Fermilab Accelerator Division

Radiation Monitoring Interface v4.0

Test Cases

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Test Case 1

Name:	Radloop Relay Drive Permit -Recoverable Conditions
Description:	Of the eight conditions required to permit the relay drive, four are "recoverable". Correction of the issue allows the condition to be met immediately without reboot. Simulate the loss of each of the four recoverable permit conditions required to issue the relay drive. It is not meant to thoroughly test the conditions themselves, but rather the summation required for permitting the drive. Each of the individual conditions will be thoroughly tested in later sections. (Note: The four non-recoverable conditions are tested in the next section.)
Req. referenced:	REQ-4.1a, REQ-4.2n, REQ-4.2o, REQ-4.2p, REQ-4.2q, REQ4.2r, REQ-4.8a, REQ-4.8b, REQ-4.8d, REQ-4.8g
Setup:	Setup the radcard in a test fixture as a rate mode Chipmunk and relay drive made up with a convenient trip setting. Verify on the "Outlying Rad Page" in the statbox and the radcard front panel.

Case	Action	Result
Condition violated (radiation)	Raise and lower the number of rad pulses, so as to meet and violate the radiation condition. Verify loss of radloops on front panel of radcard and "Radiation" error status on rad page as well as the recovery.	REQ-4.1a 6R
Condition violated (FSV)	Restore conditions and reset radloops. Toggle the Failsafe voltage switch. Verify loss of radloops on front panel of radcard and "FS Volts" error status on rad page as well as recovery as well as the recovery.	REQ-4.1a, REQ-4.8a 6R
Condition violated (IDV)	Restore conditions and reset radloops. Toggle the I.D. voltage switch.Verify loss of radloops on front panel of radcard and "ID Volts" error status on rad page as well as the recovery.	REQ-4.1a, REQ-4.8b 6R
Condition violated (missing pulses)	Restore conditions and reset radloops. Withold the pulses from the pulse input for 120 seconds and then re-apply pulses. Verify loss of radloops and loss of "DET" led on front panel of radcard and "Miss Pls" error status on rad page as well as the recovery. This test will satisfy the several other Missing Pulse requirements as noted to the left.	REQ-4.1a, REQ-4.2n, REQ-4.2o, REQ-4.2p, REQ-4.8g 6R

Notes:

Test Case 2

Name:	Radloop Relay Drive Permit -non-Recoverable Conditions
Description:	Of the eight conditions required to permit the relay drive, four are "non-recoverable". In each of the four cases a reboot with the condition remedied is the only way to meet the condition. Simulate the loss of each of the four non-recoverable permit conditions as required to issue the relay drive. These non-recoverable condition errors are tested at boot. It is not meant to test the conditions themselves but rather the summation required for permitting the drive. Each of the individual conditions will be thoroughly tested in later sections. (Note: The four recoverable conditions themselves were tested in previously.
Req. referenced:	REQ-4.1a, REQ-4.6a, REQ-4.8c
Setup:	Setup the radcard in a test fixture as a rate mode Chipmunk and relay drive made up with a convenient trip setting. Verify on the "Outlying Rad Page" in the statbox and the radcard front panel.

Case	Action	Result
Condition violated (device identity)	Remove the properly working card and change the chipmunk switch (sw0) to the OFF position. No device is selected. Re-install the card. Verify no radloops on front panel of radcard and "Device" error status on rad page. Restore the card to its original settings and reset. *	REQ-4.1a GR
Condition violated (rate/intg mode)	Remove the properly working card and change the mode such that the card wants both or neither modes. Re-install the card. Verify no radloops on front panel of radcard and "R/I Mode" error status on rad page.	REQ-4.1a, REQ-4.8c GR
Condition violated (settings integrity)	Restore conditions and reset. With the radcard relay drive permitted, connect the Programmer/Tester. Verify loss radloops on front panel of radcard and "ChkSumPrg" error status on rad page.	REQ-4.1a, REQ-4.6a GR
Condition violated (hi/lo trip setting)	Restore conditions and reset radloops. Toggle the A & B Hi/Lo switches such they result in a mismatch Verify loss of radloops on front panel of radcard and "Hi/Lo A&B" error status on rad page as well as the recovery.	REQ-4.1a, REQ-4.8d GR

