INSTRUMENT DEVELOPMENT LABORATORY
UNIVERSITY OF HAWAII MANOA

RadFETR

USERS MANUAL

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INSTRUMENT DEVELOPMENT LABORATORY

RadFETR Users Manual

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TABLE of CONTENTS

1 Introduction

This user manual is intended to provide general guidelines for the use of the RadFETR reader. RadFETR is an acronym for Radiation Field-Effect Transistor Readout. See the website http://nmrc.ie/projects/radfets/tech.html for more back information about RadFET. RadFETR is for measuring radiation damage as observed by the device. The RadFETR is able to self-trigger or can be externally triggered. The RadFETR is powered by either an external 12 volt DC power supply or a standard NIM bin power connection. If further technical information is required or a copy of the Schematics is needed please contact IDLAB technical support at idlab@phys.hawaii.edu.

2 Front Panel Inputs/Outputs and Displays

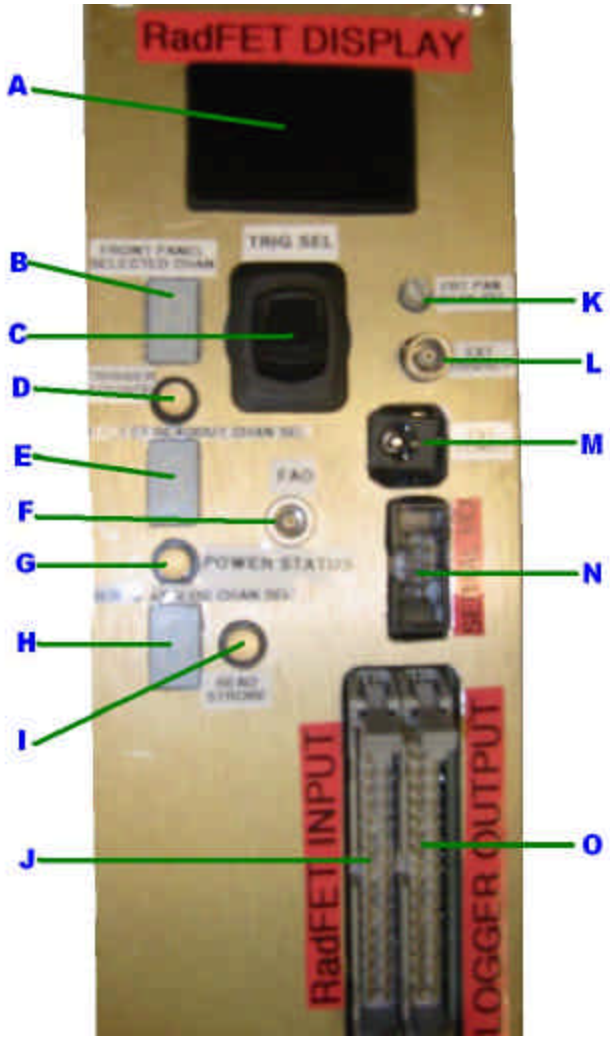


Figure 2.1 The Front Panel

A) **RadFET Display** – displays the voltage of the front panel's selected channel

B) **Front Panel Selected Chan** – displays the channel that is selected in the front panel. The coding of the channel displaying are shown in Table 2.1

C) **Trig Sel** – This toggle switch allows the user to switch between internal and external triggering mode.

D) **Trigger Source** – This LED shows whether the RadFETR is in external or in internal triggering mode. When the LED is green, the RadFETR is in internal triggering mode. When the LED is red, the RadFETR is in external triggering mode.

E) **RadFET Readout Chan Sel** – The RadFET Readout Channel Select shows which channel the RadFETR is sampling on. The channels displaying are shown in Table 2.1

Table 2.1
LED Number Coding

Actual Channel	LED Channel Display
channel 1	0
channel 2	1
channel 3	2
channel 4	3
channel 5	4
channel 6	5
channel 7	6
channel 8	7
channel 9	8
channel 10	9
channel 11	A
channel 12	B
channel 13	C
channel 14	D
channel 15	E
channel 16	F

F) **FAO** – This is a LEMO connector that allows the user to probe the channel that is selected on the front panel selected channel. The FAO can be connected to a voltmeter or even an oscilloscope. This is a great way to measure the voltage without the RadFET Display.

