### Documentation Change Record

<table>
<thead>
<tr>
<th>Issue/revision</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version 1.0</td>
<td>31 October, 2013</td>
<td>Original edition</td>
</tr>
<tr>
<td>Version 1.1</td>
<td>26 January, 2015</td>
<td>Add a column “Valid number of bits per pixel” in Table 1 “Himawari-8 and -9 observation bands”.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct errors in Table 6 “Block structures”, #4 “Navigation information block” (4, 5, 7, 8).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change the format of Table 6 “Block structures”, #6 “Inter-calibration information block”.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change the URL on p.5 to LRIT/HRIT Global Specification.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change the URL on p.15 to Meteorological Satellite Center.</td>
</tr>
<tr>
<td>Version 1.2</td>
<td>20 May, 2015</td>
<td>Change the format of Table 6 “Block structures”, #6 “Inter-calibration information block”.</td>
</tr>
</tbody>
</table>
## Contents

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1. Introduction

The Japan Meteorological Agency (JMA) plans to begin the operation of its Himawari-8 satellite in 2015 and backup-operation by its Himawari-9 satellite in 2017, with both units scheduled to continue observation until around 2029. The information derived from the satellites will be processed to create Himawari Standard Data in Himawari Standard Format as master data for all products related to information from Himawari-8 and -9. Himawari Standard Data will be provided for each observation (see Section 2) and each band (see Table 1).

Note: In the event of a Himawari-8 failure before Himawari-9 enters stand-by orbit, Himawari Standard Data will be provided using information from Himawari-7 (MTSAT-2) (see Section 6).

### Table 1 Himawari-8 and -9 observation bands

<table>
<thead>
<tr>
<th>Band number</th>
<th>Central wavelength [μm] (nominal values)</th>
<th>Valid number of bits per pixel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.46</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>0.51</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>0.64</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>0.86</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>1.6</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>2.3</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>3.9</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>6.2</td>
<td>11</td>
</tr>
<tr>
<td>9</td>
<td>7.0</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>7.3</td>
<td>12</td>
</tr>
<tr>
<td>11</td>
<td>8.6</td>
<td>12</td>
</tr>
<tr>
<td>12</td>
<td>9.6</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>10.4</td>
<td>12</td>
</tr>
<tr>
<td>14</td>
<td>11.2</td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td>12.3</td>
<td>12</td>
</tr>
<tr>
<td>16</td>
<td>13.3</td>
<td>11</td>
</tr>
</tbody>
</table>
2. Observation Areas

Himawari-8 and -9 will each carry an Advanced Himawari Imager (AHI) scanning five areas: Full Disk (images of the whole Earth as seen from the satellite), the Japan Area (Regions 1 and 2), the Target Area (Region 3) and two Landmark Areas (Regions 4 and 5). While the scan ranges for Full Disk and the Japan Area will be preliminarily fixed, those of the Target Area and Landmark Areas will be flexible to enable prompt reaction to meteorological conditions. At the beginning of Himawari-8’s operation, Landmark Area data will be used only for navigation, and are not intended for use as satellite products. In the future, JMA plans to use Region 5 for observation of phenomena such as rapidly developing cumulonimbus clouds and to provide the resulting data to users. In each 10-minute period, the AHI will scan the Full Disk once, the Japan Area and Target Area four times, and the two Landmark Areas twenty times. These 10-minute divisions are basic units of an observation schedule called a timeline. In Himawari-8 and -9’s baseline observation, the timeline will be repeated every 10 minutes except in their housekeeping operation.

The observation areas and frequencies are shown in Table 2, and scan images on a timeline are shown in Figure 1. The observation areas and numbers of pixels are shown in Table 3 (pixel numbers for regional observations may be changed in orbit testing after launch).
Table 2  Himawari-8 and -9 observation areas and frequencies

<table>
<thead>
<tr>
<th>Observation area</th>
<th>Observations per timeline</th>
<th>Time cycle [min.]</th>
<th>Observations per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Disk</td>
<td>Fixed</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Japan Area (Region 1 + Region 2)</td>
<td>Fixed</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>Target Area (Region 3)</td>
<td>Flexible</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>Landmark Area (Region 4)</td>
<td>Flexible</td>
<td>20</td>
<td>0.5</td>
</tr>
<tr>
<td>Landmark Area (Region 5)</td>
<td>Flexible</td>
<td>20</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Figure 1  Himawari-8 and -9 scan images on a timeline
Table 3  Himawari-8 and -9 observation areas and numbers of pixels

