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BYE-109350-72

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29 June 1972

MEMORANDUM FOR: Col. James C. Fitzpatrick
Chairman, KH-11 Working Group

SUBJECT : KH-11 Characteristics

1. Attached is a document describing the characteristics of the KH-11 imagery. Please recognize that this description is based on the current system design and may be subject to change as the design evolves through PDR and CDR.

2. The attachment is classified TK-H in anticipation that it can be handled in the portal compartment. As you know, this compartment has not been formally established nor have all the security guidelines been completely coordinated. I would appreciate your handling the document with these considerations in mind.

LESLIE C. DIRKS

Deputy Director of Special Projects

Att: A/S

GROUP 1
Excluded from automatic
downgrading and
declassification

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Attachment to:
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KH-11 SYSTEM OUTPUT IMAGERY DESCRIPTION

INTRODUCTION

Output imagery from the KH-11 System is in the form of a positive film transparency derived from two basic modes of system operation: the framing mode Framing mode operations are used principally to acquire imagery of small areas or point targets at high image quality:

There are several image descriptors necessary to properly characterize the output imagery from each of the two modes. These descriptors include format, dynamic range, spatial bandwidth, image modulation, noise, geometric scale, and titling. These descriptors are defined in the following sections and, where applicable, quantitative values are given. It should be recognized, however, that the present state of the development cycle of both the detailed system requirements and the system configuration itself imposes a tentative status on the descriptors and values provided.

FORMAT

Framing Mode: The basic unit of imagery in the framing mode is the frame. Each frame is comprised of four subframes of imagery, titling data, and other markings required for mensuration. The framing mode imagery and its associated data are printed on a 9.5 inch wide roll of film. The length of the roll is variable; the length of each frame and its associated data along the roll ranges from approximately 12 inches to approximately 18 inches, as described below.

The basic frame format geometry is sketched in Figure 1. Dimension A is the width of the film and is fixed at 9.5 inches. Dimension B is the width of the actual imagery and is fixed at 9.0 inches. Dimension C is the length of a subframe. This dimension

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has a minimum value of approximately 2.25 inches and a maximum value of approximately 3.75 inches. Although Dimension C will vary from frame to frame, it is a constant value for the four subframes of any given frame. Dimension D is a dead-band of non-image area separating the subframes and is fixed at approximately 0.25 inches. Dimension E is a fixed increment of 0.15 inches on each side of the subframes reserved for titling and reference markings. In addition, approximately two inches of film along the length of the roll before the first subframe of each frame are also reserved for titling data.



DYNAMIC RANGE

The minimum useful density range on the positive transparency extends from a density of 0.3 to a density of 2.0 for both framing and stripping mode imagery. This corresponds to a transmission factor through the positive transparency ranging from 0.01 to 0.50. Under normal operations, the tonal scaling for the system is designed to provide a one-to-one correspondence between transmission on the positive transparency and ground object reflectivity.

SPATIAL BANDWIDTH

Framing Mode: The center-to-center distance between adjacent sample points both along and across the film is approximately 12.6 microns, corresponding to a half-sampling frequency of 39.6 cy/mm. The maximum spatial frequency of interest in directions both parallel and perpendicular to the laser scan direction is 39.6 cy/mm. This spatial bandwidth of interest is constant for all framing mode acquisition conditions.

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IMAGE MODULATION

Framing Mode: The sine-wave modulation transfer factor for the entire system (exclusive of sampling effects) as manifested by the positive transparency at 39.6 cy/mm has a minimum value of approximately 0.03 in directions both parallel and perpendicular to the scan direction. This factor increases with decreasing spatial frequency to a value of unity at a spatial frequency of 0.

IMAGE NOISE

Image noise in the positive transparency for imagery obtained from both the framing and stripping modes is expressed in terms of the rms density variation resulting from all noise sources as a function of the average density level at which the measurement is made. The distribution of the noise is approximately Gaussian. The rms density variation is as measured with a clear circular aperture having a diameter equivalent to the sample spacing and a discrete sampling increment also equivalent to the sample spacing. Under typical operating conditions, the rms density variation as a function of density is shown in Figure 2.

IMAGE SCALE

Framing Mode: The geometric mean of the image scales in directions parallel and perpendicular to the scan direction for

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typical framing mode operations ranges from 1:16,000 to 1:55,000. Under extreme framing mode conditions, this scale may decrease to 1:120,000.