G) **Power Status** – This LED lets the user know if there is a major power problem. When the LED is green, this means that the power is "ok". When the LED is red, this means that there is a power failure.

H) **Serial Analog Chan Sel** – The Serial Analog Channel Select shows the channel that the Serial I/O is outputting. When the Serial I/O triggers in the current firmware, it goes through all 16 channel in a fraction of a sec. This means that you will not be able to see which channel the Serial I/O is triggering on with the "naked eye".

I) **Read Strobe** – This LED goes on when internal or external triggering is active. When the LED is green, this means that RadFETR samping is active. The LED turns off from green after about a second from the trigger of the system. If the external trigger is faster than about 1 Hz, this LED will look like it is always on.

J) **RadFet Input** – This 34-pin connector allows the users to put an external resistance load on any of the 16 channels of the RadFETR. To put a load on a channel, a resistance must be connected between a channel and +12 volts. The pin numbering is in Figure 2.2, and the description of each pin is in Table 2.2

Figure 2.2
Connector Pin Numbering

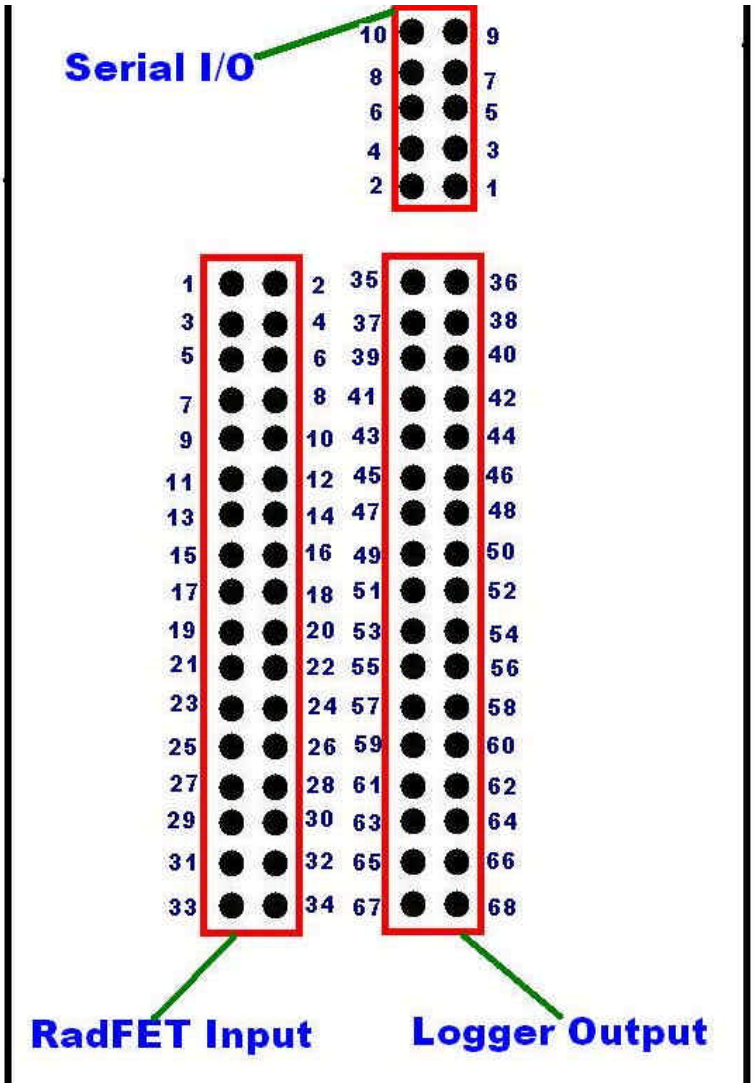


Table 2.2
Description of
RadFET Input Pins

RadFET Input Pin #	Connected to
1	Channel 1
2	Channel 2
3	+12 Volts
4	+12 Volts
5	Channel 3
6	Channel 4
7	Channel 5
8	Channel 6
9	+12 Volts
10	+12 Volts
11	Channel 7
12	Channel 8
13	Channel 9
14	Channel 10
15	+12 Volts
16	+12 Volts
17	Channel 11
18	Channel 12
19	Channel 13
20	Channel 14
21	+12 Volts
22	+12 Volts
23	Channel 15
24	Channel 16
25-32	No Connect
33	Ground
34	Ground

K) **Frt Pan Chan Sel** – The Front Panel Channel Select allows the user to change the selected front panel channel by the twist of the knob. The knob can be twisted to change from one channel to another channel with a small flat head screwdriver.

