ORIGINATOR:

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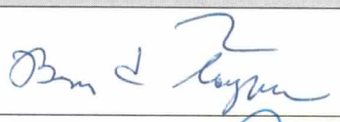
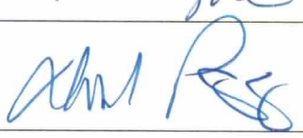
Brian Tompson	Software Engineer, Atego High Rely		5/21/2012
Don Pegg	Senior Electrical Engineer, PADT, Inc.		5/21/2012
Andrea Miller	Quality Assurance Manager		5/21/12

Document Revision History

Version Number:	Description of Change:	Date:	Updated by:
000	New document approval	5/21/12	A. Mason

EPIC ClearView Firmware
Product Requirements Trace Matrix

Reference Documents:

Application Level Firmware Verification Final Report, ENG-029
EPIC ClearView Firmware Testing Protocol, DD-003
EPIC ClearView Firmware Requirements, SR-003

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
FRD_ 0001	All firmware should be rewritten in C, it is currently written in assembler.	SR-003	**FDD_1001-** The device firmware may include third party software to provide ancillary functionality, such as a program bootloader. Some of this software may be written in assembly language.	By inspection	FDD_1001 Test 4000 of DD-003- Inspect the ClearView firmware source files and verify that the firmware is written in the 'C' Language.	Pass	
FRD_ 0003	Architecture timing will be based on hardware timers rather than the current implementation of using code execution timer.	SR-003	**FDD_1006-** The device firmware shall use the MCU Timer0 to generate a firmware clock interrupt at 5 mS intervals. **FDD_1007-** The firmware clock interrupt shall set a flag causing the main program loop to run. **FDD_1010-** The device firmware shall execute the instructions in the main program loop at the rate of the firmware clock. **FDD_1011-** The device firmware shall initiate the MCU idle mode at the end of the main loop. **FDD_1012-** The device firmware shall return to the MCU idle mode when awakened until the firmware clock indicates it is time to run the main program loop. **FDD_1040-** The device firmware shall use a timer interrupt to initiate execution of the main program loop at 5 mS intervals.	By inspection	FDD_1011 & FDD_1012 Test 4040 of DD-003- 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.	Pass	
				Functional Testing	FDD_1006, FDD_1007, FDD_1010 & FDD_1040 Test 5000 of DD-003- With the ClearView device powered on and idle, verify that the oscilloscope show a pulse every 5 ms.	Pass	
FRD_ 0004	The pulse duty cycle should be fixed to 14uS.	SR-003	**FDD_1008-** The default PWM0 timing parameters shall be set as shown in Table 5-6 of the EPIC ClearView Firmware Design document (SS-002).	Functional Testing	FDD_1008, FDD_1028, FDD_2021_Derived, FDD_1017 Test 5030 of DD-003- 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.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
				Functional Testing	FDD_1008, FDD_1035, FDD_2020_Derived Test 5035 of DD-003- 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.	Pass	
FRD_ 0005	Enable the setting of the pulse voltage level through the use of a host command. Voltage level should be defaulted to a base level. The value specified for the voltage should be a % of the original value.	SR-003	**FDD_1005-** The device firmware shall operate the SPI interface at a baud rate of 2 Mbps. **FDD_1009-** The firmware shall initialize application parameters to the values shown in Table 5-7 of the EPIC ClearView Firmware Design document (SS-002). **FDD_1017-** The device firmware shall accept and decode the host commands listed in Table 5-8 of the EPIC ClearView Firmware Design document (SS-002). **FDD_1031-** The device firmware shall set the boost voltage to a value as close to the requested voltage as allowed by the hardware. **FDD_1036-** The device firmware shall transmit SPI commands to the digital potentiometer to control the component. **FDD_2014_Derived.** The device firmware shall provide a command to turn the Boost Voltage on or off. **FDD_2017_Derived-** The device firmware shall provide a command to set explicit values of the digital potentiometer. **FDD_2019_Derived-** The firmware shall start the MCU PWM with the PWM0 pin configured as an input to initialize the MCU PWM.	By Inspection	FDD_1009 Test 4030 of DD-003- Inspect the "appInit.c" firmware source file and verify that the application values are set as shown in Table 6-2 of the EPIC ClearView Firmware Testing Protocol (DD-003).	Pass	
				By Inspection	FDD_2019_Derived Test 4035 of DD-003- 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.	Pass	
