

# TIC v8 and CTL v8.xx Data Release Notes

⚠ This is an older version of the TESS Input Catalog. It is only available for [bulk downloads](#). The [TIC Version 8.2](#) is the current version, please consult that documentation.

i The data release notes are updated by the TESS Stellar Parameter Working Group as issues are found.

## Updates to the TICv8 release notes, different from the previous version

This document should be considered a 'living-document', which will be updated as issues are identified, or as descriptions are made more accurate. This section of the release notes highlights major changes to this document between versions, identified by the version date in the title. The major document changes will also be identified in the text as **bolded text**.

List of document updates:

1. This is the first publication of the TICv8 release notes, and no bolded changes appear in the text below.

## Updates to the TICv8 CTL

This section of the release notes highlights major changes to how stars are selected for the TICv8 CTL as new versions of the CTL are generated.

List of changes to the TICv8 CTL:

1. The current version of the CTLv8.01, and is the original CTL for TICv8.

## Introduction

These release notes describe the schema, and content, of the eighth version of the TESS Input Catalog (TICv8) produced entirely by the Target Selection Working Group (TSWG). TICv8 was finalized, and prepared for delivery to the TESS Science Office (TSO), on 2019 April 15.

TICv8 has a number of minor issues (see below) that have not been fixed in this version due to time constraints during preparation. Specific details of the method of production, and the contents of TICv8, is described on the arXiv (<https://arxiv.org/pdf/1905.10694.pdf>). The full documentation for TICv7, and earlier TIC versions, can currently be found in Stassun et al. (2018, AJ, 156, 102), and on the arXiv at (<https://arxiv.org/abs/1706.00495>).

The design of TICv8 is nearly identical to TICv7, in that the original columns and their formats are the same, but there have been updates to various parameter calculations, and additional columns have been added to allow for more user flexibility. The TIC IDs have not been changed, and all future deliveries of the TIC will use the same TIC IDs for specific objects, preserving backwards compatibility. New objects added to the TIC will *always* receive new IDs. Objects may be removed from the TIC, if they are found to be spurious, but TIC IDs will always be unique, and a new TIC object will never receive the ID of an old TIC object.

## Major changes in TICv8 compared to TICv7

This delivery contains major changes in computed quantities compared to TICv7. It should be noted that the methods used to estimate a variety of stellar parameters are still under active development, and can be affected by poor catalog photometry when there is no acceptable alternative photometry for a given star.

The major changes compared to previous versions are:

1. The base catalog for TICv8 is now the Gaia DR2 catalog. This differs from the previous versions of the TIC, which were based on 2MASS. 2MASS and Gaia DR2 objects were matched using the Gaia- provided 2MASS-to-Gaia look-up table (tmass\_best\_neighbour). All 2MASS objects retained their original TICv7 TIC-ID. All Gaia objects not found in 2MASS, or earlier versions of the TIC, were given new TIC-IDs.
2. Stars identified in 2MASS as a single source, but identified in Gaia as multiple sources, are identified with the disposition = SPLIT (column 86). In this case, the 2MASS object remains in the TIC with the original TIC-ID, and two or more new sources have been added to the TIC with new TIC-IDs. In these cases, the new TIC objects will have the TIC-ID of the original object in the duplicate\_id column (column 87).
3. Stars are selected to be in the CTL if they meet the following requirements: Tmag < 13 (column 61), the Gaia quality flag is set to 1 (column 112), the star has a dwarf-like radius (the star's radius is smaller than the line in figure 10 of the full documentation), and the star's placement on the absolute Gmag (based on column 59) vs. gaia\_bp (column 108) - gaia\_rp (column 110) color-magnitude diagram suggests the star is *not* a white dwarf. Please see section 3.1 of the full documentation for more details.
4. There is no longer a specially curated 'Bright Star' list, and as a result, stars no longer have their priorities set to be 1 if their *TESS* magnitude is brighter than Tmag = 6 (column 61). Thus 'Bright stars' are no longer automatically added to the CTL.
5. There is no longer a specially curated 'Known-Planets' list. The stellar parameters for such objects in existing catalogs were found to be too inhomogeneous to properly calculate a priority. Thus 'Known planets' are no longer automatically added to the CTL.
6. CTL stars with calculated masses and radii that result in an unphysical value of log(g) > 5 (column 67) have had their CTL priorities set to 0. This was done to avoid prioritizing stars that may have poorly measured effective temperatures (column 65), extinction values (column 82), and/or parallaxes (column 22), but that still pass the quality assurance cuts. Stars in specially curated lists have been excluded from this criterion.

- In all cases, physical parameters have been calculated using the reported effective temperature (column 65), radius (column 71), and mass (column 73) in the TIC. This includes stars that may have measured physical parameters, such as  $\log(g)$  (column 67), in spectroscopic catalogs matched to TICv8. The only stellar parameters that have been adopted directly from spectroscopic catalogs are effective temperatures (column 65) and metallicities (column 69), provided the error on the effective temperature (column 66) is less than 300 K.
- When multiple spectroscopic parameters exist for a single star, in a single catalog, these values have been combined using a weighted mean.
- The coordinates (columns 14, 15, 25-28) and their uncertainties (columns 117-118) are provided in epoch 2000 due to mission requirements. Positional errors (columns 117-118) and proper motion errors (columns 18, 20) have been propagated. It should be noted that this leads to much larger errors than those in the nominal Gaia DR2 positions. Especially for Gaia DR2 stars, users should not try to propagate forward the TIC coordinates (columns 14, 15) using the proper motions (columns 17, 19) listed. Instead, users should use the original Gaia DR2 positions (columns 119, 120), proper motions (columns 14, 15), and corresponding errors for propagation (columns 121, 122). We provide RA and Dec, with errors, as given in the source catalog (Gaia DR2, 2MASS etc) in additional columns (119 - 122).
- Stars in the CTL have their priorities (column 88) multiplied by a factor of 0.1 if they are within 10 degrees of the Galactic plane (column 26). This was done to avoid prioritizing stars for two-minute cadence which may be affected by large amounts of extinction. This is a change from previous version of the TIC that de-boosted priorities if  $|b| < 15$  degrees.
- Many stars in the TIC have stellar parameters provided, regardless of their inclusion in the CTL. However, stars have their masses (column 73) calculated *only* if they have radii (column 71) smaller than the line shown in figure 10 of the full documentation. This was to avoid providing masses for stars that may be giants using an empirical relation valid only for dwarf stars. If a star is identified as a subgiant, the mass (column 71) and  $\log(g)$  (column 67) should not be considered to be reliable; however, the luminosity (column 78) and effective temperature (column 65) for these stars are considered to be reliable.
- A number of additional columns have been provided for users on MAST; see columns 89-122 below.
- The Tmag (column 61) is now calculated using colors that have been corrected for reddening. Gaia colors are preferred if they are given and match the Gaia quality criteria (`gaiaqflag = 1`, column 112). As a result, some stars may have different Tmags compared to previous versions of the TIC.
- The cool dwarf list was updated in TICv8 to only include cool dwarfs with reliable parallaxes ( $< 20\%$  error). Stars in the previous version of the cool dwarf catalog, retain their TICv7 stellar parameters, but no longer have a priority calculated.
- The only stars from the specially curated cool dwarf list which are included in CTLv8.01 are those with  $T < 16$ . This was done to limit the size of CTLv8.01 to be less than 10 million stars. Future versions of the CTL may include fainter cool dwarf stars.

