NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

*Technical Memorandum 33-595*

# *Mariner 9 Television Pictures: Microfiche Library User's Guide*

## *MTC/MTVS Real-Time Pictures*

*R. A. Becker*



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# PREFACE

The work described in this report was performed by the Mariner Mars 1971 Project of the Jet Propulsion Laboratory.

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## ABSTRACT

This document describes the content and organization of the Mariner 9 Mission Test Computer/Mission Test Video System (MTC/MTVS) microfiche library. This 775 card library is intended to supply the user with a complete record of the images received from Mars orbit during the Mariner 9 mission operations, November 15, 1971, to November 1, 1972.

## I. INTRODUCTION

The purpose of this document is to assist recipients of the Mariner 9 Mission Test Computer/Mission Test Video System (MTC/MTVS) microfiche library in making efficient use of large amounts of data to be found in the library. The content and organization of the library are described in Sections III and IV, respectively; methods of manual data retrieval are discussed in Section V.

## II. LIMITATIONS

It should be noted that this microfiche library is composed of real-time video data and, as such, contains a number of errors associated with the problems of producing processed video data in real-time. Such problems include missing lines of video data which, although recorded at Earth, do not appear on the real-time pictures due to a lack of computer lockup, missing or erroneous supplemental data indicating the location of the picture on the planet, and, in a few cases, erroneous identification numbers for some pictures. All known cases of wrong identification numbers have been hand-corrected in the microfiche library. Since errors in the supplemental data blocks accompanying the pictures are not always obvious, it is advisable to look up corrected data in the Microfiche Index Catalog (see Sections III, IV, and V) if scientific analysis is to be undertaken. All longitude values given in the data blocks of pictures taken before orbit 44 are inadvertently east longitude and should be subtracted from 360 degrees to obtain the proper west longitude figure. Wherever the term "W LONGITUDE" appears in the data block, the values are given in the proper (west) longitude system.

A second microfiche library containing images which have been further processed to replace missing lines where possible and to reduce the effects

of camera nonlinearities will be released in mid-1973. Erroneous and omitted picture-location data will be corrected in the library.

## III. LIBRARY CONTENT

During its useful in-flight lifetime, the Mariner 9 spacecraft recorded and telemetered to Earth 7, 329 pictures of Mars, the Martian satellites, Saturn, and star fields. Three or four differently processed versions of each picture were produced immediately upon receipt of telemetry by the MTC/MTVS at the Jet Propulsion Laboratory, Pasadena, California. These real-time pictures have been compiled onto 775 microfiche cards to form this library. The 60 images on each card are arranged in the COSATI format.

Detailed supporting information for each television picture is compiled separately on 16 microfiche cards called the Microfiche Index Catalog. The catalog includes data on picture location on the planet, picture orientation, slant range from camera to center of picture, time, and viewing and illumination geometry. This information is included as a supplement to the library.

In some instances, replays of telemetry tapes were made in order to recover data dropped during the original processing through the MTC/MTVS. Both the original data and the replays are included in the library, however, on different microfiche cards. Replay data can be located by use of the Microfiche Index Catalog, to be discussed later in Section V.

## IV. ORGANIZATION OF THE DATA

The recorded video images have been transferred onto microfiche cards in the same chronological order as they were originally recorded by the MTC/MTVS on 70-mm film. Generally, 31 to 33 pictures were taken during each orbit around Mars. All pictures for a given orbit are contained on a set of cards (generally three in number) packaged in individual envelopes for each orbit. The library consists of these envelopes arranged in orbit-sequential order plus one envelope containing the Microfiche Index Catalog.

The three or four processed versions of each Mariner 9 picture are displayed consecutively on the cards. Two particular versions, a raw picture and a shading-corrected version, are always present. For some of the

preorbit pictures of the full disc of the planet, a contoured version was produced by removing (clipping) significant bits in the digital video data. During most of the orbital operations, either a horizontal high-pass-filter (HPF) version or a vertical-automatic-gain-control (VAGC) version was generated. For some of the later orbits, both the HPF and the VAGC versions were produced in addition to the raw and shading-corrected versions, making four versions in all. The details of the processing used to produce these pictures are not given here. This information appears in Ref. 1.

