EPIC™ RESEARCH DIAGNOSTICS	**EPIC ClearView Firmware Testing Protocol**

ORIGINATOR:

Name	Job Title	Signature	Date
Brian Tompson	Software Engineer, Atego High Rely		4/3/2012

APPROVALS:

Name	Job Title	Signature	Date
Andrew Mason	Chief Technology Officer		4/3/12
Don Pegg	Senior Electrical Engineer, PADT, Inc.		4/3/2012
Andrea Miller	Quality Assurance Manager		4/3/12

Firmware Testing Document

For

EPIC ClearView Device

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1.0 Purpose

The purpose of this document is to test the low level firmware design requirements for the EPIC ClearView device.

2.0 Scope

The scope consists of the EPIC ClearView device firmware testing; no other systems requirements are tested in this document.

3.0 Definitions

3.1 Terms and acronyms

Term	Definition
<CR>	Carriage return character – ASCII 0x0D
<LF>	Linefeed character – ASCII 0x0A
ASCII	American Standard Code for Information Interchange
I/O	Input/Output
ISR	Interrupt service routine
MCU	Micro Controller Unit – Microchip PIC18F25J10-I/SS
PWM	Pulse Width Modulation
PWM0	The digital hardware signal coming from the MCU used to control the boost voltage power supply output pulse
SPI	Serial Peripheral Interface
USART	Universal Serial Asynchronous Receiver Transmitter
USB	Universal Serial Bus

Table 3-1 Terms and acronyms

3.2 Reference documents

Document	Description
EPIC Camera Firmware – Requirements.docx	Firmware high level requirements
EPICCLEARVIEW_Firmware_Design.docx	Firmware low level requirements
39682E.pdf	PIC18F45J10 Family Data Sheet
ADC101S021.pdf	Single Channel, 50 to 200 ksps, 10-Bit A/D Converter
C18_User_Guide_51288j.pdf	MPLAB® C18 C COMPILER USER'S GUIDE
11195c.pdf	Single/Dual Digital Potentiometer with SPI™ Interface

Table 3-2 Reference documents

3.3 Traceability

Test cases are numbered in a manner to support tracing the firmware test cases to the firmware design detail. Test cases begin with a uniquely numbered label "TEST_nnnn", and end with the label or labels of the design requirement or requirements, that the test case is intended to test. The trace tags are enclosed in square brackets '[]'.

4.0 System Overview

The EPIC ClearView measures electrical resistance of the skin by putting a fingertip in contact with a glass electrode. A series of electrical impulses are applied to the glass electrode generating a localized electromagnetic field around the finger. Under the influence of this field, and depending on the resistance of the skin of the fingertip, a high frequency current is created resulting in an ionization in the visible and ultraviolet light range. The ionization event is captured by a digital camera.

The ClearView device firmware runs on a Microchip PIC18F25J10 microcontroller (MCU). The firmware accepts serial commands from a host computer, and controls the electrical pulses applied to the glass electrode. The controlling pulse output by the MCU (PWM0) triggers the actual electrical pulse applied to the glass electrode. The duration that the PWM0 is active, is the exposure time for the camera.

The firmware design utilizes the hardware peripherals included in the MCU to control; system timing, communications, boost voltage, PWM0 pulse width frequency and duration, and to monitor the boost voltage level. Firmware execution is controlled by the use of timers and interrupts. The MCU Timer0 is used as the firmware clock and causes the main control loop to execute every 5 mS. The MCU Timer2 is used to control PWM0 pulse width and frequency. Serial communications with the host computer are interrupt driven for data reception and transmission.

Refer to the "EPICCLEARVIEW_Firmware_Design" document for additional details.

5.0 Firmware Test Procedure

Fill out the test identifier form in Table 8-1 to record information about how the test was performed.

As each test is completed enter the test results on the corresponding line in Table 8-2

5.1 Test Types

This procedure consists of two types of tests; inspection and functional testing.

5.2 Testing by Inspection

Testing by inspection consists of reviewing specified portions of the ClearView device firmware source code. A person familiar with the 'C' programming language and embedded microcontroller firmware should perform these tests.

