TECHNICAL REPORT TR-77-2

INDEX OF 3.2-mm AND 10.6-μm IMAGE DATA TAPES

Physical Sciences Directorate
Technology Laboratory

1 February 1977

Approved for public release; distribution

US Army Missile Research and Development Command
Redstone Arsenal, Alabama 35809
DISPOSITION INSTRUCTIONS
DESTROY THIS REPORT WHEN IT IS NO LONGER NEEDED. DO NOT RETURN IT TO THE ORIGINATOR.

DISCLAIMER
THE FINDINGS IN THIS REPORT ARE NOT TO BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION UNLESS SO DESIGNATED BY OTHER AUTHORIZED DOCUMENTS.

TRADE NAMES
USE OF TRADE NAMES OR MANUFACTURERS IN THIS REPORT DOES NOT CONSTITUTE AN OFFICIAL ENDORSEMENT OR APPROVAL OF THE USE OF SUCH COMMERCIAL HARDWARE OR SOFTWARE.
INDEX OF 3.2-mm AND 10.6-μM IMAGE DATA TAPES

Image data
Magnetic tape
Submillimeter wavelengths

This report describes image data of military vehicles at wavelengths of 3.2 μm and 10.6 μm available on magnetic tape from the Physical Sciences Directorate. This report is to provide an index of the available images for prospective users. Additional study of the images and methods of processing them will be carried out at Hughes Research Laboratories and the US Army Missile Research and Development Command.

Approved for public release; distribution unlimited.
INDEX OF 3.2-mm AND 10.6-μm IMAGE DATA TAPES

B. D. Guenther

DA Project No. 1L161102AH49
AMCMS Code No. 611102.H490011

Approved for public release; distribution unlimited

Physical Sciences Directorate
Technology Laboratory
US Army Missile Research and Development Command
Redstone Arsenal, Alabama 35809
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>5</td>
</tr>
<tr>
<td>II. BACKGROUND</td>
<td>5</td>
</tr>
<tr>
<td>III. DESCRIPTION OF THE IMAGE SCAN SYSTEM.</td>
<td>7</td>
</tr>
<tr>
<td>IV. DATA PROCESSING</td>
<td>18</td>
</tr>
<tr>
<td>V. DATA DISPLAY</td>
<td>18</td>
</tr>
<tr>
<td>VI. TARGETS</td>
<td>23</td>
</tr>
<tr>
<td>Appendix A. INDEX OF DATA TAPE</td>
<td>31</td>
</tr>
<tr>
<td>Appendix B. COMPUTER PROGRAMS</td>
<td>109</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

The original suggestion to simulate submillimeter images by operating at 940 GHz and scaling the range was made by Dr. J. Allen, Office of the Director of Defense Research and Engineering. The selection of target matrix was aided by Dr. V. Corcoran, IDA consultant to the Director of Defense Research and Engineering. Mr. Robert McMillan of Rome Air Development Center gave valuable assistance by smoothing the contractual support. Colonel T. M. Robinson, NGB, USPFO for California, arranged availability of target vehicles. Lieutenant Colonel Reigel, Commander 3d Battery, 185th Armored Battalion, California National Guard, provided support and allowed the use of facilities and equipment under his command. Dr. N. George, Dr. J. S. Bennett, and Dr. C. R. Christenson have been involved in fruitful discussions of imaging with coherent systems. The assistance provided by Dr. George in obtaining visual displays of some of the data is greatly appreciated. The author's collaborators in the US Army Missile Research and Development Command submillimeter program, Dr. R. L. Hartman and Dr. W. L. Gamble, were involved in this effort from its inception and have provided invaluable advice and support. Most of all, thanks goes to Dr. J. M. Baird and Mr. John F. Heney of Hughes Research Laboratory who were truly dedicated to the support of this mission.
I. INTRODUCTION

This report describes image data of military vehicles at wavelengths of 3.2 mm and 10.6 μm available on magnetic tape from the Physical Sciences Directorate, US Army Missile Research and Development Command (MIRADCOM), Redstone Arsenal, Alabama.

The images were obtained through the use of the Hughes Research Laboratories mobile image scanning equipment. All the data described here were taken 7 June 1976 through 11 June 1976 at a California National Guard Armory in San Diego, California. Thanks are due to Lt. Col Curtis E. Reigel, Commander, 3rd Battalion, 185th Armor, for providing support and allowing the use of the facilities and equipment under his command.

This report is to provide an index of the available images for prospective users. Additional study of the images and methods of processing them will be carried out both at Hughes Research Laboratories and MIRADCOM.

II. BACKGROUND

A basic research program was established in December 1975 at MIRADCOM to evaluate the submillimeter wavelength region of the electromagnetic spectrum for possible Army applications. The goal of this program is to determine if an all-weather capability will be provided by utilization of these wavelengths. Initial emphasis was created by an ASAP summer study in 1974 by Dr. Paul W. Kruse which suggested that submillimeter waves could provide sufficient resolution and inclement weather penetration to allow the Army to acquire, recognize, and direct conventional weapons fire onto hostile targets such as tanks and other military vehicles[1-4]. The 1976 ASAP summer study reviewed the MIRADCOM effort [5].

The primary reasons for selecting this wavelength region are as follows:

a) Millimeter and centimeter wavelengths are not seriously degraded by inclement weather but they cannot provide sufficient resolution for target identification without exceeding the restrictions placed on antenna size by operational systems.

b) Optical and infrared wavelengths can provide the required resolution for target identification but propagation of these wavelengths in inclement weather is poor.
c) Submillimeter wavelengths can be used with system compatible antenna sizes to provide a narrow beam that will minimize the problem of clutter returns and provide sufficient resolution for accurate target location, size discrimination, and shape recognition capability. Clear air attenuation is expected to be high but inclement weather effects should not seriously degrade the beam.

The characteristics of submillimeter waves suggest potential application in the following:

a) Terminal homing.
b) Target designation.
c) Active seekers.
d) Beam riders.
e) Prelaunch guidance.
f) Surveillance.
g) Target acquisition.
h) Secure communications.
i) Reducing system vulnerability to antiradiation missiles (ARM) and electronic countermeasures (ECM).

Before any application can be undertaken, a data base in the submillimeter region must be established. Propagation in conjunction with meteorological observations and data on target reflectivities and scene contrast needed for image capability predictions are the most important inputs needed for the data base.

A more specific list of the critical data inadequacies in the area of propagation can be given [6]. There are no experimental data on scattering. Measurements of absorption in clear air are limited and do not include detailed meteorological measurements. Observed fluctuations in attenuation are not explained. The theories on clear air absorption do not work well in the atmospheric windows. The data base for extinction in rain, snow, and fog is very limited. A bibliography to provide an introduction to the field of submillimeter propagation is available [7].

A program is currently under way at MIRADCOM to obtain a statistically meaningful data base for submillimeter propagation in the atmospheric windows at approximately 750, 850, and 1.3 mm [8].

It was decided that the most productive technique for evaluating the imaging capability at these wavelengths was not to build an imaging submillimeter radar but rather to use an existing 3.2-mm radar at ranges which simulate the resolution one would obtain with a submillimeter wave radar.
In addition to obtaining the simulated submillimeter data, high resolution images were obtained both at 3.2 mm and at 10.6 μm. These data are now available in digital format. The high resolution data allow digital image processing to be used to study the effects of image degradation and image enhancement.

The intensity of the returned signal is calibrated with respect to the return from a polished gold sphere. It is hoped that these calibrated data will be useful to system designers. Calibrated target signature data of this type are not available in the submillimeter wavelength region; neither are data available on optical properties of materials in this region. A program is beginning at MIRADCOM to fill this gap. The 3.2-mm and 10.6-μm data will aid in interpretation and evaluation of the submillimeter target signature and optical constant parameters.

III. DESCRIPTION OF THE IMAGE SCAN SYSTEM

There is a detailed description [9] of the image scanning equipment and the methods used to calibrate the equipment. A summary of that description will be given here.

A. The 3.2-mm Equipment

The 3.2-mm system used a Hughes LOW-1 backward wave oscillator (BWO) to provide at least 1 W of power to the 45-cm transmitting antenna. A separate receiving antenna with an identical aperture feeds the heterodyne receiver. At 14.6 m, the system resolution spot size (at the 3-dB points) is oval in shape with a height of 10 cm and a width of 8.2 cm. The calibration of the receiver is shown in Figure 1.

The system response was calibrated against the backscatter from a polished 50-mm (2-in.) diameter gold-plated chrome steel sphere. The sphere was assumed to have the theoretical radar cross section of $-26.9$ dB/m. The data are digitized into 12 bits and stored on magnetic tape for later processing. To convert this integer value to voltage, the relationship $10 V = 4096$ is used. An effective radar cross section (RCS) referenced to the gold sphere can be calculated by using the following expression:

$$\text{RCS (dB/m)}^2 = 6.91 \left( \frac{I}{409.6} - V_s \right) - 26.9 \tag{1}$$

where $I$ = the integer value on the data tape and $V_s$ = the voltage reading from the 50-mm gold sphere. The sphere voltage was taken at the end of every scan when the transmitter and receiver were parallel.
Figure 1. IF amplifier and detector calibration data.
polarized. When the transmitter and receiver were cross polarized, the following expression was used to calculate the backscattered intensity:

\[
\text{Intensity (dB)} = 6.91 \left( \frac{1}{409.6} - 10 \right) .
\]

The accepted definition of radar cross section is the area intercepting that amount of power which, when scattered equally in all directions, produces an echo equal to that from the target \([10]\). Thus, a specular sphere with a geometrically projected area of a square meter (a radius of \(1/\sqrt{\pi}\)) has an RCS of a square meter. This definition implies that the target is smaller than the illuminating beam. Therefore, the RCS calculated using Equation (1) should be used as a calibrated reflectance, not as an RCS usable in the radar range equations.