## Currently known quirks and issues with TICv8

### General Issues

There are a number of minor issues, and quirks, which have been identified by the TSWG. Users should read this section carefully, before accepting TIC quantities at face value.

- Some stars may have reported stellar parameter errors that are larger than the parameter quantity. Users are cautioned against using these parameters in calculations for publications.
- Users are reminded that stars that have ecliptic latitudes between  $-6$  and  $6$  degrees have their priorities set to zero. This "gap" in priority is meant to mimic the expected gap in camera coverage for the two year primary TESS mission.
- Some stars in the hot subdwarf list do not have errors for their stellar parameters. These were adopted 'as-is' for consistency.
- The disposition column identifies objects that are included in the TIC, but are likely spurious, or related to other TIC objects in a non-trivial, non-astrophysical way. Currently, this column is populated as a NULL, DUPLICATE (6), ARTIFACT (7), or SPLIT (8). When a single star in a previous TIC is found to be two or more actual sources due to the enhanced resolution of Gaia DR-2, the original TICID gets the disposition SPLIT. New TICIDs are assigned to the objects and the original TICID is in column DUP\_ID (column 87). The original star "SPLIT" star will have NULL in the `dup_id`. The DUPLICATE flag means the star is listed twice (or more) in the TIC due to prior cross-matching difficulties. In this case, DUP\_ID contains the TICID of the real star.
- Users should note the metallicity (column 69) has been adopted when available from a spectroscopic catalog, but it is not directly used in any calculation. This may result in physical parameters that are not strictly consistent with the reported metallicity.
- The listed RA (column 14) and Dec (column 15) are *not* measured positions, but positions which have been propagated to EPOCH J2000.0. Users should not try to propagate forward the TIC coordinates using the proper motions listed. Instead, users should use the original catalog position (column 119 & 120), proper motions (columns 17 & 19), and corresponding errors for propagation.
- If a star is identified as a subgiant, and a mass and  $\log(g)$  are provided, users should not consider these parameters to be reliable, because the empirical relations designed to calculate the mass are valid for dwarf stars. However the luminosity and effective temperature should be accurate.
- Asymmetric errors are computed using a Monte Carlo method and are only provided for CTL stars which are not in a specially curated list. There are borderline cases where the peak of the property-distribution was too close to the validity-limit of the property-relation in order to compute reliable errors. These stars will have no or asymmetric errors for just some properties.
- Negative errors for some Bmag and Vmag uncertainties: there are 40354 stars with negative Vmag uncertainties and 4395461 stars with negative Bmag uncertainties. The negative error values are all for stars from APASS DR9, and are magnitudes for which only one observation is used, and therefore are Poisson errors rather than standard deviation. When constructing the TIC, these negative values were not caught and converted into positive values, and thus are recorded as negative values in TIC8. Users should feel free to convert them to positive values and use them as a valid estimate of the uncertainty.
- Negative E(B-V) values: there are two different origins for negative uncertainties in the "eneg\_EBV" and "epos\_EBV" columns. In the first case, if "EBVFlag" = "schlegel" they are simple numerical and conversion errors between double and single precision values. These uncertainty values actually should be assumed to be 0.0. There are approximately 2.5 million stars in this group. If "EBVFlag" = 'panstarrs' the negative values originate from former CTL targets that got a negative value from the Monte Carlo method that was not restored properly. In these cases the value is assumed to be NULL, e.g., the negative value does not have any useful meaning. There are 34 total targets with this problem, the complete list is given below (one's in bold and underlined are CTL stars).

2500669, 6380774, 59886010, 66689089, 95953951, 96290610, 102780462, 106545533, 106925979, 106968320, 106995912, 150847797, 152213395, 202173923, 203817705, 256283293, 268080493, 284238301, 284706155, 321910060, 348470096, 352516090, 365424002, 381458401, 391991123, 399107554, 416800445, 427104893, 432892646, 1654554857, **1498525**, **1500006**, **1501102**, **2652592**

### Joins

All stars affected are stars originating from TIC7 which did not get matched up with a Gaia DR2 star in TIC8. In all these cases, it turned out that there is a valid match between the TIC7 star and a Gaia DR2 star, and thus it is possible to update the older TIC7 values that ended up in TIC8 with improved, Gaia-derived values, unless it is a star from a specially curated list, in which case the parameters are taken from those curated lists.

The following table summarizes the known cases. These targets are identical and should have been matched together in TIC v8, but were not. Users should be aware that these are the same objects, and thus parameters from the TIC8 ID under the "Gaia DR2" column can be associated with the same TIC8 ID in the "from TIC7" column.

| TOI     | TIC8 ID (from TIC7) | TIC8 ID (from GaiaDR2)  | Comments                                         |
|---------|---------------------|-------------------------|--------------------------------------------------|
| 454.01  | 153077621           | 651051509               | 153077621 is a cool dwarf                        |
| 573.01  | 296780789           | 876200724               | 296780789 is a cool dwarf                        |
| 722.01  | 38509907            | 684936227               | 38509907 has a spectroscopic Teff                |
| 1421.01 | 329277372           | 2019613336              | Gaia photometry unreliable, RUWE = 41.2 (not ok) |
| --      | 430528563           | 2014876481              | this is Tycho2 3969-00744-1                      |
| 1309.01 | 430528566           | 2014876461              | this is most likely Tycho2 3969-00744-2          |
| 651.01  | 72090501            | 709725833               | likely TYC 5366-2280-1 (Vizier: bad RA, Dec)     |
| 1169.01 | 302518439           | 802647157 and 802647158 | TYC 4381-01655-1 and -2                          |

**Additional Note:** TIC 72090499 and 72090500 looked as if they should be joined, but they are two bona-fide stars with separate detections in Gaia DR2 and Tycho.

## Splits

In this case a star originating from TIC7 is an unresolved double-star in 2MASS and has at least two entries in Gaia DR2 that did not get matched up properly in TIC8. All magnitudes (Tessmag, Vmag, J, H, K, etc) and stellar properties of the TICID (Teff, radius, mass, etc) are most likely corrupted and should NOT be used. How strong they are affected depends on the ratio of fluxes (e.g., the values from the TIC IDs corresponding to the resolved Gaia DR2 sources). **IMPORTANT:** Please note that there is no way to tell if any TESS signal came from a given star in the unresolved binary system.