In the original format of the primary 70-mm film record, each version of each picture is framed by a pair of histograms and a "data block" (Fig. 1). The histograms show the frequency distribution of brightness levels in the image before and after the process used in producing that particular version. The data block contains picture identification information and details regarding the color filter used in the TV camera, the exposure time, slant range, picture location, and processing parameters. The listings in the data block are explained in Fig. 2.

In order to exploit the maximum amount of format space for picture data, the data block has been selectively excluded from the format that is reproduced on the microfiche cards. Only the picture and the histograms below it normally appear. However, the data block for the last version of a given picture is reproduced in a separate image location on the card directly following the version to which it corresponds. Since the data blocks for all versions are identical as far as range, coverage, and camera information is concerned, the inclusion of just one data block is sufficient.

The physical arrangement of the three (or four) processed versions of each picture and the data block is illustrated in Fig. 3.

On the last card of each orbit card set, several frames are dedicated to supplying updated support information of the type found in the Microfiche Index Catalog. This information was the best available at the time the main library was generated and, in general, is quite accurate. However, since it is possible that the supplemental library (the Microfiche Index Catalog) may be updated and reissued as better supporting data becomes available, it is urged that the latest index catalog always be used for serious analysis.

Two other special frames are included on the last card. The first of these is the "Notice" frame, which describes briefly the various versions of each picture and the data block (see Fig. 4). The final frame on each card set is the "Explanation of Data" block, which defines the terms used in the support data found on the last card and in the index catalog (Fig. 5).

The Microfiche Index Catalog is packaged in a separate envelope and contains only support data arranged chronologically. Methods of using the Microfiche Index Catalog are discussed in the next section.

## V. USE OF THE MICROFICHE LIBRARY

Perhaps the simplest use of the library is merely scanning through pictures in the chronological order of their acquisition, searching for features of interest. When something is found, the user may determine when, where, and how the picture was taken by using the data block, the supporting data on the last card of the orbit set, or the Microfiche Index Catalog. Or, conversely, if the user is aware of identification numbers of specific photographs he would like to observe, he can, by means of the index catalog, locate the pictures in the main library.

### A. Picture Identifiers

The primary identification in this library is the number of the microfiche card and the location in which the picture is found on the card. Thus 4232-1 A09 would be the identification for the picture or data that appears on microfiche card 4232-1 at row A and Column 9. This identification is relevant only to this library and appears in no other compilation of Mariner 9 data except for the first four digits, which identify the MTC/MTVS 70-mm negative roll on which the telemetered data was originally recorded.

A very widely used identification is the data automation subsystem clock time commonly referred to as the "DAS time." This is an eight-digit number signifying the reading of a digital clock on the spacecraft which counts in increments of 1.2000 s. Although the DAS time is printed on every MTC/MTVS data block, it imparts no information other than chronology and exhibits a five-count systematic bias when compared with the picture support data. The DAS time appearing in the data block is related to the instant of

closing of the television camera shutter. It must be remembered that the DAS time identifies uniquely a specific television picture telemetered from the spacecraft; it does not identify uniquely the various processing versions of that picture, but is included with each version.

Another identification technique is the PIcture IDentifier (PIID). This is a long series of numbers and letters giving more than chronological information about the picture. For example, the identifier 198 B 03 27 M 06044 indicates a picture taken on the 198th orbit with the B (telephoto) camera. This was the third picture of a total of 27 taken during that orbit. The picture was taken for mapping and geology purposes and was the 6044th picture taken during the mission. This identifier is informative but also long and unwieldy and does not appear on MTC/MTVS real-time pictures. However, it is listed in the support data because it may be used extensively in future references.

As an example of the various identifiers, we take the picture described above:

| | | |
|---|---|---|
| DAS Time | 08692189 | |
| PIID | 198 B 03 27 M 06044 | |
| Microfiche library location | 4232-1 A09 | |
| MTC/MTVS 70-mm Negative roll and file (Frame) numbers | Raw version | 4232-7 |
| | Shading-corrected version | 4232-8 |
| | VAGC version | 4232-9 |

B. Lookup by DAS Time and Card Titles

If the DAS time of the desired picture is known, one may locate the orbit set of cards containing the picture by scanning the title headings on the cards. These titles give the range of DAS times covered by the orbit set. The same range is called out on all cards of the orbit set; therefore, only one card per orbit set need be examined. Since DAS times run sequentially through the library, higher DAS counts will be located near the back of the library and lower ones near the front.