<table>
<thead>
<tr>
<th>Observation area</th>
<th>Band number (see Table 1)</th>
<th>Spatial resolution at SSP (sub satellite point) (^1) [km]</th>
<th>Numbers of pixels</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>East-west direction</td>
<td>North-south direction</td>
<td></td>
</tr>
<tr>
<td>Full Disk</td>
<td>3</td>
<td>0.5</td>
<td>22,000</td>
<td>22,000</td>
</tr>
<tr>
<td></td>
<td>1, 2, 4</td>
<td>1</td>
<td>11,000</td>
<td>11,000</td>
</tr>
<tr>
<td></td>
<td>5 – 16</td>
<td>2</td>
<td>5,500</td>
<td>5,500</td>
</tr>
<tr>
<td>Japan Area (Region 1 + Region 2)</td>
<td>3</td>
<td>0.5</td>
<td>6,000</td>
<td>4,800</td>
</tr>
<tr>
<td></td>
<td>1, 2, 4</td>
<td>1</td>
<td>3,000</td>
<td>2,400</td>
</tr>
<tr>
<td></td>
<td>5 – 16</td>
<td>2</td>
<td>1,500</td>
<td>1,200</td>
</tr>
<tr>
<td>Target Area (Region 3)</td>
<td>3</td>
<td>0.5</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>1, 2, 4</td>
<td>1</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>5 – 16</td>
<td>2</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Landmark Area (Region 4)</td>
<td>3</td>
<td>0.5</td>
<td>2,000</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>1, 2, 4</td>
<td>1</td>
<td>1,000</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>5 – 16</td>
<td>2</td>
<td>500</td>
<td>250</td>
</tr>
<tr>
<td>Landmark Area (Region 5)</td>
<td>3</td>
<td>0.5</td>
<td>2,000</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>1, 2, 4</td>
<td>1</td>
<td>1,000</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>5 – 16</td>
<td>2</td>
<td>500</td>
<td>250</td>
</tr>
<tr>
<td>(During backup operation by Himawari-7 (MTSAT-2))</td>
<td>VIS</td>
<td>1</td>
<td>11,000</td>
<td>11,000</td>
</tr>
<tr>
<td>Full Disk</td>
<td>IR 1 – 4</td>
<td>4</td>
<td>2,750</td>
<td>2,750</td>
</tr>
<tr>
<td>(During backup operation by Himawari-7 (MTSAT-2))</td>
<td>VIS</td>
<td>1</td>
<td>11,000</td>
<td>5,500</td>
</tr>
<tr>
<td>Half Disk</td>
<td>IR 1 – 4</td>
<td>4</td>
<td>2,750</td>
<td>1,375</td>
</tr>
</tbody>
</table>

\(^1\) The point of intersection between the surface of the Earth and a straight line connecting the satellite and the Earth’s center
3. Map Projection Method

For Himawari Standard Data, Normalized Geostationary Projection is adopted as defined in LRIT/HRIT Global Specification\(^2\) Section 4.4. The projection describes the view from the satellite to an idealized earth.

The parameters of the geographic coordinate system used for Himawari Standard Data are based on WGS84 (World Geodetic System 1984)\(^3\) as recommended in ETSAT6/Doc. 16 (1) Implications of Using the World Geodetic System 1984 (WGS84)\(^4\).

\(^2\) LRIT/HRIT Global Specification, CGMS, 2013
\(^3\) http://earth-info.nga.mil/GandG/wgs84/
\(^4\) http://www.wmo.int/pages/prog/sat/meetings/ET-SAT-6.php
4. File Naming Convention

In the naming convention for Himawari Standard Data, capitals in file names indicate unique letters, and italics depend on the observation time, band numbers and other parameters. The meanings of italics are shown in Table 4, where the time zone is UTC (Coordinated Universal Time).

Note: Observation data may be divided into segment files as needed (see Table 4 kll).