Notes: * "DEVICE" SHOULD BE "SYSTEM ERROR" ON RAD PAGE AND HI-LOW LEDS ON RAD CARD WILL BE FLASHING

Test Case 3

Name:	Relay Driver Requirement -**Radiation Condition**
Description:	Test the "radiation" condition required for the relay drive permit. To meet the radiation condition the radiation level must be less than or equal to the tripsetting. Any detected level above the trip setting should result in loss of the radiation condition. The card runs in two modes, rate and integrating and will be tested in each mode. We are not testing the rate calculation itself but rather the loss of the radiation condition due to a higher radiation level than the trip setting. Calculations will be tested elsewhere.
Req. referenced:	REQ-4.2a
Setup:	Setup the radcard in a test fixture as a rate mode Chipmunk and relay drive made up with a convenient trip setting. Verify on the "Outlying Rad Page" in the statbox and the radcard front panel. The last two cases will require an integrating mode radcard setting.

Case	Action	Result
Condition Met (rate mode)	Verify that a rate mode radiation level, less than or equal to the trip setting results in the condition being met.	REQ-4.2a GR
Condition Violated (rate mode)	Verify that a rate mode radiation level, greater than the trip setting results in the condition being violated.	REQ-4.2a GR
Condition Met (integrating mode)	With the card now setup as an integrating mode Chipmunk, verify that an integrating mode radiation level, less than or equal to the trip setting results in the condition being met.	REQ-4.2a GR
Condition Violated (rate mode)	Verify that a integrating mode radiation level, greater than the trip setting results in the condition being violated.	REQ-4.2a GR

Notes:

Test Case 4

Name:	Relay Driver Requirement -**Device Selection Condition**
Description:	Test the "device type selection" condition (proper sw0-sw3 setup) required for the relay drive permit. To meet the "device type selection" condition, the on board switches (sw0-sw3) must be positioned to select a single device. This test for proper device selection occurs at boot only. The card must be rebooted with the proper configuration to successfully boot. Do not confuse this test with the "loss" of the ID or Failsafe voltages when running normally; they will be tested elsewhere. Two other device selection errors occur when selecting a device that cannot run in the selected mode of operation. A TLM cannot run in rate mode and a Scarecrow cannot run in integrating mode. These are flagged as device errors.
Req. referenced:	REQ-4.2b
Setup:	Setup the radcard in a test fixture as a rate mode Chipmunk and relay drive made up with a convenient trip setting. Verify on the "Outlying Rad Page" in the statbox and the radcard front panel.

Case	Action	Result
Condition violated (no device type)	Set sw0, sw1, sw2, sw3 all off, and insert card into radcard tester. Verify the boot with error.	REQ-4.2b 6R
Condition violated (multiple device types	Set any switch ON in addition to the Chipmunk switch (sw0). and insert radcard into tester. Verify the boot with error.	REQ-4.2b 6R
Condition violated (Integrating Scarecrow)	Set device to be a Scarecrow with the mode being integrating. Verify the boot with error.	REQ-4.2b 6R
Condition violated (Rate Mode TLM)	Set device to be a TLM with the mode being rate. Verify the boot with error.	REQ-4.2b 6R

Notes:

Test Case 5

Name:	Relay Driver Requirement -**Failsafe Voltage Condition**
Description:	Test the failsafe voltage condition +required for the relay drive permit. To meet the failsafe voltage condition the failsafe voltage must be present in the proper polarity at boot (tested previously) and must stay present at all times to allow the condition to be met. Any loss of the voltage will result in a violation of the condition. Note that this violation can be recovered from, although a human intervention, a reset, will be required to restore the relay drive. Status of the failsafe condition is indicated on the radcard front panel and rad page.
Req. referenced:	REQ-4.2c, REQ-4.2d, REQ-4.8a
Setup:	Setup the radcard in a test fixture with the pulses being received via front panel switch "TEST" position. Set the radcard to run in rate mode as the device of your choice. Adjust radcard test fixture and Tester Box such that all eight of the conditions are met for relay drive permit. Verify on the "Outlying Rad Page" in the statbox and the radcard front panel.