B. The 10.6-μm System

A 1-W CO₂ laser lasing on the P20 line provides the transmitting signal for the 10.6-μm imaging system. The natural divergence of the laser output beam results in a 4-cm, horizontally polarized, illuminated spot on a target at 14.6 m. A 2-mm diameter liquid nitrogen cooled HgCdTe detector positioned in the back focal plane of a 20-cm diameter F/4 telescope acts as the receiver. The receiver was polarization insensitive. Synchronous video detection at 1 K Hz with an integration time of 0.01 sec is used to eliminate the effects of background radiation.

The 10.6-μm images differ from those obtained at 3.2 mm in several important respects:

1) The resolution of the 10.6-μm transmitter is approximately twice that of the 3.2-mm transmitter (4 cm versus 10 cm).

2) The receiver in the 10.6-μm system performs speckle averaging resulting in the 3.2-mm data having a larger component of speckle noise. This speckle noise further reduces the effective resolution of the 3.2-mm system \([11, 12]\).

3) Heterodyne detection was used at 3.2 mm but video detection was used at 10.6 μm.

4) The 3.2-mm receiver is sensitive to only one polarization while the 10.6-μm receiver is polarization insensitive.

The calibration curve for the 10.6-μm system is shown in Figure 2. The data are stored digitally in the same format as the 3.2-mm image data. When the reflected signal is referenced to the same gold sphere as was used in the 3.2-mm calibration, the following equation gives the effective cross section:
Figure 2. Plot of calibrated data for 10.6-μm receiver.
RCS (dB/m²) = 5.346(\frac{1}{409.6} - V_s) - 26.93 \tag{3}

The return from the gold sphere, \( V_8 \), was recorded at the end of each run. The same warning should be kept in mind when using Equation (3) that was given with Equation (1).

When the exterior light level remained constant, very good visible records were obtained (Figure 3a).

C. Visible System

A passive visible system with resolution of \(-3\) mrad was used to provide a boresight reference record for the 3.2-mm data. However, the lack of an automatic gain control (AGC) on this data channel and the fact that the light levels often changed rapidly during a scan produced streaking in most of the visible sensor images (Figure 3b). Nevertheless, the visible images can still be used to obtain the spatial origin of the reflectivity data in the 3.2-mm and 10.6-\(\mu\)m records.

D. Accessory Equipment

An equipment van and azimuth and elevation (AZ/EL) scanning pedestal from a 584 radar system were used to house all of the equipment and provide the scanning capability needed to form images. Figure 4 shows the system in operation at San Diego, California.

The scanning motors in the AZ/EL pedestal were replaced by stepping motors. Data were recorded when the motors were stepped from top to bottom, left to right. In all but two cases, the scattered intensity was recorded every 3.5 mrad in AZ and 3.4 mrad in EL.

The raw data tapes were returned to Hughes Research Laboratories where they were read, unpacked into separate computer files for each wavelength, and stored on a final 9-track data tape at a density of 800 BPI. The 12-bit work for each intensity is right-justified into a 16-bit work and written into two bytes on the tape. Each file on the data tape contains one image written in a TV raster format a row at a time. The data files are blocked into records 2048 bytes long (1024 intensity readings) without regard to the raster format. If the last record of a file does not contain 2048 bytes, then the remaining bytes are filled with zeros. Figure 5 shows the first 3 image rows of file No. 32.

The first file contains an EBCDIC listing of the data tape directory. A printout of this file is shown in Figure 6. The remaining 135 files contain the binary image data. In each data file, the first three intensities have been replaced by the number of columns, the number of rows, and a zero (first three numbers in the listing shown in Figure 5).
Figure 3. Visible image files.
Figure 4. Experimental equipment and operational arrangement.
Figure 5. Sample of image data in digital format.
HUGHES/MICOM MULTISPECTRAL SCAN DATA

THIS TAPE CONTAINS SCAN DATA TAKEN BY HUGHES RESEARCH LABORATORY SPONSORED BY ARMY MISSILE COMMAND. THE DATA WAS TAKEN DURING THE WEEK OF JUNE 7, 1976 IN SAN DIEGO. THE TARGETS ARE AN M18A2 TANK AND ASSORTED MILITARY TRUCKS AND JEPPS. THE WAVELENGTHS ARE 1.2 mm, 10.6 micron (NIGHT ACTIVE SYSTEMS), AND PASSIVE VISIBLE. (IN SOME CASES THE VISIBLE IMAGES ARE EMPTY DUE TO DARKNESS DURING SCANNING.)

FOR FURTHER INFORMATION CONTACT
B. D. GENTNER (MICOM) (205) 876-3420
J. R. RAINEY (HUGHES) (213) 456-8411

TAPE CHARACTERISTICS

- ****
- **NO LABEL**
- **800 API (LOW DENSITY)**
- **BLOCKING SIZE 2048**
- **ALL FILES ARE BINARY EXCEPT FOR THE FIRST FILE WHICH IS EBCDIC.**
- **INTENSITIES ARE 12 BITS AND ARE RIGHT JUSTIFIED IN 16 BITS (THIRD INTENSITIES PER 32 BIT WORD)**
- **9 TRACK TAPE**
- **13k FILES**
- **NOTE** THE UPPER LEFT THREE INTENSITIES CONTAIN THE FOLLOWING:

\( [1^f] = \text{NUMBER OF COLUMNS} \)
\( [2^f] = \text{NUMBER OF ROWS} \)
\( [3^f] = \text{ZERO FIELDED} \)

TAPE DIRECTORY

THE FOLLOWING IS A DIRECTORY OF THE MICOM DATA TAPE WHERE THE FILES ARE LISTED IN THE ORDER OF OCCURRENCE ON THE TAPE. EACH TAPE NUMBER REFERS TO THE ORIGINAL DATA TAPE RECORD. EACH SCAN NUMBER REPRESENTS ONE SCAN WITH THREE SENSORS. THE WAVELENGTH USED IS DESCRIBED. THE BITS PER INTENSITY IS 12 (RIGHT JUSTIFIED IN 16 BITS) THE NUMBER OF ROWS (VERTICAL DIMENSION) PER PICTURE IS GIVEN. THE NUMBER OF COLUMNS (HORIZONTAL DIMENSION) PER PICTURE IS GIVEN. CAUTIONS: THE FIRST FILE IS EBCDIC THE 135 FOLLOWING ARE BINARY.

(a)

Figure 6. EBCDIC listing of the data tape directory.
<table>
<thead>
<tr>
<th>FILE</th>
<th>TAPE</th>
<th>SCAN</th>
<th>WAVELENGTH</th>
<th>mTS</th>
<th>SL/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>77</td>
<td>47b</td>
<td>47b</td>
<td>5.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>10</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>11</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>21</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>27</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>28</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>29</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>2a</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>30</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>32</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>33</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>34</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>35</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>36</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>37</td>
<td></td>
<td>6.2 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b)

Figure 6. (Continued.)
IV. DATA PROCESSING

The digital records have 4096 gray levels available; no image display can provide such a large dynamic range. It is therefore necessary to process the digital data before creating a visual record. One of the most straightforward methods of converting the digital data to useable gray scale values is to perform a linear mapping of the form:

\[ I_{\text{display}} = 256 \left( \frac{I_o - I_{\text{min}}}{I_{\text{max}} - I_{\text{min}}} \right) \]  

This simple mapping function is shown graphically in Figure 7. It converts the 12-bit digital data to 8-bit gray scale data and was used to create all of the images shown in this report.

Mapping of one image intensity into a new image intensity, independent of position, is called point processing. Point processing is one of a number of digital image processing techniques which can be used to provide the viewer with information or insight about the image [13]. The sole purpose of the point processing function shown in Figure 7 was to provide a visual record of the data file. Follow-on work will examine the usefulness of more complicated digital image enhancement techniques.

V. DATA DISPLAY

During a scan, a composite image was produced in the radar van by exposing a polaroid film to an oscilloscope trace whose x and y deflections are associated with the AZ/EL scan and whose z-axis modulation is associated with signals from the three sensors. An example of such a composite image is shown in Figure 8. The images from the top to bottom are associated with the 10.6-μm, visible, and 3.2-mm sensors, respectively. These composite displays provide the operator with evidence that a successful scan has been completed but very little information about the quality of the images is provided by this crude display.

Once the data have been obtained and a final data tape created, digital image processing can be used to provide images for any display. Figure 9a shows the easiest display to implement. The digital image data were mapped onto the integers from 0 to 2 and a line printer was used to generate the image. Another simple method for generating visual images utilizing equipment available in most laboratories is shown in Figure 9b. A Versatec Matrix Model 1200A is used to print, in binary format, an image with eight grey levels.

There are several types of display devices available which can provide high quality images from digital data. Figure 10 shows images produced by two such devices. On the left of Figure 10 is a composite
Figure 7. Linear mapping used for point processing.
Figure 18. Composite real time image. (Scan No. 27-11 images of two jeeps at 45°, top to bottom 10.6 um visible and 3.2 mm, respectively.)
Figure 9. Image file No. 14 produces on line printer (a). The numbers 0 and 2 have been shaded with a colored pencil to enhance the contrast. Three printouts (b) of image file No. 14 using a versatec plotter and three different point processing functions.
Figure 10. Comparison of image display devices.
image produced during a scan in real time. The center column of images contains photographs of a Conographics Model C9 gray level cathode ray tube (CRT) computer terminal which is capable of displaying up to 256 gray levels in a 1024 by 1024 pixel image. The photographs are a poor representation of the actual images because the film does not have the dynamic range of the display; nor is the film response matched to the display.

