

MDI Keyword Descriptions

Level 1.5

<http://soi.stanford.edu/sssc/doc/keywords.html>

1. ABS_MIN: minimum of the absolute values of the data
2. AVG_FLUX: TOT_FLUX divided by NPIXFLUX
3. B0: heliographic coordinate of the sub-observation point in degrees
4. BFITZERO: magnetogram zero offset
5. BITPIX: mandatory FITS data type. Must be second keyword in header
6. BLANK: Undefined integer pixels are set to this value. Missing float pixels are set to NaN (not a number)
7. BLDVER00: level 0 software version number
8. BLDVER01: level 1 software version number
9. BLDVER15: level 1.5 software version number
10. BSCALE: scaling factor to convert data to float
11. BUNIT: physical units of the data. for example, m/s
12. BZERO: offset applied to true pixel values
$$\text{physical_value} = \text{fits_pixel_value} \times \text{b scale} + \text{b zero}$$
13. CADENCE: time step in seconds between adjacent data samples
14. CALTBLS: calibration files pathname
15. CDELTA1: solarSoft keyword. same as XSCALE
16. CDELTA2: solarSoft keyword. same as YSCALE
17. CENTER_X: $X_0 + 1.0$
18. CENTER_Y: $Y_0 + 1.0$
19. CMPERRS: number of compression errors
20. COMMENT: comment, usually a reference to online documentation and source of data
21. CONFORMS: used by gather_info to determine time step
22. CRPIX1: SolarSoft keyword. Disk center x-coordinate, lower left = (1,1)
23. CRPIX2: SolarSoft keyword. Disk center y-coordinate, lower left = (1,1)
24. CTYPE1: SolarSoft keyword. X-axis is EW on disk in arcsec from disk center
25. CTYPE2: SolarSoft keyword. Y-axis is NS on disk in arcsec from disk center

26. DATAFILE: SOI data file name. Generated by the vds library
27. DATAKIND: Pointer to keyword list. Not fully implemented
28. DATAKURT: Kurtosis (4th moment of the data distribution)
29. DATAMAX: Maximum data value in units specified by BUNIT
30. DATAMEAN: Mean value of data in units specified by BUNIT
31. DATAMEDN: Approximation of data median - may not be accurate
32. DATAMIN: Minimum data value in units specified by BUNIT
33. DATANAME: Dataname is currently left blank
34. DATASIGN: Sign convention. The value is -1 for velocity data, which signifies the convention that positive is in the redshift direction (away from the observer)
35. DATASKEW: 3rd moment of the data distribution
36. DATAVALS: Number of non-missing values in data record
37. DATA_RMS: RMS value of data in units specified by BUNIT
38. DATE: File creation date
39. DATE-OBS: Date of T_OBS in UT as DD/MM/YY
40. DATE_OBS: UT start time of obs in CCSDS format
41. DNAME0: Descriptive name of the first variable in a data set
42. DNOTE0: Comment field for var 0
43. DPC: 8- or 10-character version of data product code
44. DPC_CONF: Indicates whether the DPC is a conforming or non-conforming DPC
45. DPC_CROP: Crop radius in CCD pixels
46. DPC_FORM: Image format. Possibilities are, 'Cropped', 'Raster Compressed'
47. DPC_OBSR: DPC description. For example, 'HR_Filtergram' / High-Resolution Filtergram
48. DPC_ORGN: Origin of data. Possibilities are 'Space', 'Sim', 'Grnd'
49. DPC_RATE: Data channel. Possibilities are 'High-Rate' (160kbps) or 'Low-Rate' (5kbps)
50. DPC_SMPL: Sample period in seconds
51. DPC_STR: 10-character version of data product code
52. DSDS_UID: Database ID
53. DSIGN0: Sign convention of first variable
54. DSNAME: SSSC data set name prog:mdi,level:lev1.5,series:hr_M_1024x500_01h[35855]

55. DTYPE: Data type. V = dopplergram, B = magnetic field, C = continuum M=modulation
56. DUNIT0: Currently blank. should be copy of DATANAME for each var
57. DVALS0: Number of non-missing values in all records in a data set
58. D_MAX0: Maximum value of all records in a data set
59. D_MEAN0: Mean value of all records in a data set
60. D_MIN0: Minimum value of all records in a data set
61. D_RMS0: RMS value of all records in a data set
62. D_VARS: Number of variables in a data set
63. EARTH_B0: Heliographic Latitude of the center of the earth
64. EARTH_CR: Heliographic rotation number for EARTH_L0
65. EARTH_D: Sun-center to Earth-center distance in AU
66. EARTH_DT: Delay time between T_OBS and T_EARTH ($T_EARTH = T_OBS + EARTH_DT$)
67. EARTH_L0: Heliographic Longitude of the center of the earth
68. EARTH_R0: Radius of the Sun in arc seconds, as viewed from earth
69. EARTH_VN: "Northward" velocity of Earth in m/s. Positive is in direction of solar north
70. EARTH_VR: Radial velocity of Earth in m/s. Positive direction toward the Sun
71. EARTH_VW: Westward" velocity of Earth in m/s. Positive is in direction of Earth's orbit
72. END: Mandatory FITS. Marks the end of the FITS header
73. EPH_QUAL: Status value returned by soho_ephemeris. 0 means the ephemeris data is good
74. FD_SCALE: Nominal full-disk plate scale = 1.97784
75. FNDLMBAN: Angle between y-axis and major-axis in degrees
76. FNDLMBMA: Major-axis length in pixels
77. FNDLMBMI: Minor-axis length in pixels
78. FNDLMBXC: X-center of image in pixels
79. FNDLMBYC: Y-center of image in pixels
80. HISTORY: Comment field, usually with a comment about processing history
81. HR_MAG: Magnification factor of the high-resolution magnetograms with respect to the full-disk images. The current value is 3.267
82. I_DREC: Record ID number