				Functional Testing	FDD_1005 Test 5005 of DD-003- With the ClearView device powered on and idle, verify that the oscilloscope shows a clock signal with a period of 500 ns (2 MHz).	Pass	
				Functional testing	FDD_1002, FDD_1017, FDD_2002_Derived, FDD_2003_Derived, FDD_2013_Derived, FDD_1017 Test 5040 of DD-003- 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.	Pass	
				Functional testing	FDD_2008_Derived, FDD_2016_Derived, FDD_1017 Test 5060 of DD-003- 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.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
				Functional testing	FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017, FDD_1027_Derived Test 5080 of DD-003- 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.	Pass	
				Functional testing	FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017 Test 5085 of DD-003- 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.	Pass	
				Functional Testing	FDD_2014_Derived, FDD_1017 Test 5115- 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 is a 0.	Pass	
				Application Level Functional Testing	Step 5.1 of the Application Level Firmware Verification Protocol (ENG-029)- Verification that pulse voltage (i.e., 50% to 110%) selected through the ClearView application results in the expected boost voltage values.	Pass	
FRD_ 0006	Turn off power supply if Boost voltage is out of required range.	SR-003	**FDD_1005-** The device firmware shall operate the SPI interface at a baud rate of 2 Mbps. **FDD_1033-** The device firmware shall shut off the boost voltage if the voltage measured is less than 53V or greater than 200V. **FDD_1034-** The device firmware shall terminate an exposure if the voltage measured is less than 53V or greater than 200V. **FDD_1037-** The device firmware shall receive SPI data from the analog to digital converter component.	By inspection	FDD_1033 & FDD_1034 Test 4045 of DD-003- 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.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
			FDD_2010_Derived- The device firmware shall use an interrupt service routine to send and receive multi-byte SPI data.	Functional Testing	FDD_1005 Test 5005 of DD-003- With the ClearView device powered on and idle, verify that the oscilloscope shows a clock signal with a period of 500 ns (2 MHz).	Pass	
				Functional Test	FDD_1037, FDD_2010_Derived, FDD_2012_Derived Test 5015 of DD-003- 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'.	Pass	
				Functional testing	FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017 Test 5080 of DD-003- 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.	Pass	
				Functional testing	FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017 Test 5085 of DD-003- 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.	Pass	
FRD_ 0007	Enable the setting of the pulse duration through the use of a host command.	SR-003	**FDD_1017-** The device firmware shall accept and decode the host commands listed in Table 5-8 of the EPIC ClearView Firmware Design document (SS-002). **FDD_1026-** The device firmware shall set the exposure duration to the value received. **FDD_1035-** The device firmware shall terminate an exposure when the exposure duration has been met. **FDD_2009_Derived-** The device firmware shall reject exposure durations of less than 0.1 seconds or greater than 90 seconds	Functional Testing	FDD_1008, FDD_1035, FDD_2020_Derived Test 5035 of DD-003- 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.	Pass	
				Functional Test	FDD_1002, FDD_1017, FDD_2002_Derived, FDD_2003_Derived, FDD_2013_Derived Test 5040 of DD-003- 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.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
			FDD_2020_Derived. The device firmware shall configure the PWM0 pin as an input to end an exposure.	Functional testing	FDD_2008_Derived, FDD_2016_Derived, FDD_1017 Test 5060 of DD-003- 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.	Pass	
				Functional testing	FDD_2009_Derived, FDD_1017 Test 5090 of DD-003- 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.	Pass	
				Functional testing	FDD_1026 Test 5095 of DD-003- 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.	Pass	
				Functional Testing	FDD_1024, FDD_1017 Test 5100 of DD-003- 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.	Pass	