Case	Action	Result
Condition Violated	Press the "FS TEST" button on the radcard front panel to interrupt the failsafe signal. Verify that the condition is violated and we lose relay drive permits. Verify that the radcard front panel "FS" led is extinguished.	REQ-4.2c, REQ-4.8a GR
Condition Met	Release the "FS TEST" button on the radcard front panel to restore the failsafe signal. Verify that the condition is met and a reset restores relay drive permits. Verify that the radcard front panel "FS" led is lit.	REQ-4.2d, REQ-4.8a GR
Condition Violated	Toggle the FSV switch on the test fixture to the opposite polarity.Verify that the condition is violated and we lose relay drive permits. Verify that the radcard front panel "FS" led is extinguished.	REQ-4.2c, REQ-4.8a GR

Notes:

Test Case 6

Name:	Relay Driver Requirement -**Identification Voltage Condition**
Description:	Test the identification voltage condition required for the relay drive permit. To meet the identification voltage condition the identification voltage must be present in the proper polarity at boot (tested previously) and must stay present at all times to allow the condition to be met. Any loss of the voltage will result in a violation of the condition. Note that this violation can be recovered from, although a human intervention, a reset, will be required to restore the relay drive. Status of the identification condition is indicated on the radcard front panel and rad page.
Req. referenced:	REQ-4.2e, REQ-4.2f, REQ-4.9b
Setup:	Setup the radcard in a test fixture with the pulses being received via front panel switch "TEST" position. Set the radcard to run in rate mode as the device of your choice. Adjust radcard test fixture and Tester Box such that all eight of the conditions are met for relay drive permit. Verify on the "Outlying Rad Page" in the statbox and the radcard front panel.

Case	Action	Result
Condition Violated	Press the "ID TEST" button on the radcard front panel to interrupt the failsafe signal. Verify that the condition is violated and we lose relay drive permits. Verify that the radcard front panel "ID" led is extinguished.	REQ-4.2e, REQ-4.8b 6R
Condition Met	Release the "ID TEST" button on the radcard front panel to restore the failsafe signal. Verify that the condition is met and a reset restores relay drive permits. Verify that the radcard front panel "ID" led is lit.	REQ-4.2f, REQ-4.8b 6R
Condition Violated	Toggle the IDV switch on the test fixture to the opposite polarity.Verify that the condition is violated and we lose relay drive permits. Verify that the radcard front panel "ID" led is extinguished.	REQ-4.2e, REQ-4.8b 6R

Notes:

Test Case 7

Name:	Relay Driver Requirement -**Rate/Integrating Mode Selection Condition**
Description:	Test the rate/integrating selection condition required for the relay drive permit. To meet the rate/integrating selection condition, only sw4 (rate) or sw5 (integrating) can be chosen. Multiple selections or no selections, result in a rate/integrating selection condition violation. This test for proper rate/integrating mode occurs at boot only. The card must be rebooted with the proper configuration to successfully boot. Note: Proper opration of a specific mode and it's associated calculations, will be tested elsewhere.
Req. referenced:	REQ-4.2g, REQ-4.2h, REQ-4.2i, REQ-4.2j, REQ-4.8c, REQ-4.8e, REQ-4.9c, REQ-4.9e
Setup:	Setup the radcard in a test fixture with the pulses being received. Set the radcard to run in rate mode as a Chipmunk. Adjust the radcard test fixture and Tester Box such that all eight of the conditions are met for relay drive permit. Verify on the "Outlying Rad Page" in the statbox and the radcard front panel.

