which also monitors echo amplitude.   The computer is programmed to
sweep through a specified range of carrier frequency and record
the echo amplitude as a function of frequency, and it is also
used to process the data as described below.

    High pressures were generated with a Bridgman  piston-cylin-
der apparatus with kerosene pressure medium.   Pressure was deter-
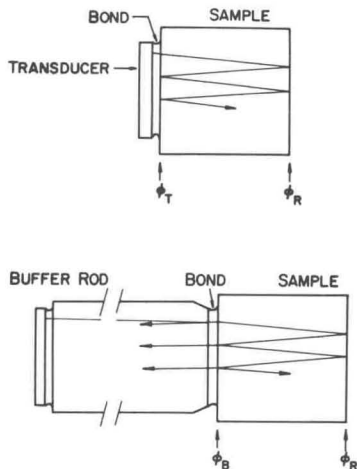mined to within 1% with a Heise gauge.



*Fig. 2.   Schematic diagram of the transducer-bond-
sample and buffer rod-bond-sample assemblies in this
study.*

    The transducer-buffer-bond-sample configurations used are
illustrated in Figure 2.   Samples used in this study--both about
1 cm in size--were a synthetic stoichiometric spinel ($MgAl_2O_4$)
crystal obtained from Union Carbide and a synthetic $MgF_2$ crystal
obtained from Optovac, Inc.   Opposite faces on the samples were
polished flat and parallel to within about one µ.   A fused quartz
buffer rod was used.   Transducers were bonded by Dow Corning resin
276-V9 or, for some zero-pressure runs, phenyl salicylate.   Coup-
ling between the buffer rod and samples was achieved in several
different ways:   with dry lapped contact; with lapped contact
immersed in a fluid pressure medium, such as isopentane; with a
lapped contact wetted with the fluid (but not immersed); and with
a V9 resin bond.

III. DATA PROCESSING

An example of amplitude-frequency data is illustrated in
Figure 3(a). The broad amplitude envelope results from the com-
bined response of the electronics and the transducer resonance (in
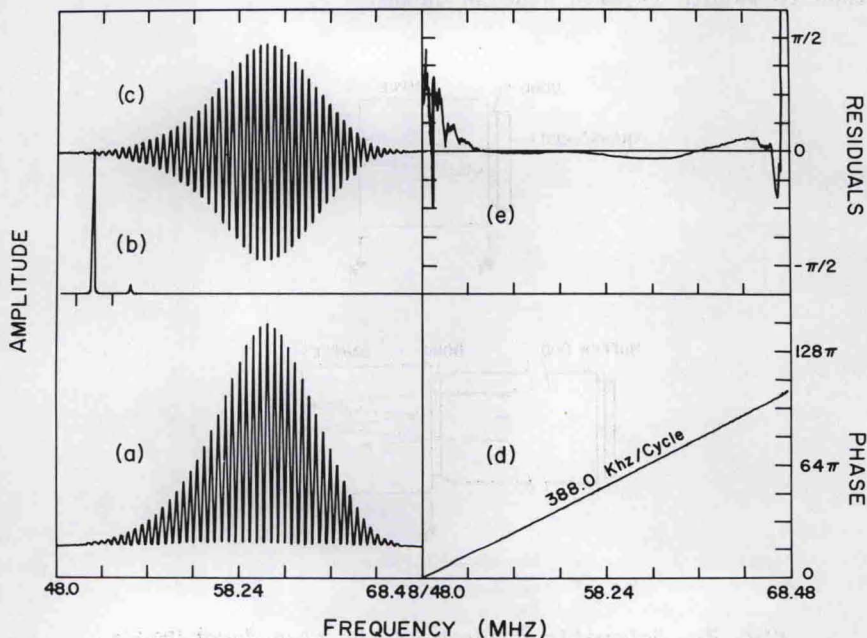this case the fundamental resonance frequency of the transducer



Fig. 3. (a) Amplitude-frequency interference pattern
obtained from the ultrasonic interferometer. (b) Spectrum
of a. Filter window is indicated by tick marks below
spectrum. (c) Filtered amplitude-frequency data with
envelope, harmonics, and noise removed. (d) Instantaneous
phase of c versus frequency. (e) Residuals of d from
a bestfit line.

was 20 Mhz). The narrow peaks result from successive constructive
interferences of the superposed echoes in the sample. The condi-
tion for constructive interference is that the phase difference
between successive echoes be equal to $2n\pi$, where $n$ is an integer,
i.e.:

$$\frac{4\pi f L}{v} + \phi_r = 2n\pi \tag{1}$$

where $f$ is the carrier frequency, $L$ is the sample length, $v$ is the
sound velocity in the sample, and $\phi_r$ is the total phase shift pro-
duced by reflections at the sample faces. If the carrier frequency