L) **Ext Trigger** – This LEMO connector allows the user to send an external trigger into the RadFETR. A TTL level signal between +2 and +3.3 volts is required to externally trigger the RadFETR.

M) **Ext Power** – This is the external power connector which allows the user to power the RadFETR from the front panel. The required DC voltage for the external power is +12 volts.

N) **Serial I/O** – This is the serial input/output connector. In Figure 2.2, the pin numbering for this connector is shown. The serial analog input/out connector allows the user to do two things. One is to program the CPLD that is in the board without having to open the casing. The program serial pins are pins 5 through 10. The second thing is a quick readout of all 16 channels with a signal from SAO (pin 1). The readout pins are pins 1 through 4. The serial pin description is seen in Table 2.3

Table 2.4
Description of Serial I/O Pins

Serial Pin #	Connection to
1	SAO
2	SATS1
3	SATS2
4	Ground
5	+5 Volts
6	Ground
7	TCK
8	TDO
9	TDI
10	TMS

O) **Logger Output** – The Logger Output is a 34 pin connector that provides readout of all 16 channels. The numbing of this connector is shown on Figure 2.2 A description of the pins is provided in Table 2.4

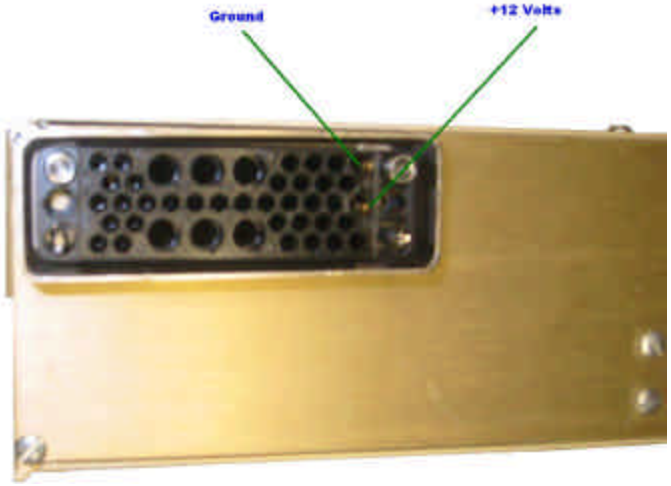
Table 2.4
Description of Logger Output Pins

Pin #	Connected to
35	Channel 1
37	Channel 2
39	Channel 3
41	Channel 4
43	Channel 5
45	Channel 6
47	Channel 7
49	Channel 8
51	Channel 9
53	Channel 10
55	Channel 11
57	Channel 12
59	Channel 13
61	Channel 14
63	Channel 15
65	Channel 16
36,38,40	Ground
42,44,46	Ground
48,50,52	Ground
54,56,58	Ground
60,62,64	Ground
66,67,68	Ground

3 Powering Up

The RadFETR is power up by either the DC power connection which is found on the Front panel or by the use of standard NIM bin connection. There are only two pins being used to provide corresponding power of 12 volts. This is shown in Figure 3.1.