Case	Action	Result
Condition Met (rate, Chipmunk)	With sw4 ON/sw5 OFF/Chipmunk selected, reboot the radcard and verify that rate mode Chipmunk is selected on the radcard front panel.	REQ-4.2h, REQ-4.8c 6R
Condition Met (rate, Scarecrow)	With sw4 ON/sw5 OFF/Scarecrow selected, reboot the radcard and verify that rate mode Scarecrow is selected on the radcard front panel.	REQ-4.2h, REQ-4.8c 6R
Condition Met (rate, FOX)	With sw4 ON/sw5 OFF/FOX selected, reboot the radcard and verify that rate mode FOX is selected on the radcard front panel.	REQ-4.2h, REQ-4.8c 6R
Condition Violated (rate TLM)	With sw4 ON/sw5 OFF/TLM selected, reboot the radcard and verify that a rate mode TLM is seen as an error on the radcard front panel.	REQ-4.2h, REQ-4.8c, REQ-4.9e 6R
Condition Met (integrating, Chipmunk)	With sw4 OFF/sw5 ON/ and Chipmunk selected, reboot the radcard and verify that integrating mode Chipmunk is selected on the radcard front panel.	REQ-4.2g, REQ-4.8c 6R
Condition Met (integrating, TLM)	With sw4 OFF/sw5 ON/ and TLM selected, reboot the radcard and verify that integrating mode TLM is selected on the radcard front panel.	REQ-4.2g, REQ-4.8c 6R
Condition Met (integrating, FOX)	With sw4 OFF/sw5 ON/ and FOX selected, reboot the radcard and verify that integrating mode FOX is selected on the radcard front panel.	REQ-4.2g, REQ-4.8c 6R
Condition Violated (integrating Scarecrow)	With sw4 OFF/sw5 ON/Scarecrow selected, reboot the radcard and verify that a integrating mode Scarecrow is seen as an error on the radcard front panel.	REQ-4.2h, REQ-4.8c, REQ-4.8e 6R
Condition Violated (both modes selected)	With sw4 ON/sw5 ON and any device selected, reboot the radcard and verify that selection of two modes is seen as an error on the radcard front panel.	REQ-4.2i, REQ-4.8c, REQ-4.8e 6R
Condition Violated (neither mode selected)	With sw4 OFF/sw5 OFF and any device selected, reboot the radcard and verify that selection of no mode is seen as an error on the radcard front panel.	REQ-4.2i, REQ-4.8c, REQ-4.8e 6R

Notes: ON THE VERIFY DEVICE + MODE MODE IS SEEN ~~ONLY~~ ON CARD + PAGE BUT DEVICE ONLY ON PAGE. Agreed but the fact that you set the ID/FSV on the test fixture and the front panel indicates no error (ID & FSV leds correct) and no system error and the proper mode is displayed is indicative of either the success or failure of the test. gm

Test Case 8

Name:	Relay Driver Requirement -**Settings Integrity Condition**
Description:	Test the settings integrity condition required for the relay drive permit. To meet the settings integrity voltage condition the settings chksum held in EEPROM must match that calculated when the trip settings and software version are retrieved from EEPROM. This condition also incorporates the attachment of the Programmer/Tester as part of the condition. The code assumes that when the P/T is attached, the chksum is by default, incorrect. Note: This condition is not recoverable and the card must be re-programmed unless it is a P/T detach which results in a reboot as a condition of detachment automatically.
Req. referenced:	REQ-4.2k, REQ-4.2l, REQ-4.2m Fixed 4/4/16
Setup:	Setup the radcard in a test fixture with the pulses being received via front panel switch "TEST" position. Set the radcard to run in rate mode as a Chipmunk. Adjust radcard test fixture and Tester Box such that all eight of the conditions are met for relay drive permit. Verify on the "Outlying Rad Page" in the statbox and the radcard front panel.

Case	Action	Result
Condition Met	Reboot card to force the boot read of the trip settings. Verify that the radcard comes up as expected.	REQ-4.2m 6R
Condition Violated	With the aid of a developer, install a version of the software differing from that which was used in the previously calculated checksum stored in the EEPROM. (Simply changing the version number #define will accomplish this easily.)	REQ-4.2k, REQ-4.2m 6R
Condition Met	Re-program the trip settings into this newly versioned software and reboot.	REQ-4.2k, REQ-4.2m 6R *
Condition Violated	Attach the P/T with its programming cable. Verfiy that the radloops drop. Remove the cable which should force a reboot. Verify that the radcard recovers to its radloop permitted state.	REQ-4.2l

Notes: Found code error that prevented programing a card with this system error. Was corrected by GG. Test cases work! 4/4/16 Retested 5/3/16

Test Case 9

Name: Radiological Device Calibration Factor

Description: Each of the four radiological devices compatible with the v4.0 radcard has its own unit of calibration, referred to as a calibration factor. Each radiological device will indicate the radiological field level expressed as a number of pulses, each of a value equal to its calibration factor. The assignment of the proper calibration factor to each of the radiological devices is of the utmost priority. The radcard will run in a rate repetion mode or an integrated time mode. Both modes will be verified.