TITLING

Framing Mode: Framing mode imagery is titled in man-readable form on the frame format in the areas reserved for this purpose. The following data is provided on all frames:

- a) date and time of image acquisition
- b) frame identification number
- c) vehicle identification number
- d) orientation (north vector applicable at approximate center of frame)
- e) image scale (at approximate center of frame)
- f) target location
- g) stereo pair identification number
- h) target identification number
- i) image classification
- j) reference grid marks



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- a) date and time of image acquisition
- b) strip identification number
- c) vehicle identification number
- d) orientation (north vector at center of strip)
- e) image scale
- f) target area location
- g) image classification
- h) reference grid marks

The data specified in (d), (e), (f), and (h) only are included in the strip margins at intervals of nominally six inches along the strip and apply to the imagery in the immediate vicinity of the marking.

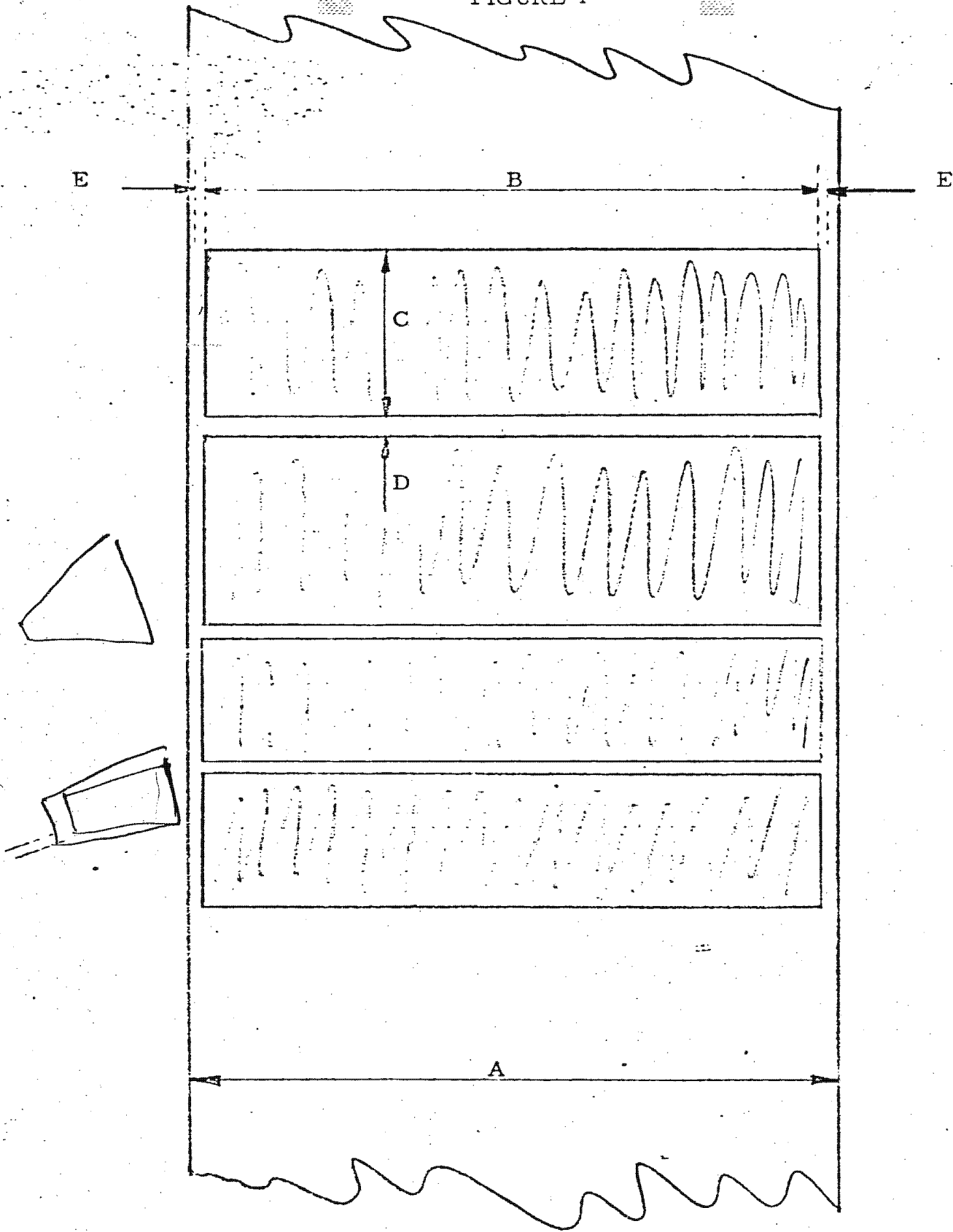
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FIGURE 1