Figure 3.1 Description of Nim Bin Pins



When using the front panel DC to power the RadFETR, +12 volts DC is required. The amount of current to run RadFETR is about 650mA. Make sure that the Power Status LED is Green before use of the RadFETR before using either type of power. The DC connector is shown in Figure 3.2. The outer shell of the connector is the ground connection. The inner shell of the connector is the +12 volts connection.

Figure 3.2 Description of DC Power Connector Shells

4 Types of Readout

There are three ways to get readout from the RadFETR. One way is done with the FAO. Another is using the 34 pin Logger Output. The last way is with the Serial I/O.

4.1 FAO Readout

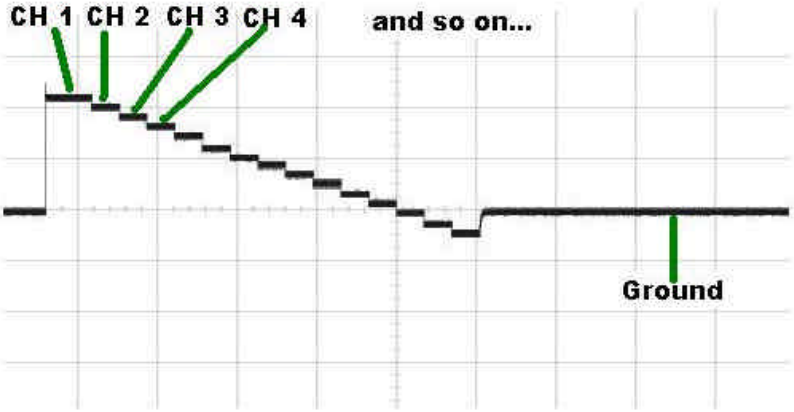
The FAO is a LEMO connector that allows the user to probe the channel that is selected on the front panel selected channel. The FAO can be connected to a voltmeter or even an oscilloscope. This is a great way to measure the voltage without the RadFET Display. Remember that when taking readouts with the FAO that you are only measuring one single channel that has been selected.

4.2 Logger Output Readout

The Logger Output is a 34 pin connector that sends a signal of the voltage of the channel that is being sampled. The numbering of this connector is shown on Figure 2.2. A description of the pins is shown in Table 2.4. There is a convenient ground pin next to each signal pin. This type of read out only sends a signal of the channel that being triggered.

