

# EXTENDING DIII-D NEUTRAL BEAM MODULATED OPERATIONS WITH A CAMAC BASED TOTAL-ON-TIME INTERLOCK\*

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A new total-on-time interlock has decreased the constraints on the time history of neutral beam pulses at the DIII-D National Fusion Facility. The interlock, called the neutral beam on-time-limiter (NBOTL), is a custom built CAMAC module utilizing a Xilinx 9572 complex programmable logic device (CPLD) as its primary circuit. The neutral beam injection systems are the primary source of auxiliary heating for DIII-D plasma discharges and contain eight sources capable of delivering 20 MW of power. The delivered power is typically limited to 3.5 s total-on-time per source to protect beam-line components, while a DIII-D plasma discharge usually exceed 5 s. Implemented as a hardware interlock within the neutral beam power supplies, the NBOTL limits the total beam injection time. While allowing it to be modulated on and off to meet the research needs. The NBOTL guards against command faults and allows the modulated beam injection to be safely spread over a longer plasma discharge time.

The NBOTL design is an example of incorporating modern circuit design techniques (CPLD) within an established format (CAMAC). The CPLD is the heart of the NBOTL and contains 90% of the circuitry, including a loadable, 1 MHz, 28 bit, BCD count down timer, buffers, and CAMAC communication circuitry. This paper discusses the circuit design and implementation. Of particular interest is the melding of flexible modern programmable logic devices with the CAMAC form factor.

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