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CALIBRATION CHECK

A general check of calibration accuracy may be made by displaying the output of the **CAL** terminal on the screen. This terminal provides a square wave l of 2V p-p. This signal should produce a displayed waveform amplitude of four divisions at .5 V/div sensitivity for both channel 1 and 2(with probes set for direct). With probes set for X10, thereshould be four divisions amplitude at 50 mV/div sensitivity. The **VARIABLE** controls must be set to **CAL** during this check.

NOTE

The **CAL** signal should be used only as a general check of calibration accuracy, not as a signal source for performing recalibration adjustments; a voltage standard calibrated at several steps and of 0.3% or better accuracy is required for calibration adjustments.
The CAL signal should not be used as a time base standard.

APPENDIX

IMPORTANT CONSIDERATIONS FOR RISE TIME
AND FALL TIME MEASUREMENTS

Error in Observed Measurement

The observed rise time (or fall time) as seen on the CRT is actually the cascaded rise time of the pulse being measured and the oscilloscope's own rise time. The two rise times are combined in square law addition as follows:

$$T_{observed} = \sqrt{(T_{pulse})^2 + (T_{scope})^2}$$

The effect of the oscilloscope's rise time is almost negligible when its rise time is at least 3 times as fast as that of the pulse being measured. Thus, slower rise times may be measured directly from . the CRT However, for faster rise time pulses, an error is introduced that increases progressively as the pulse rise time approaches that of the oscilloscope. Accurate measurements can still be obtained by calculation as described below.

Direct Measurements

The Models 404/406/409 oscilloscopes have a rated rise time of 8.8 ns. Thus, pulse rise times of about 27ns or greater can be measured directly. Most fast rise times are measured at the fastest sweep speed and using X10 magnification. For the Models 404/406/409, this sweep rate is 10 ns/div. A rise time of less than about four divisions at this sweep speed should be calculated.

Calculated Measurements

For observed rise times of less than 27 ns, the pulse rise time should be caluclated to eliminate the error introduced by the cascaded oscilloscope rise time. Calculate pulse rise time as follows:

$$T_{pluse} = \sqrt{(T_{observed})^2 + (T_{scope})^2}$$

Limits of Measurement

Measurements of pulse rise times that are faster than the scope's rated rise time are not recommended because a very small reading error introduces significant error into the calculation. This limit is reached when the"observed"rise time is about 1.3 times greater than t he scope's rated rise time, about 12 ns minimum for the Models 404/406/409.

Probe Considerations

For fast rise time measurements which approach the limits of measurement, direct connection via 50 W coaxial cable and 50 W termination is recommended where possible. When a probe is used, its rise time is also cascaded in square law addition. Thus the probe rating should be considerably faster than the oscilloscope if it is to be disregarded in the measurement.