5.3 Functional Testing

Functional testing involves operating a ClearView device in a laboratory setting, using a serial terminal and an oscilloscope.

5.3.1 Equipment Requirements

- A Windows computer with USB 2.0
- Oscilloscope comparable to the Tektronix TDS-1002
- PuTTY terminal application (open source)

6.0 Firmware Inspection Test Cases

6.1 Software language

6.1.1 TEST_4000 – 'C' Language

Test Type: Inspection

Inspect the ClearView firmware source files and verify that the firmware is written in the 'C' Language. [FDD_1001]

Rationale:
None required.

6.2 Hardware Initialization

6.2.1 TEST_4010 – MCU Configuration

Test Type: Inspection.

Inspect the "hardwareInit.c" firmware source file and verify that the configuration values are set as shown in Table 6-1. [FDD_2002_Derived]

Rationale:
The configuration bits are set using the "#pragma config" preprocessor command near the top of the "hardwareInit.c" file.

Note: Two additional configuration settings are called out in the requirement FDD_2002_Derived; WDTEN, and DEBUG. Both the watchdog enable (WDTEN) and the in-circuit debug (DEBUG) values are tested in section 7.2.1. The justification is as follows. The watchdog is initially turned off with the '#pragma config WDTEN = OFF' command. In the __init function in the hardareInit.c file, the watchdog is conditionally turned on, only if the in-circuit debug (DEBUG) is turned off. Therefore a passing result in section 7.2.1 verifies that the watchdog is enabled and the in-circuit debug is turned off.

Parameter	Default Value	Description
XINST	OFF	Instruction set extension
STVREN	ON	Reset on stack overflow
CP0	OFF	Code protection
FCMEN	OFF	Fail-Safe clock monitor
IESO	OFF	Two-speed start-up
FOSC2	ON	Default system clock
FOSC	HS	HS oscillator
WDTPS	8	Watchdog timer 32 ms
CCP2MX	DEFAULT	CCP2 MUX

Table 6-1 MCU configuration values

6.2.2 TEST_4015 – Initialize I/O pins

Test Type: Inspection.

Inspect the __init function in the "hardwareInit.c" firmware source file and verify that the TRISA, TRISB, are set to 0x00, and the TRISC is set to 0x90. [FDD_2003_Derived, FDD_2004_Derived]

Rationale:
The __init function is a special function that is called by the Microchip C18 compiler. This function is called before control is transferred to the main function after a MCU reset.

6.2.3 TEST_4020 – SPI Interface

Test Type: Inspection.

Inspect the spi_init function in the "spi.c" firmware source file and verify that the SSP1CON register is used. [FDD_2005_Derived]

Rationale:
Note: The PIC18F25J10 MCU used in the ClearView device has 2 SPI interfaces, SSP1, and SSP2. Only SSP1 is used.

6.2.4 TEST_4025 – Initialize Outputs

Test Type: Inspection.

Inspect the __init function in the "hardwareInit.c" firmware source file and verify that LATA, LATB, and LATC are all set to 0x00. [FDD_2006_Derived]

Rationale:
The LATA, LATB, and LATC registers control the output pins on the MCU.

6.2.5 TEST_4030 – Application Variables

Test Type: Inspection

Inspect the "appInit.c" firmware source file and verify that the application values are set as shown in Table 6-2. [FDD_1009]

Rationale:
The appInit_main function is called at the beginning of the main function. The variables are initialized there.

Parameter	Default Value
TP1_OUTPUT	on
SPI_ADC_CS	disable
SPI_POT_CS	disable
clearView_state	STARTUP_STATE
IDLEN	1 (idle sleep mode)
TMR0IE	enable
TMR0ON	1
PWM0 Frequency	1100 Hz
PWM0 Width	14 uS
clearView_exposure	0.5 seconds
Boost voltage	100%

Table 6-2 Application default values

6.2.6 TEST_4035 – Initialize MCU PWM

Test Type: Inspection.

Inspect the appInit function in the "appInit.c" firmware source file and verify that in the 'PWM0 setup' section the PWM pin is configured as an input, and that the PWM timer (TMR2) is turned on. [FDD_2019_Derived]

Rationale:
The appInit_main function is called at the beginning of the main function and performs the PWM initialization.

