The FAST Facility comprises of an electron injector based on the Advanced Superconducting Test Accelerator (ASTA) [3], a RFQ based proton injector and the Integrable Optics Test Accelerator (IOTA) storage ring. The electron beam is produced by a 1.3 GHz RF photoinjector and then accelerated to ~50 MeV by two 1.3 GHz SRF cryomodules, each containing a single 9-cell cavity. The beam will then be injected into the linear accelerator which consists of a 12-m long, 1.3 GHz 8-cavity superconducting cryomodule (CM2). This is a Tesla type III cryomodule[1] driven by a 5 MW klystron. The electron beam energy gain will be approximately 300 MeV at this stage. The facility is also being expanded to accommodate further advanced accelerator research and development with the installation of a 2.5 MeV proton/H- RFQ accelerator. This accelerator starts with a 50 kV, 40 mA proton (or H-ion) source coupled to a pulsed 325 MHz RFQ to 2.5 MeV with a 1ms pulse duration for injecting into IOTA. This ring is 39 meters in circumference and will also be capable of storing electrons from 50 to 150 MeV in energy. Figure 1 shows the placement of the ring in the FAST facility layout.

The Machine protection System (MPS) is being developed in stages that are commensurate with the commissioning goals for FAST. The primary objectives from the MPS point of view are to mitigate beam induced damage to the machine components and to provide a comprehensive overview of the entire accelerator based on the input status of all the relevant subsystems [2].

The overall MPS design is divided into 3 layers; a sensor layer to collect sub-system status, a process layer that utilizes the status to generate the permits and an actuator layer to receive the permits and inhibit the beam. The initial stage of this development involves the design of the Laser Pulse Controller.

The Laser Pulse Controller (LPC) is designed to be the primary actuator for beam inhibits. Its main function is to provide a gate to the gun laser system via the Pockels cells with a width that corresponds to the total number of 3 MHz pulses allowed without crossing the programmable threshold for losses. The maximum width of the gate is 1 ms which would accommodate a maximum of 3000 bunches. It is designed to inhibit the system within the 1ms macro-pulse window.

The main MPS permit generator board is the central component of the system that serves to collect status (OK/Not-OK) information from the various machine subsystems. The information is used in conjunction with user input such as operational mode and beam mode requests to generate a permit condition. The subsystems interface with the system through several modules that are designed to maintain signal integrity and provide noise immunity by converting input signals to Low Voltage differential signal levels (LVDS).

A web page, as shown in Figure 9, serves as the entry point to the user interface. This page provides a global view of the permit system, a list of all pertinent applications and has a global log of all critical MPS messages.

The front-end signal processing boards used are based on electronics designed by Jefferson Lab for their 12 GeV loss monitor system upgrade [4]. These BLM boards have been modified to meet the specific machine requirement at FAST. The main design change was to process the amplified signals from these boards using faster 125 MHz digitizer boards. The signals are further processed by an on-board Field programmable gate array to provide the required threshold levels and protection system shut-down signals.