The highest quality hard copy images were produced by a flying spot scanner with matched photographic equipment. These images are shown in the right-hand column of Figure 11. The visible image is a normal photograph included for reference.

VI. TARGETS

The targets used to generate the images on the data tape are shown in Figure 10. The mess truck and trailer are a mobile kitchen and supply trailer constructed from plywood on a standard Army truck bed. The paint samples used in this experiment were made according to MIL specification of 1.5-ft aluminum squares. The top coats used were:

a) TT-E-489 gloss enamel, black No. 17038.
b) MIL-E-52227 semigloss enamel, olive drab No. 24037.
c) TT-E-527 lusterless enamel, olive drab No. 34087.
d) TT-E-516 lusterless enamel, white No. 37875.
e) TT-E-489 gloss enamel, black No. 17038.
f) MIL-E-46136 semigloss solar heat reflecting enamel, Type II, olive drab No. 24087 over an undercoat of MIL-E-46127 gray solar heat reflecting paint.
g) MIL-E-46096 lusterless solar heat reflecting enamel, olive drab No. 34087 over an undercoat of TT-E-516.

Different primers were used on the two sides of the aluminum plates, as follows:

a) TT-P-1757 zinc chromate primer, green No. 34141.
b) MIL-P-52192 epoxy primer, red. Only samples with the first undercoat were measured due to high winds. In addition to the painted samples, scans over the following unpainted samples were made:

1) Plywood behind canvas.
2) Aluminum behind canvas.
3) Galvanized steel samples produced by two different types of surface treatment were used.
4) 304 stainless steel.
5) 410 stainless steel.
6) Unpainted aluminum.

Appendix A provides detailed information about the contents of the 3.2-mm and 10.6-μm files recorded on the data tape. A photograph of the target is included with the other information. The histograms of reflectivity values provided with each file present graphically the information content of the image contained in a given dynamic range. They also provide the information needed to perform certain types of processing.

The histograms, when used in conjunction with a program such as BIWT (Appendix B), provide information about the spatial origin of given reflectivity values. Figure 12 demonstrates the implementation of this "intensity dissection" of an image. Figure 12a is from file No. 11 and is a 3.2-mm image of a tank taken with the transmit and receive antennas parallel polarized. Figure 12b is from file No. 98 and is identical to Figure 12a except that the transmit and receive antennas are cross polarized. Figure 12c is the 10.6-μm image of the same target and is from file No. 12.
Figure 12a. Intensity dissection of...
Intensity dissection of image.
12b. Intensity dissection of image.
Figure 12c. Intensity dessection of image.
Intensity dessection of image.
REFERENCES


Appendix A. INDEX OF DATA TAPE

In the data index which follows, information will be provided to aid the user in selecting image data for evaluation:

1) A photograph of the target and its location with respect to the scanner.
2) A composite image obtained during the scan.
3) Calibration voltages and additional comments.
4) Histograms of the 3.2-mm and 10.6-μm data files and images produced using the digital data.

A summary of scans by target type is provided in Table A-1.
## TABLE A-1. LIST OF THE TARGETS SCANS TAKEN

<table>
<thead>
<tr>
<th>Target</th>
<th>Angle of View</th>
<th>1.2-mm Polarization</th>
<th>Range (ft)</th>
<th>Tape and Scan No.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-in. Ball</td>
<td></td>
<td>HH</td>
<td>51.5</td>
<td>27-1 and 2</td>
<td></td>
</tr>
<tr>
<td>M48A5 Tank</td>
<td>Side</td>
<td>HH</td>
<td>50</td>
<td>27-3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45°</td>
<td>HH</td>
<td>50</td>
<td>27-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Head</td>
<td>HH</td>
<td>50</td>
<td>27-5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Back</td>
<td>HH</td>
<td>50</td>
<td>27-6 and 8</td>
<td>Scanned after dark</td>
</tr>
<tr>
<td></td>
<td>Head</td>
<td>VH</td>
<td>50</td>
<td>29-2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>VH</td>
<td>50</td>
<td>29-7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45°</td>
<td>VH</td>
<td>50</td>
<td>29-8</td>
<td>Light rain</td>
</tr>
<tr>
<td></td>
<td>Back</td>
<td>VH</td>
<td>50</td>
<td>29-12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>VH</td>
<td>100</td>
<td>29-13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>100</td>
<td>29-14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>200</td>
<td>29-21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>400</td>
<td>29-15 to 19</td>
<td></td>
</tr>
<tr>
<td>2-1/2 Ton Truck with Canvas Top</td>
<td>Front</td>
<td>HH</td>
<td>50</td>
<td>28-5</td>
<td>Two vehicles in one scan</td>
</tr>
<tr>
<td></td>
<td>Back</td>
<td>HH</td>
<td>50</td>
<td>28-6</td>
<td>Includes water trailer</td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>50</td>
<td>28-7</td>
<td>Includes water trailer</td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>VH</td>
<td>50</td>
<td>29-5</td>
<td>Includes water trailer, after dark</td>
</tr>
<tr>
<td></td>
<td>Head</td>
<td>VH</td>
<td>50</td>
<td>29-9</td>
<td>Dark overcast</td>
</tr>
<tr>
<td></td>
<td>Back</td>
<td>VH</td>
<td>50</td>
<td>29-12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>VH</td>
<td>100</td>
<td>29-13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>100</td>
<td>29-14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>200</td>
<td>29-21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>400</td>
<td>29-15 to 19</td>
<td></td>
</tr>
<tr>
<td>Jeeps with end without Rubberised Canvas</td>
<td>Head</td>
<td>HH</td>
<td>50</td>
<td>27-9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Back</td>
<td>HH</td>
<td>50</td>
<td>27-10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>50</td>
<td>27-11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>VH</td>
<td>50</td>
<td>27-12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45°</td>
<td>VH</td>
<td>50</td>
<td>29-1</td>
<td>Includes trailer</td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>VH</td>
<td>50</td>
<td>29-3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Head</td>
<td>VH</td>
<td>50</td>
<td>29-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Back</td>
<td>VH</td>
<td>50</td>
<td>29-5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>VH</td>
<td>100</td>
<td>29-13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>100</td>
<td>29-14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>HH</td>
<td>400</td>
<td>29-15 to 19</td>
<td></td>
</tr>
<tr>
<td>Jeep with Enclosed Cab</td>
<td>Side</td>
<td>HH</td>
<td>50</td>
<td>28-1</td>
<td></td>
</tr>
<tr>
<td>2-1/2 Ton Truck with Wooden Side Rails</td>
<td>Side</td>
<td>HH</td>
<td>50</td>
<td>28-12</td>
<td>Rain</td>
</tr>
<tr>
<td></td>
<td>Side</td>
<td>VH</td>
<td>50</td>
<td>29-6</td>
<td>After dark</td>
</tr>
<tr>
<td>2-1/2 Ton Field Kitchen with Trailer</td>
<td>Side</td>
<td>HH</td>
<td>50</td>
<td>28-14</td>
<td>Wooden enclosure on truck</td>
</tr>
<tr>
<td>Target panels (1.5 ft square)</td>
<td>Normal</td>
<td>HH</td>
<td>50</td>
<td>28-7</td>
<td>Six bare metal panels, night</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>HH</td>
<td>50</td>
<td>28-8</td>
<td>Six bare metal panels, rain,</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>HH</td>
<td>50</td>
<td>28-10</td>
<td>double density data</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>HH</td>
<td>50</td>
<td>28-11</td>
<td>Seven painted panels, rain,</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>HH</td>
<td>50</td>
<td>28-13</td>
<td>normal density data</td>
</tr>
<tr>
<td></td>
<td>20°</td>
<td>HH</td>
<td>50</td>
<td>28-13</td>
<td>Seven painted panels</td>
</tr>
</tbody>
</table>

NOTE: The following files are either partial scans or scans that are suspect due to temporary equipment problems.

<table>
<thead>
<tr>
<th>Target</th>
<th>Angle of View</th>
<th>1.2-mm Polarization</th>
<th>Range (ft)</th>
<th>Tape and Scan No.</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank</td>
<td>Back</td>
<td>HH</td>
<td>50</td>
<td>27-7</td>
<td></td>
</tr>
<tr>
<td>2-1/2 Ton Truck</td>
<td>Side</td>
<td>HH</td>
<td>50</td>
<td>28-2</td>
<td>Not supplied on data tape</td>
</tr>
<tr>
<td>Unknown Target</td>
<td>Side</td>
<td>HH</td>
<td>50</td>
<td>28-6</td>
<td>Not supplied on data tape</td>
</tr>
<tr>
<td>Tank</td>
<td>Back</td>
<td>VH</td>
<td>50</td>
<td>28-10</td>
<td>Not supplied on data tape</td>
</tr>
<tr>
<td>Test Panels</td>
<td>Normal</td>
<td>HH</td>
<td>50</td>
<td>28-9</td>
<td>Rain</td>
</tr>
</tbody>
</table>

*HH = Horizontal-Horizontal (parallel polarization)
*HV = Horizontal-Vertical (cross polarization)
SCAN NO. 27—01 AND 27—02

TARGET: GOLD REFERENCE SPHERE

IMAGE SIZE: 18 COLUMNS, 20 ROWS

FILE NO. | $V_1$ | WAVELENGTH
---------|-------|----------
2.5      | 3.57  | 3.2 mm   
3.6      | 7.34  | 10.6 μm  
4.7      | –     | VISIBLE  