Calibration Factors

Chipmunk	2.5 uRem/pls
Scarecrow	25 uRem/pls
FOX	1.0 uRem/pls
TLM	1 nanoCoulomb/pls

Req. referenced: REQ-4.3a, REQ-4.3b, REQ-4.3c, REQ-4.3d

Setup: The integrating mode calibration factors will be tested first as it is essentially "number of counts". Setup the radcard in a test fixture as an integrating chipmunk. With the radcard in "TEST" mode, reboot it and apply the mRem settings in the tables below via the P/T in integrating mode. Verify the readings in the statbox on the rad monitor page to the table below. Reboot between values. Verify all the valid rate/integrate modes on the appropriate devices as listed below.

Case	Action				Result
Integrating Mode Chipmunk Verification	Intg	Cal Factor	0.0000025 Rem/pls		
	Chipmunk				
	mRem/hr	cts/hr	cts/interval	Hz	
	0.4	160	40.00	0.04	GR
	1	400	100.00	0.11	GR
	10	4000	1000.00	1.11	GR
	50	20000	5000.00	5.56	GR
	100	40000	10000.00	11.11	GR
	600	240000	60000.00	66.67	GR
Integrating Mode Scarecrow Verification	Not allowed				
Integrating Mode FOX Verification	Intg	Cal Factor	0.000001 R/pls		
	FOX				
	mRem/hr	cts/hr	cts/interval	Hz	
	0.4	400	100.00	0.11	GR
	1	1000	250.00	0.28	GR
	5	5000	1250.00	1.39	GR
	10	10000	2500.00	2.78	GR
	250	250000	62500.00	69.44	GR

Integrating Mode TLM Verification

Intg	Cal Factor	0.000000001 R/pls		
TLM				
nC/min	cts/hr	cts/interval	Hz	
10	600	150.00	0.17	GR
100	6000	1500.00	1.67	GR
1000	60000	15000.00	16.67	GR
2000	120000	30000.00	33.33	GR
3600	216000	54000.00	60.00	GR

Setup: The rate mode calibration factor will be tested next. Now we will be looking at the "rate" at which pulses arrive. Setup the radcard in a test fixture as a rate mode chipmunk. Using the P/T in rate mode, apply the mRem settings in the tables below via the front panel. Verify the mRem readings in the statbox on the rad monitor page to the table below. Reboot between values.

Rate Mode Chipmunk Verification

Rate		tc_{625}= 0.0000000625		
Chipmunk	(f = mRem/9)			
mRem/hr	freq	period	mcu_tc_{625}	
1	0.111111111	9.0000	144,000,000.00	GR
5	0.555555556	1.8000	28,800,000.00	GR
10	1.111111111	0.9000	14,400,000.00	GR
50	5.555555556	0.1800	2,880,000.00	GR
600	66.66666667	0.0150	240,000.00	GR

Rate Mode Scarecrow Verification

Rate		tc_{625}= 0.0000000625		
Scarecrow	(f = (mRem/10)/9)			
mRem/hr	freq	period	mcu_tc_1	
100	1.111111111	0.9000	14,400,000.00	GR *
500	5.555555556	0.1800	2,880,000.00	GR
1000	11.11111111	0.0900	1,440,000.00	GR
6000	66.66666667	0.0150	240,000.00	** GR

Note: 66 cts(100mR) background

Rate Mode FOX Verification

Rate		tc_{625}= 0.0000000625		
FOX	(f = mRem/3.6)			
mRem/hr	freq	period	mcu_tc_1	
0.5	0.138888889	7.2000	115,200,000.00	GR
1	0.277777778	3.6000	57,600,000.00	GR
5	1.388888889	0.7200	11,520,000.00	GR
10	2.777777778	0.3600	5,760,000.00	GR
250	69.44444444	0.0144	230,400.00	GR

