, press ENTER once to get the prompt "->"

- On TeraTerm, goto FILE->SEND FILE and select **ModeCheck.txt** from the location C:\#Waters_Test_Programs\Kestrel\Firmware\
- Following message will be displayed:

```
diag_cli
```

```
0x2967864 (tShell0): pcieKestrelDrvOpen: Inside the Function...
```

```
Opened pcieSpi Driver File /pcieKestrel with fd : 20
```

cli: PCIe Device Access : Done

cli: Version = 0.1

Waters_EPC>>read 0xA1B4

read 0xA1B4

Address : 0xA1B4 (41396)

Data : 0x226 (550) ← ENSURE THIS NUMBER REPORTED IS 0x226

Waters_EPC>>read 0x0180

read 0x0180

Address : 0x180 (384)

Data : 0x4800 (20992) ← ENSURE THIS NUMBER REPORTED IS 0x4800

Waters_EPC>>exit

exit

value = 0 = 0x0

(Time required: 1 minutes)

8.3.1.10. Updating PCIE Firmware

Tasks/Instructions

Make sure that "->" prompt is present on TeraTerm window

- On TeraTerm, goto FILE->SEND FILE and select **FPGA_runtime_V.txt** from the location C:\#Waters_Test_Programs\Kestrel\Firmware\
- Wait until the update is complete - this will take a few minutes.
- On success, the following message will be displaced on the terminal window.

[=====]100%

Firmware successfully updated.

Note: - If the PCIE firmware is already up to date, this will be reported as "Firmware current and has not been updated". In this case further action is not required.

- Switch OFF power to the UUT
- Remove jumper link on J2

- Switch ON power to the UUT
- Wait for UUT to boot up with D61 flashing GREEN ONLY and make sure that the UUT has booted up to the prompt "->" in the TeraTerm window

Note:- The network connection may connect/disconnect a few times before any text will appear on the TeraTerm window. At the end of boot up, if the "->" prompt doesn't appear on TeraTerm window, press ENTER once to get the prompt "->"

- On TeraTerm, goto FILE->SEND FILE and select **ModeCheck.txt** from the location C:\#Waters_Test_Programs\Kestrel\Firmware\

- Following message will be displayed:

diag_cli

0x2967864 (tShell0): pcieKestrelDrvOpen: Inside the Function...

Opened pcieSpi Driver File /pcieKestrel with fd : 20

cli: PCIe Device Access : Done

cli: Version = 0.1

Waters_EPC>>read 0xA1B4

read 0xA1B4

Address : 0xA1B4 (41396)

Data : 0x204 (516) ← ENSURE THIS NUMBER REPORTED IS 0x204

Waters_EPC>>read 0x0180

read 0x0180

Address : 0x180 (384)

Data : 0x5600 (20992) ← ENSURE THIS NUMBER REPORTED IS 0x5600

Waters_EPC>>exit

exit

value = 0 = 0x0

Switch power OFF to the UUT

Disconnect UUT from programming equipment

(Time required: 25 minutes)

8.3.1.11. Programming Complete

If the UUT has failed one or more of the tests detailed in this section, the material is to be assessed and where appropriate reworked and retested/reprogrammed.

If the UUT has passed all tests detailed in this section, mark the board using suitable indicator.

8.4. Removed

8.5. Functional Test 2 (FCT2)

8.5.1. Functional Automated Test (Pre Conformal Coating)

8.5.1.1. Equipment Required

Equipment Number:	Equipment Description
TE82988-x	WAT2 (Waters Automated Tester) set and up ready for testing
279002953-x	Test Box/Fixture for testing UUT

8.5.2. Running ATE Test

Tasks/Instructions
<i>Carefully Attach Test Fixture to WAT2, if not already done.</i> <i>Attach UUT inside Test Fixture as instructed and shown during ATE test.</i> <i>Run the Test Sequence which can be found in Start Program Files Waters Test Programs 210000792HVC Rev_C.</i> <i>Follow any on screen instructions during the test.</i> <i>Once testing is complete remove the UUT from the test box.</i> If the UUT has failed one or more of the tests detailed in this section, the material is to be assessed and where appropriate reworked and retested/reprogrammed. If the UUT has passed all tests detailed in this section, mark the board using suitable indicator.

8.6. Functional Test 3 (FCT3)

8.6.1. Functional Automated Test (Post Conformal Coating)

8.6.1.1. Equipment Required

Equipment Number:	Equipment Description
TE82988-x	WAT2 (Waters Automated Tester) set up and ready for testing
279002953-x	Test Box/Fixture for testing UUT

8.6.2. Running ATE Test

Tasks/Instructions

Carefully Attach Test Fixture to WAT2, if not already done.

Attach UUT inside Test Fixture as instructed and shown during ATE test.

Run the Test Sequence which can be found in **Start|Program Files|Waters Test Programs|210000792|Rev_G**.

Follow any on screen instructions during the test.

Once testing is complete remove the UUT from the test box.

If the UUT has failed one or more of the tests detailed in this section, the material is to be assessed and where appropriate reworked and retested/reprogrammed.

If the UUT has passed all tests detailed in this section, mark the board using suitable indicator.

9. SIGNING OFF

If the UUT has failed one or more of the tests detailed in this document, the material is to be assessed and where appropriate reworked. If a repair is required within the conformal coating area (see latest version of PCB Document 210000792.pdf) it must be re-conformal coated before retesting.

If the UUT has passed all tests detailed in this document please fill in the information box on the PCBA as per drawing below.

Test By	
Date	

Insert your name here

Insert date ALL tests completed here

If there is a label printed automatically from the test solution, please attach this label as per the latest drawings for the Unit Under Test found in SAP.

10. APPENDICES

N/A

HISTORY PAGE

VERSION:	01	ORIGINATOR:	Sadiq Mohsin	DAR:	48409
COMMENTS: <i>New Document</i>					
Version:	02	Originator:	Sadiq Mohsin	DAR:	49564
Comments: <i>Programming method changed to reflect variations in DCC status. I.e DCC can be formatted/unformatted, programmed/unprogrammed prior to FCT2. Also system BIOS changed.</i>					
Version:	03	Originator:	Sadiq Mohsin	DAR:	50002
Comments: <i>FCT2 from revision 02 of this document renumbered to FCT3 (no changes to test step functionality) and new FCT2 (HV conformal coated circuit) added to aid manufacturing process control. New test fixture numbers.</i>					
VERSION:	04	ORIGINATOR:	Sadiq Mohsin	DAR:	55817
Comments: Template info updated. Section 3. – 'QMS' row added Section 5. – Form removed Section 6. – 'QMS1' row added Section 8.1.1. – Inspection description modified to comply with template Section 8.2.1. – ICT test description modified to comply with template Section 8.3.1.1. – 'USB flash drive' row added Section 8.3.1.2. – WatersFileService redirection added Section 8.3.1.3. - .bat file name modified to reflect revision of file Section 8.3.1.4. - .bat file name modified to reflect revision of file Section 8.3.1.5. - .bat file name modified to reflect revision of file Section 8.3.1.8. – failsafe image revision number corrected. Removed prompt to "...check this with SAP...". Section 8.3.1.9. – runtime image revision number corrected to current level. Removed prompt to "...check this with SAP...". Section 8.4. – Moved to sub level of section 8.3. Section 8.5.2. – Test program reference changed to include revision/version. Added sentences for course to take in the event of failure or pass. Section 8.6.2. - Test program reference changed to include revision/version. Added sentences for course to take in the event of failure or pass. Section 9. – Reference to PCB conformal coating file added. Section 10. – Removed photo					