NOTE: DISTANCE TO SPHERE IS 51 ft. TWO IDENTICAL SCANS OF THE REFERENCE SPHERE WERE MADE. ONLY DATA FOR ONE SCAN IS SHOWN. NO IMAGE PRINTOUT IS GIVEN. FOR SCANS NO. 27—01 THROUGH 28—14, 10 dB OF ATTENUATION WAS PLACED AT THE RECEIVER ANTENNA. IT SHOULD BE NOTED THAT THE LAST TWO COLUMNS OF EACH ROW ARE DUMMY PIXELS WHOSE VALUES ARE ZERO.
SCAN NO. 27-03

TARGET: M48 A5 TANK, SIDE VIEW

IMAGE SIZE: 174 COLUMNS, 96 ROWS

FILE NO.  V5  WAVELENGTH
8    3.57  3.2 mm
9    7.36  10.6 μm
10   –     VISIBLE

NOTE: DISTANCE FROM CENTER OF SCAN TO TARGET
LEFT 51 ft  CENTER 49 ft 5 in.  RIGHT 50 ft 4 in.
VISIBLE SCAN IS STREAKED DUE TO CLOUDS
TARGET: M48A5 TANK, 45° VIEW

IMAGE SIZE: 147 COLUMNS, 98 ROWS

FILE NO. | $V_s$ | WAVELENGTH
---------|------|-------------
11       | 3.6  | 3.2 mm
12       | 7.35 | 10.6 $\mu$m
13       |      | VISIBLE

NOTE: DISTANCE TO TARGET
LEFT 64 ft 4 in. CENTER 47 ft 5 in.
RIGHT 58 ft 11 in.

IT SHOULD BE NOTED THAT WHEN AN ODD NUMBER OF COLUMNS OCCURS, AN EXTRA PIXEL IS ADDED TO EACH ROW TO MAKE THE NUMBER OF COLUMNS EVEN. THE VALUE OF THIS PIXEL IS ZERO. THIS MAKES THE LAST THREE COLUMNS ZERO.
TARGET: M48A5 TANK, HEAD–ON

IMAGE SIZE: 102 COLUMNS, 96 ROWS

FILE NO.   $V_t$    WAVELENGTH
          14    3.6    3.2 mm
          15    7.36   10.6 µm
          16

NOTE: DISTANCE TO TARGET  LEFT 45 ft 4 in. CENTER 45 ft RIGHT 45 ft 3 in.
TARGET: M48A5 TANK, REAR VIEW

IMAGE SIZE: 99 COLUMNS, 98 ROWS

FILE NO.  V_s  WAVELENGTH
20   3.6   3.2 mm
21   7.36  10.6 μm
22   —   VISIBLE

NOTE: ANOTHER TANK PASSED BEHIND TARGET DURING THE SCAN. SCAN NO. 27–8 IS A REPEAT OF THIS SCAN AND CAN BE USED FOR SPECKLE AVERAGING.

SCAN NO. 27–8

IMAGE SIZE: 90 COLUMNS, 98 ROWS

A REPEAT OF SCAN NO. 27–7. CALIBRATION VOLTAGES ARE IDENTICAL.
DISTANCE TO TARGET:  LEFT 45 ft 1 in.  CENTER 45 ft 4 in.  RIGHT 45 ft 2 in.
TARGET: TWO JEEPS, HEAD ON; ONE WITH RUBBERIZED CANVAS TOP.

IMAGE SIZE: 117 COLUMNS, 72 ROWS

FILE NO. | V$_{s}$ | WAVELENGTH
---------|--------|-------------
26       | 3.6 V  | 3.2 mm      
27       | 7.35 V | 10.6 \(\mu\)m
28       | —      | VISIBLE

NOTE: DISTANCE TO TARGET.
RIGHT—HAND SIDE: LEFT 50 ft 5 in. RIGHT 50 ft 4 in.
LEFT—HAND SIDE: LEFT 48 ft 7 in. RIGHT 49 ft 7 in,
FILE NO. 26 HAS A GOOD VISIBLE RECORD.
TARGET: TWO JEEPS, ONE WITH A RUBBERIZED CANVAS TOP
REAR VIEW

IMAGE SIZE: 102 COLUMNS, 73 ROWS

FILE NO. $V_s$ WAVELENGTH
29 3.6 V 3.2 mm
30 7.25 V 10.6 μm
31 – VISIBLE

NOTE: DISTANCE TO TARGET
RIGHT—HAND SIDE: LEFT 50 ft 4 in. RIGHT 49 ft 10 in.
LEFT—HAND SIDE: LEFT 50 ft 7 in. RIGHT 50 ft 11 in.

FILE NO. 31 HAS A GOOD VISIBLE RECORD.
TARGET: TWO JEEPS, ONE WITH A RUBBERIZED CANVAS TOP, 45° VIEW

IMAGE SIZE: 174 COLUMNS, 73 ROWS

FILE NO. V_S WAVELENGTH
32  3.55 V  3.2 mm
33  7.20 V  10.6 µ
34  —        VISIBLE

NOTE: DISTANCE TO TARGET
RIGHT—HAND SIDE: LEFT 58 ft 1 in. RIGHT 51 ft 7 in.
LEFT—HAND SIDE: LEFT 58 ft RIGHT 55 ft 4 in.
FILE NO. 34 HAS A GOOD VISIBLE RECORD.
TARGET: TWO JEEPS AND ONE TRAILER, SIDE VIEW.
ONE JEEP WITH RUBBERIZED CANVAS TOP

IMAGE SIZE: 213 COLUMNS, 64 ROWS

FILE NO.  WAVELENGTH
35     3.6     3.2 mm
36     7.15    10.8 μm
37     —       VISIBLE

NOTE: DISTANCE TO TARGET
TRAILER: LEFT 47 ft 8 in. RIGHT 49 ft
COVERED JEEP: LEFT 40 ft 2 in. RIGHT 49 ft 2 in.
JEEP: LEFT 49 ft 1 in. RIGHT 52 ft
FILE NO. 37 CONTAINS A GOOD VISIBLE RECORD.
TARGET: JEEP TOTALLY ENCLOSED BY CANVAS TOP, SIDE VIEW

IMAGE SIZE: 87 COLUMNS, 52 ROWS

FILE NO. $V_\lambda$ WAVELENGTH
38  3.56  3.2 mm
39  6.9   10.6 $\mu$m
40  

NOTE: RANGE TO TARGET
RIGHT 52 ft 11 in. CENTER 52 ft 7 in.
LEFT 52 ft 11 in.
A VISIBLE IMAGE IS AVAILABLE

BAD FILE
TARGET: 2 1/2 CANVAS–COVERED TRUCK WITH WATER–TANK TRAILER, SIDE VIEW

IMAGE SIZE: 201 COLUMNS, 66 ROWS

FILE NO. | V | WAVELENGTH
--- | --- | ---
44 | 3.55 | 3.2 mm
45 | 6.7 | 10.6 µm
46 | – | VISIBLE

NOTE: NO VISIBLE IMAGE.
TARGET: 2 1/2 TON, CANVAS-COVERED TRUCK WITH WATER-TANK TRAILER AT 45°

IMAGE SIZE: 144 COLUMNS, 76 ROWS

FILE NO.  V_s  WAVELENGTH
47    3.6  3.2 mm
48    6.9  10.6 μm
49    -   VISIBLE

NOTE: RANGE TO TARGET
LEFT 89 ft CENTER 65 ft 11 in. RIGHT 45 ft 6 in.

NO DATA IN VISIBLE FILE. FOR SOME REASON UNKNOWN TO THE AUTHOR, THE PROGRAM HIS WILL NOT WORK ON FILE NO. 47. HOWEVER, GOOD IMAGES CAN BE PRODUCED FROM THIS FILE
SCAN NO. 28–5

TARGET: FRONT AND BACK VIEW OF 2 1/2 TON CANVAS— COVERED TRUCK

IMAGE SIZE: 156 COLUMNS, 98 ROWS

FILE NO. | V | WAVELENGTH
-------- | --- | -----------------
50       | 3.6 | 3.2 mm
51       | 6.8 | 10.6 μm
52       | —   | VISIBLE

NOTE: RANGE
LEFT TRUCK: LEFT 43 ft 4 in. RIGHT 42 ft 4 in.
RIGHT TRUCK: LEFT 44 ft RIGHT 44 ft 8 in.

NO DATA IN VISIBLE FILE.
TARGET: FROM LEFT—TO—RIGHT:
1. WOOD BEHIND CANVAS
2. ALUMINUM BEHIND CANVAS
3. GALVANIZED STEEL
4. GALVANIZED STEEL
5. 304 STAINLESS STEEL
6. 410 STAINLESS STEEL
7. ALUMINUM

IMAGE SIZE: 108 COLUMNS, 64 ROWS

FILE NO. V,WAVELENGTH
53 3.6 3.2 mm
54 6.8 10.8 μm
55 — VISIBLE

NOTE: RANGE WAS 48 ft 2 in.
FILE NO. 28–8

TARGET: SAME AS FILE NO. 28–9, BUT AZ AND EL STEPS WERE 1.7 mrad, GIVING A HIGHER DENSITY OF DATA POINTS.

IMAGE SIZE: 216 COLUMNS, 90 ROWS

<table>
<thead>
<tr>
<th>FILE NO.</th>
<th>$\nu$</th>
<th>WAVELENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>3.6</td>
<td>3.2 mm</td>
</tr>
<tr>
<td>57</td>
<td>7.1</td>
<td>10.8 $\mu$m</td>
</tr>
<tr>
<td>58</td>
<td>–</td>
<td>VISIBLE</td>
</tr>
</tbody>
</table>

NOTE: A LIGHT RAIN WAS FALLING.
TARGETS: PAINTED ALUMINUM PANELS 1 1/2 ft SQUARE. THE PRIMER WAS 1757—TT—P—1757 ZINC CHROMATE PRIMER, GREEN NO. 34151. THE TOP COATS WERE FROM LEFT TO RIGHT.

