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Hairpin Lock-in Circuit for Real-Time Plasma Density Measurements[1] SHON MACKIE, YHOSHUA WUG, XINGCHEN FAN, TROY CARTER, PATRICK PRIBYL, Basic Plasma Science Facility at UCLA — We describe a circuit which allows a hairpin resonator probe to measure the plasma density in real time. Recent work has demonstrated that hairpin probes can be implemented cheaply and without too much difficulty using commercial o_the shelf microwave electronics (see X. Fan, also at this conference). Using such a probe to diagnose the density has typically involved sweeping over a band of frequencies that includes the resonant peak, then identifying the resonance and deriving the corresponding density for that sweep. The present work adapts a lock-in type of circuit, which is commonly used to actively maintain resonance in high precision lasers, to find and lock onto the hairpin's resonance in real-time. An error signal is generated by introducing a small oscillation to the input of a voltage-controlled oscillator, and monitoring the output of the mixer that detects the transmitted signal from the probe. The response is then fed into a PID controller to maintain the control voltage at resonance. One goal of the current work is to shorten the time response of the lock-in circuit to 1 us or less. This would be sufficiently fast to allow the hairpin probe to be used as a diagnostic of the plasma density during an Alfven wave in the Large Plasma Device at UCLA.

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