4.3 Serial Readout

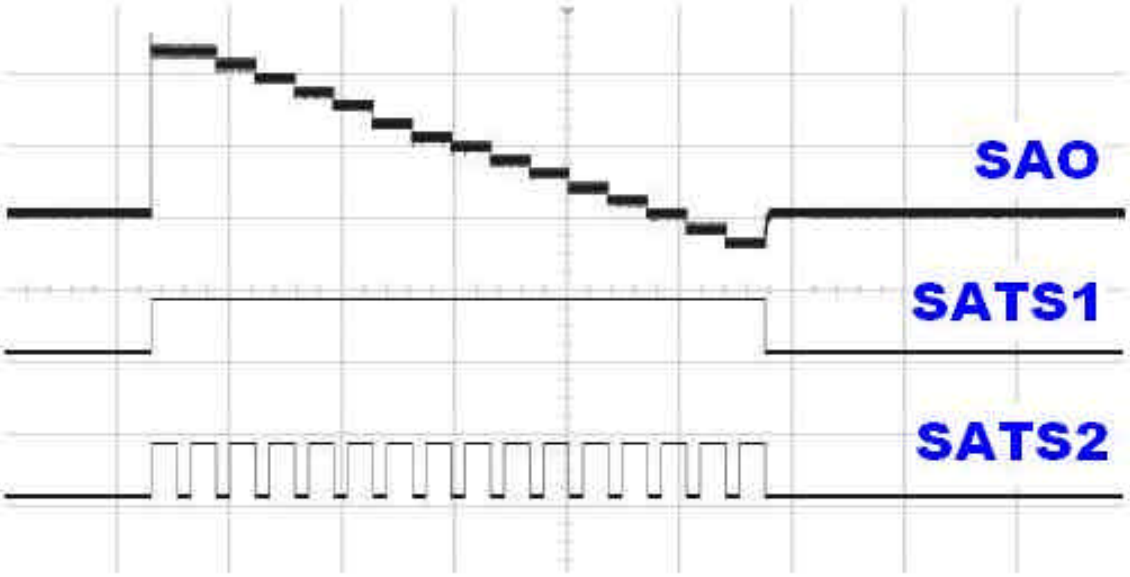
Figure 4.1
SAO Readout



The Serial Readout is a great way of measure all 16 channels quickly and compactly. In Figure 2.2, the pin numbering for this connector is shown. The serial pin description is seen in Table 2.3. SAO (pin 1) is the readout of pin. An example of this signal is provided in Figure 4.1. The amplitude of the signal is the voltage of channel. The signal goes in numerical order from channel 1 through channel 16. As seen in Figure 4.2, SAO is the signal of all 16 channels. Timing references are provided to aid in using an external ADL. SATS1 is

the enable signal which indicates that the serial output is active. SATS2 is a sample stroke signal which may be used to initiate an ADL conversion cycle.

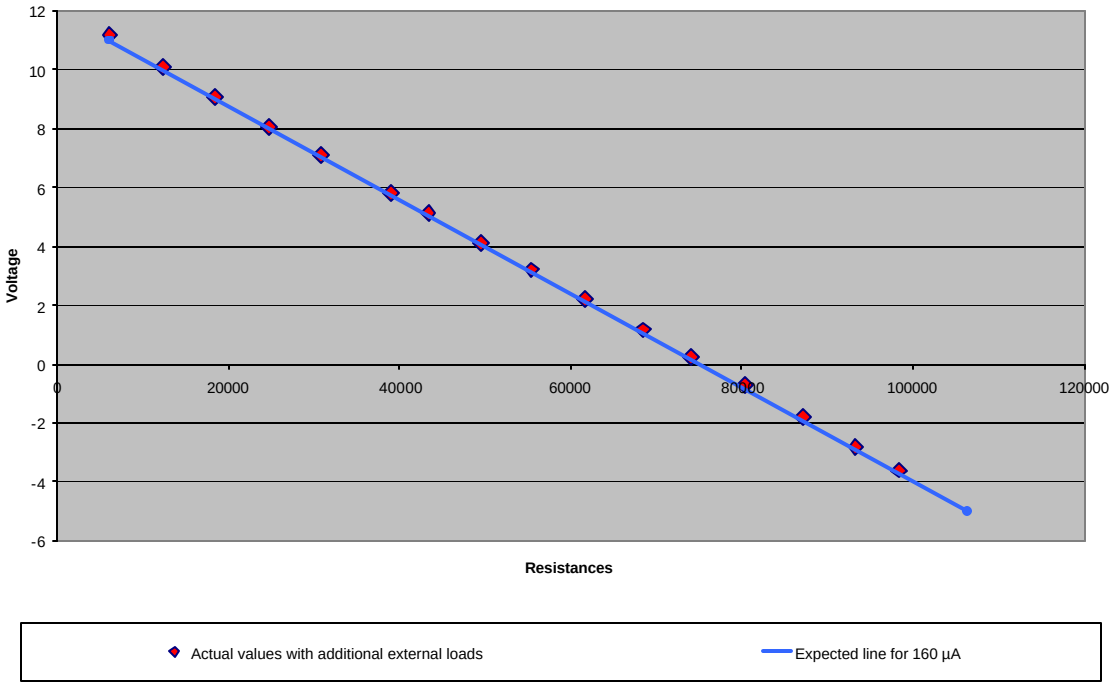
Figure 4.2



5 Attributes of RadFETR

When the RadFETR samples a channel a 160 µA current source is applied. This effect at this current source on a set of load test resistors can be seen in Figure 5.1. On each channel, there is one 2.2 µF capacitor that holds the voltage.