6.2.7 TEST_4040 – MCU Idle Mode

Test Type: Inspection.

Inspect the firmwareSleep function in the "clearView.c" firmware source file and verify that the 'Sleep' function is called. Additionally verify that the do-while loop only exits when the variable 'clearView_firmwareSleep' is set to TRUE. [FDD_1011, FDD_1012]

Rationale:
The 'Sleep' function causes the MCU to enter the Idle mode. Additionally, the variable clearView_firmwareSleep is only set in the interrupt hander for the firmware clock (ISR_TMR0).

6.2.8 TEST_4045 – Boost Out of Range

Test Type: Inspection.

Inspect the checkBoostVoltage function in the "exposure.c" firmware source file. Verify that testing the BOOST_MAX_VOLTAGE, and BOOST_MIN_VOLTAGE cause the clearView_state variable to be set to one of the FATAL_BOOST_STATEs. Further verify that at the end of the checkBoostVoltage function, if a FATAL_BOOST_STATE is set, that BOOST_PON (Boost Power On) is turned off, and the clearView_shutter variable is set to 0. [FDD_1033, FDD_1034]

Rationale:
If the Boost Voltage is less than BOOST_MIN_VOLTAGE, or greater than BOOST_MAX_VOLTAGE the Boost power is turned off, and the clearView_shutter variable is set to 0, which in turn causes any exposure in progress to be terminated.

7.0 Firmware Functional Test Cases

For the majority of the test cases in this section it is assumed that the ClearView device is turned on and connected to the host computer via a USB cable.

Note: In Normal mode, all ClearView device commands must be entered in their entirely without the time between any characters exceeding 0.5 seconds. In order to allow commands to be entered at a human friendly pace, Terminal mode can be used. To place the ClearView firmware in Terminal mode, use the PuTTY terminal to enter the command 'T=1' followed by a carriage return. This command must be entered quickly. After Terminal mode is entered, the 0.5 second time restriction is removed until the ClearView device is reset or the power is cycled off then on.

Test cases the explicitly include the direction to "Turn on the ClearView device", should not use Terminal mode unless it is specified in the test case.

7.1 Application Initialization

7.1.1 TEST_5000 – Firmware Clock Rate

Test Type: Functional.

Setup the oscilloscope:
Volts/Div: 1 V
Sec/Div: 1 ms/div
Trigger type: Edge
Trigger Source: Ch1
Trigger Slope: Rising
Trigger Mode: Normal
Trigger voltage: ~1.5 V
Connect the oscilloscope ground to TP7
Connect the oscilloscope probe to TP1.

With the ClearView device powered on and idle, verify that the oscilloscope show a pulse every 5 ms. [FDD_1006, FDD_1007, FDD_1010, FDD_1040]

Rationale:
This tests show the firmware clock rate of 5 ms. The firmware clock is what causes the firmware main loop to operate every 5 ms.

7.1.2 TEST_5005 – SPI Communication Rate

Test Type: Functional.

Setup the oscilloscope:

Volts/Div:	1 V
Sec/Div:	250 ns/div
Trigger type:	Edge
Trigger Source:	Ch1
Trigger Slope:	Falling
Trigger Mode:	Normal
Trigger voltage:	~1.5 V

Connect the oscilloscope ground to TP7
Hold the oscilloscope probe to pin-2 of U5

With the ClearView device powered on and idle, verify that the oscilloscope shows a clock signal with a period of 500 ns (2 MHz). [FDD_1005]

Rationale:
This tests show the SPI clock rate of 2 Mbps.

7.1.3 TEST_5010 – Host Communications

Test Type: Functional.

Connect the host computer to the ClearView device using the USB cable. Open the PuTTY terminal application. Configure the PuTTY terminal to the values in Table 7-1. Turn on the ClearView device. Using the PuTTY terminal on the host computer, enter the command 'i' followed by a carriage return. Verify that the information command response is displayed. Refer to Table 7-2 for the format of the information message. [FDD_1004, FDD_1013, FDD_1029, FDD_1038, FDD_1039, FDD_1017]

Example information message:
`>,00,i,0,00.5,100,1100,1,127.5,14,1C,R04.00.00`

Rationale:
If the information command functions, the communication parameters with the host computer are correct and the communications occur in both directions (duplex).