The following table contains the original TIC8 ID (from the unresolved source in TIC7) and the two TIC8 IDs for the source coming from the Gaia DR2 IDs.

| TOI     | TIC8 ID (from TIC7 source) | TIC8 ID (from Gaia-resolved source #1) | TIC8 ID (from Gaia-resolved source #2) | Comments                                                           |
|---------|----------------------------|----------------------------------------|----------------------------------------|--------------------------------------------------------------------|
| --      | 92359852                   | 651667036                              | 651667038                              | RUWE < 1.1 for 92359852 and 651667036 (ok)                         |
| 1606.01 | 125735470                  | 640763859                              | 640763860                              | 125735470 and 640763859 have similar properties                    |
| 268.01  | 219253008                  | 685340264                              | 685340263                              | 219253008 and 685340264 have similar properties                    |
| 1014.01 | 96246348                   | 772008799                              | 772008800                              | 772008799 is brighter, but too hot for stellar property estimation |
| 1044.01 | 463402815                  | 854828119                              | 854828120                              | flags for 854828119 not ok, but ruwe = 0.93                        |
| --      | 385105618                  | 642958052                              | 642958048                              | flagged as multiple in TIC7, split now, spect teff                 |
| 594.01  | 146406806                  | 824851863                              | 824851862                              | 2 Tycho and Gaia detections                                        |
| 1169.01 | 302518439                  | 802647157                              | 802647158                              | TYC 4381-01655-1 and -2                                            |

## Artifacts

| TIC ID    | 2MASS ID         | Comments                                                                   |
|-----------|------------------|----------------------------------------------------------------------------|
| 269701145 | 20080397+6651023 | near TOI 1339, sitting on an artifact around the bright star TIC 269701147 |
| 158025009 | 14274177+4157124 |                                                                            |
| 178819687 | 12575199-3945275 |                                                                            |
| 178819685 | 12575242-3945196 |                                                                            |
| 94986318  | 05272486-1416301 |                                                                            |
| 233087859 | 18084971+6040417 | near TOI-1184                                                              |
| 233087857 | 18084897+6040463 | near TOI-1184                                                              |

## TICv8 Column Schema - Executive Summary

| Column Number | Column Name | Data Type | Description                       | Units    |
|---------------|-------------|-----------|-----------------------------------|----------|
| 1             | ID          | long      | TESS Input Catalog identifier     |          |
| 2             | Version     | string    | Version Identifier for this entry | yyyymmdd |
| 3             | HIP         | long      | Hipparcos Identifier              |          |
| 4             | TYC         | string    | Tycho2 Identifier                 |          |
| 5             | UCAC        | string    | UCAC4 Identifier                  |          |
| 6             | TWOMASS     | string    | 2MASS Identifier                  |          |
| 7             | SDSS        | string    | SDSS DR9 Identifier               |          |
| 8             | ALLWISE     | string    | ALLWISE Identifier                |          |
| 9             | GAIA        | string    | GAIA Identifier                   |          |
| 10            | APASS       | string    | APASS Identifier                  |          |
| 11            | KIC         | long      | KIC Identifier                    |          |
| 12            | Objtype     | string    | Object Type                       |          |
| 13            | Typesrc     | string    | Source of the object              |          |
| 14            | RA          | double    | Right Ascension epoch 2000        | deg      |
| 15            | Dec         | double    | Declination epoch 2000            | deg      |
| 16            | Posflag     | string    | Source of the position            |          |
| 17            | pmRA        | double    | Proper Motion in Right Ascension  | mas/yr   |
| 18            | e_pmRA      | double    | Uncertainty in PM Right Ascension | mas/yr   |
| 19            | pmDec       | double    | Proper Motion in Declination      | mas/yr   |
| 20            | e_pmDec     | double    | Uncertainty in PM Declination     | mas/yr   |
| 21            | PMFlag      | string    | Source of the Proper Motion       |          |
| 22            | plx         | double    | Parallax                          | mas      |
| 23            | e_plx       | double    | Error in the parallax             | mas      |
| 24            | PARFlag     | string    | Source of the parallax            |          |
| 25            | GalLong     | double    | Galactic Longitude                | deg      |
| 26            | GalLat      | double    | Galactic Latitude                 | deg      |
| 27            | EcLong      | double    | Ecliptic Longitude                | deg      |
| 28            | EcLat       | double    | Ecliptic Latitude                 | deg      |
| 29            | Bmag        | float     | Johnson B                         | mag      |
| 30            | e_Bmag      | float     | Uncertainty in Johnson B          | mag      |
| 31            | Vmag        | float     | Johnson V                         | mag      |
| 32            | e_Vmag      | float     | Uncertainty in Johnson V          | mag      |
| 33            | umag        | float     | Sloan u                           | mag      |
| 34            | e_umag      | float     | Uncertainty in Sloan u            | mag      |
| 35            | gmag        | float     | Sloan g                           | mag      |
| 36            | e_gmag      | float     | Uncertainty in Sloan g            | mag      |
| 37            | rmag        | float     | Sloan r                           | mag      |
| 38            | e_rmag      | float     | Uncertainty in Sloan r            | mag      |
| 39            | imag        | float     | Sloan I                           | mag      |
| 40            | e_imag      | float     | Uncertainty in Sloan I            | mag      |
| 41            | zmag        | float     | Sloan z                           | mag      |
| 42            | e_zmag      | float     | Uncertainty in Sloan z            | mag      |
| 43            | Jmag        | float     | 2MASS J                           | mag      |
| 44            | e_Jmag      | float     | Uncertainty in 2MASS J            | mag      |