C. Lookup by DAS Time and the Microfiche Index Catalog

If a search for the DAS time is made in the index catalog, the user will be directed to the proper card, row, and column for each version of the

picture and will be presented with the most accurate support data. To expedite locating the proper card in the index catalog, the user is referred to Table 1.

D. Lookup by Orbit Number and MTC/MTVS Negative Roll Number

If the orbit number of a picture is known, the user may locate the orbit card set containing the picture by using Table 2, which relates orbit number to MTC/MTVS negative roll number. The roll number is found in the title at the top of the main library cards. This method is useful if the PIID of the desired picture is known. An expedient alternative to this is to insert labeled divider cards between every fifth orbit set. When doing this, care should be taken to insure that replay data, which has nonsequential negative roll numbers, is properly filed. This may be done through reference to Table 2.

E. Lookup by Martian Latitude and Longitude

When it is desired to locate pictures taken at specific areas of the planet without foreknowledge of the appropriate picture identifiers, use must be made of the locator tables given in Ref. 2. Frames identified in this manner can be located on the microfiche cards by any of the methods described above.

## REFERENCES


1. Cutts, J. A., Mariner Mars 1971 Television Picture Catalog, Technical Memorandum 33-585, Vol. I, Jet Propulsion Laboratory, Pasadena, Calif. (to be published).

2. Koskela, P. E., Mariner Mars 1971 Television Picture Catalog – Sequence Design and Picture Coverage, Technical Memorandum 33-585, Vol. II, Jet Propulsion Laboratory, Pasadena, Calif., Dec. 15, 1972.

Table 1. DAS time ranges on Microfiche Index Catalog cards

| If DAS time lies between | Use index catalog card (page) number listed below: |
|---|---|
| 1, 460, 392 - 2, 102, 695 | 1 |
| 2, 102, 730 - 2, 676, 380 | 2 |
| 2, 676, 415 - 3, 216, 925 | 3 |
| 3, 216, 960 - 3, 755, 400 | 4 |
| 3, 785, 325 - 3, 898, 305 | 5 |
| 4, 328, 350 - 5, 022, 708 | 6 |
| 5, 022, 743 - 5, 563, 283 | 7 |
| 5, 563, 913 - 6, 104, 103 | 8 |
| 6, 104, 138 - 6, 643, 873 | 9 |
| 6, 676, 808 - 7, 219, 203 | 10 |
| 7, 219, 238 - 7, 758, 658 | 11 |
| 7, 758, 693 - 8, 334, 904 | 12 |
| 8, 333, 259 - 9, 018, 839 | 13 |
| 9, 019, 154 - 9, 989, 984 | 14 |
| 10, 022, 674 - 12, 996, 097 | 15 |
| 13, 021, 297 - 13, 165, 356 | 16 |