Value	Parameter
Baud rate	9600 bps
Data bits	8
Parity	none
Stop bits	1

Table 7-1 Communications parameters

Data	Format and units
Flood LED status	- 1 byte ('0' or '1')
Exposure duration	- 4 bytes Seconds (ss.s)
Boost voltage setting	- 3 bytes %
PWM0 frequency	- 4 bytes Hertz
PON state	- 1 byte ('0' or '1')
Boost voltage reading	- 5 bytes Volts (vvv.v)
PWM0 width	- 2 bytes uS
Reset condition	- 2 bytes hex
Firmware version	- 9 bytes (Rnn.nn.nn)

Table 7-2 Information command data

7.1.4 TEST_5015 – Boost Off at Powerup

Test Type: Functional.

Note: The timing is critical for this test to be successful. Read all the steps in this section before running the test. Execute the steps quickly until the test is complete.

Turn on the ClearView device, wait 35 seconds, then turn the ClearView device off then back on quickly. Using the PuTTY terminal on the host computer, repeatedly enter the command 'i' followed by a carriage return. Verify that the information message starts with '>,40,i', then eventually changes to '>,00,i'. [FDD_1037, FDD_2010_Derived, FDD_2012_Derived]

Rationale:
The ClearView firmware logic uses the SPI communication with the ADC to read the Boost Voltage. At power up, the firmware waits for the Boost Voltage to fall below a specified value before turning the Boost power on. The error code 40, indicates that the firmware is waiting for the Boost Voltage to fall. The error code 00, indicates that the ClearView detected that the Boost Voltage had fallen below the required value, and turned the Boost power on.

7.1.5 TEST_5020 – Reset Status

Test Type: Functional.

Turn off the ClearView device and wait 5 seconds, then turn the ClearView device on. Using the PuTTY terminal verify that the reset code in the powerup information message is correct as shown in bold here. [FDD_1003]

```
>,00,i,0,00.5,100,1100,0,000.0,14,1C,R04.00.00
```

Rationale:
The reset code is saved after a reset and displayed as part of the response to the information command.

7.1.6 TEST_5025 – Reset Flag Clear

Test Type: Functional.

Using the PuTTY terminal on the host computer, enter the command 'R=1' followed by a carriage return. Verify that the reset code in the information command is correct as shown in bold. [FDD_2007_Derived, FDD_2015_Derived, FDD_1017]

```
>,00,i,0,00.5,100,1100,0,000.0,14,0F,R04.00.00
```

Rationale:
The 'R=1' command causes the ClearView firmware to perform a software reset. The reset condition flags must be cleared after powerup by the firmware to indicate the correct reset code after the software reset.

7.1.7 TEST_5030 – PWM0 Default Timing

Test Type: Functional.

Setup the oscilloscope:
Volts/Div: 1 V
Sec/Div: 2.5 us/div
Trigger type: Edge
Trigger Source: Ch1
Trigger Slope: Falling
Trigger Mode: Normal
Trigger voltage: ~1.5 V
Connect the oscilloscope ground to TP7
Connect the oscilloscope probe to TP6.

Power on the ClearView device. Using the PuTTY terminal on the host computer, enter the command 'g' followed by a carriage return. Verify that the oscilloscope captures a PWM0 waveform with a duty cycle of 14 us +- 1 us. Change the oscilloscope timebase to 250 us/div. Verify that the period is 91 us +- 2 us. [FDD_1008, FDD_1028, FDD_2021_Derived, FDD_1017]

Rationale:
After powering on the ClearView device, the default PWM0 timing values shown in Table 6-2 are used. The 'g' command initiates an exposure. The oscilloscope shows the required PWM0 timing.

7.1.8 TEST_5035 – Default Exposure Duration

Test Type: Functional.

