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SCHEMES FOR RECORDING NANOSECOND HIGH-POWER MICROWAVE PULSES BY DETECTORS ON HOT CARRIERS

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To detect nanosecond high-power microwave pulses [1], waveguide detectors [2–4] are used, based on the effect of a decrease in carrier mobility in a semiconductor upon absorption of microwave energy. The detectors use p-type Ge or n-type Si crystals. Examples of the two measurement schemes used are shown in Figures 1 and 2.

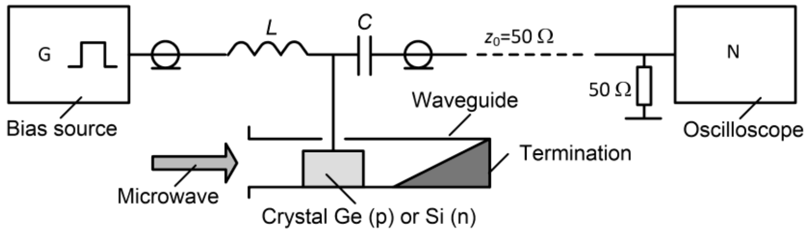

Fig. 1. Measurement scheme with a bias source next to the detector.

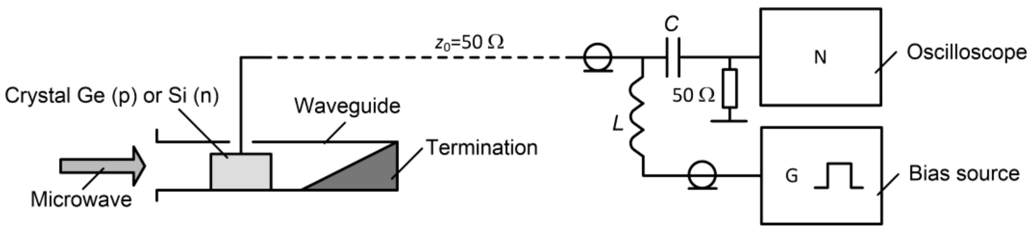

Fig. 2. Measurement scheme with remote bias source.

In both schemes, a bias voltage pulse with an amplitude U_0 and a duration significantly exceeding the duration of the microwave pulse is supplied to the crystal from the pulse generator through the inductance L. This voltage sets the steady current I_0 in the crystal and the initial resistance of the crystal R_0. When a microwave wave appears in the waveguide, the crystal resistance $R(t)$ increases, which is determined by the microwave power $P(t)$, which depends on time t. Under the condition $L / R(t) >> \tau$, where τ is the duration of the microwave pulse, the current through the crystal during the microwave pulse remains constant and equal to the initial value I_0. The output signal of the detector is determined by the registration circuit and depends on the voltage increase $\Delta U(t) = I_0[R(t) - R_0]$ on the crystal. In the scheme presented in Figure1, the bias source is close to the detector, and the bias signal at the cable input is suppressed by capacitance C. According to the conditions of the experiments, the useful signal is transmitted over a cable with a length usually exceeding the length of the signal in the cable to a remote oscilloscope for registration. This circuit corresponds to the detector calibration circuit. The only difference is that the microwave pulse in the calibration procedure is supplied from a special magnetron oscillator [4]. Therefore, the calibration corresponds to the measurement conditions in experiments with high-power microwave pulses. In the scheme presented in Figure 2, the bias source is removed from the detector by a cable length and is located next to the oscilloscope. The measurement conditions are different from the calibration conditions.

In this paper, the applicability of the calibration conditions (Figure 1) is analytically considered in this case as well.

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