Table 2. Relation of roll numbers to orbit numbers

| Orbit number | MTC/MTVS negative roll number | Orbit number | MTC/MTVS negative roll number | Orbit number | MTC/MTVS negative roll number |
|---|---|---|---|---|---|
| 1 | 4009, 4010 | 47 | 4058 | 92 | 4113, 4108 |
| 2 | 4011 | 48 | 4059 | 93 | 4115 |
| 3 | 4012 | 49 | 4060 | 95 | 4116 |
| 5 | 4013 | 50 | 4061 | 96 | 4117 |
| 6 | 4014 | 51 | 4062 | 97 | 4118, 5000 |
| 7 | 4015 | 52 | 4063 | 98 | 4119, 5002, 4180 |
| 8 | 4016 | 53 | 4064, 4066 | 99 | 4120, 4122, 5001 |
| 9 | 4017 | 54 | 4065 | 100 | 4121, 5003 |
| 10 | 4018 | 55 | 4067, 4069 | 101 | 4123, 5004 |
| 11 | 4019 | 56 | 4068 | 102 | 4124, 5006 |
| 12 | 4020 | 57 | 4070, 4072 | 103 | 4125, 5010 |
| 13 | 4021 | 58 | 4071 | 104 | 4126, 5009 |
| 14 | 4022 | 59 | 4073, 4075 | 104 | 4127, 4128 |
| 15 | 4023 | 60 | 4074 | 105 | 4129, 5055 |
| 16 | 4024 | 61 | 4076, 4078 | 106 | 4130, 5011 |
| 17 | 4025 | 62 | 4077 | 107 | 4131, 5014 |
| 18 | 4026 | 63 | 4079 | 108 | 4132, 5007 |
| 19 | 4027 | 64 | 4080 | 109 | 4133 |
| 20 | 4028 | 65 | 4081 | 110 | 4134 |
| 21 | 4029 | 66 | 4082 | 111 | 4136 |
| 22 | 4030 | 67 | 4083 | 112 | 4137 |
| 23 | 4031 | 68 | 4084 | 113 | 4138 |
| 24 | 4032 | 69 | 4086, 4150A | 114 | 4139 |
| 25 | 4033 | 70 | 4087, 4150C | 115 | 4140 |
| 26 | 4034 | 71 | 4088 | 116 | 4140B |
| 27 | 4037 | 72 | 4089 | 117 | 4142 |
| 28 | 4038 | 73 | 4090 | 118 | 4143 |
| 29 | 4039 | 74 | 4091 | 119 | 4144 |
| 30 | 4040 | 75 | 4092 | 120 | 4145, 5008 |
| 31 | 4041 | 76 | 4093 | 121 | 4146 |
| 32 | 4042 | 77 | 4095 | 122 | 4147 |
| 33 | 4043 | 78 | 4096 | 123 | 4148 |
| 34 | 4044 | 79 | 4097 | 124 | 4149 |
| 35 | 4045 | 80 | 4098, 4150B | 125 | 4151 |
| 36 | 4046 | 81 | 4099 | 126 | 4152 |
| 37 | 4047 | 82 | 4100 | 127 | 4154 |
| 38 | 4048 | 83 | 4102 | 128 | 4155 |
| 39 | 4049 | 84 | 4103 | 129 | 4156 |
| 40 | 4050 | 85 | 4104 | 130 | 4157 |
| 41 | 4051, 4185 | 86 | 4105 | 131 | 4158 |
| 42 | 4052 | 87 | 4106 | 132 | 4159 |
| 43 | 4053 | 88 | 4107 | 133 | 4160 |
| 44 | 4054 | 89 | 4108, 4109 | 134 | 4161 |
| 45 | 4055 | 90 | 4110 | 135 | 4162 |
| 46 | 4056 | 91 | 4112, 4114 | 136 | 4163 |

Table 2 (contd)