Setup the oscilloscope:
Volts/Div: 1 V
Sec/Div: 100 ms/div
Trigger type: Edge
Trigger Source: Ch1
Trigger Slope: Falling
Trigger Mode: Normal
Trigger voltage: ~1.5 V
Connect the oscilloscope ground to TP7
Connect the oscilloscope probe to TP6.
Note: On the TDS-1002 oscilloscope 'Peak Detect' on the acquire menu must be turned on.

Power on the ClearView device. Using the PuTTY terminal on the host computer, enter the command 'g' followed by a carriage return. Verify that the oscilloscope captures a PWM0 waveform for a period of 0.5 seconds. [FDD_1008, FDD_1035, FDD_2020_Derived]

Rationale:
After powering on the ClearView device, the default PWM0 exposure duration values are used. The oscilloscope shows the required exposure duration.

7.2 Fault Recovery

7.2.1 TEST_5040 – Watchdog Timer

Test Type: Functional Test.

Using the PuTTY terminal on the host computer, enter the command 'D=1' followed by a carriage return. Verify that the power up information is displayed. Verify that the reset code in the information command is correct as shown in bold. [FDD_1002, FDD_1017, FDD_2002_Derived, FDD_2003_Derived, FDD_2013_Derived, FDD_1017]

>,00,i,0,00.5,100,1100,0,000.0,14,**17**,R04.00.00

Rationale:
The 'D=1' command forces a watchdog timeout. The watchdog timer will reset the MCU. Observe the PuTTY terminal window and look for the power up information to be displayed.

7.3 Host Communications

7.3.1 TEST_5045 – Host Response Only

Test Type: Functional.

With the PuTTY terminal running on the host computer, turn on the ClearView device. Verify that the powerup information message is displayed on the terminal, and no other messages appear. [FDD_1015]

Rationale:
The ClearView device only outputs an information message to the host at powerup.

7.3.2 TEST_5050 – Incomplete Messages

Test Type: Functional.

Turn on the ClearView device. Using the PuTTY terminal on the host computer, enter the partial command 'v=' wait for at least 0.5 seconds, then enter the remainder of the command '100' and a carriage return. Verify the error response below is as shown. Using the PuTTY terminal enter the command 'i' followed by a carriage return. Verify the information message below is shown. [FDD_1014, FDD1018, FDD_1020, FDD_1020]

Error response:

```
?,81,100
```

Information message:

```
>,40,i,0,00.5,100,1100,0,085.9,14,1C,R04.00.00
```

Rationale:
When there is more than 0.5 seconds between characters in a command, the command is discarded. When the remainder of the command is entered, the ClearView firmware considers it to be a new command. When carriage return is entered the ClearView firmware interprets the fragment of a command as a bad command. The ClearView firmware response to bad commands begins with a '?' character, and the response to good commands begins with a '>' character.

7.3.3 TEST_5055 – Host No Echo

Test Type: Functional.

Turn on the ClearView device. Using the PuTTY terminal enter the command 'i' followed by a carriage return. Verify that the command that was typed did not appear on the PuTTY terminal.

Enter Terminal mode using the PuTTY terminal by entering the command 'T=1' followed by a carriage return. Using the PuTTY terminal enter the command 'i' followed by a carriage return. Verify that the command that was typed did appear on the PuTTY terminal. [FDD_1016]

Rationale:
In normal mode commands typed on the PuTTY terminal are not echoed back to the host. When Terminal mode is active, the commands typed on the PuTTY terminal are echoed back to the host.

7.4 Host Commands

7.4.1 TEST_5060 – Command Terminators

Test Type: Functional.

Enter Terminal mode using the PuTTY terminal by entering the command 'T=1' followed by a carriage return. Using the PuTTY terminal enter the command 'i' followed by CTRL-M. Verify that the information message is displayed. Repeat the test except follow the command 'i' with the CTRL-J character. Verify that the information message is displayed. [FDD_2008_Derived, FDD_2016_Derived, FDD_1017]

Rationale:
The 'T=1' command puts the ClearView firmware in Terminal mode. The CTRL-M and CTRL-J characters represent the carriage return <CR> and linefeed <LF> characters respectively. When either character is received, the ClearView firmware executes the command.

7.4.2 TEST_5065 – Extra Terminators

Test Type: Functional.