				Application Level Functional Testing	Step 5.2 of the Application Level Firmware Verification Protocol (ENG-029)- Verification that varying the pule duration through the ClearView application results in the expected pulse duration.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
FRD_ 0008	Add host command to control “Flood” LED output. The states are defined as on and off.	SR-003	**FDD_1017-** The device firmware shall accept and decode the host commands listed in Table 5-8 of the EPIC ClearView Firmware Design document (SS-002). **FDD_1030-** The device firmware shall operate the flood LED based on the parameter value of the LED command.	Functional testing	FDD_1030, FDD_1017 Test 5075 of DD-003- 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.	Pass	
				Application Level Functional Testing	Step 5.3 of the Application Level Firmware Verification Protocol (ENG-029)- Verification that LED Off commands within the application actually turn the LED off.	Pass	
FRD_ 0009	Enable the PWM0 signal frequency to be controlled by a host command. There will be multiple frequency settings.	SR-003	**FDD_1017-** The device firmware shall accept and decode the host commands listed in Table 5-8 of the EPIC ClearView Firmware Design document (SS-002). **FDD_1027-** The device firmware shall set the PWM0 frequency to a frequency as close to the requested frequency as allowed by the hardware. **FDD_2019_Derived-** The firmware shall start the MCU PWM with the PWM0 pin configured as an input to initialize the MCU PWM.	By Inspection	FDD_2019_Derived Test 4035 of DD-003- 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.	Pass	
				Functional Testing	FDD_1008, FDD_1028, FDD_2021_Derived, FDD_1017 Test 5030 of DD-003- 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.	Pass	
				Functional Test	FDD_1002, FDD_1017, FDD_2002_Derived, FDD_2003_Derived, FDD_2013_Derived Test 5040 of DD-003- 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.	Pass	
				Functional testing	FDD_2008_Derived, FDD_2016_Derived, FDD_1017 Test 5060 of DD-003- 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.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
				Functional testing	FDD_1027, FDD_1017 Test 5110 of DD-003- 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.	Pass	
				Application Level Functional Testing	Step 5.4 of the Application Level Firmware Verification Protocol (ENG-029)- Verification that LED Off commands within the application actually turn the LED off.	Pass	
FRD_ 0010	Add a host command to stop the pulse duration before the predefined time has completed. If the duration was set to 30 seconds, sending this command before 30 seconds would stop the pulse.	SR-003	**FDD_1017-** The device firmware shall accept and decode the host commands listed in Table 5-8 of the EPIC ClearView Firmware Design document (SS-002). **FDD_1024-** The device firmware shall terminate an active exposure when an abort command is received from the host.	Functional testing	FDD_2008_Derived, FDD_2016_Derived, FDD_1017 Test 5060 of DD-003- 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.	Pass	
				Functional testing	FDD_2009_Derived, FDD_1017 Test 5090 of DD-003- 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.	Pass	
				Functional Testing	FDD_1024, FDD_1017 Test 5100 of DD-003- 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.	Pass	
				Application Level Functional Testing	Step 5.5 of the Application Level Firmware Verification Protocol (ENG-029)- Verification that Abort button in the ClearView software stops the pulse duration before the duration.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
FRD_0011	Add a host command to initialize the pulse; this would start the pulse for the selected duration.	SR-003	**FDD_1017-** The device firmware shall accept and decode the host commands listed in Table 5-8 of the EPIC ClearView Firmware Design document (SS-002). **FDD_1028-** The device firmware shall initiate an exposure when the go command is received from the host if the firmware is in the ready state. **FDD_2021_Derived.** The device firmware shall initiate an exposure by configuring the PWM0 pin as an output.	Functional Testing	FDD_1008, FDD_1028, FDD_2021_Derived, FDD_1017 Test 5030 of DD-003- 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.	Pass	
				Functional testing	FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017 Test 5080 of DD-003- 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.	Pass	
