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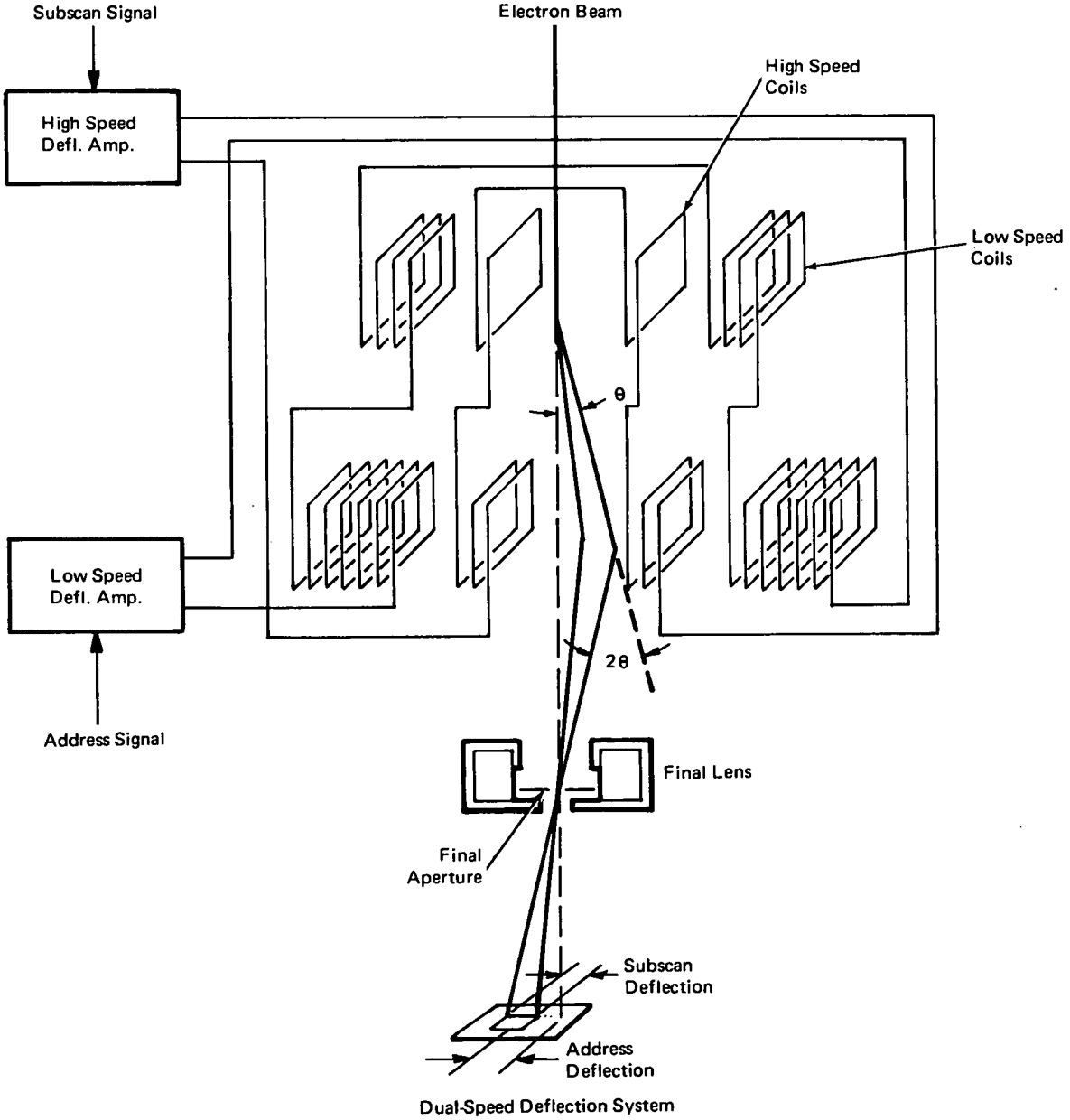
Marshall Space Flight Center

Two-Speed Deflection System For Electron Micropattern Generator



Dual-Speed Deflection System

(continued overleaf)

The dual-speed deflection system serves as an essential component of an electron beam pattern generation system that will be used to generate high quality, high resolution masks for use in optical or electron projection lithographic systems. The application of electron beam lithography to solid state device fabrication requires improved exposure speed capability of the single beam electron micropattern generator. The use of a fine electron beam for pattern generation is dependent on factors such as resolution versus size of field, alignment methods, and operating speed. Operating speed, the time required to make an electron beam exposure of a pattern over the area of a silicon wafer, depends upon a combination of factors. These include beam current for the maximum permissible beam diameter, electro-resist sensitivity, maximum data rate of the system, maximum speed of beam deflection, and the time required for the step and repeat operation. The procedure is related to a method for reducing the data rate requirement of the system through the use of a high-speed deflection of the beam in a small local subraster of prescribed dimensions, and for obtaining such high-speed deflection over a limited area by means of a two-speed deflection system.

The two-speed, dual deflection system deflects the beam through a set of coils at an angle θ and then deflects the beam through twice that angle in the second set of coils. Thus, the beam crosses the vertical axis of a column in the plane of a final aperture and hence in the median plane of the final lens. A major advantage of the system is that it reduces beam shape distortion in the final lens caused by off-axis beam traversal. In the electron micropattern generator, both upper and lower deflection coils have a low inductance secondary set of coils added. A high frequency waveform of desired amplitude is imposed on the high speed coils to create the subraster. This dual low-speed/high-speed deflection system can be used to advantage in obtaining fast transient response to small incremental deflection signals, which make up 90% of the address instructions. This is accomplished when the unbalanced signal, arising from the low response speed of the high inductance deflection yoke, is fed as an error signal into the high speed deflection amplifier. An appropriate compensating current in the fast coil is developed very rapidly, thereby giving a step output in total deflection coil current, or in net deflection magnetic field. It is anticipated that this system will permit settling times on the order of 100 nanoseconds for small positional increments. This becomes of considerable importance in rapid exposure of masks when permitted by new developments of other limiting factors, including beam current and electro-resist sensitivities.

Notes:

1. Information concerning this innovation may be of interest to manufacturers of integrated circuits.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Code A&PS-TU
   Marshall Space Flight Center, Alabama 35812
   Reference: B72-10668

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

Patent Counsel
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Source: P. R. Malmberg of
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