Using the PuTTY terminal enter several carriage returns. Verify that no messages appear from the ClearView device in response to the carriage returns. [FDD_1019]

Rationale:
Extra carriage returns (command terminators) are silently discarded.

7.4.3 TEST_5070 – Response Termination

Test Type: Functional.

Using the PuTTY terminal turn on session logging. Turn on the ClearView device, then close the PuTTY terminal to save the log file. Open the PuTTY log file with a hex editor and verify that the powerup information message is terminated with a <CR><LF> combination (0x0D, 0x0A). [FDD_1022]

Rationale:
The ClearView firmware terminates responses with a <CR><LF> combination.

7.4.4 TEST_5075 – LED Command

Test Type: Functional Test.

Using the PuTTY terminal on the host computer, enter the command 'l=1' followed by a carriage return. Verify that the flood LED is illuminated on the ClearView device. Using the PuTTY terminal on the host computer, enter the command 'l=0' followed by a carriage return. Verify that the flood LED is extinguished on the ClearView device. [FDD_1030, FDD_1017]

Rationale:
The 'I=1' and 'I=0' commands turn the flood LED on and off, respectively.

7.4.5 TEST_5080 – Voltage command

Test Type: Functional Test.

Using the PuTTY terminal on the host computer, enter the command 'v=140' followed by a carriage return. Verify that the ClearView firmware response begins as shown below indicate the command was accepted. Using the PuTTY terminal on the host computer, enter the command 'i' followed by a carriage return. Verify that the Boost Voltage is within +- 2 volts of 159 V. [FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017]

Voltage command response:

```
>,00,v=140
>,00,i,0,00.5,140,1100,1,159.1,14,1C,R04.00.00
```

Rationale:
The 'v=050' command sets the Boost Voltage to 50% by communicating with the Boost control using the SPI interface. The information command shows the new Boost Voltage.

7.4.6 TEST_5085 – Voltage RAW command

Test Type: Functional Test.

Using the PuTTY terminal on the host computer, enter the command 'V=FF' followed by a carriage return. Verify that the ClearView firmware response begins as shown below to indicate the command was accepted. Wait 30 seconds. Using the PuTTY terminal on the host computer, enter the command 'i' followed by a carriage return. Verify that the Boost Voltage is within +- 2 volts of 62 V. [FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017]

Voltage RAW response:

```
>,00,V=FF

>,00,i,0,00.5,255,1100,1,061.8,14,1C,R04.00.00
```

Rationale:
The 'V=15' command sets the Boost Voltage by communicating with the Boost control using the SPI interface. The information command shows the new Boost Voltage.

7.4.7 TEST_5090 – Invalid Exposure Duration

Test Type: Functional.

Using the PuTTY terminal on the host computer, enter the command 'e=00.0' followed by a carriage return. Verify that the ClearView firmware response begins as shown below to indicate the command was rejected. Using the PuTTY terminal on the host computer, enter the command 'e=91.0' followed by a carriage return. Verify that the ClearView firmware response begins as shown below to indicate the command was rejected. [FDD_2009_Derived, FDD_1017]

Rejected exposure durations:

```
?,81,e=00.0
?,81,e=91.0
```

Rationale:
The PWM0 exposure duration was cannot be set to a value less than 0.1 seconds or greater than 90 seconds.

7.4.8 TEST_5095 – Exposure Duration

Test Type: Functional.

Setup the oscilloscope:

Volts/Div:	1 V
Sec/Div:	5 s/div
Trigger type:	Edge
Trigger Source:	Ch1
Trigger Slope:	Falling
Trigger Mode:	Normal
Trigger voltage:	~1.5 V

Connect the oscilloscope ground to TP7
Connect the oscilloscope probe to TP6.
Note: On the TDS-1002 oscilloscope 'Peak Detect' on the acquire menu must be turned on.

Power on the ClearView device. Using the PuTTY terminal on the host computer, enter the command 'e=30.0' followed by a carriage return. Using the PuTTY terminal on the host computer, enter the command 'g' followed by a carriage return. Verify that the oscilloscope captures a PWM0 waveform for a period of 30 seconds. [FDD_1026]

Rationale:
The PWM0 exposure duration was set to 30 seconds. The oscilloscope shows the required exposure duration.