83. IM_SCALE: Nominal pixel scale in arc-seconds/pixel.

$$\text{IM_SCALE} = \text{FD_SCALE}/\text{MAGNIFY}$$
84. INSTRUME: MDI
85. INTERVAL: Integration time in seconds
86. ITIME: GONG keyword. Same as CADENCE
87. L0: Heliographic coordinate of the sub-observation point in degrees
88. MAGNIFY: Magnification factor used. The value is 1 for all images other than high-resolution magnetograms, in which case it takes on the value of HR_MAG
89. MDIREF: T_REF as a number
90. MDI_X0: Full Disk Image x-center in pixels. Value taken from pointing info.
91. MDI_Y0: Full Disk Image y-center in pixels. Value taken from pointing info.
92. MEAN_FLD: Sum of B over pixels within radius ($0.95 \times R_{\text{SUN}}$) divided by NPIXFLUX.
93. MISSPKTS: Number of missing packets.
94. MISSVALS: Number of missing values in data record.
95. NAXIS: Mandatory. Number of axes. Must be third keyword in header.
96. NAXIS1: Mandatory. Size of first dimension. Must follow NAXIS in header.
97. NAXIS2: Mandatory. Size of second dimension. Must follow NAXIS1 in header.
98. NPIXFLUX: Number of pixels within radius $0.95 \times R_{\text{SUN}}$.
99. OBS_B0: Heliographic Latitude of the observer's disk center.
100. OBS_CR: Carrington rotation number for OBS_L0.
101. OBS_DIST: Distance of observer to Sun center in AU.
102. OBS_L0: Heliographic Longitude of the observer's disk center.
103. OBS_MODE: DPC description. For example, 'HR_Filtergram' / High-Resolution Filtergram.
104. OBS_R0: Apparent semi-diameter of Sun in arc seconds from SOHO.
105. OBS_TYPE: Observable code determined from DPC.
106. OBS_VN: "Northward" velocity of observer in m/s. Positive is in direction of solar north.
107. OBS_VR: Radial velocity of observer in m/s. Positive direction is away from the Sun.
108. OBS_VW: "Westward" velocity of observer in m/s. Positive is in direction of Earth's orbit.
109. OBT_TIME: Local On Board Time of start of data.

110. ORIENT: The orientation of the Sun's image in the file/array is defined by a character string indicating the "side" of the Sun (with an assumed position angle of 0) that corresponds to the origin and x-axis used for the pointing and scale parameters. This string contains 4 characters from the set N,S,E,W and tells the "corner" for the (0,0) pixel and the corner for the (xmax,0) pixel. In the soho nominal image orientation, with P_ANGLE correction applied, this would be "SESW".
111. ORIGIN: Organization that created the FITS file. SOHO-SOI.
112. PIXLENX: Pixel x-dimension. 1.0 for SOI.
113. PIXLENY: Pixel y-dimension. 1.0 for SOI.
114. PLATE_X: Pixel x-coordinate of image center.
 $0.5 \times (cols, rows - 1)$ for reconstructed 2-d images.
115. PLATE_Y: Pixel y-coordinate of image center.
 $0.5 \times (cols, rows - 1)$ for reconstructed 2-d images.
116. PROTOCOL: Conforming dataset file format.
117. P_ANGLE: Angular location of the solar north pole on the image after mappings have been performed.
118. ROLL_TBL: Name of roll angle table from which P_ANGLE, SOLAR_P and SOLAR_P0 are interpolated; "none" if no table is used; "not used" if a table is specified but the interpolation failed for any reason.
119. ROLL_UPD: Last modification time of the roll angle table; blank if ROLL_TBL is "none" or "not used".
120. QUALITY: Status summary, 0 == no known problems.
121. RUNTIME: Date data was processed. Format yyyy.mm.dd_hh:mm:ss_UT
122. R_SUN: Semi-major axis length of the apparent solar image when plotted with square image elements.
123. SIMPLE: Mandatory. File type. Mandatory in primary header. Must be F(alse) if the file does not conform to the FITS standard, otherwise T(rue). Must be first keyword in header.
124. SITE: 'md' for MDI.
125. SIZERRS: Potential number of size errors from compressed data (used as a quality flag).
126. SOLAR_B0: Same as OBS_B0 - Heliographic Latitude of the observer's disk center.
127. SOLAR_P: Original position angle of the solar north pole measured eastward (counterclockwise) from plate "north" (degrees).
128. SOLAR_P0: Same as SOLAR_P - position angle of the Solar North pole.
129. SOURCE: Database data source prog:mdi,level:lev1[2],series: 4b4a2d00_01h[35855]:sel[53].