| Orbit number | MTC/MTVS negative roll number | Orbit number | MTC/MTVS negative roll number | Orbit number | MTC/MTVS negative roll number |
|---|---|---|---|---|---|
| 137 | 4164 | 183 | 4215, 4226 | 229 | 4264 |
| 138 | 4165 | 184 | 4216 | 230 | 4265 |
| 139 | 4166 | 185 | 4218 | 231 | 4266 |
| 140 | 4167 | 186 | 4219 | 232 | 4267 |
| 141 | 4168 | 187 | 4220 | 233 | 4268 |
| 142 | 4169 | 188 | 4221 | 234 | 4269 |
| 143 | 4170, 4172 | 189 | 4222 | 235 | 4270 |
| 144 | 4171 | 190 | 4223 | 236 | 4271 |
| 145 | 4173 | 191 | 4224 | 237 | 4272 |
| 146 | 4174 | 192 | 4225 | 238 | 4273 |
| 147 | 4176 | 193 | 4227 | 239 | 4274 |
| 148 | 4177 | 194 | 4228 | 240 | 4275 |
| 149 | 4178 | 195 | 4229 | 241 | 4276 |
| 150 | 4179 | 196 | 4230 | 242 | 4277 |
| 151 | 4181 | 197 | 4231 | 243 | 4278 |
| 152 | 4182 | 198 | 4232 | 244 | 4279 |
| 153 | 4183 | 199 | 4233 | 245 | 4280, 4281 |
| 154 | 4184 | 200 | 4234 | 248 | 4282, 4283 |
| 155 | 4186 | 201 | 4235 | 258 | 4284 |
| 156 | 4187 | 202 | 4236 | 259 | 4286 |
| 157 | 4188 | 203 | 4237 | 260 | 4285 |
| 158 | 4189 | 204 | 4238 | 261 | 4285, 4286 |
| 159 | 4190 | 205 | 4239 | 262 | 4286 |
| 160 | 4191 | 206 | 4240 | 416 | 4287 |
| 161 | 4192 | 207 | 4241 | 417 | 4287, 4292 |
| 162 | 4193 | 208 | 4242 | 422 | 4288 |
| 163 | 4194 | 209 | 4243 | 430 | 4289, 5017 |
| 164 | 4195 | 210 | 4244, 4263 | 431 | 4289, 5017 |
| 165 | 4196 | 211 | 4245 | 436 | 4290, 5018 |
| 166 | 4197 | 212 | 4246 | 437 | 4290, 5018 |
| 167 | 4198 | 213 | 4247 | 444 | 4291 |
| 168 | 4199, 4204 | 214 | 4248 | 445 | 4291 |
| 169 | 4200, 4217 | 215 | 4249 | 450 | 4293 |
| 170 | 4201 | 216 | 4250 | 451 | 4293 |
| 171 | 4202 | 217 | 4251 | 458 | 4294 |
| 172 | 4203 | 218 | 4252 | 459 | 4294 |
| 173 | 4205 | 219 | 4253 | 473 | 4295 |
| 174 | 4206 | 220 | 4254 | 478 | 4295 |
| 175 | 4207 | 221 | 4255 | 479 | 4295 |
| 176 | 4208 | 222 | 4256 | 528 | 4296 |
| 177 | 4209 | 223 | 4257 | 533 | 4296 |
| 178 | 4210 | 224 | 4258 | 529 | 4296 |
| 179 | 4211 | 225 | 4259 | 667 | 4297, 5019 |
| 180 | 4212 | 226 | 4260 | 668 | 4297, 5019 |
| 181 | 4213 | 227 | 4261 | 675 | 4298 |
| 182 | 4214 | 228 | 4262 | 676 | 4298 |

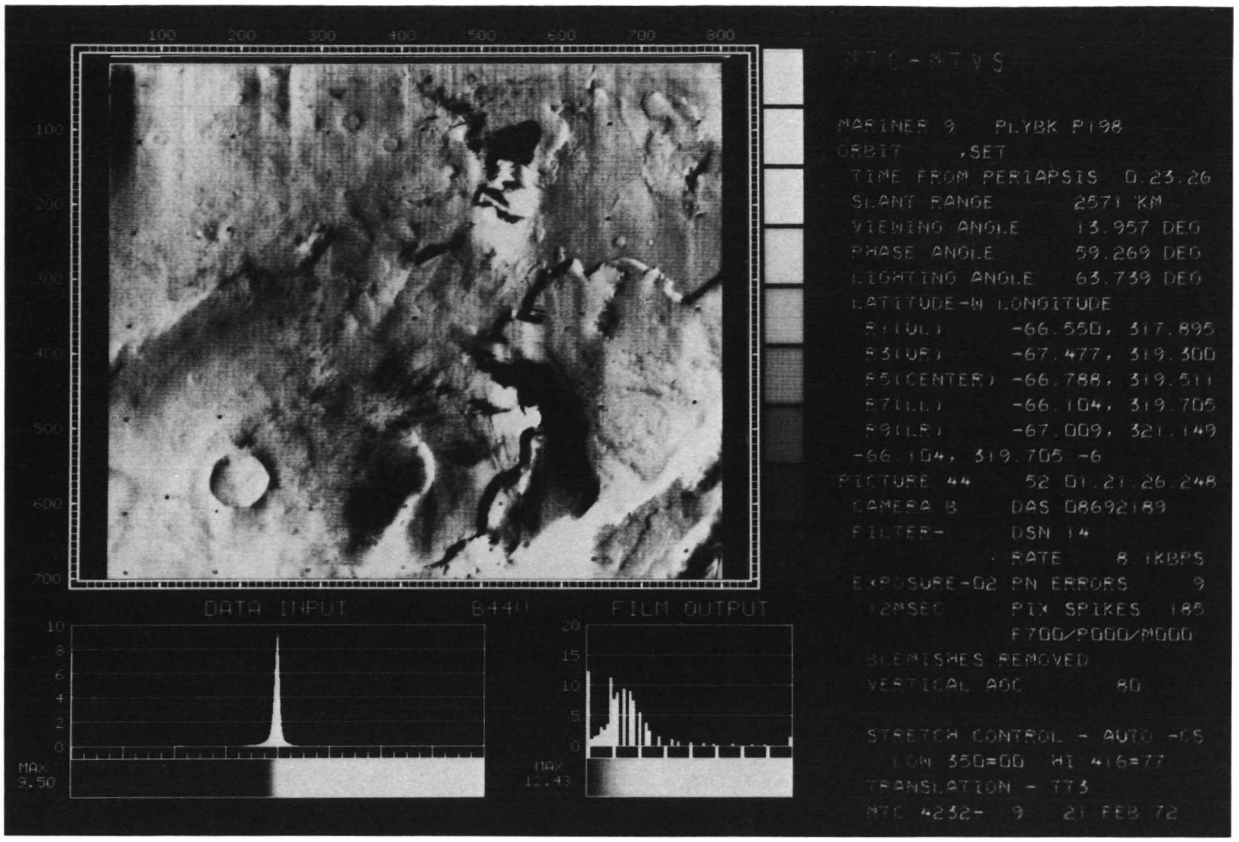


Fig. 1. MTC/MTVS real-time picture

```
MTC-MTVS

MARINER 9   PLYBK P229          — orbit number during which picture was taken (orbit 229)
ORBIT    ,SET
 TIME FROM PERIAPSIS  0.29.44  — time at which picture was taken, relative to time of periapsis, hr-min-sec
 SLANT RANGE       3412 KM     — distance from spacecraft to planet at center of picture, km
 VIEWING ANGLE     41.316 DEG  — view angle at center of picture (see Fig. 5 for definition)
 PHASE ANGLE       73.959 DEG  — phase angle at center of picture (see Fig. 5 for definition)
 LIGHTING ANGLE    62.633 DEG  — solar incidence zenith angle at center of picture (see Fig. 5 for definition)
 LATITUDE-W LONGITUDE
  R1(UL)      -63.283, 346.316 — latitude and west longitude of upper left corner of picture
  R3(UR)      -64.479, 353.968 —    "       "   "        "     "  upper right  "    "     "
  R5(CENTER)  -63.404, 354.848 —    "       "   "        "     "      center       "     "
  R7(LL)      -62.362, 355.388 —    "       "   "        "     "  lower left   "    "     "
  R9(LR)      -63.391,   3.315 —    "       "   "        "     "  lower right  "    "     "
 -62.362, 355.388 -8
PICTURE 49    67 19.54.25.765 — DAS picture count (not relevant);     telemetry receipt time (day-hr-min-sec)
 CAMERA B     DAS 09806799    — camera identification (A = wide angle, B = telephoto);   DAS Time
 FILTER-      DSN 14          — color filter setting (not relevant after orbit 118); tracking station in use
              RATE   4.05KBPS — telemetry bit rate in use at time of transmission (4.05 kilobits per second)
 EXPOSURE-03 PN ERRORS    40
  24MSEC      PIX SPIKES 1822 — camera shutter exposure time (24 msec); "pix spikes" is a noise level indicator
              F700/P000/M000  — fully-reproduced scan lines = 700, partial lines = 0, missing lines = 0
  BLEMISHES REMOVED           — certain non-random noises have been smoothed over
  VERTICAL AGC       80       — processing version identification

  STRETCH CONTROL - AUTO -CS
    LOW 350=00  HI 416=77     — various picture processing parameters
  TRANSLATION - TT3
  MTC 4264- 7   07 MAR 72     — MTC/MTVS negative roll number and file number;   processing date
```