7.4.9 TEST_5100 – Abort Command

Test Type: Functional Test.

Setup the oscilloscope:
Volts/Div: 1 V
Sec/Div: 5 s/div
Trigger type: Edge
Trigger Source: Ch1
Trigger Slope: Falling
Trigger Mode: Normal
Trigger voltage: ~1.5 V
Connect the oscilloscope ground to TP7
Connect the oscilloscope probe to TP6.
Note: On the TDS-1002 oscilloscope 'Peak Detect' on the acquire menu must be turned on.

Note: Section 7.4.8 must be completed immediately prior to performing this test.

Using the PuTTY terminal on the host computer, enter the command 'g' followed by a carriage return. Before 30 seconds has expired, use the PuTTY terminal on the host computer to enter the command 'a' followed by a carriage return. Verify that the oscilloscope captures a PWM0 waveform for a period of approximately the time between the issuing the 'g' and 'a' commands. [FDD_1024, FDD_1017]

Rationale:
The 30 second exposure duration was terminated when the 'a' abort command was executed.

7.4.10 TEST_5105 – Command Rejection

Test Type: Functional Test

Note: Section 7.4.8 (or section 7.4.9) must be completed immediately prior to performing this test.

Using the PuTTY terminal on the host computer, enter the command 'g' followed by a carriage return. Before 30 seconds has expired, use the PuTTY terminal on the host computer to enter each of the commands in Table 7-3 with the exception of the 'Abort' command. Verify that every command is responded to with a bad command response, beginning as shown. [FDD_1023]

Rationale:
All commands except the Abort command (tested in section 7.4.9) are rejected while an exposure is in progress.

7.4.11 TEST_5110 – Frequency Command

Test Type: Functional.

Setup the oscilloscope:

Volts/Div:	1 V
Sec/Div:	250 us/div
Trigger type:	Edge
Trigger Source:	Ch1
Trigger Slope:	Falling
Trigger Mode:	Normal
Trigger voltage:	~1.5 V

Connect the oscilloscope ground to TP7
Connect the oscilloscope probe to TP6.

Using the PuTTY terminal on the host computer, enter the command 'f=1000' followed by a carriage return. Using the PuTTY terminal on the host computer, enter the command 'g' followed by a carriage return. Verify that the oscilloscope captures a PWM0 waveform with a period of 1 ms +- 2 us. [FDD_1027, FDD_1017]

Rationale:
After powering on the ClearView device, the default PWM0 period is approximately 0.91 ms. The 'f=1000' command changes the PWM0 period to 1 ms (1,000 Hz). The oscilloscope shows the required PWM0 timing.

7.4.12 TEST_5115 – Power Command

Test Type: Functional Test.

Using the PuTTY terminal on the host computer, enter the command 'P=0' followed by a carriage return. Verify that the ClearView firmware response begins as shown below to indicate the command was accepted. Using the PuTTY terminal on the host computer, enter the command 'i' followed by a carriage return. Verify that the Boost Power field show in bold below is a 0. [FDD_2014_Derived, FDD_1017]

```
>,88,i,0,30.0,255,1000,0,047.5,14,1C,R04.00.00
```

Rationale:
The 'P=0' commands turn the Boost power off.