|    |             |        |                                       |        |
|----|-------------|--------|---------------------------------------|--------|
| 45 | Hmag        | float  | 2MASS H                               | mag    |
| 46 | e_Hmag      | float  | Uncertainty in 2MASS H                | mag    |
| 47 | Kmag        | float  | 2MASS K                               | mag    |
| 48 | e_Kmag      | float  | Uncertainty in 2MASS K                | mag    |
| 49 | TWOMflag    | string | Quality Flags for 2MASS               |        |
| 50 | prox        | float  | Distance to 2MASS nearest neighbor    | arcsec |
| 51 | W1Mag       | float  | WISE W1                               | mag    |
| 52 | e_W1Mag     | float  | Uncertainty in WISE W1                | mag    |
| 53 | W2Mag       | float  | WISE W2                               | mag    |
| 54 | e_W2Mag     | float  | Uncertainty in WISE W2                | mag    |
| 55 | W3Mag       | float  | WISE W3                               | mag    |
| 56 | e_W3Mag     | float  | Uncertainty in WISE W3                | mag    |
| 57 | W4mag       | float  | WISE W4                               | mag    |
| 58 | e_W4Mag     | float  | Uncertainty in WISE W4                | mag    |
| 59 | Gmag        | float  | GAIA G Mag                            | mag    |
| 60 | e_Gmag      | float  | Uncertainty in GAIA G                 | mag    |
| 61 | Tmag        | float  | TESS Magnitude                        | mag    |
| 62 | e_Tmag      | float  | Uncertainty in TESS Magnitude         | mag    |
| 63 | TESSFlag    | string | TESS Magnitude Flag                   |        |
| 64 | SPFlag      | string | Stellar Properties Flag               |        |
| 65 | Teff        | float  | Effective Temperature                 | K      |
| 66 | e_Teff      | float  | Uncertainty in Effective Temperature  | K      |
| 67 | logg        | float  | log of the Surface Gravity            | cgs    |
| 68 | e_logg      | float  | Uncertainty in Surface Gravity        | cgs    |
| 69 | M/H         | float  | Metallicity                           | dex    |
| 70 | e_M/H       | float  | Uncertainty in the Metallicity        | dex    |
| 71 | Rad         | float  | Radius                                | solar  |
| 72 | e_Rad       | float  | Uncertainty in the Radius             | solar  |
| 73 | Mass        | float  | Mass                                  | solar  |
| 74 | e_Mass      | float  | Uncertainty in the Mass               | solar  |
| 75 | rho         | float  | Stellar Density                       | solar  |
| 76 | e_rho       | float  | Uncertainty in the Stellar Density    | solar  |
| 77 | LumClass    | string | Luminosity Class                      |        |
| 78 | Lum         | float  | Stellar Luminosity                    | solar  |
| 79 | e_Lum       | float  | Uncertainty in Luminosity             | solar  |
| 80 | d           | float  | Distance                              | pc     |
| 81 | e_d         | float  | Uncertainty in the distance           | pc     |
| 82 | e(b-v)      | float  | Applied Color Excess                  | mag    |
| 83 | e_e(b-v)    | float  | Uncertainty in Applied Color Excess   | mag    |
| 84 | numcont     | long   | Number of Contamination Sources       |        |
| 85 | contratio   | float  | Contamination Ratio                   |        |
| 86 | disposition | string | Disposition type                      |        |
| 87 | dup_id      | long   | Points to the duplicate object TIC ID |        |
| 88 | priority    | double | CTL priority                          |        |

The following columns have been added to the public release of TICv8 on MAST

| Column Number | Column Name   | Data Type | Description                                         | Units |
|---------------|---------------|-----------|-----------------------------------------------------|-------|
| 89            | eneg_EBV      | float     | Negative error for EBV                              | mag   |
| 90            | epos_EBV      | float     | Positive error for EBV                              | mag   |
| 91            | EBVFlag       | string    | Source of EBV                                       |       |
| 92            | eneg_Mass     | float     | Negative error for Mass                             | solar |
| 93            | epos_Mass     | float     | Positive error for Mass                             | solar |
| 94            | eneg_Rad      | float     | Negative error for Radius                           | solar |
| 95            | epos_Rad      | float     | Positive error for Radius                           | solar |
| 96            | eneg_rho      | float     | Negative error for Density                          | solar |
| 97            | epos_rho      | float     | Positive error for Density                          | solar |
| 98            | eneg_logg     | float     | Negative error for Surface Gravity                  | cgs   |
| 99            | epos_logg     | float     | Positive error for Surface Gravity                  | cgs   |
| 100           | eneg_lum      | float     | Negative error for Luminosity                       | solar |
| 101           | epos_lum      | float     | Positive error for Luminosity                       | solar |
| 102           | eneg_dist     | float     | Negative Error for Distance                         | pc    |
| 103           | epos_dist     | float     | Positive Error for Distance                         | pc    |
| 104           | distFlag      | string    | Source of distance                                  |       |
| 105           | eneg_Teff     | float     | Negative error for effective temperature            | K     |
| 106           | epos_Teff     | float     | Positive error for effective temperature            | K     |
| 107           | TeffFlag      | string    | Source of effective Temperature                     |       |
| 108           | gaiabp        | float     | Gaia Bp magnitude                                   | mag   |
| 109           | e_gaiabp      | float     | Error in Gaia Bp magnitude                          | mag   |
| 110           | gaiarp        | float     | Gaia Rp magnitude                                   | mag   |
| 111           | e_gaiarp      | float     | Error in Gaia Rp magnitude                          | mag   |
| 112           | giaqflag      | int       | Quality of Gaia information                         |       |
| 113           | starchareFlag | float     | Error of asymmetric errors                          |       |
| 114           | VmagFlag      | float     | Source of V magnitude                               |       |
| 115           | BmagFlag      | float     | Source of B magnitude                               |       |
| 116           | splits        | string    | Identifies if star is in a specially curated list.  |       |
| 117           | e_RA          | double    | Error in RA                                         | mas   |
| 118           | e_Dec         | double    | Error in Dec                                        | mas   |
| 119           | RA_orig       | double    | RA from original catalog                            | deg   |
| 120           | Dec_orig      | double    | Dec from original catalog                           | deg   |
| 121           | e_RA_orig     | double    | Ra error as given in original catalog               | mas   |
| 122           | e_Dec_orig    | double    | Dec error as given in original catalog              | mas   |
| 123           | raddflag      | int       | 1 - dwarf by radius, 0 - giant by radius            |       |
| 124           | wdflag        | int       | 1 - star in Gaia's photometric "White Dwarf region" |       |

## Detailed descriptions, and notes, of individual TICv8 columns

No. Name Notes

- 1 TICID A unique identifier for every object in the TIC. The ID is unique and permanent. If an object is removed from the TIC in later versions, a new object will never inherit an old ID.
- 2 Version This column denotes the date, in YYYYMMDD format, in which the TIC was finalized and prepared for delivery. For TICv8 this is 20190410.
- 3 HIP The matched Hipparcos identifier. This match has not been updated in TICv8.

- 4 TYC The matched Tycho identifier. This match has not been updated in TICv8.
- 5 UCAC The matched UCAC-4 identifier. This match has not been updated in TICv8.
- 6 TWOMASS The matched 2MASS identifier. This match has not been updated in TICv8.
- 7 SDSS The values given are the 64-bit "objID" values, not the IAU-format "SDSS J" identifiers. This match has not been updated in TICv8.
- 8 ALLWISE The matched ALLWISE identifier. This match has not been updated in TICv8.
- 9 GAIA The matched Gaia DR2 identifier has been updated in TICv8. Gaia IDs in TICv8 are included for stars that are found in the Gaia-provided Gaia-2MASS look-up table. These identifiers have been updated by the Gaia team from DR1 to DR2, and may not be consistent between TICv7 and TICv8.
- 10 APASS The matched APASS identifier. APASS stars do not have identifiers, only coordinates. The primary key of an internal TIC version of the APASS database table as a proxy identifier. This match has not been updated in TICv8.
- 11 KIC The matched Kepler Input Catalog (KIC) identifier. This match has not been updated in TICv8.
- 12 Objtype This column identifies the astronomical type for a given TIC object. An object in the TIC is either a STAR (1), or an EXTENDED (2) object.
- 13 Typesrc This column is a flag which denotes the source of the object in the TIC. These flags are briefly defined below, and users are directed to the appendix of the full documentation for a more comprehensive description of each source.