				Functional testing	FDD_2009_Derived, FDD_1017 Test 5090 of DD-003- 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.	Pass	
				Functional Testing	FDD_1024, FDD_1017 Test 5100 of DD-003- 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.	Pass	
				Application Level Functional Testing	Step 5.6 of the Application Level Firmware Verification Protocol (ENG-029)- Verification that Begin Exposure button in the ClearView software successfully initializes the correct pulse duration.	Pass	

EPIC ClearView Firmware
Product Requirements Trace Matrix

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
FRD_ 0012	Separate the operation of the hardware from the flow of the software.	SR-003	**FDD_1006-** The device firmware shall use the MCU Timer0 to generate a firmware clock interrupt at 5 mS intervals. **FDD_1007-** The firmware clock interrupt shall set a flag causing the main program loop to run. **FDD_1010-** The device firmware shall execute the instructions in the main program loop at the rate of the firmware clock. **FDD_1011-** The device firmware shall initiate the MCU idle mode at the end of the main loop. **FDD_1012-** The device firmware shall return to the MCU idle mode when awakened until the firmware clock indicates it is time to run the main program loop. **FDD_1038-** The device firmware shall use an interrupt service routine to collect the characters received from the host. **FDD_1039-** The device firmware shall use an interrupt service routine to transmit responses to the host. **FDD_1040-** The device firmware shall use a timer interrupt to initiate execution of the main program loop at 5 mS intervals.	By inspection	FDD_1011 & FDD_1012 Test 4040 of DD-003- 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.	Pass	
				Functional Testing	FDD_1006, FDD_1007, FDD_1010 & FDD_1040 Test 5000 of DD-003- With the ClearView device powered on and idle, verify that the oscilloscope show a pulse every 5 ms.	Pass	
FRD_ 0013	Utilize watchdog timer to insure that the firmware properly recovers from unexpected errors.	SR-003	**FDD_1002-** The watchdog timer will reset the MCU if the timer is not reset within 32 mS. The 32 mS watchdog timeout was selected to ensure that the power up initialization would complete before the watchdog needed to be reset. **FDD_2002_Derived-** The MCU shall use the configuration values in Table 5-2 of the EPIC ClearView Firmware Design document (SS-002). **FDD_2003_Derived-** After reset and before control is transferred to the main function, the firmware shall initialize the MCU hardware. **FDD_2004_Derived-** The device firmware shall configure unused MCU I/O pins as outputs. **FDD_2005_Derived-** The device firmware shall operate a single SPI	By Inspection	FDD_2002_Derived Test 4010- Inspect the “hardwareInit.c” firmware source file and verify that the configuration values are set as shown in Table 6-1 of the EPIC ClearView Firmware Testing Protocol (DD-003).	Pass	
				By Inspection	FDD_2003_Derived, FDD_2004_Derived Test 4015- 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.	Pass	
				By Inspection	FDD_2005_Derived Test 4020- Inspect the spi_init function in the “spi.c” firmware source file and verify that the SSP1CON register is used.	Pass	
				By Inspection	FDD_2006_Derived Test 4025- Inspect the __init function in the “hardwareInit.c” firmware source file and verify that LATA, LATB, and LATC are all set to 0x00.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
			interface on the MCU. **FDD_2006_Derived-** The device firmware shall drive unused outputs to a logic low state during hardware initialization.	Functional testing	FDD_1002, FDD_1017, FDD_2002_Derived, FDD_2003_Derived, FDD_2013_Derived, FDD_1017 Test 5040 of DD-003- 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.	Pass	
FRD_ 0014	Implement two-way communications between the host computer and the device.	SR-003	**FDD_1004-** The device firmware shall communicate with the host using the parameters in Table 5-4 of the EPIC ClearView Firmware Design document (SS-002). **FDD_1013-** The device firmware communications with the host shall be full duplex. **FDD_1038-** The device firmware shall use an interrupt service routine to collect the characters received from the host. **FDD_1039-** The device firmware shall use an interrupt service routine to transmit responses to the host.	Functional Testing	FDD_1004, FDD_1013, FDD_1029, FDD_1038, FDD_1039, FDD_1017 Test 5010 of DD-003- 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 of the EPIC ClearView Firmware Testing Protocol (DD-003). 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 of the EPIC ClearView Firmware Testing Protocol (DD-003) for the format of the information message	Pass	