Command	Syntax	Values	Example
Abort	a<CR><LF>	n/a	Abort exposure a<CR><LF> 0x61,0x0D,0x0A
Diagnostic	D=1<CR><LF>	n/a	force a MCU watchdog reset D=1<CR><LF> 0x44,0x3D,0x31,0x0D,0x0A NOTE: no response is sent to the host
Exposure duration	e=nn.n<CR><LF>	00.5 second exposure 01.0 second exposure 02.0 second exposure 30.0 second exposure	set next exposure time to 0.5 seconds e=00.5<CR><LF> 0x65,0x3D,0x30,0x30,0x2E,0x35,0x0D,0x0A
Frequency PWM0	f=nnnn<CR><LF>	0750 Hz, 0800 Hz, 0850 Hz, 0900 Hz, 0950 Hz, 1000 Hz, 1050 Hz, 1100 Hz, 1150 Hz, 1200 Hz	set PWM0 frequency to 1,100 Hz f=1100<CR><LF> 0x66,0x3D,0x31,0x31,0x30,0x30,0x0D,0x0A
Go	g<CR><LF>	n/a	start exposure g<CR><LF> 0x67,0x0D,0x0A
Information	i<CR><LF>	n/a	Request status information i<CR><LF> 0x69,0x0D,0x0A
LED	l=n<CR><LF>	0 - off 1 - on	turn Flood LED off l=0<CR><LF> 0x6c,0x3d,0x30,0x0D,0x0A
Power	P=n<CR><LF>	0 - off 1 - on	turn boost power off P=0<CR><LF> 0x50,0x3D,0x30,0x0D,0x0A
Reset	R=1<CR><LF>	n/a	force a MCU software reset R=1<CR><LF> 0x52,0x3D,0x31,0x0D,0x0A NOTE: no response is sent to the host
Terminal	T=n	0 - off 1 - on	set terminal on – echo back host commands T=1<CR><LF> 0x54,0x3D,0x31,0x0D,0x0A

Command	Syntax	Values	Example
Voltage (digital pot)	v=nnn<CR><LF>	050 %, 060 %, 070 %, 080 %, 090 %, 100 %, 110 %, 120 %,	set voltage to 110 % of normal v=110<CR><LF> 0x76,0x3d,0x31,0x31,0x30,0x0D,0x0A
Voltage RAW pot value	V=nn<CR><LF>	0xFF – 0x00	set digital pot value to 0x28 V=28<CR><LF> 0x56,0x3D,0x32,0x38,0x0D,0x0A

Table 7-3 Host commands

8.0 Test Results

Tester Name	
Date	
Firmware Revision	
ClearView serial number	

Table 8-1 Test Identifier

Test Case	Result (Pass/Fail)
6.1.1 TEST_4000 – 'C' Language	
6.2.1 TEST_4010 – MCU Configuration	
6.2.2 TEST_4015 – Initialize I/O pins	
6.2.3 TEST_4020 – SPI Interface	
6.2.4 TEST_4025 – Initialize Outputs	
6.2.5 TEST_4030 – Application Variables	
6.2.6 TEST_4035 – Initialize MCU PWM	
6.2.7 TEST_4040 – MCU Idle Mode	
6.2.8 TEST_4045 – Boost Out of Range	
7.1.1 TEST_5000 – Firmware Clock Rate	
7.1.2 TEST_5005 – SPI Communication Rate	
7.1.3 TEST_5010 – Host Communications	
7.1.4 TEST_5015 – Boost Off at Powerup	

Test Case	Result (Pass/Fail)
7.1.5 TEST_5020 – Reset Status	
7.1.6 TEST_5025 – Reset Flag Clear	
7.1.7 TEST_5030 – PWM0 Default Timing	
7.1.8 TEST_5035 – Default Exposure Duration	
7.2.1 TEST_5040 – Watchdog Timer	
7.3.1 TEST_5045 – Host Response Only	
7.3.2 TEST_5050 – Incomplete Messages	
7.3.3 TEST_5055 – Host No Echo	
7.4.1 TEST_5060 – Command Terminators	
7.4.2 TEST_5065 – Extra Terminators	
7.4.3 TEST_5070 – Response Termination	
7.4.4 TEST_5075 – LED Command	
7.4.5 TEST_5080 – Voltage command	
7.4.6 TEST_5085 – Voltage RAW command	
7.4.7 TEST_5090 – Invalid Exposure Duration	
7.4.8 TEST_5095 – Exposure Duration	
7.4.9 TEST_5100 – Abort Command	
7.4.10 TEST_5105 – Command Rejection	
7.4.11 TEST_5110 – Frequency Command	
7.4.12 TEST_5115 – Power Command	

Test Case	Result (Pass/Fail)
Overall Results	

Table 8-2 Test Results

Document Revision History

Version Number:	Description of Change:	Date:	Updated by:
1.0	Initial document creation	20-Mar-12	B. Tompson
1.1	Added test setup details	21-Mar-12	B. Tompson
000	Approval into the Design History File	4/3/12	B. Tompson