$$P = P' + \frac{(u - u')^2}{V_0(\eta - \eta')} , \qquad (5.3)$$

and

$$P = \rho_0^Y Zu \qquad (5.4)$$

which relate mechanical parameters when the shock wave, initially in the Lucite, traverses the Lucite-YIG interface. This is a system of three equations in three unknowns; P, u, and η. The first is Equation (4.7) with the pressure on the Hugoniot recentered about P' and η' in the Lucite. The second is obtained from mass and momentum jump conditions across the reflected shock in the Lucite. The third is an elastic P - u relation for YIG. The system of three equations was solved numerically by a Newton-Raphson iteration technique for the required mechanical parameters.

A technique devised to serve as a consistency check on the numerical methods and equations of state used was to substitute a quartz gauge for the YIG. To be consistent, the actual recorded stress should agree with that calculated through the previous numerical procedure. This was found to be the case within $\pm 4\%$ over several shots. The variation was not consistently above or below.

Also observed on the quartz gauge records was the deterioration in the stress profile due to propagation through the 1 mil copper-epoxy grid. The effect on the profile was to create a finite rise time of approximately 50 nanoseconds. After the quartz gauge profiles were corrected for finite strain,[53] there still existed a slight ramp of less than 2% across the recording time of the quartz. Although this may be due to incorrect compensation for finite strain, it may also be the effect of dissipation in propagating the stress wave through 1.5 mm of Lucite as has been observed by Barker and

Hollenbach.[57] This possible effect was ignored. It would be slight in any case as can be seen from the profiles published by Barker and Hollenbach.

In summary, the projectile velocity for a series of shots was assumed to be the average obtained from these shots. The state of strain in the YIG was obtained with this projectile velocity and the calculation described in this section. This calculation of the strain should be accurate to $\pm 5\%$.

5.3. Transverse Magnetization

The last experimental parameter required is the magnetization corresponding to a given magnetic field and shock induced anisotropy field. This is obtained by measuring the reduction in magnetization, δM, assuming that prior to arrival of the shock wave the material is in a state of magnetic saturation. The magnetization is then

$$M = M_s + \delta M$$

where M is negative. δM is obtained through

$$\delta M = \frac{10^8}{4\pi bND} \mathcal{E} \quad (5.5)$$

as discussed in Section 4.3 where it was assumed that $\mathcal{E}$ was constant, produced by a steady state shock wave progressing through the magnetic medium.

A typical oscilloscope record from which this magnetic information must be deduced is shown in Figure 5.1. A negative emf is developed during the first transit of the wave corresponding to the expected demagnetization of the magnetic material. The subsequent behavior is determined by alternate remagnetization and demagnetization as the stress wave reverberates back and forth in the magnetic material. A fairly accurate acoustic velocity in YIG can be determined from these records. Only the first half cycle is utilized in analysis of the magnetic state behind the shock.