gaia2 - stellar source from Gaia DR2

hip - stellar source is hipparcos

cooldwarfs - stellar source is the cool dwarf list

2mass - stellar source is 2MASS

lepine - Lepine (2011,AJ, 142, 138) All-sky Catalog of Bright M Dwarfs

tmgaia - stellar source from Gaia DR1 with unique 2MASS match

tmgaia2 - stellar source from Gaia DR2 with unique 2MASS match

tmmgaia - stellar source from Gaia without unique 2MASS match

hotsubdwarf - stellar source is the hot subdwarf list

gicycle1 - stellar source is the GI cycle 1 program

gistars8 - stellar source is the GI cycle 2 program

Astroseis - point source from the asteroseismology group

- 14 RA The right ascension of the object in degrees. The right ascension is provided in epoch 2000 due to mission requirements. Users are requested to use the original catalog right ascension (column 119) when propagating positions forward.
- 15 Dec The declination of the object in degrees. The declination is provided in epoch 2000 due to mission requirements. Users are requested to use the original catalog declination (column 120) when propagating positions forward.

- 16 Posflag This column is a flag which denotes the source of a given TIC object's position. These flags are briefly defined below, and users are directed to the appendix of the full documentation for a more comprehensive description of each source.

gaia2 - stellar source from Gaia DR2

hip - stellar source is Hipparcos

cooldwarfs - stellar source is the cool dwarf list

2mass - stellar source is 2MASS

lepine - Lepine (2011, AJ, 142, 138) All-sky Catalog of Bright M Dwarfs

tmgaia - stellar source from Gaia DR1 with unique 2MASS match

tmgaia2 - stellar source from Gaia DR2 with unique 2MASS match

tmmgaia - stellar source from Gaia without unique 2MASS match

hotsubdwarf - stellar source is the hot subdwarf list

gicycle1 - stellar source is the GI cycle 1 program

Astroseis - point source from the asteroseismology group

2MASSEXT - extended source from 2MASS extended source catalog

17 pmRA The right ascension proper motions in mas/yr. The vast majority of the stars in TICv8 have their proper motions adopted from Gaia DR2, however, stars which were not identified in Gaia DR2 have their proper motions provided in the TICv7 order of preference described in Stassun et al. (2018, AJ, 156, 102).

18 pmRA\_e The right ascension proper motion errors in mas/yr. The vast majority of stars in TICv8 have their proper motion errors adopted from Gaia DR2, however, stars which were not identified in Gaia DR2 have their errors adopted from additional catalogs following the order of preference used for TICv7 described in Stassun et al. (2018, AJ, 156, 102).

19 pmDec The declination proper motion in mas/yr. This column follows similar rules described in the description for Column 17.

20 pmDec\_e The declination proper motion error in mas/yr. This column follows similar rules described in the description for Column 18.

21 PMFlag This column is the flag which provides the source of the proper motion. The flags are provided below with a brief description. The vast majority of stars in TICv8 have their proper motion adopted from Gaia DR2, however, stars which were not identified in Gaia DR2 have their proper motions adopted from additional catalogs following the order of preference used for TICv7 described in Stassun et al. (2018, AJ, 156, 102).

gaia2 - proper motion from Gaia DR2

tgas - proper motion from Tycho2-Gaia Astrometric Solution

sblink - proper motion from SuperBlink

tycho2 - proper motion from Tycho 2

hip - proper motion from Hipparcos

ucac5 - proper motion from UCAC5

ucac4 - proper motion from UCAC4

hsoy - proper motion from Hot Stuff for One Year

22 plx The parallax values in mas. The vast majority of stars have parallaxes provided by Gaia DR2. Please note, in some cases, these parallaxes may be unphysical (negative), but they are reported identical to what is provided in Gaia DR2. In cases where a star does not have a parallax in Gaia DR2, the parallaxes were adopted following the order of preference used in TICv7 described in Stassun et al. (2018, AJ, 156, 102).

23 e\_plx The error in the parallax in mas. The vast majority of stars have parallax errors provided by Gaia DR2. In cases, where a star does not have a parallax in Gaia DR2, the parallaxes were adopted following the order of preference used in TICv7 described in Stassun et al. (2018, AJ, 156, 102).

24 PARFlag This column is a flag which denotes the source of the parallax. The flags are provided below with a brief description. The vast majority of stars have parallaxes provided by Gaia DR2. In cases where a star does not have a parallax in Gaia DR2, the parallaxes were adopted following the order of preference used in TICv7 described in Stassun et al. (2018, AJ, 156, 102).

gaia2 - parallax from Gaia DR2

tgas - parallax from the Tycho-Gaia Astrometric Solution

hip - parallax from hipparcos.

25 GalLong The Galactic longitude of the object in degrees. This position is provided in epoch 2000 due to mission requirements.

26 GalLat The Galactic latitude of the object in degrees. This position is provided in epoch 2000 due to mission requirements.

27 EcLong The ecliptic longitude of the object in degrees. This position is provided in epoch 2000 due to mission requirements.

28 EcLat The ecliptic latitude of the object in degrees. This position is provided in epoch 2000 due to mission requirements.

29 Bmag The Johnson B magnitude. When an observed optical B magnitude is not provided, a B magnitude is calculated following the relations implemented for TICv7 described in Stassun et al. (2018, AJ, 156, 102).

30 e\_Bmag The error in the Johnson B magnitude.

31 Vmag The Johnson V magnitude. Observed V magnitudes are preferred when they are converted from Tycho Vt, Hipparcos or UCAC. Otherwise, a Johnson V magnitude is calculated from the Gaia colors (G, Bp, Rp) for stars that do not have a reliable observed Johnson V magnitude. If a star does not have a reliable Gaia color, the V magnitude is calculated following the relations implemented for TICv7 described in Stassun et al. (2018, AJ, 156, 102).

32 e\_Vmag The error in the Johnson V magnitude.

33 umag The u magnitude adopted from SDSS adopted when available.

34 e\_umag The u magnitude error adopted from SDSS adopted when available.

35 gmag The g magnitude adopted from SDSS adopted when available.

36 e\_gmag The g magnitude error adopted from SDSS adopted when available.

37 rmag The r magnitude adopted from SDSS adopted when available.

38 e\_rmag The r magnitude error adopted from SDSS adopted when available.

39 imag The i magnitude adopted from SDSS adopted when available.

40 e\_imag The i magnitude error adopted from SDSS adopted when available.

41 zmag The z magnitude adopted from SDSS adopted when available.

42 e\_zmag The z magnitude error adopted from SDSS adopted when available.