- 130. SQID: Sequence ID.
- 131. S_ANGLE: Position angle of S_MAJOR axis. Default is 0 for MDI.
- 132. S_MAJOR: Scale for semi-major axis of squished Earth-based images. Default is 1 for MDI.
- 133. S_MINOR: Scale for semi-minor axis of squished Earth-based images. Default is 1 for MDI.
- 134. TBLXYUPD: Pointing table last modification date.
- 135. TELESCOP: SOHO.
- 136. TIME-OBS: Time of T_OBS in UT as hh:mm:ss.ss.
- 137. TOT_FLUX: Sum of $|B|$ over pixels within radius $0.95 \times R_{SUN}$.
- 138. T_BLOCK: Specifies time increment that the dataset is stored (or blocked) in.
- 139. T_EARTH: Time of observation had it occurred on Earth.
 $T_EARTH = T_OBS + EARTH_DT$.
- 140. T_EPOCH: Epoch for this time series.
- 141. T_FIRST: UT start time of observation (center of averaging interval).
- 142. T_LAST: UT end time of observation (center of averaging interval).
- 143. T_OBS: Actual (center) of integration time.
- 144. T_REC: Intended observation time.
- 145. T_REF: Local on-board time (LOBT) stamp.
- 146. T_START: Beginning time of first image in a data set.
- 147. T_STOP: Just past ending time of last image in a data set.
- 148. VCOR1: Observer's velocity in m/s.
- 149. VDS_VERS: VDS version number.
- 150. X0: Distance along x-axis to center of solar disk from first pixel center in array pixels

$$X0 = [(MDI_X0 - 511.5 - X_OPAXIS) \times MAGNIFY - X_OFFSET + 512.0] / X_SCALE - 0.5$$
- 151. XCEN: The location of the x-center of the image array on the Sun measured in arc-seconds from the center of the Sun's disk, positive is to the West (North).
- 152. XSCALE: $XSCALE = X_SCALE \times IM_SCALE$
- 153. XY_FROM: Source of pointing information.
- 154. XY_QUAL: Status value returned by mdi_pointing. 0 means the pointing data is good.

155. X_OFFSET: Sampled field of view origin distance from full field of view origin. Units are CCD pixels. These offsets are always non-negative. They are zero in full-disk, full CCD field of view case. There is some small correction (see gather_xy_rsun) in vw_V case. In the extracted image cases, these parameters are determined from COFF parameter. For binned data where the center of the lower left bin is offset from the center of the lower left pixel in the CCD X_OFFSET is computed as that distance in pixels divided by the binning. I.e. for flux budget it is 3.5/8.0.
156. X_OPAXIS: Instrument field of view axis (i.e. optical axis) arc-seconds from the center of the Sun's disk, plus to the West (North).location wrt full disk magnification instrument ccd center. This is the current HR center location on the fd optical axis on the ccd. in fd case this is 0.0, 0.0 in hr it is (516.6-511.5) and (573.0-511.5) for X,Y, i.e. (5.1, 61.5).
157. X_SCALE: CCD pixels per bin. XY_SCALE are the size of image elements in units of CCD pixels where the pixels are each of angular size IM_SCALE. If the pixels are rectangular X_SCALE, Y_SCALE, and IM_SCALE should form a consistent set. For MDI these scale factors for X and Y include the high-res vs. full disk and the binning information.
158. Y0: Distance along y-axis to center of solar disk from first pixel center in array pixels.

$$Y0 = [(MDI_Y0 - 511.5 - Y_OPAXIS) \times MAGNIFY - Y_OFFSET + 512.0]/Y_SCALE - 0.5$$
159. YCEN: The location of the y-center of the image array on the Sun measured in arc-seconds from the center of the Sun's disk, positive is to the West (North).
160. YSCALE: $YSCALE = Y_SCALE \times IM_SCALE$
161. Y_OFFSET: Sampled field of view origin distance from full field of view origin. Units are CCD pixels. These offsets are always non-negative. They are zero in full-disk, full CCD field of view case. There is some small correction (see gather_xy_rsun) in vw_V case. In the extracted image cases, these parameters are determined from COFF parameter. For binned data where the center of the lower left bin is offset from the center of the lower left pixel in the CCD X_OFFSET is computed as that distance in pixels divided by the binning. I.e. for flux budget it is 3.5/8.0.
162. Y_OPAXIS: Instrument field of view axis (i.e. optical axis) location wrt full disk magnification instrument ccd center. This is the current HR center location on the fd optical axis on the ccd. in fd case this is 0.0, 0.0 in hr it is (516.6-511.5) and (573.0-511.5) for X,Y, i.e. (5.1, 61.5).
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