Rate Mode TLM Verification

Not allowed

Notes: *FOUND CODE PROBLEM SCALE OFF BY FACTOR 10 IT WAS CORRECTED

**Note: gg The radmon page will show the hi trip pt as being erroneous at this high a level as I am stealing the hi trip MSB for an indicator of a "rad13" card until all are replaced. I verified the correct "6000" value in high and lo trip pts via dp-view with Gary Ross gg GR

Radmon page software will be modified. gg 5/4/16

Test Case 10

Name:	Rate Repetition Mode Functionality
Description:	At its simplest, the rate repetition algorithm compares the rate at which rad pulses are arriving, to the rate permitted by the trip point setting. Taking it a bit further, the card measures the period between pulses (rate) expressed in timer-counter pulses (tc's). This is compared to the trip setting expressed in these same tc's. In actual implementation, the algorithm looks for **nine** consecutive periods (10 pulses) that exceed the trip point setting and removes the radiation condition required by the relay drive if it finds them. In the case of the radiation condition being violated, it can be restored upon the arrival of pulses in which there are **three** consecutive periods (4 pulses) that do not exceed the trip point setting.
Req. referenced:	REQ-4.4a, REQ-4.4b
Setup:	Set the radcard to run in rate mode as Chipmunk set to trip at 10 mRem. Set the P/T to 10.1 mR/hr in Rate mode with the radcard RUN/TEST switch in the "RUN" position. As usual, verification will be via the "Outlying Rad Page" in the statbox and the radcard front panel. *

Case	Action	Result
Condition Violated	Move the RUN/TEST switch to the "TEST" position and count the "bad" pulses going into the card as the P/T outputs them. Upon receipt of the 10th pulse (9th period) the rate mode radiation condition should trip. Verify.	REQ-4.4a, REQ-4.8f, REQ-4.8j 6R
Condition Met	With the radiation condition still violated, adjust the P/T down to 10 mR/hr and count the pulses until the raditions condition recovers. It should be 4 pulses (3 periods). Verify.	REQ-4.4b, REQ-4.8f, REQ-4.8j 6R

Notes: The time rate mode is not permitted for the TLM radiological device.

*USE the P/T IN RATE MODE SET FOR 10 mR Chip. PRESS the over Button which Brings it TO 10% OVER For this Trip.

Corrected master Document as prog runner/tester uses "10% over".

gw 5/9/16

Test Case 11

Name:	Integrating Mode Functionality
Description:	The integrated time mode counts the pulses received over a 15-minute window with an appropriate number of background pulses subtracted every minute. If at any time, the number of pulses exceeds the number of counts allowed by the trip point setting, it will result in the loss of the "Radiation" condition, dropping both of the rad loop relays. At the end of every minute the background radiation pulses (specific to the type of attached radiological device) will be subtracted from the total number of pulses. At the end of a 15-minute integrating window the number of pulses equivalent to the trip point setting will be subtracted from the total number of pulses as part of the integrating mode calculation. No subtraction shall result in a negative number of accumulated pulses. If any subtraction results in a number less than that specified by the trip point setting, minus 10 counts (a sort of "trip hysteresis"), the radiation condition of the relay drive will be restored.
Req. referenced:	REQ-4.5a, REQ-4.5b, REQ-4.5c, REQ-4.5d
Setup:	Setup an integrating mode chipmunk radcard with the radcard RUN/TEST switch in the "RUN" position in the test fixture with the pulses being received from an old tester running at 0.6 mR/Hr (chipmunk background). Set up the P/T at 10 mR/hr and Integrating Chipmunk mode. Put switch in the "TEST" mode and reboot the radcard. The radcard should be have all conditions met except the Missing Pluse condition and no accumulated pulses. As usual, verify on the "Outlying Rad Page" in the statbox and the radcard front panel.