43 Jmag The J magnitude adopted from 2MASS adopted when available.

44 e\_Jmag The J magnitude error adopted from 2MASS adopted when available.

45 Hmag The H magnitude adopted from 2MASS adopted when available.

46 e\_Hmag The H magnitude error adopted from 2MASS adopted when available.

47 Kmag The K magnitude adopted from 2MASS adopted when available.

48 e\_Kmag The K magnitude error adopted from 2MASS adopted when available.

49 TWOMflag The quality flags from 2MASS are provided in a similar format to the EPIC catalog: ph\_qual-rd\_flag-bl\_flg-cc\_flg-gal\_contam-mp\_flag.

50 prox The distance in arcseconds to the 2MASS nearest neighbor.

51 W1Mag The W1 magnitude adopted from ALLWISE adopted when available.

52 e\_W1Mmag The W1 magnitude error adopted from ALLWISE adopted when available.

53 W2Mag The W2 magnitude adopted from ALLWISE adopted when available.

54 e\_W2Mmag The W2 magnitude error adopted from ALLWISE adopted when available.

55 W3Mag The W3 magnitude adopted from ALLWISE adopted when available.

56 e\_W3Mmag The W3 magnitude error adopted from ALLWISE adopted when available.

57 W4Mag The W4 magnitude adopted from ALLWISE adopted when available.

58 e\_W4Mmag The W4 magnitude error adopted from ALLWISE adopted when available.

57 Gmag The G magnitude adopted from Gaia DR2 adopted when available.

58 e\_Gmag The G magnitude error adopted from Gaia DR2 adopted when available.

61 Tmag The TESS magnitude for the object, this column is never NULL. The Tmag values are typically based on relations that depend on Gaia Bp and Rp magnitudes (see section 3.2.1 in the full documentation for the relation). TESS magnitudes for objects without appropriate Gaia Bp or Rp magnitude had their TESS magnitudes calculated using relations implemented for TICv7 described in Stassun et al. (2018, AJ, 156, 102). Stars which were in the specially curated hot subdwarfs, and cool dwarfs lists had their TESS magnitudes directly adopted.

62 e\_Tmag The error in the TESS magnitude.

63 TESSflag These flags denote which relation, or catalog, provides the TIC TESS magnitude. Full descriptions can be found in Section 2.3.1 of the full documentation:

#### Flags described in TICv8 documentation

goffs - magnitude from offset from Gaia

gpbr - magnitude from cooldwarfs

gbprp - magnitude calculated from observed Gaia Bp-Rp

rerred - magnitude calculated after de-reddening Gaia Bp-Rp and re-reddening the result

hotsd - magnitude from the hot subdwarf list

cdwrf - magnitude from cool dwarf list (Muirhead et al 2018)

#### Flags described in TICv7 documentation

gaiav - magnitude calculated from G and V (see Stassun et al. 2018, AJ, 156, 102))

gaiaj - magnitude calculated from G and 2MASS J (see Stassun et al. 2018, AJ, 156, 102))

gaiah - magnitude calculated from Gaia and 2MASS H (see Stassun et al. 2018, AJ, 156, 102))

gaiak - magnitude calculated from G and 2MASS Ks (see Stassun et al. 2018, AJ, 156, 102))

voffset - magnitude calculated from V and offset (see Stassun et al. 2018, AJ, 156, 102))

gaiaoffset - magnitude calculated from G and an offset (see Stassun et al. 2018, AJ, 156, 102))

joffset - magnitude calculated from 2MASS J offset (+0.5 for J-Ks < -0.1) (see Stassun et al. (2018, AJ, 156, 102))

joffset2 - magnitude calculated from 2MASS J and an offset (+1.75 for J-Ks > 1) (see Stassun et al. (2018, AJ, 156, 102))

hoffset - magnitude calculated from 2MASS H offset (see Stassun et al. (2018, AJ, 156, 102))

koffset - magnitude calculated from 2MASS Ks and offset (see Stassun et (2018, AJ, 156, 102))

vjh - magnitude calculated from V and 2MASS J-H (see Stassun et al. (2018, AJ, 156, 102))

jhk - magnitude calculated from 2MASS J-Ks (see Stassun et al. (2018, AJ, 156, 102))

vjk - magnitude calculated from V and 2MASS J-Ks (see Stassun et al. (2018, AJ, 156, 102))

jh - magnitude calculated from 2MASS J-H (see Stassun et al. (2018, AJ, 156, 102))

tmvk - magnitude calculated from V and 2MASS Ks (same as vk) (see Stassun et al. (2018, AJ, 156, 102))

bpjk - magnitude calculated from photographic B and 2MASS J-Ks (see Stassun et al. (2018, AJ, 156, 102))

from\_apass\_i - magnitude from cool dwarf list (Muirhead et al 2018)

from\_sdss\_ik - magnitude from cool dwarf list (Muirhead et al 2018)

wmean\_vk\_jhk - magnitude from cool dwarf list (Muirhead et al 2018)

64 SPFlag These flags denote the origin of stellar parameters:

cdwrf - mass and radius adopted from the Cool Dwarf list

hotstd - mass and radius adopted from the Hot Subdwarf list

gaia2 - mass and radius computed using Gaia DR2 parameters

tic7 - mass and radius directly copied from TICv7

65 Teff The effective temperature of the object in K. The effective temperatures come from one of four sources, in the following order of preference: (1) the Cool Dwarf list or the Hot Subdwarf list; (2) spectroscopic catalogs (see Column 64); (3) dereddened Bp-Rp color (column 108, 110); and (4) non-dereddened Bp-Rp color (column 108, 110).

66 e\_Teff The error in the effective temperature of the object in K. The error provided for the effective temperature is a symmetrized error, calculated by arithmetic mean of the asymmetric errors (columns 105 and 106). It is possible these errors may be larger than the value reported in column 65. Users are cautioned this means the reported value is untrustworthy.

67 Logg The surface gravity of the object in cgs. The surface gravity is calculated using the nominal formula:  $\log_{10}(G \cdot M \cdot M_{\text{sun}} / (R \cdot R_{\text{sun}})^2)$ . Where  $M_{\text{sun}}$  is the mass of the Sun,  $G$  is the gravitational constant,  $R_{\text{sun}}$  is the Radius of the Sun,  $M$  is the mass of the star (column 73), and  $R$  is the radius of the star (column 71). Some stars may have unphysical  $\log(g)$  values for their estimated temperature, such as  $\log(g) > 5$ , but these  $\log(g)$  values should be internally consistent with the provided mass and radii of each star. The surface gravities provided are not the values reported by spectroscopic catalogs; they are always calculated from the reported masses and radii of a given object.

68 e\_logg The error in the surface gravity in cgs units. The error provided for the surface gravity is a symmetrized error, calculated by arithmetic mean of the asymmetric errors (columns 98 and 99). It is possible these errors may be larger than the value reported in column 67. Users are cautioned this means the reported value is of untrustworthy.