Fig. 2. Definition of data block listings

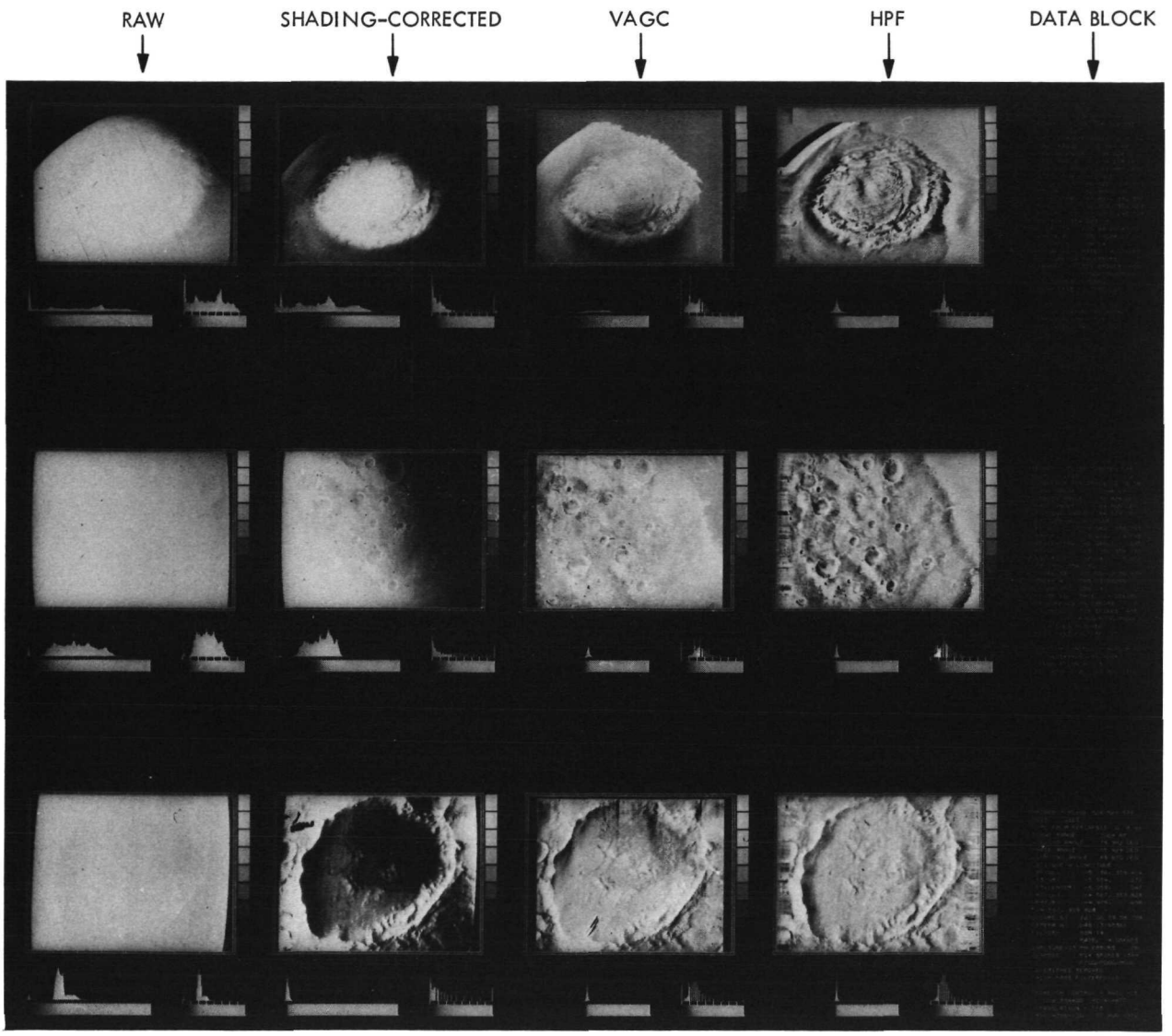


Fig. 3. Physical arrangement of processing versions and data block

**-NOTICE-**

These cards present several images of the photographs taken of Mars and its satellites by Mariner 9. The first image is always a "raw" picture (one which has not experienced spatial filtering or contrast enhancement by computer techniques). The second image has had its contrast increased by computer techniques and has been approximately corrected for spatial variation in sensitivity of the television vidicon. One dimensional, high-pass spatial filtering and contrast enhancement has been applied by the computer to the third image. In some cases a fourth image is included which differs from the third only in the manner and direction of spatial filtering. The final image for each photograph is a data block presenting timing, geometry, camera settings, and telemetry conditions. The latitude and longitude values given in the data blocks are based upon predictions and may contain significant errors. Revised values, as of July 15, 1972, are listed on the last card pertaining to each revolution.