The general file name format is:

\[ HS_{aaa}_yyyyymmd_dd_hnhn_Bbbcccc_Rjj_Skkll.DAT \]

Table 4  Definitions of Italics in the file name general format

<table>
<thead>
<tr>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(aaa)</td>
<td>Satellite name</td>
</tr>
<tr>
<td></td>
<td>H08: Himawari-8</td>
</tr>
<tr>
<td></td>
<td>H09: Himawari-9</td>
</tr>
<tr>
<td></td>
<td>H07: Himawari-7 (MTSAT-2)</td>
</tr>
<tr>
<td>(yyyy)</td>
<td>Observation start time (timeline) [year] (4 digits)</td>
</tr>
<tr>
<td>(mm)</td>
<td>Observation start time (timeline) [month] (01 – 12)</td>
</tr>
<tr>
<td>(dd)</td>
<td>Observation start time (timeline) [day] (01 – 31)</td>
</tr>
<tr>
<td>(hh)</td>
<td>Observation start time (timeline) [hour] (00 – 23)</td>
</tr>
<tr>
<td>(nn)</td>
<td>Observation start time (timeline) [min.] (every 10 min.)</td>
</tr>
<tr>
<td></td>
<td>During backup operation by Himawari-7 (MTSAT-2), (nn) is equivalent to 00, 15 or 30.</td>
</tr>
<tr>
<td>(bb)</td>
<td>Band number (01 – 16) (see Table 1)</td>
</tr>
<tr>
<td></td>
<td>During backup operation by Himawari-7 (MTSAT-2):</td>
</tr>
<tr>
<td></td>
<td>01: Himawari-7 VIS (central wavelength 0.68 μm)</td>
</tr>
<tr>
<td></td>
<td>02: Himawari-7 IR4 (central wavelength 3.7 μm)</td>
</tr>
<tr>
<td></td>
<td>03: Himawari-7 IR3 (central wavelength 6.8 μm)</td>
</tr>
<tr>
<td></td>
<td>04: Himawari-7 IR1 (central wavelength 10.8 μm)</td>
</tr>
<tr>
<td></td>
<td>05: Himawari-7 IR2 (central wavelength 12.0 μm)</td>
</tr>
<tr>
<td>(cccc)</td>
<td>Observation area and number</td>
</tr>
<tr>
<td></td>
<td>FLDK: Full Disk</td>
</tr>
<tr>
<td></td>
<td>JPee: Japan Area</td>
</tr>
<tr>
<td></td>
<td>Observation number on the timeline (ee = 01 – 04)</td>
</tr>
<tr>
<td>Region</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>R3ff</td>
<td>Region 3 (Target Area)</td>
</tr>
<tr>
<td></td>
<td>Observation number on the timeline (ff = 01 – 04)</td>
</tr>
<tr>
<td>R4gg</td>
<td>Region 4 (Landmark Area)</td>
</tr>
<tr>
<td></td>
<td>Observation number on the timeline (gg = 01 – 20)</td>
</tr>
<tr>
<td>R5ii</td>
<td>Region 5 (Landmark Area)</td>
</tr>
<tr>
<td></td>
<td>Observation number on the timeline (ii = 01 – 20)</td>
</tr>
</tbody>
</table>

During backup operation by Himawari-7 (MTSAT-2):
- FLDK: Full Disk
- HNDK: Half Disk of Northern Hemisphere
- HSDK: Half Disk of Southern Hemisphere

<table>
<thead>
<tr>
<th>Segment Number</th>
<th>Spatial resolution at SSP</th>
<th>Total Number of Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>jj</td>
<td>Spatial resolution at SSP</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>0.5 km</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1 km</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>2 km</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>4 km</td>
<td></td>
</tr>
</tbody>
</table>

Information on the segment division of Himawari Standard Data
- kk: segment number (01 – ll)
- ll: total number of segments (01 – 99)
- (0101: no division)
5. Himawari Standard Format (Version 1.2)

Himawari Standard Format data are comprised of 12 blocks. The file structure is shown in Table 5, and the details of each block are given in Table 6.

<table>
<thead>
<tr>
<th>Block number</th>
<th>Block name</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>(Header block) Basic information block</td>
</tr>
<tr>
<td>#2</td>
<td>(Header block) Data information block</td>
</tr>
<tr>
<td>#3</td>
<td>(Header block) Projection information block</td>
</tr>
<tr>
<td>#4</td>
<td>(Header block) Navigation information block</td>
</tr>
<tr>
<td>#5</td>
<td>(Header block) Calibration information block</td>
</tr>
<tr>
<td>#6</td>
<td>(Header block) Inter-calibration information block</td>
</tr>
<tr>
<td>#7</td>
<td>(Header block) Segment information block</td>
</tr>
<tr>
<td>#8</td>
<td>(Header block) Navigation correction information block</td>
</tr>
<tr>
<td>#9</td>
<td>(Header block) Observation time information block</td>
</tr>
<tr>
<td>#10</td>
<td>(Header block) Error information block</td>
</tr>
<tr>
<td>#11</td>
<td>(Header block) Spare block</td>
</tr>
<tr>
<td>#12</td>
<td>Data block</td>
</tr>
</tbody>
</table>
Table 6  Block structures

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Type</th>
<th>Word size in bytes</th>
<th>Number of words</th>
<th>Value [unit] and remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Header block number</td>
<td>I1</td>
<td>1</td>
<td>1</td>
<td>= 1</td>
</tr>
<tr>
<td>2</td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 282 [bytes]</td>
</tr>
<tr>
<td>3</td>
<td>Total number of header blocks</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 11</td>
</tr>
</tbody>
</table>
| 4   | Byte order                    | I1            | 1                  | 1               | 0: Little Endian
1: Big Endian |
| 5   | Satellite name                | C             | 1                  | 16              | Himawari-8
Himawari-9
(MTSAT-2: backup operation) |
| 6   | Processing center name        | C             | 1                  | 16              | MSC: Meteorological Satellite Center
OSK: Osaka District
Meteorological Observatory |
| 7   | Observation area              | C             | 1                  | 4               | (See Table 4 cccc) |
| 8   | Other observation information (Note: processing center use only) | C | 1 | 2 |
| 9   | Observation timeline          | I2            | 2                  | 1               | hhmm (integer)
hh [hour] (00 – 23)
mm [min.] (00 – 50, every 10 [min.])
(00, 15 or 30: backup operation) |
<p>| 10  | Observation start time        | R8            | 8                  | 1               | [MJD (Modified Julian Date)] |
| 11  | Observation end time          | R8            | 8                  | 1               | [MJD] |
| 12  | File creation time            | R8            | 8                  | 1               | [MJD] |
| 13  | Total header length           | I4            | 4                  | 1               | [bytes] |</p>
<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Format</th>
<th>Length</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Total data length</td>
<td>I4</td>
<td>4</td>
<td>1 [bytes]</td>
</tr>
<tr>
<td>15</td>
<td>Quality flag 1</td>
<td>II</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Operation flag</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bit 1 (MSB)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: quality flag 1 valid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: quality flag 1 invalid</td>
<td></td>
<td></td>
<td>(= 1: backup operation)</td>
</tr>
<tr>
<td></td>
<td>Bit 2: sun-related data degradation (ex. sun avoidance, stray light)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: no possibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: some possibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bit 3: moon-related data degradation (ex. moon avoidance)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: no possibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: some possibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bit 4: satellite status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: in operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bit 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: not maneuvering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: maneuvering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bit 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: not unloading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: unloading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bit 7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: not in solar calibration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: in solar calibration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bit 8 (LSB)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0: not in solar eclipse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1: in solar eclipse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Quality flag 2</td>
<td>II</td>
<td>1</td>
<td>1 Spare</td>
</tr>
<tr>
<td>17</td>
<td>Quality flag 3</td>
<td>II</td>
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<td>1</td>
</tr>
<tr>
<td></td>
<td>(Note: processing center use only)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Quality flag 4</td>
<td>II</td>
<td>1</td>
<td>1</td>
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<td></td>
<td>(Note: processing center use only)</td>
<td></td>
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</tr>
<tr>
<td>19</td>
<td>File format version</td>
<td>C</td>
<td>1</td>
<td>32 (Left-justified string)</td>
</tr>
<tr>
<td>20</td>
<td>File name</td>
<td>C</td>
<td>1</td>
<td>128 (See Section 4.)</td>
</tr>
<tr>
<td>21</td>
<td>Spare</td>
<td>–</td>
<td>40</td>
<td>1 Spare</td>
</tr>
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</table>
### #2 Data information block