79 M/H The metallicity of the object in dex. The metallicity is only provided if it was reported in a spectroscopic catalog matched to TICv8, using the order preference described in section 2.1.1 of the full documentation. If a catalog provided more than one measurement of the metallicity for the a single object, the metallicities were combined using a weighted-mean. These metallicities were not used in any calculation, are only provided for convenience, and may conflict with reported masses and radii -- especially for very metal rich or very metal poor stars. Users are cautioned against using the reported metallicities with the calculated TICv8 stellar parameters, without additional vetting.

70 e\_M/H The error in the metallicity of an object in dex. For stars with spectroscopic metallicity from a single observation, the error was copied from the relevant catalog. The SPOCS and GALAH catalogs do not provide uncertainties for metallicities; 0.10 and 0.05 dex were assigned, respectively, based on the reported statistical error from these catalogs.

71 Rad The stellar radius in solar units. The vast majority of stellar radii in TICv8 were estimated using three techniques, in the following order of preference: (1) radii provided by the specially curated Cool Dwarf list; (2) radii provided in the Hot Subdwarf list; or (3) using the Gaia distance, bolometric corrections, G magnitude, and a preferred temperature. (4) Some stars had their properties either imported directly from TICv7, or calculated using TICv7 relationships, if their Gaia parameters were deemed unreliable enough to determine stellar characteristics (gaiaqlflag = 0; column 112). Users are directed to Stassun et al. (2018, AJ, 156, 102) for a detailed description of the relations used to estimate these radii.

72 e\_Rad The error in the radius in solar units. The error provided for the radius is a symmetrized error, calculated by arithmetic mean of the asymmetric errors (columns 95 and 96). It is possible these errors may be larger than the value reported in column 71. Users are cautioned this means the reported value is of untrustworthy.

73 Mass The stellar mass in solar units. The stellar masses were estimated using three techniques: (1) masses provided in the specially curated cool dwarf list; (2) masses provided in the specially curated hot subdwarf list; or (3) using a unified relation based on measured masses for eclipsing binaries as well as simulations using Galactic structure models (see section 2.2.5 in the full documentation for details).

74 e\_Mass The error in the mass in solar units. The error provided for the mass is a symmetrized error, calculated by arithmetic mean of the asymmetric errors (columns 92 and 93). It is possible these errors may be larger than the value reported in column 73. Users are cautioned this means the reported value is of untrustworthy.

75 Rho The density of the object in solar units. The density is calculated using the formula  $M/R^3$ , where M is the mass of the star (column 73) and R is the radius of the star (column 71).

76 Rho\_e The error in the density in solar units. The error provided for the density is a symmetrized error, calculated by arithmetic mean of the asymmetric errors (columns 96 and 97). It is possible these errors may be larger than the value reported in column 75. Users are cautioned this means the reported value is of untrustworthy.

77 LumClass This flag denotes the luminosity class of the star. These flags are defined as follows:

dwarf - the star has a radius smaller than the line in Figure 10 of the full documentation

giant - the star has a radius larger than the line in Figure 10 of the full documentation

rpmjdwarf - the star has unreliable Gaia information, but the reduced proper motion calculated in TICv7 identifies the star as a dwarf.

rpmjgiant - the star has unreliable Gaia information, but the reduced proper motion calculated in TICv7 identifies the star as a giant.

Stars with the flags of rpmjdwarf and rpmjgiant are assumed to be a dwarf, or giant stars based on their reduced proper motion in coordination with their 2MASS J magnitude (see Stassun et al. (2018, AJ, 156, 102)). Users should be aware the rpmjdwarf flag effectively means that the star is either a dwarf or a subgiant, based on reduced proper motion cuts.

78 Lum The luminosity of the object in solar units. The luminosity is calculated using the following formula and defined in solar units:  $R^2 \cdot (T_{\text{eff}}/5772)^4$ , where R is the radius of the star (column 73) and  $T_{\text{eff}}$  is the effective temperature (column 65).

79 Lum\_e The error in the luminosity in solar units. The error provided for the luminosity is a symmetrized error, calculated by arithmetic mean of the asymmetric errors (columns 100 and 101). It is possible these errors may be larger than the value reported in column 78. Users are cautioned this means the reported value is of untrustworthy.

80 d The distance to the object in pc. These distances have been adopted from Bailer-Jones et al. (2018), when available. While some parallax measurements may be negative, the Bailer-Jones distance estimator is always positive.

81 e\_d The error in the distance to the object in pc. The error in the distance is a symmetrized error, calculated by arithmetic mean of the asymmetric errors (columns 102 and 103). It is possible these errors may be larger than the value reported in column 80. Users are cautioned this means the reported value is of untrustworthy.

82 e(b-v) The applied color excess for the object in mag. Wherever possible we de-reddened adopted used E(B-V) from the Pan-STARRS dust map and the Schlegel et al. (1998) map where either the star is outside the Pan-STARRS footprint. The extinction value for stars with distances less than 100 pc has been set to 0. We applied a correction factor of 0.884 for the conversion from Schlegel 1998 to Schlafly & Finkbeiner 2011. Values based on Schlegel have been corrected for the distance, values based on Pan-STARRS depend intrinsically on distance. Column 91 indicates which of the dustmaps would be used for dereddening. Please note that dereddening corrections are only applied if the Gaia quality flag is 1.

83 e\_e(b-v) The error in the color excess for the object in mag. The error in the color excess is a symmetrized error, calculated by arithmetic mean of the asymmetric errors (columns 89 and 90). It is possible these errors may be larger than the value reported in column 82. Users are cautioned this means the reported value is of untrustworthy.

84 numcont The number of contaminants found within 10" of the star, used in the calculation of the contamination ratio.

85 contratio The contamination ratio is defined as the nominal flux from the contaminants divided by the flux from the source. Flux contamination is calculated for all stars in the CTL, and the procedure for TICv8 is identical to the procedure for TICv7. See section 3.3.3 of Stassun et al. (2018, AJ, 156, 102) for a complete description of the contamination ratio calculation.

86 disposition This column identifies objects that are included in the TIC, but are likely spurious, or related to other TIC objects in a non-trivial, non-astrophysical way. Currently, this column is populated as a NULL, DUPLICATE (6), ARTIFACT (7), or SPLIT (8). When a single star in a previous TIC is found to be two or more actual sources due to the enhanced resolution of Gaia DR-2, the original TICID gets the disposition SPLIT. New TICIDs are assigned to the objects and the original TICID is in column DUP\_ID (column 87). The original star "SPLIT" star will have NULL in the dup\_id. The DUPLICATE flag means the star is listed twice (or more) in the TIC due to prior cross-matching difficulties. In this case, DUP\_ID contains the TICID of the real star.

87 dup\_id This column points to the TIC ID of the 'other' object in a DUPLICATE, or SPLIT set of stars.