Case	Action	Result
Background Verification Trip Hysteresis	Send a single pulse from the P/T to clear the Missing Pulse condition. Send the 10 mR amount of counts from the P/T which will trip the card since the accumulated pulses will be the trip setting plus the single pulse used to meet all conditions. With the radcard in this tripped condition, switch radcard back to the "RUN" position. Wait one minute and verify that 4 pulses are subtracted from the total counts and that the Radiation condition does NOT clear. The hysteresis will prevent the clear.	REQ-4-5a, REQ-4-5b GR
Verify Hysteresis	Continuing the above, lower the background setting to 0.1 mR/hr to prevent a "Missing Pulse" condition violation. Watch the "Total Counts" for a few minutes and verify that once we have dropped 10 pulses below the trip setting hysteresis point, the "Radiation" condition is met.	REQ-4-5a, REQ-4-5c GR
Integrating Mode Trip Setting Recovery Verification	Continuing the above, raise the background enough to cause a "Radiation" condition violation and then lower it to 0.6 mR/hr. The background will be sutracted every minute. Watch the "Total Counts" for a 15 minutes and verify that the trip point setting, in counts, is subtrated from "Total Counts". at INTMIN IS	REQ-4-5a, REQ-4-5a GR
TLM Background Verification	Having verified the above, we need to make sure we wipe off the proper amount of background counts for the TLM. Cause a "Radiation" condition viloation with a TLM-based radcard and verify that 5 counts are removed every integrating minute.	REQ-4-5a, REQ-4-5b GR

Fox Background Verification	The FOX radiological device is handled a bit differently that the other devices. Since it has a background of 4.5 mRem, we subtract 5 counts a minute and 4 counts the next. Verify the alternating subtraction of 4 or 5 counts every integrating minute.	REQ-4-5a, REQ-4-5b 6R
Notes: The time integration mode is not permitted for the scarecrow radiological device at this time. Corrected above typos in Master document		

Test Case 12

Name: Trip Point programmability and Security Verification

Description: The radcard is programmed by a device referred to as the "Programmer/Tester" (P/T). It is a device built in-house that sends the trip point setting as a number. It does **not** send the trip point setting as a number of counts or tc's. It sends the desired tripsetting in mR/hr, in tenths, times 10. (The TLM setting is the trip setting in nC/min.) We will set specific trip settings and verify that the number of pulses received is correct by viewing the "TPCnts" field in the statbox of the "Outlying" rad monitor page. Since the setting is mR/hr (nC/min) it is valid for rate **and** integrating modes of operation. In programming the trip settings we should verify that attachment of the P/T programming cable causes a loss of the radloops.

Req. referenced: REQ-4.6a, REQ-4.6b, REQ-4.6c,REQ-4.6d, REQ-4.6e, REQ-4.6f, REQ-4.6g, REQ-4.6h

Setup: Setup the radcard in a test fixture as a rate mode Chipmunk set at a convenient trip setting and radloops made up.

Case	Action	Result
P/Tcable attachment causes radloop opening	Attach P/T Programming cable to radcard. Loops should drop.	REQ-4.6a, REQ-4.6b GR

Setup: Setup the radcard in a test fixture with the intent to program a rate mode setting to a chipmunk. Program in the following trip points and verify the "TotCts", the "mRem/hr" and the "TPCnts". They should agree with the following chart. Verification via Chipmunks will suffice for all rate-based devices.

Case	Action	Result
Chipmunk Scarecrow FOX Trip Setting Verification (mR/hr)		REQ-4.6b, REQ-4.6c

Rate	
Chipmunk Scarecrow FOX	Setting in Cnts
mRem/hr	Setting in Cnts
1	100.00
5	500.00
10	1,000.00
50	5,000.00
600	60,000.00

GR
GR
GR
GR
GR

Setup: Setup the radcard in a test fixture with the intent to program an integrating mode mode setting to a TLM. Program in the following trip points and verify the "TotCts", the "nC/min" and the "TPCnts". They should agree with the following chart. Verification via Chipmunks will suffice for all rate-based devices.

Case	Action	Result
TLM Trip Setting Verification (nC/min)		REQ-4.6b, REQ-4.6d

Intg	
TLM	
nC/min	Setting in Cnts
500	7,500.00
1000	15,000.00
3000	45,000.00
3600	54,000.00

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Setup: Finish the programming of any trip setting that is different than the one you started with. and reboot, which will verify the ability to save this new value in EEPROM and retrieve it upon boot.

