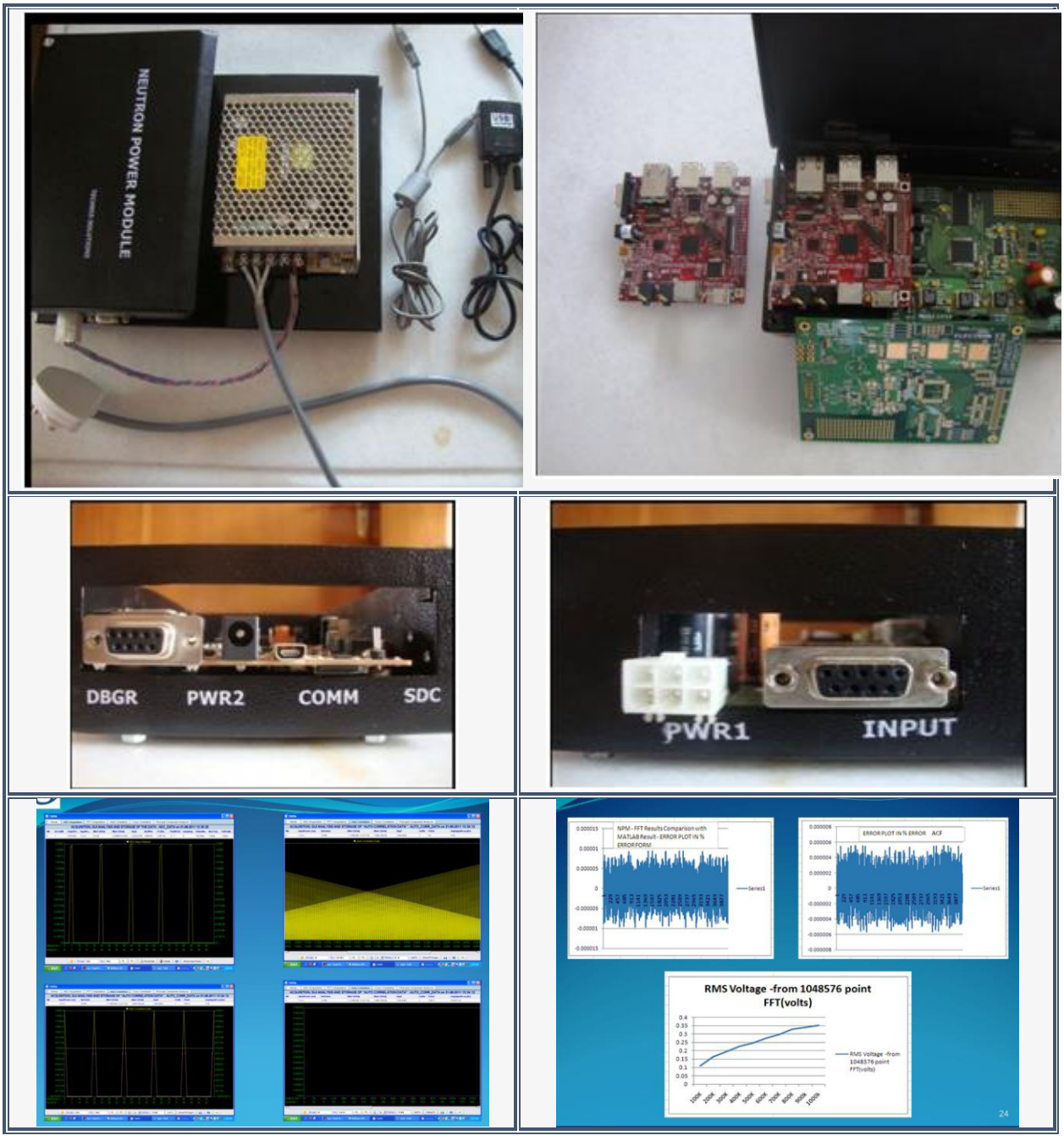
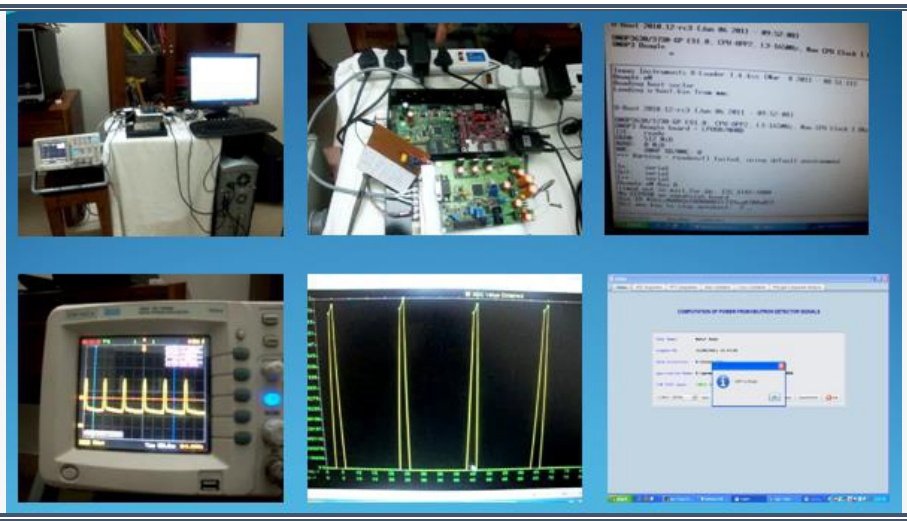
Table 1 - NEUTRON POWER MODULE