1. MIL—E—52798 LUSTERLESS ENAMEL, CAMOUFLAGE. FOREST GREEN (USED ON NEW PERSHING, LANCE, AND TOW).
2. MIL—E—52227 SEMIGLOSS ENAMEL NO. 24037,

1. MIL—E—52798 LUSTERLESS ENAMEL, CAMOUFLAGE. FOREST GREEN (USED ON NEW PERSHING, LANCE, AND TOW).
2. MIL—E—52227 SEMIGLOSS ENAMEL, OLIVE DRAB NO. 24037, (USED ON LANCE).
3. TT—E—527 LUSTERLESS ENAMEL, OLIVE DRAB NO. 34087 (USED ON PERSHING).
4. TT—E—516 LUSTERLESS ENAMEL, WHITE NO. 37875.
5. TT—E—489 GLOSS ENAMEL, BLACK NO. 17038.
6. MIL—E—46136 SEMIGLOSS SOLAR HEAT REFLECTING ENAMEL, TYPE II, OLIVE DRAB NO. 24087, WITH A MIL—E—46127 GRAY SOLAR HEAT REFLECTING UNDERCOAT.
7. MIL—E—46096 LUSTERLESS SOLAR HEAT REFLECTING ENAMEL, OLIVE DRA B NO. 34087, WITH A TT—E—516 LUSTERLESS ENAMEL, WHITE UNDERCOAT (USED ON HERCULES AND HAWK).

IMAGE SIZE: 168 COLUMNS, 43 ROWS

SCAN NO. 28–10
TARGETS: SAME AS IN SCAN NO. 28–9
IMAGE SIZE: 186 COLUMNS, 41 ROWS

SCAN NO. 28–11
TARGETS: SAME AS IN SCAN NO. 28–9, BUT WITH STEP SIZES OF 3.5 mrad IN AZ AND 3.4 mrad IN EL.
IMAGE SIZE: 99 COLUMNS, 44 ROWS

FILE NO.  | WAVELENGTH
----------|------------
65        | 3.8        | 3.2 mm
66        | 7.1        | 10.6 μm
67        |            | VISIBLE
TARGET: 2 1/2 TON TRUCK WITH WOOD SIDE RAILS, SIDE VIEW.

IMAGE SIZE: 156 COLUMNS, 88 ROWS

FILE NO.  $V_n$  WAVELENGTH
68   3.7   3.2 mm
69   7.2   10.8 μm
70   -     VISIBLE

NOTE: RANGE
LEFT 47 ft 1 in.  CENTER 47 ft 11 in.  RIGHT 46 ft
A LIGHT RAIN WAS FALLING DURING THE FIRST 2 MIN OF THE SCAN.
SCAN NO. 28–13

TARGET: REPEAR OF SCAN NO. 28–13 WITH THE METAL PLATES TITLED AWAY FROM THE SCANNER 20° WITH RESPECT TO THE NORMAL.

IMAGE SIZE: 111 COLUMNS, 44 ROWS

FILE NO. $V_1$ WAVELENGTH

| 71  | 3.7 | 3.2 mm |
| 72  | 7.3 | 10.6 $\mu$m |
| 73  | –   | VISIBLE   |

NOTE: THE MEASUREMENTS ON THESE PAINTED SAMPLES WERE TERMINATED DUE TO HIGH WINDS.
TARGET: SIZE VIEW OF MOBILE FIELD KITCHEN, CONSTRUCTED OF PLYWOOD ON A 2 1/2 TON TRUCK BEN. SUPPLY TRAILER IS ATTACHED TO TRUCK.

IMAGE SIZE: 225 COLUMNS, 100 ROWS

FILE NO. Vs WAVELENGTH
74 3.7 3.2 mm
75 7.3 10.6 μm
76 — VISIBLE

NOTE: RANGE TO TARGET.
LEFT 51 ft 5 in. CENTER 46 ft 5 in. RIGHT 46 ft
TARGET: SIDE VIEW OF JEEP WITH TRAILER.

IMAGE SIZE: 123 COLUMNS, 69 ROWS

FILE NO.  V\textsubscript{5}   WAVELENGTH

\begin{tabular}{ccc}
77 & 1 & 3.2 mm \\
78 & 7.1 & 10.6 \mu m \\
79 & - & VISIBLE \\
\end{tabular}

NOTE: RANGE TO TARGET.
LEFT 50 ft 1 in. CENTER 49 ft 1 in. RIGHT 49 ft 1 in.

* THE POLARIZATION OF THE RECEIVER ANTENNA IS PERPENDICULAR TO THE POLARIZATION OF THE TRANSMITTER ANTENNA (CROSS POLARIZED). THE SPECULARLY REFLECTING GOLD SPHERE CAN NO LONGER BE USED TO CALIBRATE THE RETURN.

IN ALL PREVIOUS SCANS, 10 dB OF ATTENUATION WAS PLACED AT THE RECEIVER ANTENNA; IN ALL OF THE REMAINING SCANS, NO ATTENUATION WAS USED IN THE RECEIVER.

IN ALL OF THE CROSS POLARIZED SCANS THE 10.6 \mu m SCANS WERE NOT MODIFIED; THUS, THEY CONTAIN NO NEW INFORMATION.
SCAN NO. 29–2

TARGET: M48 TANK, VIEW IS HEAD–ON

IMAGE SIZE: 99 COLUMNS, 103 ROWS

FILES NO. 80 (3.2 mm) AND 82 (VISIBLE) ARE UNCALIBRATED. FILE NO. 81 (10.6 μm) HAS A \( V_t = 7.1 \).

NOTE: RANGE TO TARGET.
LEFT 44 ft 7 in. CENTER 45 ft  RIGHT 46 ft 4 in.

THE 3.2 mm DATA ARE CROSS POLARIZED.
TARGET: JEEP WITH RUBBERIZED CANVAS TOP AND TRAILER - 45° VIEW

IMAGE SIZE: 100 COLUMNS, 79 ROWS

FILE NO. WAVELENGTH
83  3.2 mm
84  10.6 µm CROSS POLARIZED
85  VISIBLE

RANGE TO TARGET
LEFT 57 ft 10 in, CENTER 48 ft 11 in, RIGHT 50 ft 3 in.
SCAN NO. 29-4

TARGET: 2 JEEPS, ONE REAR VIEW AND ONE FRONT VIEW

IMAGE SIZE: 120 COLUMNS, 75 ROWS

FILE NO.  
86  3.2 mm  
87  10.6 μm  CROSS POLARIZED  
96  VISIBLE

NOTE: PHOTOGRAPH AND REAL TIME COMPOSITE IMAGE ARE NOT AVAILABLE
SCAN NO. 29–5

TARGET: 2 1/2 TON CANVAS COVERED TRUCK WITH WATER TANK TRAILER – SIDE VIEW

IMAGE SIZE: 201 COLUMNS, 97 ROWS

<table>
<thead>
<tr>
<th>FILE NO.</th>
<th>WAVELENGTH</th>
<th>V₁</th>
</tr>
</thead>
<tbody>
<tr>
<td>89</td>
<td>3.2 mm</td>
<td>CROSS POLARIZED</td>
</tr>
<tr>
<td>90</td>
<td>10.6 μm</td>
<td>7.1</td>
</tr>
<tr>
<td>91</td>
<td>VISIBLE</td>
<td>–</td>
</tr>
</tbody>
</table>

RANGE TO TARGET
LEFT 53 ft CENTER 48 ft 1 in. RIGHT 50 ft 2 in.

NOTE: SCAN MADE AT DUSK SO THERE IS NO VISIBLE IMAGE
SCAN NO. 29-6

TARGET: 2 1/2 TON TRUCK WITH FLAT BED AND WOODEN SIDE RAILS — SIDE VIEW.

IMAGE SIZE: 183 COLUMNS, 96 ROWS

FILE NO. WAVELENGTH  V8
92    3.2 mm  CROSS POLARIZED
93    10.6 μm  7.1
94    VISIBLE

RANGE TO TARGET
LEFT 51 ft 2 in. CENTER 50 ft 1 in. RIGHT 50 ft 10 in.
NOTE: NO VISIBLE IMAGE—SCAN MAKE AT DUSK.
TARGET M48 TANK – SIDE VIEW

IMAGE SIZE: 183 COLUMNS, 89 ROWS

FILE NO.  WAVELENGTH    $V_6$

| 95 | 3.2 mm  | CROSS POLARIZED |
| 96 | 10.6 μm | 7.1 V           |
| 97 | VISIBLE |                 |

RANGE TO TARGET
LEFT 51 ft 7 in.  RIGHT 50 ft 3 in.

NOTE: THE GAIN OF THE 3.2 mm SYSTEM WAS INCREASED BY APPROXIMATELY A FACTOR OF FOUR. NO CHANGE WAS MADE IN THE 10.6 μm SYSTEM.
SCAN NO. 29–8

TARGET: M48 TANK AT 45 deg VIEW

IMAGE SIZE: 174 COLUMNS, 100 ROWS

FILE NO. WAVELENGTH
98  3.2 mm  CROSS POLARIZED
99  10.6 μm
100  VISIBLE

RANGE TO TARGET
LEFT 59 ft 9 in.  CENTER 44 ft 11 in.  RIGHT 55 ft 5 in.
TARGET: 2 1/2 TON CANVAS COVERED TRUCK — HEAD ON

IMAGE SIZE: 75 COLUMNS, 100 ROWS

FILE NO. WAVELENGTH
101 3.2 mm
102 10.6 μm
103 VISIBLE

RANGE TO TARGET
LEFT 46 ft 6 in. RIGHT 47 ft 8 in.

NOTE: THE PAINT ON MANY OF THE VEHICLES WAS QUITE WEATHERED. THE HOOD ON THIS TRUCK WAS RUSTY.
TARGET: M48 TANK – BACK VIEW

IMAGE SIZE: 102 COLUMNS 95 ROWS

FILE NO.  WAVELENGTH
104       3.2 mm
105       10.6 μm
106       VISIBLE

RANGE TO TARGET  LEFT 45 ft 11 in. RIGHT 45 ft 10 in.

NOTE: A VERY LIGHT DRIZZLE WAS FALLING.
SCAN NO. 29–12

TARGET: 2 1/2 TON TRUCK WITH CANVAS TOP—REAR View

<table>
<thead>
<tr>
<th>FILE NO.</th>
<th>WAVELENGTH</th>
<th>WAVELENGTHS</th>
<th>RANGE TO TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>107</td>
<td>3.2 mm</td>
<td>CROSS POLARIZED</td>
<td>LEFT 43 ft 7 in.</td>
</tr>
<tr>
<td>108</td>
<td>10.8 µm</td>
<td>7.2 V</td>
<td>RIGHT 43 ft 7 in.</td>
</tr>
<tr>
<td>109</td>
<td>VISIBLE</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: THE REAL TIME COMPOSITE IMAGE IS NOT AVAILABLE FOR THIS SCAN.
TARGET: FRONT VIEW FROM LEFT TO RIGHT OF A 2 1/2 TON CANVAS COVERED TRUCK, A JEEP, A CORNER CUBE MOUNTED IN THE CENTER OF A BLACK SQUARE OF PAPER MOUNTED ON WHITE CARDBOARD, AND AN M-48 TRUCK.

IMAGE SIZE 138 COLUMNS 59 ROWS

FILE NO. WAVELENGTH
110 3.2 mm
111 10.6 μm
112 VISIBLE

RANGE TO TARGET 100 ft
NOTE: THE TRANSMIT AND RECEIVE ANTENNA ARE CROSS POLARIZED. THE RECEIVED SIGNAL WAS QUIET WEAK.
TARGET: THIS IS A REPEAT OF SCAN NO. 29–13

FILE NO. WAVELENGTH
113 3.2 mm
114 10.6 μm
115 VISIBLE

RANGE TO TARGET: SAME AS SCAN NO. 29–13

NOTE: SCAN NO. 29–13 WAS REPEATED WITH THE POLARIZATION OF THE TRANSMIT AND RECEIVE ANTENNAS PARALLEL RATHER THAN CROSSED.
SCAN NO. 29–15, 16 AND 17
THESE FILES DO NOT CONTAIN MEANINGFUL INFORMATION. THE
SCANS WERE USED TO ALIGN THE SYSTEM AT THE 400 ft RANGE.

SCAN NO. 29–18

TARGET: FRONT VIEW LEFT TO RIGHT A 2 1/2 TON TRUCK, A
CORNER CUBE, A JEEP, A CORNER CUBE AND A TANK.

IMAGE SIZE: 81 COLUMNS AND 49 ROWS

FILE NO. WAVELENGTH
125 3.2 mm
129 10.6 μm
127 VISIBLE

RANGE TO TARGET 400 ft
NOTE: THERE IS A LARGE AMOUNT OF PARALLAX BETWEEN THE IMAGES
AT 3.2 mm AND 10.6 μm. THE 10.6–μm FIELD (NO. 129) HAS NOT BEEN
EXAMINED.
SCAN NO. 29–19

TARGET: FRONT VIEW FROM LEFT TO RIGHT A 2 1/2 TON TRUCK, A JEEP AND A TANK

IMAGE SIZE: 84 COLUMNS 48 ROWS

FILE NO. WAVELENGTH
128 3.2 mm
129 10.6 μm
130 VISIBLE

RANGE TO TARGET 400 ft

NOTE: THE LARGE OIL STORAGE TANK VISIBLE IN THE PHOTOGRAPH ON THE RIGHT SIDE OF THE TANK AT A RANGE OF 250 ft DOES APPEAR IN THE 3.2-mm IMAGE.
TARGET: SIDE VIEW FROM LEFT TO RIGHT OF A CANVAS COVERED 2 1/2 TON TRUCK AND AN M48 TANK

IMAGE SIZE 75 COLUMNS 40 ROWS

FILE NO. WAVELENGTH
131 3.2 mm
132 10.6 μm
133 VISIBLE

RANGE TO TARGET IS 400 ft
TARGET: FRONT VIEW FROM LEFT TO RIGHT
A 2 1/2 TON TRUCK AND AN M48 TANK

IMAGE SIZE 75 COLUMNS 48 ROWS

FILE NO. | WAVELENGTH
---|---
134 | 3.2 mm
135 | 10.6 μm
136 | VISIBLE

RANGE TO TARGET 200 ft
FILE NO. 134

MAX RCN = -60.0 DB
MAX RCN = -60.0 DB
MAX RCN = -60.0 DB
MAX RCN = -60.0 DB
RCN = -50.0 DB REMOVED

FILE NO. 134
Appendix B. COMPUTER PROGRAMS

To indicate the methods used to handle the image data described in this report, a listing of the computer programs is provided in this appendix.

The program entitled RI'MT reads the data from the magnetic tape and stores the data in a computer disk file for later use. The data are arranged so that individual rows can be accessed from the disk file.

Program WDT allows the binary data to be printed out in integer format. No modification to the data is made except a change from binary to integer format.

Program HIS uses the calibration information to convert the binary data to effective radar cross section values. A histogram of the data is then created and plotted. The resolution of the histogram can be modified by changing the value of the variable INT.

Program WMT produces a crude visible image of the data by mapping the intensity values onto the numbers from 0 to 9.

Program BWT produces a visible image of the data using a Versatic Plotter. Calibrated intensity contours can also be created using this program.
Program RDMT to Read Data Files into Computer Disk File

```
0001  PROGRAM RDMT
0011  C READ IMAGE DATA FROM DATA TAPE AND STORE IN
0021  C DISK FILE CALLED DATA1
0031  C B.B. CHETHEE 12/27/76
0041  DIMENSION JBUF(128) IDATA(1024) IPRA(5)
0051  DIMENSION IFILE(8)
0061  DATA IFILE-2HDA 2HDA 1H1/
0071  C GO TO PROPER FILE
0081  CALL RMAR(IPRA)
0091  IPRA(1)=IPRA(1)-1
0101  10 CALL EYEC(3 1310B)
0111  IPRA(1)=IPRA(1)-1
0121  IF(IPRA(1).GT.0) GO TO 10
0131  C READ IN FIRST RECORD
0141  CALL EYEC(1 110B IDATA 1024)
0151  C CALCULATE NUMBER OF ROWS IN FILE
0161  IC=IDATA(1)
0171  IP=IDATA(2)
0181  IRR=1024/IC
0191  LEP=1024-IC*IRR
0201  IC1=IC/2
0211  IC2=IC-IC1
0221  IC1=IC2
0231  IC2=2*IC2
0241  IRO=0
0251  KTAB=0
0261  C STORE COMPLETE ROWS CONTAINED IN RECORD INTO DISK
0271  100 DO 11 KB=1 IRR
0281  C STORE FIRST 1/2 OF ROW INTO ODD SECTOR OF DISK
0291  DO 12 IC=1 IC1
0301  L=IC+IC2+(KB-1)*KTAB
0311  12 JBUF(KC)*IDATA(L)
0321  C STORE LAST 1/2 OF ROW INTO EVEN SECTOR OF DISK
0331  DO 13 IC=1 IC2
0341  L=IC+IC1+(KB-1)*KTABLE
0351  13 JBUF(KC)*IDATA(L)
0361  C CONTINUE
0371  11 CONTINUE
0381  IF(LEP).GT.0 GO TO 70
0391  C STORE ROW DIVIDED BETWEEN TWO RECORDS
0401  70 IROV=1705+1
0411  IFOL=LEF-IC1
0421  IOD=0
0431  JN=0
0441  IF(IFOL).LT.20 GO TO 99
0451  C IF OVER 1/2 OF ROW STORE FIRST 1/2 IN ODD SECTOR:
0461  99 DO 22 KA=1 IC1
0471  L=KA+IC2+IRF+KTB
0481  22 JBUF(KA)*IDATA(L)
0491  JUL=JX+1
0501  CALL EYEC(15 102B JBUF IC1 IFILE JS)
0511  C GET NEXT RECORD FROM TAPE
0521  24 CALL EYEC(1 110B IDATA 1024)
```
0065  ITAB=0
0066  IF(IFOL) 80 40 31
0067  30  ICOL=IC1
0068  31  ITAB+ICOL-LEF
0069  32  ITAB-LEF+1
0070  L=1
0071  C STORE REMAINDER OF FIRST 1/2 OF ROW DIVIDED BETWEEN "BOD"D
0072  DO 32 KA=ICOL ICOL
0073  JBUF(KA)=IDATA(L)
0074  32  L=L+1
0075  CALL EXEC(15 102B JBUF ICOL IFILE JF)
0076  IF(1FOL) 80 50
0077  40  DO 41 KA+1 IC2
0078  41  L=KA+ITAB
0079  42  JBIF(KA)=IDATA(L)
0080  43  JH=1
0081  44  JS=JS+1
0082  CALL EXEC(15 102B JBUF IC2 IFILE JF)
0083  C STORE LAST 1/2 OF ROW DIVIDED BETWEEN RECORDS
0084  50  INWv INOW+1NR
0085  51  ITAB=ITAB+IC2=JH
0086  52  ITAB+1094=JTAB
0087  53  JNR=ITAB/IC
0088  54  ITAB=ITAB-IC=JH
0089  55  IF(1FJ) 60 60 100
0090  60  WRITE(1 50) JF
0091  60  WRITE(1 90) JF
0092  90  FORMAT("DATA LOADED IN IS IN SECTORS")
0093  END
0094  ENDS
0095  **** LIST END ****
Program WDT to List Contents of Image File Stored in Computer