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<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Header block number</td>
<td>I1</td>
<td>1</td>
<td>1</td>
<td>= 2 (Fixed value)</td>
</tr>
<tr>
<td>2</td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 50 [bytes] (Fixed value)</td>
</tr>
<tr>
<td>3</td>
<td>Number of bits per pixel</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 16 (Fixed value)</td>
</tr>
<tr>
<td>4</td>
<td>Number of columns</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>(See Table 3)</td>
</tr>
<tr>
<td>5</td>
<td>Number of lines</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>(See Table 3)</td>
</tr>
<tr>
<td>6</td>
<td>Compression flag for data block #12</td>
<td>I1</td>
<td>1</td>
<td>1</td>
<td>0: no compression (default)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: gzip</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2: bzip2</td>
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<td>7</td>
<td>Spare</td>
<td></td>
<td></td>
<td>40</td>
<td>1 Spare</td>
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</tbody>
</table>

### #3 Projection information block

(See footnote 2; LRIT/HRIT Global Specification Section 4.4, CGMS, 1999)

<table>
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<tr>
<th></th>
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<th>Type</th>
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<th>Value</th>
<th>Notes</th>
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<td>1</td>
<td>Header block number</td>
<td>I1</td>
<td>1</td>
<td>1</td>
<td>= 3 (Fixed value)</td>
</tr>
<tr>
<td>2</td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 127 [bytes] (Fixed value)</td>
</tr>
<tr>
<td>3</td>
<td>sub_lon</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>= 140.7 [degrees]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(= 145 [degrees]: backup operation)</td>
</tr>
<tr>
<td>4</td>
<td>CFAC</td>
<td>I4</td>
<td>4</td>
<td>1</td>
<td>Column scaling factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(= 40,932,513 (visible band): backup operation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(= 1,0233,128 (infrared band): backup operation)</td>
</tr>
<tr>
<td>5</td>
<td>LFAC</td>
<td>I4</td>
<td>4</td>
<td>1</td>
<td>Line scaling factor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(= 40,932,513 (visible band): backup operation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(= 1,0233,128 (infrared band): backup operation)</td>
</tr>
<tr>
<td>6</td>
<td>COFF</td>
<td>R4</td>
<td>4</td>
<td>1</td>
<td>Column offset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(= 5,500.5 (visible band): backup operation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(= 1,375.5 (infrared band): backup operation)</td>
</tr>
<tr>
<td>7</td>
<td>LOFF</td>
<td>R4</td>
<td>4</td>
<td>1</td>
<td>Line offset</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(= 5,500.5 (Full Disk, visible band): backup operation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(= 1,375.5 (Full Disk, infrared band): backup operation)</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Code</td>
<td>PRECISION</td>
<td>8th</td>
<td>7th</td>
</tr>
<tr>
<td>----</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
<td>-----------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>8</td>
<td>Distance from Earth’s center to virtual satellite ( (R_s) )</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Earth’s equatorial radius ( (r_{eq}) )</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Earth’s polar radius ( (r_{pol}) )</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>( \frac{(r_{eq}^2 - r_{pol}^2)}{r_{eq}^2} )</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>( \frac{r_{pol}^2}{r_{eq}^2} )</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>( \frac{r_{eq}^2}{r_{pol}^2} )</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Coefficient for ( S_d (R_s^2 - r_{eq}^2) )</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Resampling types</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td></td>
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(Note: processing center use only)
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<thead>
<tr>
<th>16</th>
<th>Resampling size (Note: processing center use only)</th>
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<th>1</th>
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</thead>
<tbody>
<tr>
<td>17</td>
<td>Spare</td>
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<td>40</td>
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**#4 Navigation information block**

