RadFET Reader

By Larry Ruckman
What is a RadFET?

- RadFET is an acronym for Radiation Sensitive MOSFET.
- ZVN3306 is the Radiation Sensitive MOSFET that is being used in RadFET.
• Radiation induced a load on the silicon oxide part of the MOSFET
Type of Data

- Current
- Voltage

Graph showing:
- Increasing dose
- Pre-irradiation
- Increase in interface states

Axes:
- $V_{gs}$
- $V_{fn}$
- $V_{f1}$

Legend:
- $I_{ds}$
What is RadFETR going to be used for?

- The RadFETR is going to replace the old RadFET sensors that are currently being used around the world right now.
Bias Current = \frac{AV}{R} = \frac{(-10\text{V}) - (-15)}{31250\Omega} = 5\text{ Volts} = 160\mu\text{A}
Plot of the Bias Current

-6 -4 -2 0 2 4 6 8 10 12
0 20000 40000 60000 80000 100000 120000

Voltage

0 20000 40000 60000 80000 100000 120000
0 2 4 6 8 10 12

Resistances

Actual values with additional external loads
Expected line for 160 µA
Voltage Drop of a +8 Volt Sample
Voltage Drop of a +4 Volt Sample
Voltage Drop of a Zero Volt Sample

\[ \Delta X = 30.00 \text{s} \]
\[ \frac{1}{\Delta X} = 33.333 \text{mHz} \]
\[ \Delta Y(1) = 9.06 \text{mV} \]
Voltage Drop of a +4 Volt Sample

\[ \Delta X = 30.00s \]
\[ 1/\Delta X = 33.333\text{mHz} \]
\[ \Delta Y(1) = 10.00\text{mV} \]
...Then What is the Leakage Current???

\[ I = \frac{\Delta Q}{\Delta \text{time}} \]

\[ C = \frac{Q}{V} \]

\[ \Delta Q = \Delta V \cdot C \]

\[ \begin{array}{l}
C = 2.2\mu F = \text{Constant} \\
\Delta \text{Time} = 30 \text{ seconds} \\
\Delta V \approx 9.5 \text{ mV}
\end{array} \]

\[ I \approx \frac{\Delta Q}{\Delta \text{time}} = \frac{\Delta V \cdot C}{\Delta \text{time}} \approx \frac{(9.5 \text{ mV}) \cdot (2.2 \mu F)}{30 \text{ seconds}} \approx 700 \text{ pA} \]
Powering UP

- Standard NIM BIN Connector
- External DC Power Connector
2 Types of Triggering

- Internal Triggering
- External Triggering
The Internal triggering is activated through the CPLD.
This LEMO connector allows the user to send an external trigger into the RadFETR. A TTL level signal between +2 to +3.3 volts is required to externally trigger the RadFETR.
3 Types of Readout

- FAO
- Logger Output
- Serial I/O
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.
The Logger Output is a 34 pin connector that sends a signal of the voltage of the channel that is being sampled. There is a convenient ground pin next to each signal pin. This type of readout only sends a signal of the channel that is being sampled.
The Serial Readout is a great way of measuring all 16 channels quickly and compactly. SAO (pin 1) is the readout of pin. The amplitude of the signal is the voltage of channel. The signal goes in numerical order from channel 1 through channel 16. 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.
An Example of Serial Readout
Serial Readout
with Timing References
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>RadFETR</th>
<th>RADFETR2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board Size</td>
<td>7” X 7.125”</td>
<td>8.25” X 7.125”</td>
</tr>
<tr>
<td>Negative Power</td>
<td>-10 Volts</td>
<td>-15 Volts</td>
</tr>
<tr>
<td>5 Volt Regulator Heat Issue</td>
<td>Voltage Regulator was Toasty</td>
<td>Made room for a heat sink</td>
</tr>
<tr>
<td>Voltage Rating on Cap 2.2µF</td>
<td>16 Volts</td>
<td>35 Volts</td>
</tr>
<tr>
<td>LM7805CK Pin Numbering</td>
<td>Error on pin numbering</td>
<td>Fixed</td>
</tr>
<tr>
<td>Overall Power Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPLD Firmware Sampling Problems</td>
<td></td>
<td>Fixed</td>
</tr>
</tbody>
</table>
RadFETR2 Schedule

- Receive RadFETR2 by August 16, 2004
- By October 1, 2004 – have 5 working boards with covers.
- By October 29, 2004 – have all 10 boards working with covers.