0001 FTN L T
0002 PROGRAM WDT
0003 C PRINT THE CONTENTS OF THE DISK FILE DATA
0004 C WHICH CONTAINS AN IMAGE DATA FILE
0005 C B.D. GUENTHER 12/27/76
0006 DIMENSION IBUF(128) JBUF(128) IFILE(3)
0007 IFILE(1)=2HDA
0008 IFILE(2)=2HFA
0009 IFILE(3)=1HI
0010 WRITE(1,1)
0011 1 FORMAT("INPUT - OF SECTORS")
0012 READ(1,98) ISEC
0013 99 FORMAT(13)
0014 WRITE(1,4)
0015 4 FORMAT("INPUT - OF COLUMN")
0016 READ(1,99) ICOL
0017 WRITE(1,2)
0018 2 FORMAT("INPUT FILE ")
0019 READ(1,99) IFI
0020 WRITE(6,91) IFI
0021 91 FORMAT("FILE NUMBER = 13")
0022 IC1=ICOL/2
0023 93 FORMAT("IMAGE ROW NUMBER = 13")
0024 5 FORMAT(10(18,2W))
0025 IC2=IC1-IC1
0026 IC1=IC2
0027 H=0
0028 DO 3 IF=2 ISEC 2
0029 J=K-1
0030 H=H+1
0031 CALL EXEC(14 1638 IBUF IC1 IFILE J)
0032 CALL EXEC(14 1638 JBUF IC2 IFILE K)
0033 WRITE(6,93) H
0034 WRITE(6,93)(IBUF(L)=1 IC1)
0035 WRITE(6,93)(JBUF(L)=1 IC2)
0036 CALL EXEC(3 1106B -1)
0037 END
0038 END
0039 *** LIST END ***
Program HIS to Calculate and Plot a Histogram of an Image File

```fortran
0001  F T N  L  T
0002  P R O G R A M  H I S
0003  C  -  C A L C U L A T E  A N D  P L O T  H I S T O R A M  O F  I M A G E  D A T A
0004  C  S T O R E D  I N  D A T A  F I L E  C A L L E D  D A T A1
0005  C  B. D. G U E N T H E R  1 2 / 2 7 / 7 6
0006  D I M E N S I O N  J B U F ( 1 2 8 )  Y ( 1 0 2 4 )  X ( 1 0 2 4 )  I F I L E ( 3 )
0007  D I M E N S I O N  I P A T ( 4 )  I T I ( 4 )  I X ( 6 )  I Y ( 5 )  I T ( 1 3 )
0008  C O M M O N  I C O R N ( 3 5 )
0009  D A T A  I F I L E / 2 H D A  H I T A  1 H 1 / 1 T 1 / 2 H F 1 2 H E  2 H 1 2 H 1 /
0010  D A T A  R A / 9 9 9 9 . / I P A T / 1 0 4 2 1 B 2 1 0 4 2 B 4 2 1 0 4 1 B 1 0 4 2 1 0 /
0012  D A T A  I Y / 1 2 H E  2 H E  2 H E  2 H E  2 H E  1 H E /
0013  D A T A  I Y / 2 2 H E  2 H E  2 H E  2 H E  2 H E  2 H E /
0014  1 2 R / N  2 E F  1 E  2 E  2 E D  2 E  2 H E  2 H E /
0015  1  F O R M A T ( ' I N P U T  # O F  S E C T O R S ' )
0016  2  F O R M A T ( ' I S ' )
0017  3  F O R M A T ( ' I N P U T  # O F  C O L U M N S ' )
0018  4  F O R M A T ( ' I N P U T  S P H E R E  V O L T A G E ' )
0019  5  F O R M A T ( ' I N P U T  0 0 1 - 1 0 . 6  - 0 1 - 3 . 2  0 0 0 - " 1 * " )
0020  6  F O R M A T ( ' I N P U T  F I L E  ** ' )
0021  W R I T E ( 1 )  1
0022  R E A D ( 1 2 )  I N S E C
0023  W R I T E ( 1 3 )
0024  R E A D ( 1 2 )  I C O L
0025  W R I T E ( 1 4 )
0026  R E A D ( 1 2 )  S N O L
0027  W R I T E ( 1 5 )
0028  R E A D ( 1 2 )  X O D
0029  W R I T E ( 1 6 )
0030  " R E A D ( 1 2 )  I F Y
0031  C  C L E A R  P L O T  B U F F E R
0032  D O  1 0  J = 1 1 0 2 4
0033  X ( J ) = 0.
0034  1 0  X ( J ) = 0.
0035  H S = 0.
0036  I C I = I C O L / 2
0037  I C I = I C O L - I C I
0038  C  " R E A D  I M A G E  D A T A  O F F  D I S K
0039  D O  2 0  I = 1 1 5  E C
0040  C A L L  E X E C ( 1 4  1 6 8 B  J B ! F  I G I  I F I L E  1 )
0041  I F ( K D D ) 3 0  1 1 3 1
0042  1 1  A = 6 . 9 1
0043  C = 6 .
0044  G O  T O  3 2
0045  3 0  A = 6 . 9 1
0046  C = 2 6 . 9
0047  G O  T O  3 2
0048  3 1  A = 5 . 3 4 6
0049  C = 2 6 . 9
0050  3 2  M I N = 0.0
0051  I N T + 1
0052  C  C A L C U L A T E  H I S T O R A M
0053  D O  1 9  J = 1 1 5 1
0054  I F ( J B I T ( J ) ) 1 9  1 9  3 3
0055  X ( X ) = A R C ( F L O A T ( J B I T ( J ) ) / 4 0 9 6 . 6 ) - 1 1 " N O L " - C
0056  K I = I F ( X ( X ) / ( V O L - M I N ) / I N T ) + 1
0057  Y ( X ) = X ( X ) - 1
0058  I F ( K I - H S ) 1 9  3 4
0059  M Z = K I
0060  1 9  C O N T I N U E
0061  2 9  C O N T I N U E
0062  C  C O N V E R T  T O  K O C C U R R E N C E
0063  B I G = 0.
0064  D O  4 0  J = 1 1 5 2
```

113
0065 40  BIG=BIG+Y(J)
0066  DO 50 J=1,N2
0067  K1=(2*J)-1
0068  K3=2*J
0069  Y(K1)=(Y(J)-100.)/BIG
0070  50  Y(K3)=Y(K1)
0071  C CREATE Y-ARRAY
0072  DO 51 J=1,N2
0073  K1=(2*J)-1
0074  K3=2*J
0075  Y(K1)=INTEG(J-1)+MIN
0076  51  Y(K3)=INTEG(J)+MIN
0077  N2=2+K2
0078  C PLOT HISTOGRAM
0079  60  CALLMODE(0,0,1.)
0080  CALL SCAN(Y,-N2,440)
0081  CALL DIAG(Y,-N2,440)
0082  IF(KOD)=1 62 61
0083  62  CALL AXXES(9.0 1Y1 11.1 1Y)
0084  GO TO 63
0085  61  CALL AVEC(26.1 1Y2 11.1 1Y)
0086  63  CALLMODE(0,0,1.)
0087  CALL NOTE(2.3 0. 1W1 0)
0088  CALL NOTE(0 0 1FY 0)
0089  CALLMODE(10 0 1FAT 4.)
0090  CALL TONE(0. 0. 440 0)
0091  CALL TONE(Y,-N2,1)
0092  CALL DIAG(0.0.19000)
0093  CALL DIAG(0 0 9999)
0094  CALL AVEC(3 1106B -1)
0095  80  TOP
0096  END
0097  ENDS
**** LIST END ****
Program WDT to Create a Visible Image Using a Line Printer

0001 FTN L T
0002 PROGRAM WDT
0003 C CREATE A VISIBLE RECORD OF IMAGE STORED IN DISK FILE DATA1
0004 C BY USING THE LINE PRINTER
0005 C B.D. GENTHER 12/27/76
0006 DIMENSION JBUF(128) IFILE(3)
0007 IFILE(1)=2HDA
0008 IFILE(2)=2HTA
0009 IFILE(3)=1H1
0010 1 FORMAT (I1)
0011 1 FORMAT ("INPUT # OF SECTORS")
0012 READ(1 90) ISEC
0013 90 FORMAT (I3)
0014 WRITE(1 4)
0015 4 FORMAT ("INPUT # OF COLUMNS")
0016 READ(1 90) ICOL
0017 WRITE(1 91)
0018 91 FORMAT ("INPUT OFFSET")
0019 READ(1 6) IOF
0020 6 FORMAT (I4)
0021 WRITE(1 92)
0022 92 FORMAT ("INPUT NORMALIZATION")
0023 READ(1 6) IIN
0024 ICI=ICOL/2
0025 IC2=ICOL-ICI
0026 ICI=IC2
0027 C CONVERT LEFT 1/2 IMAGE DATA TO INTEGERS 0-9
0028 DO 2 J=1 ISEC 2
0029 CALL EXEC(14 103B JBUF IC1 IFILE J)
0030 DO 30 JK=1 IC1
0031 JBUF(JK)=JBUF(JK-IOF)/IIN
0032 IF (JBUF(JK)) 20 20
0033 20 JBUF(JK)=0
0034 21 IF(10-JBUF(JK)) 30 30
0035 30 JBUF(JK)=9
0036 10 CONTINUE
0037 C WRITE LEFT 1/2 OF ALL ROWS
0038 2 WRITE(6 5) JBUF(JC) JC=1 IC1
0039 5 FORMAT(69(I1))
0040 C SKIP A PAGE
0041 CALL EXEC(3 1106B 63)
0042 C CONVERT RIGHT 1/2 IMAGE DATA TO INTEGERS 0-9
0043 DO 3 K=2 ISEC 3
0044 CALL EXEC(14 103B JBUF IC2 IFILE K)
0045 DO 40 KL=1 IC2
0046 JBUF(KL)=JBUF(KL-IOF)/IIN
0047 IF(JBUF(KL)) 50 50
0048 50 JBUF(KL)=0
0049 51 IF(10-JBUF(KL)) 60 60
0050 60 JBUF(KL)=9
0051 40 CONTINUE
0052 C WRITE RIGHT 1/2 OF ALL ROWS
0053 3 WRITE(6 5) JBUF(JC) JC=1 IC2
0054 CALL EXEC(3 1106B -1)
0055 END
0056 ENDS LIST END
Program BIWT to Create a Visible Image