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<th>(Fixed value)</th>
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<tbody>
<tr>
<td>2</td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 139 [bytes]</td>
<td>(Fixed value)</td>
</tr>
<tr>
<td>3</td>
<td>Navigation information time</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[MJD]</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>SSP longitude</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[degrees]</td>
<td>($=-10^{10}$ (no information): backup operation)</td>
</tr>
<tr>
<td>5</td>
<td>SSP latitude</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[degrees]</td>
<td>($=-10^{10}$ (no information): backup operation)</td>
</tr>
<tr>
<td>6</td>
<td>Distance from Earth’s center to Satellite</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[km]</td>
<td>($=-10^{10}$ (no information): backup operation)</td>
</tr>
<tr>
<td>7</td>
<td>Nadir longitude</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[degrees]</td>
<td>($=-10^{10}$ (no information): backup operation)</td>
</tr>
<tr>
<td>8</td>
<td>Nadir latitude</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[degrees]</td>
<td>($=-10^{10}$ (no information): backup operation)</td>
</tr>
<tr>
<td>9</td>
<td>Sun’s position</td>
<td>R8</td>
<td>8</td>
<td>3</td>
<td>[km]</td>
<td>(x, y, z) (J2000 inertial coordinate)</td>
</tr>
<tr>
<td>10</td>
<td>Moon’s position</td>
<td>R8</td>
<td>8</td>
<td>3</td>
<td>[km]</td>
<td>(x, y, z) (J2000 inertial coordinate)</td>
</tr>
<tr>
<td>11</td>
<td>Spare</td>
<td></td>
<td>40</td>
<td>1</td>
<td>Spare</td>
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**#5 Calibration information block**

<table>
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<th>1</th>
<th>= 5</th>
<th>(Fixed value)</th>
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<tbody>
<tr>
<td>2</td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 147 [bytes]</td>
<td>(Fixed value)</td>
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<td>3</td>
<td>Band number</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>(See Table 1)</td>
<td>($=1$ (Himawari-7 VIS 0.68 [μm]): backup operation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>($=2$ (Himawari-7 IR4 3.7 [μm]): backup operation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>($=3$ (Himawari-7 IR3 6.8 [μm]): backup operation)</td>
<td></td>
</tr>
</tbody>
</table>

$^5$ The point of intersection between the sensor nadir and the surface of the Earth
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>backup operation) (= 4 (Himawari-7 IR1 10.8 [μm]): backup operation) (= 5 (Himawari-7 IR2 12.0 [μm]): backup operation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Central wave length</td>
<td>R8</td>
<td>8</td>
</tr>
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<td>5</td>
<td>Valid number of bits per pixel</td>
<td>I2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Count value of error pixels</td>
<td>I2</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Count value of pixels outside scan area</td>
<td>I2</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Gain for count-radiance conversion equation</td>
<td>R8</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Constant for count-radiance conversion equation</td>
<td>R8</td>
<td>8</td>
</tr>
</tbody>
</table>

**Infrared band (Band No. 7 – 16)**

(Band No. 2 – 5: backup operation (See Table 4 bb))

<p>| | | | |</p>
<table>
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<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Correction coefficient of sensor Planck functions for converting radiance to brightness temperature ($c_0$)</td>
<td>R8</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>($c_1$)</td>
<td>R8</td>
<td>8</td>
</tr>
</tbody>
</table>
| 12 | ($c_2$) | R8 | 8 | 1 | $T_b = c_0 + c_1 T_e + c_2 T_e^2$  
$c_0$ [K]  
$c_1$ [1]  
$c_2$ [K⁻¹] |
<p>| 13 | Correction coefficient of sensor Planck functions for converting brightness temperature to radiance ($C_0$) | R8 | 8 | 1 | $T_e = C_0 + C_1 T_b + C_2 T_b^2$ |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Format</th>
<th>Length</th>
<th>Data</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>( C_1 )</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ I(\lambda, T_e) = \frac{2hc^2}{\lambda^5} \left(\frac{1}{\exp\left(\frac{hc}{kT_e}\right)} - 1 \right) ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>( C_2 )</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( C_0 ) [K] ( C_1 ) [1] ( C_2 ) [K(^{-1})]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Speed of light ((c))</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[m/s]</td>
</tr>
<tr>
<td>17</td>
<td>Planck constant ((h))</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[J]</td>
</tr>
<tr>
<td>18</td>
<td>Boltzmann constant ((k))</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[J/K]</td>
</tr>
<tr>
<td>19</td>
<td>Spare</td>
<td>—</td>
<td>40</td>
<td>1</td>
<td>Spare</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Visible, near-infrared band (Band No. 1 – 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Band No. 1: backup operation (See Table 4 bb))</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Format</th>
<th>Length</th>
<th>Data</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Coefficient ((c')) for transformation from radiance ((I)) to albedo ((A))(^{6})</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ A = c' I ] [ A [1] ] [ c' [(m(^2) sr (\mu\text{m}) / W] ] [ I [W / (m(^2) sr (\mu\text{m})] ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Spare</td>
<td>—</td>
<td>104</td>
<td>1</td>
<td>Spare</td>
</tr>
</tbody>
</table>

#6 Inter-calibration information block\(^{7}\)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Format</th>
<th>Length</th>
<th>Data</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Header block number</td>
<td>I1</td>
<td>1</td>
<td>1</td>
<td>= 6 (Fixed value)</td>
</tr>
<tr>
<td>2</td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 259 [bytes]  (Fixed value)</td>
</tr>
<tr>
<td>3</td>
<td>GSICS calibration coefficient (Intercept)</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>Calibration coefficients from the Global Space-based Inter-Calibration System (GSICS)(^{8}).</td>
</tr>
<tr>
<td>4</td>
<td>GSICS calibration coefficient (Slope)</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>Intercept [W / (m(^2) sr (\mu\text{m})] ] Slope [W / (m(^2) sr (\mu\text{m count)})]</td>
</tr>
<tr>
<td>5</td>
<td>GSICS calibration coefficient (Quadratic term)</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>Quadratic term [W / (m(^2) sr (\mu\text{m count}^2))]</td>
</tr>
<tr>
<td>6</td>
<td>Radiance bias for standard scene</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>Radiance bias and its uncertainty for standard scene.</td>
</tr>
<tr>
<td>7</td>
<td>Uncertainty of radiance bias for standard scene</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>Undefined value = (-10^{10}) (Band No. 1-6) [K] (Band No. 7-16)</td>
</tr>
<tr>
<td>8</td>
<td>Radiance for standard scene</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[K] (Band No. 7-16)</td>
</tr>
<tr>
<td>9</td>
<td>Start time of GSICS Correction validity period</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[MJD]</td>
</tr>
<tr>
<td>10</td>
<td>End time of GSICS Correction validity period</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

\(^{6}\) \[ A = \pi I / S_0 \] \[ S_0: \text{band solar irradiance [W / (m}^2 \(\mu\text{m})] \]

\(^{7}\) \(-10^{10}\) (undefined value) for No. 3-12 in the case GSICS Correction is N/A or backup operation is performed.

\(^{8}\) http://ds.data.jma.go.jp/mscweb/data/monitoring/calibration.html
<table>
<thead>
<tr>
<th></th>
<th>Radiance validity range of GSICS calibration coefficients (upper limit)</th>
<th>R4</th>
<th>4</th>
<th>1</th>
<th>([\text{W} / (\text{m}^2 \text{sr} \mu\text{m} \text{count})]) (Band No. 1-6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radiance validity range of GSICS calibration coefficients (lower limit)</td>
<td>R4</td>
<td>4</td>
<td>1</td>
<td>([\text{K}]) (Band No. 7-16)</td>
</tr>
<tr>
<td></td>
<td>File name of GSICS Correction</td>
<td>C</td>
<td>1</td>
<td>128</td>
<td>Reference GSICS Correction file</td>
</tr>
<tr>
<td></td>
<td>Spare</td>
<td>—</td>
<td>56</td>
<td>1</td>
<td>Spare</td>
</tr>
</tbody>
</table>

### #7 Segment information block

<table>
<thead>
<tr>
<th></th>
<th>Header block number</th>
<th>I1</th>
<th>1</th>
<th>1</th>
<th>= 7</th>
<th>(Fixed value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 47 [bytes]</td>
<td>(Fixed value)</td>
</tr>
<tr>
<td></td>
<td>Total number of segments</td>
<td>I1</td>
<td>1</td>
<td>1</td>
<td>(1: no division)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Segment sequence number</td>
<td>I1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>First line number of image segment</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spare</td>
<td>—</td>
<td>40</td>
<td>1</td>
<td>Spare</td>
<td></td>
</tr>
</tbody>
</table>