Case	Action	Result

EEPROM Verification	Verify via the "Outlying Rad Monitor" page that the new tripsetting is retained across a reboot of the radcard.	REQ-4.6e GR
Setup:	While programming in a tripsetting of large magnitude (600 mR/hr Chipmunk), remove the pulse input cable before all the pulses have been sent, while leaving the programming cable attached.	
Case	**Action**	**Result**
Invalid Tripsetting	Verify that an incorrect programming sequence results in a "System Error". Pull the programming cable to force a reboot and verify that the previous tripsetting is still in force. Verify on radcard front panel as well as on the "Outlying rad monitor" page. ~~The pront panel should show the HI/Lo leds alternating rapidly.~~	REQ-4.6f, REQ-4.6g GR
Setup:	Leave radcard in same state as last test setup.	
Case	**Action**	**Result**
Correct Tripsetting	Verify that an properly programmed sequence results in a successful programming of the radcard. The radcard should retain the desired tripsetting upon reboot.Verify on radcard front panel as well as on the "Outlying rad monitor" page. The EEPROM "Write Protect" line can be verified by making sure it is currently HI with an oscilloscope. If the new tripsetting is retained, we know the WP (u8-7) line did go low.	REQ-4.6f, REQ-4.6g, REQ-4.6h GR
Notes:	Fixed text above in master document	

Test Case 13

Name:	Heartbeat/Watchdog System Verification
Description:	Upon the failure of the processor to strobe the Maxim DS1232 watchdog chip less than every 1.2 seconds, the DS1232 watchdog will respond as follows. The rad13 daughter board and processor will be reset which will remove the software generated pulse train that drives the rad loop relays. Additionally both the real-time and latched rad loop relay inputs will be pulled to ground breaking both loops. A visual indication of the microprocessor activity (heartbeat) is also provided to the user via the front panel.
Req. referenced:	REQ-4.7a,REQ-4.8h
Setup:	Set the radcard to run in rate mode as Chipmunk set to trip at 10 mRem. Check the pulse train on the DS1232 Strobe (u1-7) for a perion of 400 msec. Upon the loss of the strobe pulses, the DS1232 should fault and clamp the relay drive. As usual, verification will be via the "Outlying Rad Page" in the statbox, the radcard front panel and with a scope.

Case	Action	Result
Watchdog violation	With the radcard made up and providing radloop drive, clip u1 pin 7 lead thus removing the strobe signal from the DS1232. Verify the loss of radloop drive on the rad page, front panel, and a logic low on u1-5. Toss the sacrificed watchdog chip.	REQ-4.7a GR
MCU heartbeat	Verify that there is a heartbeat visual indicator flashingon the front panel.	REQ-4.8h GR

Notes:

Test Case 14

Name:	Network Communications
Description:	The radcard will continue to use the existing Safety System 4-wire RS-485 polled network. The polling packet is simply a card address in the range $00 - $EF. The returned data packet is likewise simple. In the case of an "acknowledge' of the poll (no data change on the radcard), the returned packet consists of an initial byte containing the payload size (number of "bytes to follow") and an ID byte. In the case of a change in any data on the radcard, a "full data" packet will be sent. The packet consists of the payload size byte, the ID byte, and the fourteen bytes of radcard described below.
Req. referenced:	REQ-4.9a, REQ-4.9b, REQ-4.9c, REQ-4.9d, REQ-4.9e,REQ-4.9f, REQ-4.9g, REQ-4.9h, REQ-4.8i
Setup:	Set the radcard to run in rate mode as Chipmunk set to trip at 10 mRem in the radcard test fixture. As usual, verification will be via the "Outlying Rad Page" in the statbox and the radcard front panel.

Case	Action	Result
Address Switch	With the card running normally, adjust the address switches to an address that is not used on the port you are using. The card should continue to communicate. A reboot will result in no communications. ~~No front panel~~ LED and a "MALFUNCTION" on the radmon page. Adjusting back to the proper address should return the card to proper operation and reboot Verify. The ability to treat addresses as "commands" is not active.	REQ-4.9a, REQ-4.9b, REQ-4.8i GR
Packet	Requirements 4.9c thru 4.9h are verified at the development level via waveform analyzer.	REQ-4.9c, REQ-4.9d, REQ-4.9e, REQ-4.9f, REQ-4.9g, REQ-4.9h

Notes: Fixed above text in Master Document. [illegible]

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