Figure 5.1
Graph of the Load versus Voltage with Load Test Resistor



The leakage surrent of this RadFETR storage capacitor is calculated to be about 700pA in each channel. Figure 5.2 is the drop of voltage for an 8 volts sample. Figure 5.3 is the same for a 4 volts sample. Figure 5.4 is the same for a zero volts sample. Figure 5.5 is the same for a negative 4 volts sample. Figures 5.2-5.5 shows the drop in voltage over a time period of 30 seconds. On average the change is between 9 to 10 mV.

Figure 5.2
Voltage Drop of a +8V Sample

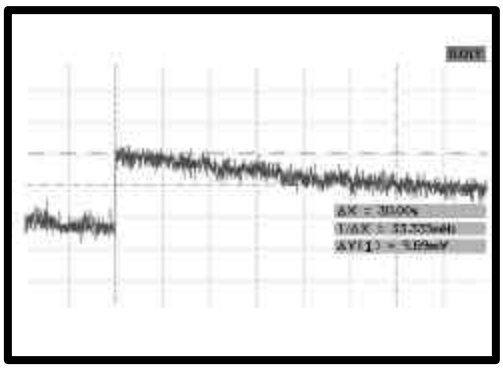


Figure 5.3
Voltage Drop of a +4V Sample

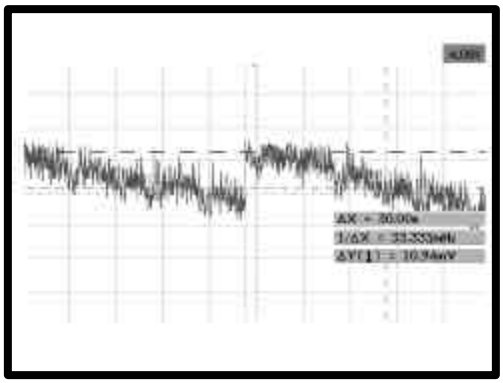


Figure 5.2
Voltage Drop of a Zero Volt Sample

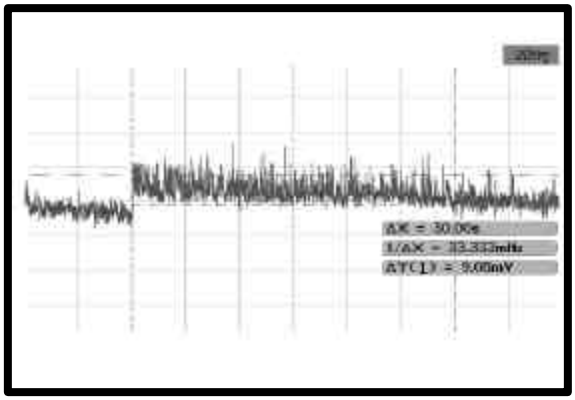
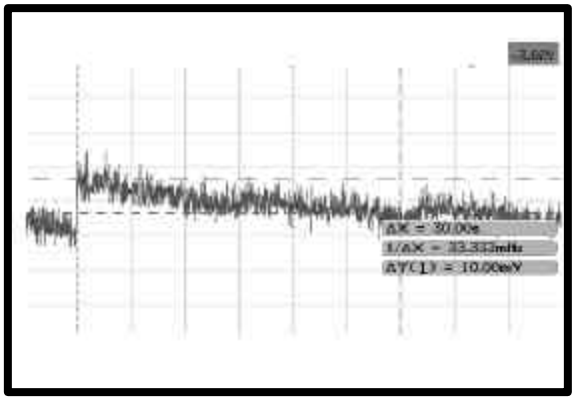


Figure 5.3
Voltage Drop of a -4V Sample



5 References

Instrument Development Laboratory----------
www.phys.hawaii.edu/~idlab

RADFET Techincal Information ----------
http://nmrc.ie/projects/radfets/tech.html

Ionizing Radiation Sensor----------
www.mdl.sandia.gov/mstc/technologies/microsensors/radiationsensor.html

NOTE: Make sure that you check the IDLAB website for the latest version of the schematics and firmware. www.phys.hawaii.edu/~idlab