Fig. 4. "Notice" block

## MARINER 9 TV PICTURES MICROFICHE CATALOG INDEX

## EXPLANATION OF DATA

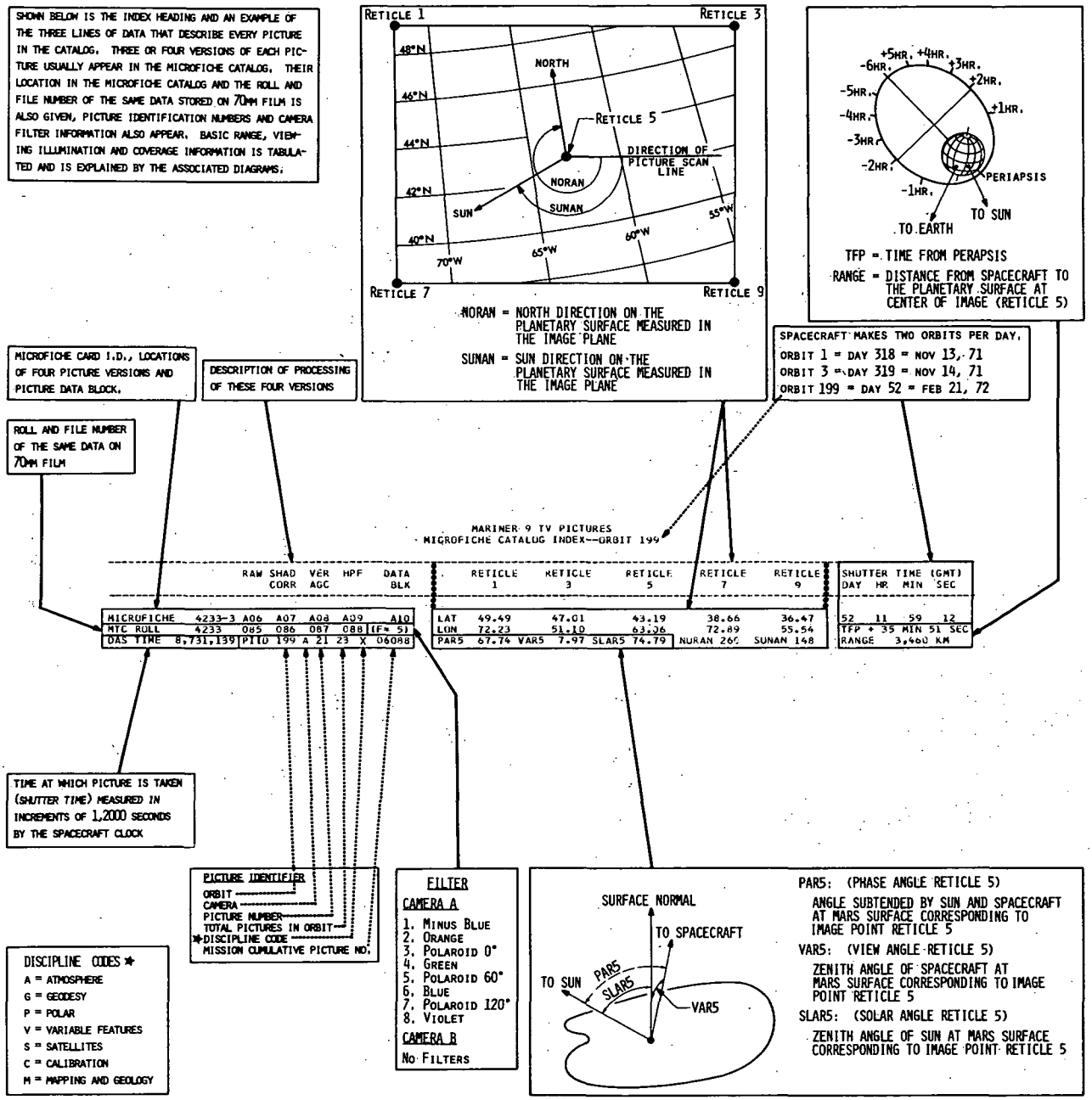


Fig. 5. Explanation of supporting data



NASA — JPL — Coml., L.A., Calif.