				Application Level Functional Testing	Step 5.7 of the Application Level Firmware Verification Protocol (ENG-029)- Verification that issued commands are displayed in the debug log window of the ClearView software.	Pass	
FRD_ 0015	Implement a simple serial protocol to make the host communications more robust and modifiable.	SR-003	**FDD_1014-** In normal operation mode, the device firmware shall silently discard host messages as incomplete if time to receive the complete message exceeds 500 mS. **FDD_1016-** In normal operation mode the device firmware shall not echo characters received from the host back to the host. **FDD_1018-** The device firmware shall consider a host command reception complete when a command terminator character is received. **FDD_1019-** The device firmware shall silently discard additional command terminator characters until the first non-terminator character is received. **FDD_1020-** The device firmware shall begin command responses with a '>'	Functional Testing	FDD_2007_Derived, FDD_2015_Derived, FDD_1017 Test 5025 of DD-003- 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.	Pass	
				Functional testing	FDD_1002, FDD_1017, FDD_2002_Derived, FDD_2003_Derived, FDD_2013_Derived, FDD_1017 Test 5040 of DD-003- 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.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
			character to indicate the host command was processed successfully. **FDD_1021-** The device firmware shall begin responses with a '?' character to indicate an error occurred. **FDD_1022-** The device firmware shall terminate responses with a <CR><LF> combination. **FDD_1023-** While an exposure is in progress, the device shall reject any host commands except the abort command. **FDD_2008_Derived-** The device firmware shall recognize either a <CR> (0x0D) or <LF> (0x0A) character as a host command terminator. **FDD_2013_Derived-** The device firmware shall provide a command to force a MCU watchdog reset. **FDD_2015_Derived-** The device firmware shall provide a command to force a software reset. **FDD_2016_Derived-** The device firmware shall provide a command to turn terminal mode on and off.	Functional Testing	FDD_1014, FDD_1018, FDD_1020, FDD_1020 Test 5050 of DD-003- 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.	Pass	
				Functional Testing	FDD-1016 Test 5055 of DD-003- 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.	Pass	
				Functional testing	FDD_2008_Derived, FDD_2016_Derived, FDD_1017 Test 5060 of DD-003- 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.	Pass	
				Functional Testing	FDD_1019 Test 5065 of DD-003- Using the PuTTY terminal enter several carriage returns. Verify that no messages appear from the ClearView device in response to the carriage returns.	Pass	
				Functional Testing	FDD-1022 Test 5070 of DD-003- 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).	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
				Functional testing	FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017, FDD_1027_Derived Test 5080 of DD-003- 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.	Pass	
				Functional Testing	FDD_1023 Test 5105 of DD-003- 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 7-2 of the EPIC ClearView Firmware Testing Protocol with the exception of the 'Abort' command. Verify that every command is responded to with a bad command response, beginning as shown.	Pass	
FRD_ 0016	Implement a host command that will return the current settings of the device, including version number.	SR-003	**FDD_1003-** The device software shall record the condition flags that indicate the cause of the last reset. **FDD_1017-** The device firmware shall accept and decode the host commands listed in Table 5-8 of the EPIC ClearView Firmware Design document (SS-002). **FDD_1029-** The device firmware shall respond to the information command with the information listed in Table 5-9 of the EPIC ClearView Firmware Design document (SS-002). **FDD_2007_Derived-** The device firmware shall clear all the reset condition flags during application initialization. **FDD_2010_Derived-** The device firmware shall use an interrupt service routine to send and receive multi-byte SPI data. **FDD_2012_Derived-** After reset the firmware shall read the SPI ADC to confirm that the boost voltage is turned off. **FDD_2017_Derived-** The device firmware shall provide a command to set	Functional Testing	FDD_1004, FDD_1013, FDD_1029, FDD_1038, FDD_1039, FDD_1017 Test 5010 of DD-003- 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 of the EPIC ClearView Firmware Testing Protocol (DD-003). 