

MIT-BATES 50nA Electron Beam Position Monitor Electronics

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Abstract

The MIT-BATES Electron LinAc Extracted Beam physics program and Control Room beam diagnostics require real time beam position monitoring at peak beam currents of 1 to 10uA. Minimum specifications were set to <1mm RMS noise at 1MHZ BW and <0.5mm position non-linearity over 10mm at 4.0uA beam current. The NIKHEF traveling wave-guide was selected as the monitor due to the larger aperture and far lower fabrication cost over the SLAC resonant cavity type monitor. The design uses a \$3.00 wireless consumer electronics cost-driven GaAs MMIC S band down-converter chip. The down-converters IF (50MHz) is further shaped by a 100dB gain log amp/limiter chip. The log outputs of the 4 pickups are summed and result in a beam intensity signal with <0.5% of reading beam position dependence over 10mm. A high-speed analog multiplier is used as the phase detector with the hard limited IF as input. Gain is set at 100mV/mm and is remotely adjustable as is offset adjustment. Our first PCB run resulted in success and met all specifications on the bench and with beam tests. Most recent bench tests in the final enclosure measured no loss in position calibration to the equivalent of 50nA of beam current.