Program BIWT

C POINT PROCESS IMAGE IN DISK FILE CALLED DATA1
C AND WRITE ON VERSATEC IN BINARY FORMAT
C B.D. GUENTHER 12/27/76

DIMENSION JB(128) IBF(256) IFIL(3) KBTF(132)

DATA IFIL/25DA 25TA 181/
1 FORMAT "INPUT # OF SECTIONS"
2 FORMAT "INPUT # OF COLUMNS"
3 FORMAT "INPUT # OF ROWS"
4 FORMAT "INPUT MAX PIXEL VALUE"
5 FORMAT "INPUT MIN PIXEL VALUE"
6 FORMAT "INPUT SPHERE VOLTAGE"

B FORMAT "MAX "CC" = "F4.1 "DB" " ABOVE MAX "CC" = "F4.1 "DB"
9 FORMAT "MAX "CC" = "F4.1 "DB" / 5V "CC" = "F4.1 "DB" ENDED"
7 FORMAT 13)
8 FORMAT 13) FILE = "19"
9 FORMAT 13) INPUT FILE = "*")
10 FORMAT 13) INPUT PIXEL VALUE TO BE REMOVED OR MIN PIXEL VALUE"
11 FORMAT 13) INPUT PIXEL INTENSITY ABOVE MAX PIXEL"

READ(1 7) IF
WRITE(1 1)
READ(1 7) INJ
WRITE(1 2)
READ(1 7) IC
WRITE(1 3)
READ(1 7) 1
WRITE(1 4)
READ(1 #) VNMAX
WRITE(1 95)
READ(1 #) VN1
WRITE(1 9)
READ(1 #) VN2
WRITE(1 97)
READ(1 7) KOD
IF(KOD=1)21 32 31
A=5.91
C=36.9
GO TO 33
A=5.946
C=36.9
GO TO 33
A=6.91
C=9
VMAX=449.6*(((VMAX+C)/A)+V1)
VH1=449.6*(((VH1+C)/A)+V1)
V1=449.6*(((V1+C)/A)+V1)
V2=449.6*(((V2+C)/A)+V2)
DO 10 1=1 1
10=2#1-1
CALL EVEC(14 103B JBUF ICL IFILE 10)
DO 100 J=1 ICL
IF(JBUF(J).GT.VMAX) JBUF(J)=VMAX
IF(JBUF(J).EQ.VMIN) JBUF(J)=VMIN
IF(JBUF(J).LT.VMIN) JBUF(J)=VMIN/V(1/VMAX-VMIN)
100 CALL EVEC(14 103B JBUF ICL2 IFILE 1E)
DO 200 J=1 ICL2
IF(JBTTF(J)=0) JBTTF(J)=VMAX
IF(JBTTF(J).EQ.VMIN) JBTTF(J)=VMIN
IF(JBTTF(J).LT.VMIN) JBUF(J)=VMIN/(1/VMAX-VMIN)
DO 400 J=1 IC
IF(1/JBUF(J).LT.3) GO TO 20
IF(1/JBUF(J).LT.9) GO TO 40
IF(1/JBUF(J).LT.17) GO TO 50
IF(1/JBUF(J).LT.33) GO TO 60
IF(1/JBUF(J).LT.65) GO TO 70
IF(1/JBUF(J).LT.129) GO TO 80
200 JBUF(J)=ABS(VO)
DO 400 J=1 IC
IF(1/JBUF(J).LT.3) GO TO 20
IF(1/JBUF(J).LT.9) GO TO 40
IF(1/JBUF(J).LT.17) GO TO 50
IF(1/JBUF(J).LT.33) GO TO 60
IF(1/JBUF(J).LT.65) GO TO 70
IF(1/JBUF(J).LT.129) GO TO 80
GO TO 400
60 JBUF(J)=31
GO TO 400
70 JBUF(J)=63
GO TO 400
80 JBUF(J)=127
400 CONTINUE
C "PACK" 8 8 BIT PIVALS INTO ONE 16 BIT WORD
DO 900 J=1 IC1
JO=2*J-1
900 JE=2*J
IBP'(JO)=IAND(377B IBP'(JO))
IBP'(JO)=IBP'(JO)\226
IBP'(JO)=IAND(17740B IBP'(JO))
IBP'(JE)=IAND(377B IBP'(JE))
300 KBP'(J)=IAND(15 IBP'(JO)=IBP'(JE))
C PLOT 9 IDENTICAL PIVALS FOR EACH IMAGE NO1
DO 10 K=1 8
CALL EVEC(2 1068 KBP' ICl)
10 CONTINUE
1100 CALL EVEC(3 11066 -1)
STOP
1200 END
END
**** LIST END ****
## DISTRIBUTION

<table>
<thead>
<tr>
<th>Distribution Center</th>
<th>No. of Copies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commander</td>
<td></td>
</tr>
<tr>
<td>US Army Research Office</td>
<td>2</td>
</tr>
<tr>
<td>Attn: DRK5-K-E-KX, Dr. Alfred K. Nodelskya</td>
<td></td>
</tr>
<tr>
<td>P.O. Box 12211</td>
<td></td>
</tr>
<tr>
<td>Research Triangle Park</td>
<td></td>
</tr>
<tr>
<td>North Carolina 22709</td>
<td></td>
</tr>
<tr>
<td>US Army Research and Standardization Group (Europe)</td>
<td>2</td>
</tr>
<tr>
<td>Attn: Dr. Gordon Bushy</td>
<td></td>
</tr>
<tr>
<td>Dr. James Bamber</td>
<td></td>
</tr>
<tr>
<td>Dr. Edward Sedlak</td>
<td></td>
</tr>
<tr>
<td>5001 Eisenhower Avenue Alexandria, Virginia 22333</td>
<td></td>
</tr>
<tr>
<td>Headquarters</td>
<td></td>
</tr>
<tr>
<td>HQ DA (DAMA-AR)</td>
<td>2</td>
</tr>
<tr>
<td>Washington, DC 20310</td>
<td></td>
</tr>
<tr>
<td>Director of Defense Research and Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Attn: Mr. L. Weisberg</td>
<td></td>
</tr>
<tr>
<td>Washington, DC 20301</td>
<td></td>
</tr>
<tr>
<td>Director</td>
<td></td>
</tr>
<tr>
<td>Defense Advanced Research Projects Agency</td>
<td></td>
</tr>
<tr>
<td>1400 Wilson Boulevard</td>
<td></td>
</tr>
<tr>
<td>Arlington, Virginia 22209</td>
<td></td>
</tr>
<tr>
<td>Commander</td>
<td></td>
</tr>
<tr>
<td>US Army Aviation Systems Command                        12th and Spruce Streets</td>
<td></td>
</tr>
<tr>
<td>St. Louis, Missouri 63166</td>
<td></td>
</tr>
<tr>
<td>Director</td>
<td></td>
</tr>
<tr>
<td>US Army Air Mobility Research and Development Laboratory</td>
<td></td>
</tr>
<tr>
<td>Aberdeen, Maryland 21005</td>
<td></td>
</tr>
<tr>
<td>Commander</td>
<td></td>
</tr>
<tr>
<td>US Army Electronics Command</td>
<td></td>
</tr>
<tr>
<td>Attn: DRK5K-TL-1, Dr. Jacobs</td>
<td></td>
</tr>
<tr>
<td>-CT, Dr. R. Bomer</td>
<td></td>
</tr>
<tr>
<td>Fort Monmouth, New Jersey 07703</td>
<td></td>
</tr>
<tr>
<td>Director</td>
<td></td>
</tr>
<tr>
<td>US Army Night Vision Laboratory</td>
<td></td>
</tr>
<tr>
<td>Attn: John Johnson</td>
<td></td>
</tr>
<tr>
<td>Fort Belvoir, Virginia 22060</td>
<td></td>
</tr>
<tr>
<td>George Webber</td>
<td></td>
</tr>
<tr>
<td>Honeywell Systems and Research Center</td>
<td></td>
</tr>
<tr>
<td>2600 Ridgeway, Minneapolis, Minnesota 55413</td>
<td></td>
</tr>
<tr>
<td>Director</td>
<td></td>
</tr>
<tr>
<td>US Army Ballistic Research Laboratories</td>
<td></td>
</tr>
<tr>
<td>Attn: Ken Richer</td>
<td></td>
</tr>
<tr>
<td>Aberdeen Proving Ground, Maryland 21005</td>
<td></td>
</tr>
</tbody>
</table>

118