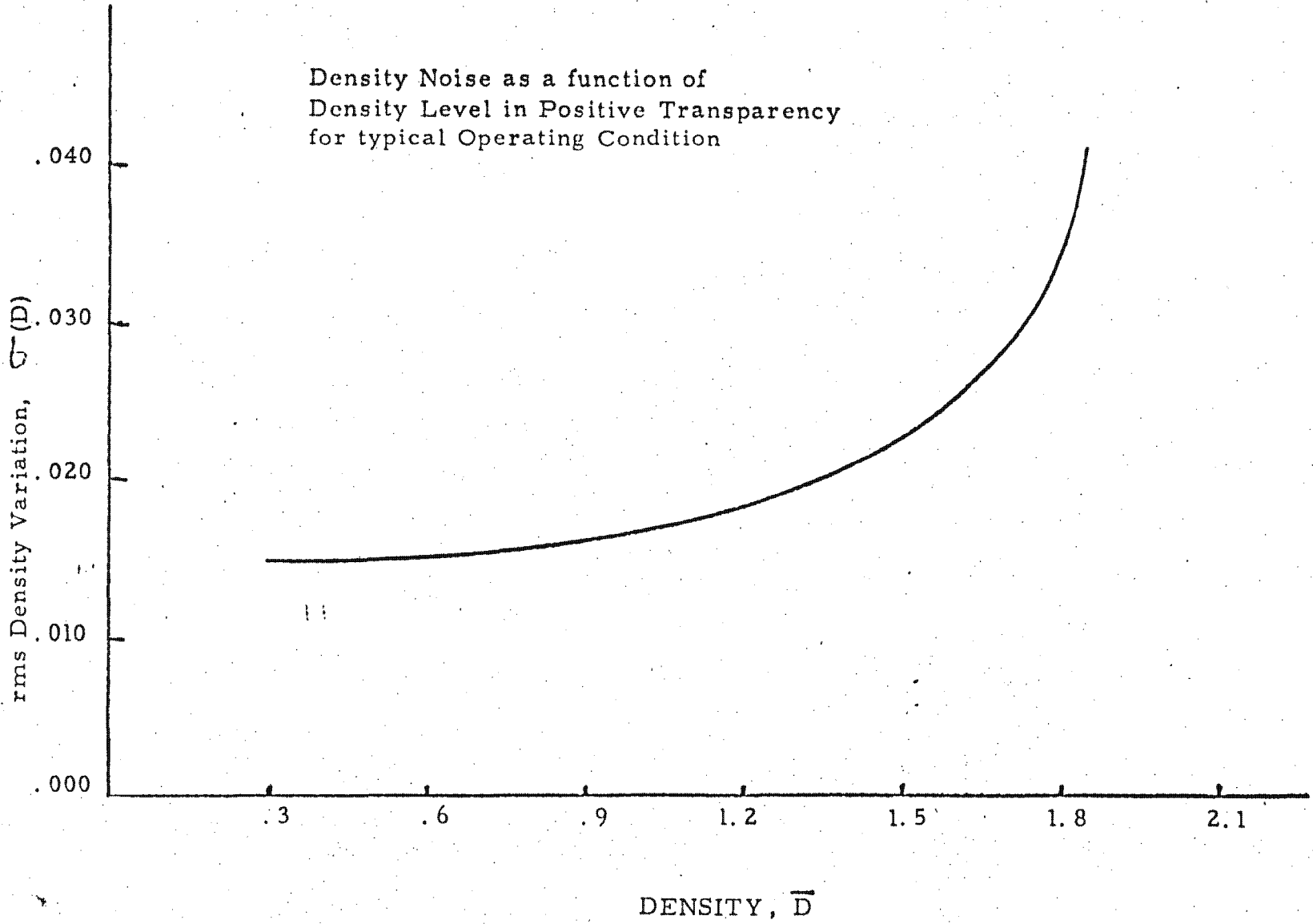
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Density Noise as a function of
Density Level in Positive Transparency
for typical Operating Condition



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