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 of the EPIC ClearView Firmware Testing Protocol (DD-003) for the format of the information message	Pass	
				Functional Test	FDD_1037, FDD_2010_Derived, FDD_2012_Derived Test 5015 of DD-003- 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'.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
			explicit values of the digital potentiometer.	Functional Testing	FDD_1003 Test 5020 of DD-003- 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.	Pass	
				Functional Testing	FDD_2007_Derived, FDD_2015_Derived, FDD_1017 Test 5025 of DD-003- 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.	Pass	
				Functional testing	FDD_1002, FDD_1017, FDD_2002_Derived, FDD_2003_Derived, FDD_2013_Derived, FDD_1017 Test 5040 of DD-003- 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.	Pass	
				Functional testing	FDD_2008_Derived, FDD_2016_Derived, FDD_1017 Test 5060 of DD-003- 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.	Pass	
				Functional testing	FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017 Test 5080 of DD-003- 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.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
				Functional testing	FDD_1031, FDD_1036, FDD_2010_Derived, FDD_1017 Test 5085 of DD-003- 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.	Pass	
				Application Level Functional Testing	Step 5.8 of the Application Level Firmware Verification Protocol (ENG-029)- Verification that to Get Information button in the ClearView software returns the appropriate data to the Device Status box.	Pass	
FRD_ 0024	Communication should always be initiated by the host, not by the device, except for the powerup information message.	SR-003	**FDD_1015-** In normal operation mode the device firmware shall only transmit to the host in response to a command from the host, except for the powerup information message. **FDD_1016-** In normal operation mode the device firmware shall not echo characters received from the host back to the host. **FDD_1019-** The device firmware shall silently discard additional command terminator characters until the first non-terminator character is received.	Functional Testing	FDD_1015 Test 5045 of DD-003- 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.	Pass	
				Functional Testing	FDD-1016 Test 5055 of DD-003- 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.	Pass	
				Functional Testing	FDD_1019 Test 5065 of DD-003- Using the PuTTY terminal enter several carriage returns. Verify that no messages appear from the ClearView device in response to the carriage returns.	Pass	
FRD_ 0025	Diagnostics mode will allow testing during the manufacturing process.	SR-003	**FDD_1017-** The device firmware shall accept and decode the host commands listed in Table 5-8 of the EPIC ClearView Firmware Design document (SS-002). **FDD_2015_Derived-** The device firmware shall provide a command to force a software reset. **FDD_2016_Derived-** The device firmware shall provide a command to turn terminal mode on and off.	Functional Testing	FDD_2007_Derived, FDD_2015_Derived, FDD_1017 Test 5025 of DD-003- 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.	Pass	
				Functional Testing	FDD-1016 Test 5055 of DD-003- 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.	Pass	

Ref. #	Requirement	Source of Requirement	Design Inputs (Specification)	Verification Methodology	Design Outputs (Verification Results)	Validation Results	Status
				Functional testing	FDD_2008_Derived, FDD_2016_Derived, FDD_1017 Test 5060 of DD-003-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.	Pass	
				Application Level Functional Testing	Step 5.9 of the Application Level Firmware Verification Protocol (ENG-029)-Verification that ClearView software successfully communicates with the device allowing test uses that will be applied during manufacturing.	Pass	