### #8 Navigation correction information block

<table>
<thead>
<tr>
<th></th>
<th>Header block number</th>
<th>I1</th>
<th>1</th>
<th>1</th>
<th>= 8</th>
<th>(Fixed value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>[bytes]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Center column of rotation</td>
<td>R4</td>
<td>4</td>
<td>1</td>
<td>[columns]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Center line of rotation</td>
<td>R4</td>
<td>4</td>
<td>1</td>
<td>[lines]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amount of rotational correction</td>
<td>R8</td>
<td>8</td>
<td>1</td>
<td>[μrad]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of correction information data for column and line direction</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Line number after rotation</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shift amount for column direction</td>
<td>R4</td>
<td>4</td>
<td>1</td>
<td>[columns]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shift amount for line direction</td>
<td>R4</td>
<td>4</td>
<td>1</td>
<td>[lines]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(7) – (9) Repeats of (6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spare</td>
<td>—</td>
<td>40</td>
<td>1</td>
<td>Spare</td>
<td></td>
</tr>
</tbody>
</table>

### #9 Observation time information block

<table>
<thead>
<tr>
<th></th>
<th>Header block number</th>
<th>I1</th>
<th>1</th>
<th>1</th>
<th>= 9</th>
<th>(Fixed value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>[bytes]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of observation times</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Line number</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

9 Correction follows the following procedure:

1. Rotate all pixels according to the “No. 5 Amount of rotational correction”.

2. Translate all pixels in the line indicated by the “No. 7 Line number after rotation” according to “No. 8 Shift amount for column direction” and “No. 9 Shift amount for line direction”. The line numbers are discrete values. For a middle line, translate according to the interpolated shift amount.
<table>
<thead>
<tr>
<th></th>
<th>Observation time</th>
<th>R8</th>
<th>8</th>
<th>1</th>
<th>[MJD]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(4) – (5) Repeats of (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Spare</td>
<td></td>
<td>40</td>
<td>1</td>
<td>Spare</td>
</tr>
</tbody>
</table>

### #10 Error information block

<table>
<thead>
<tr>
<th></th>
<th>Header block number</th>
<th>I1</th>
<th>1</th>
<th>1</th>
<th>= 10</th>
<th>(Fixed value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Block length</td>
<td>I4</td>
<td>4</td>
<td>1</td>
<td></td>
<td>[bytes]</td>
</tr>
<tr>
<td>3</td>
<td>Number of error information data</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>(= 0: backup operation)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Line number</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Number of error pixels per line</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(4) – (5) Repeats of (3)

| 6 | Spare            |    | 40| 1 | Spare |

### #11 Spare block

<table>
<thead>
<tr>
<th></th>
<th>Header block number</th>
<th>I1</th>
<th>1</th>
<th>1</th>
<th>= 11</th>
<th>(Fixed value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Block length</td>
<td>I2</td>
<td>2</td>
<td>1</td>
<td>= 259</td>
<td>[bytes]</td>
</tr>
<tr>
<td>3</td>
<td>Spare</td>
<td></td>
<td>256</td>
<td></td>
<td></td>
<td>Sparse</td>
</tr>
</tbody>
</table>

### #12 Data block

<table>
<thead>
<tr>
<th></th>
<th>Count value of each pixel</th>
<th>I2</th>
<th>2</th>
<th>Number of pixels = Number of columns × Number of lines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(See Block #5 6 count value of error pixels)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(See Block #5 7 Count value of pixels outside scan area)</td>
</tr>
</tbody>
</table>

(See Block #2 4 Number of columns)

(See Block #2 5 number of lines)
6. Backup Operation by Himawari-7 (MTSAT-2)

In the event of Himawari-8 failure before Himawari-9 starts operation as a second satellite, JMA will disseminate Himawari-7 (MTSAT-2) observation data as backup. In such cases, only full-disk or half-disk (Northern or Southern Hemisphere) observations will be made every 15 or 30 minutes, and no regional observations will be made. There will be five bands (one visible and four infrared) and a total of 56 images per day.