- Neutron Power Module (NPM) with a Desktop GUI is a high speed data acquisition and signal processing module which acquires neutron flux signal and computes Digital Signal Processing parameters to give:
  - RMS power computed through FFT for user selected frequency bands.
  - Time period of the input signal computed through Auto correlation, Cross correlation function.
  - Principal Eigen Vector computed on the input data through Principal Component Analysis.
- The Front end of NPM consists of an ACTEL FPGA based Data AQuisition (DAQ) Card on which the TI's 1GHz ARM Cortex A8 based Digital Signal Processing (DSP) Card sits.
- DAQ Card acquires 0 to 5V input data @ 100ksps (1.2Mbps) to 20Msps (240Mbps) using 12 bit paral lel ADC and transfers the data to the DSP Card using GPIO Interface @ 24Mbps.
- Input samples storage capacity of DAQ Card is 1 million samples @ 16bits.
- DAQ Card FPGA design works at a speed of 100MHz system clock frequency.
- DSP Card works on a “light weigh t Angstrom Distribution” of Linux 2.6.32 and uses the ARM Core of the Processor with NEON co -processor to facilitate faster floating point computations.
- DSP Card performs Digital signal processing operations on the acquired data such as Fast Fourier Transforms, Auto Correlation, Cross Correlation and Principal Component Analysis.
- NPM module is completely controlled by TechnidNPM GUI on a Desktop PC through USB OTG Interface.
- The acquired data or the processed data can be transferred to the Desktop PC interfaced using a USB OTG Interface @115200 kbps through a robust communication protocol.
- Online debugging messages are displayed from the DSP Card on the HYPERTERM on the Desktop PC using RS-232 debugger interface.
- NPM Module can perform upto 1Million P oint Radix 4 Fast Fourier Transform with different windowing functions such as Rectangular, Hamming and Hanning Window Function.
- NPM Module also performs upto 1 Million Point Auto-Correlation Function ACF.

- Upto 1 Million Point Cross Correlation Function can be computed where the range of periodic cross correlation frequency (generated on the DSP Card) is defined by the user and can range from 1Hz to 10MHz with fixed resolution.
- Principal Component Analysis function is limited upto finding the Principal Eig en Vector of upto 8K samples of input data.
- The Algorithms for the above DSP operations have been developed by TECHNID SOLUTIONS and the results have been compared against the results generated from MATLAB which are shown in the user manual of the NPM Module for comparison.
- An extensive GUI, besides plotting the results obtained also gives several derived parameters for each DSP operations. To mention a few:
    - Computing time period of input signal from ACF / CCF.
    - Determining relations between RMS voltages and neutron flux input count rate for selected frequency bands.
    - Comparing results across several experiments with different input rate and input sampling rate.
- Libero IDE is used for design, development and testing of FPGA based designs and development.
- Eclipse IDE for C code development for DSP Card. Val grind tool has been used for memory checks in C source code because of involvement of large number of dynamic memory operations.
- Net Beans 7.1 is used for the Java based GUI development.
- Neutron Power Module is supported by well documented User Manual describing the installation, hardware operation and operation details of the GUI.

THIS HAS BEEN DEVELOPED FOR IGCAR, KALPAKKAM FOR REACTOR INSTRUMENTATION APPLICATION