88 priority Priority of target for observation. This is a floating-point value ranging from 0 to 1, where 1 is highest priority. The priority is based on the relative ability of TESS to detect small planetary transits, and is calculated using the radius of the star, the contamination ratio, and the total expected photometric precision. Stars are given a boost factor to their priority that scales with a probabilistic model of the expected number of sectors any given star could fall in. Typically, the closer the star is to the Ecliptic North or South pole, the larger the boost factor. Stars close to the Galactic Plane ( $|b| < 10$  degrees) have been de-boosted by a factor of 0.1 since we generally have a poor understanding of their true reddening, unless they are in the specially curated cool dwarf list (see Muirhead et al. 2018) or hot subdwarf list.

The formula is defined for CTLv8.01 is:  $\text{sqrt}(N_s)/(R^{1.5} \cdot \sigma)$

where  $N_s$  is the expected number of *TESS* sectors to observe the star;  $R$  is the radius of the star (column 71), and  $\sigma$  is the expected photometric precision of the star based on the *TESS* magnitude (column 61) using the formulation from Pepper et al. 2018 (in prep). The priority is normalized by the priority for a star with  $R = 0.1$  solar,  $N_s = 12.654$  sectors, no contamination and  $\sigma = 61.75$  ppm.

Some stars will have distinct priorities:

Stars with  $\log(g)$  values that are greater than 5 have had their priorities set to 0 to avoid biases from poor quality effective temperature, extinction, or parallax measurements. Stars in the specially curated lists are excluded from this scenario.

Stars with ecliptic latitudes (column 28) less than  $\sim 6$  degrees in absolute value are not expected to be observed as part of the main mission due to a gap in camera coverage between the Southern and Northern observations. Therefore, their  $N_s$  values are 0 and thus the priority is 0.

89 eneg\_EBV The lower asymmetric error on the color excess. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

90 epos\_EBV The upper asymmetric error on the color excess. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

91 EBVFlag This flag denotes the source of the adopted extinction:

- 0 - A color excess applied of 0 (star is closer than 100 pc)
- 1 - Reddening applied from Schlegel dust maps
- 2 - Reddening applied from Pan-STARRS dust maps

92 eneg\_Mass The lower asymmetric error for the mass in solar units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

93 epos\_Mass The upper asymmetric error for the mass in solar units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

94 eneg\_Rad The lower asymmetric error for the radius in solar units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

95 epos\_Rad The upper asymmetric error for the radius in solar units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

96 eneg\_rho The lower asymmetric error for the density in solar units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

97 epos\_rho The upper asymmetric error for the density in solar units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

98 eneg\_logg The lower asymmetric error for the surface gravity in cgs units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

99 epos\_logg The upper asymmetric error for the surface gravity in cgs units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

100 eneg\_lum The lower asymmetric error for the luminosity in solar units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

101 epos\_lum The upper asymmetric error for the luminosity in solar units. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

102 eneg\_dist The lower asymmetric error for the distance in pc. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

103 epos\_dist The upper asymmetric error for the distance in pc. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

104 distFlag This column displays the source of the distance. The flag descriptions are provided below with a brief explanation.

105 eneg\_Teff The lower asymmetric error for the effective temperature in K. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

106 epos\_Teff The upper asymmetric error for the effective temperature in K. The asymmetric errors are calculated using a Monte-Carlo procedure for stars in CTLv8.01 (see section 3.2.2 of the full documentation).

107 TeffFlag The source of the effective temperature. The flag descriptions are provided below with a brief explanation.

- cdwrf - temperature from the cool dwarf specially curated list
- hotsd - temperature from the hot subdwarf specially curated list
- gaia2 - temperature from Gaia Bp - Gaia Rp color
- spect - temperature from a spectroscopic catalog

tic7 - temperature imported from TICv7

108 gaiabp The Gaia Bp magnitude, adopted when available.

109 e\_gaiabp The error in the Gaia Bp magnitude, adopted where available.

110 gaiarp The Gaia Rp magnitude, adopted when available.

111 e\_gaiarp The error in the Gaia Rp magnitude, adopted when available.

112 gaiaqflag Boolean flag that denotes the quality of the Gaia parallax and magnitude information:

-1 - insufficient information

0 - star fails astrometric or photometric quality check

1 - star passes both checks

113 starchareFlag unused

114 VmagFlag The source of the V magnitude. The source flags are defined below:

ucac4 - V magnitude calculated from ucac4 magnitude

tycho2v3- V magnitude calculated from Tycho2 Vt

tycho2v - V magnitude calculated from Tycho2 Vt

tycho - V magnitude calculated from Tycho 2 Vt

gaia2 - V magnitude from Gaia Bp - Gaia Rp color

None - should be NULL

apassdr9 - V magnitude adopted from APASS DR-9

apass - V magnitude adopted from APASS DR-7

sblink - V magnitude adopted from Super Blink

mermil - V magnitude adopted from the Mermilliod catalog

cdwarf - V magnitude adopted from the cool dwarf catalog (v6)

cdwrf - V magnitude adopted from the cool dwarf catalog (v7)

sirful - V magnitude adopted from the Sirful catalog

hipvmag - V magnitude calculated from Hipparcos

gaiak - V magnitude calculated from Gaia DR-1 G and 2MASS Ks

115 BmagFlag The source of the B magnitude. The source flags are defined below:

tycho2b3- B magnitude calculated from Tycho2 Bt

tycho2b - B magnitude calculated from Tycho2 Bt

tycho - B magnitude calculated from Tycho 2 Bt

None - should be null

apassdr9 - B magnitude adopted from APASS DR-9

bpbj - B magnitude calculated from 2MASS photometric B

mermil - B magnitude adopted from the Mermilliod catalog

116 splists Identifies whether the star is in a special list. The flags are provided below with a brief description.

Cooldwarfs\_v8 - cool dwarf star version TICv8

Hotsubdwarfs\_v8 - hot subdwarf star version TICv8

117 e\_RA The error in the right ascension in milliarcseconds.

118 e\_Dec The error in the declination in milliarcseconds.

119 RA\_orig The right ascension in degrees, as provided in the source catalog of the position.

120 Dec\_orig The declination in degrees, as provided in the source catalog of the position.

121 e\_RA\_orig The error in the right ascension in milliarcseconds, as provided in the source catalog of the position.

122 e\_Dec\_orig The error in the declination in milliarcseconds, as provided in the source catalog of the position.

123 raddflag Boolean flag that denotes if the star is a dwarf by its radius:

-1 - insufficient information

0 - star is not a dwarf

1 - star is a dwarf

124 wdflag Boolean flag that denotes if the star is in Gaias photometric "White Dwarf Region" on the HRD:

-1 - insufficient information

0 - star is not in the White Dwarf region

1 - star is in the White Dwarf region

### **Planned Improvements in Future Versions**

There are a number of planned improvements for the future versions of the TIC. At present these improvements include: