

CHANGE NOTICE

Affected Document: IS-GPS-200 Rev N	IRN/SCN Number XXX-XXXX-XXX	Date: DD-MMM-YYYY
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Authority: RFC-000544	Proposed Change Notice PCN-IS-200N-RFC544	Date: 18-MAR-2026
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Document Title: NAVSTAR GPS Space Segment/Navigation User Segment Interfaces

RFC Title: Eccentric Anomaly Rate Fix and No Cost Items

Reason For Change (Driver):

1. The Eccentric Anomaly Rate formula in all documents that describe this CNAV formula are incorrect
2. There are requirements and description changes from RFC-495A and RFC-502 which did not make it into the requirements baseline but are still correct and would help civil user equipment engineers make better civil receivers. This includes a number of Core CEI description changes that were worked out, but did not make it into RFC-502.
3. PRAT Item 2020-03 to normalize the use of scientific notation across the Public GPS interface documents has only been partially implemented
4. During the last Public ICWG, it became apparent that the Public interface documents do not use a uniform method of documenting multiplication in formulas
5. RFC-515 made a number of changes to XML which still need to be made to ICD-GPS-870 to ensure that Public users of XML are executing XML correctly

Description of Change:

1. The Eccentric Anomaly Rate formula will be corrected in all CNAV Public documents (PRAT 2025-02, Pre-RFC-1445)
2. The changes from RFCs-495A and 502 would be added into the requirements baseline (PRAT 2021-03)
3. The changes needed to normalize the use of scientific notation in the Public GPS interface documents will be completed (PRAT 2020-03)
4. The few places that use "*" or "x" to denote multiplication of scalar values will be normalized to what is used across the Public Signal-In-Space documents
5. The XML to ICD-GPS-870 would be completed so it describes the as-built XML system (Pre-RFC-1354, promulgates and completes the work started in RFC-515)

Authored By: RE: Tony Anthony **Checked By: RE: Sean Gutierrez**

AUTHORIZED SIGNATURES	REPRESENTING	DATE
	System Delta 831	
	Mission Delta 31	

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THIS DOCUMENT SPECIFIES TECHNICAL REQUIREMENTS AND NOTHING HEREIN CONTAINED SHALL BE DEEMED TO ALTER THE TERMS OF ANY CONTRACT OR PURCHASE ORDER BETWEEN ALL PARTIES AFFECTED.	Interface Control Contractor: SAIC (GPS SE&I) 200 N. Pacific Coast Highway, Suite 1800 El Segundo, CA 90245
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IS200-18:

Section Number:

3.1.0-1

WAS:

The interface between the GPS Space Segment (SS) and the GPS navigation User Segment (US) includes two RF links, L1 and L2. Utilizing these links, the space vehicles (SVs) of the SS shall provide continuous earth coverage signals that provide to the US the ranging codes and the system data needed to accomplish the GPS navigation (NAV) mission. These signals shall be available to a suitably equipped user with RF visibility to an SV.

Redlines:

The interface between the GPS Space Segment (SS) and the GPS navigation User Segment (US) includes two RF links, L1 and L2. Utilizing these links, the space vehicles (SVs) of the SS shall provide continuous earth coverage signals that provide to the US the ranging codes and the system data needed to accomplish the GPS navigation (NAV) mission. ~~These signals shall be available to a suitably equipped user with RF visibility to an SV.~~

IS:

The interface between the GPS Space Segment (SS) and the GPS navigation User Segment (US) includes two RF links, L1 and L2. Utilizing these links, the space vehicles (SVs) of the SS shall provide continuous earth coverage signals that provide to the US the ranging codes and the system data needed to accomplish the GPS navigation (NAV) mission.

Rationale:

CRM #86 10/30/2022: Remove duplicate sentence that had been moved to next paragraph. This is a correction to an administrative requirement "split" that accidentally hadn't been completed. (T. Anthony)

IS200-2405:

Insertion after object IS200-1315

Section Number:

3.2.1.3.2

WAS:

<INSERTED OBJECT>

Redlines:

Object Heading 3.2.1.3.2 [C/A Code Cross-correlation Mitigation](#)

Object Type: [Header](#)

IS:

Object Heading 3.2.1.3.2 C/A Code Cross-correlation Mitigation

Object Type: Header

Rationale:

3/9/2026 CRM #6 Add Cross-Correlation Advice (T. Anthony)

IS200-2406:

Insertion below object IS200-2405

Section Number:

3.2.1.3.2.0-1

WAS:

<INSERTED OBJECT>

Redlines:

The code-division-multiple-access techniques that allow differentiation between SVs generally provide about 25 dB of margin between signals. This separation is generally sufficient to provide cross-correlation protection. However, some user integrations are able to track signals that are more than 25 dB below nominal power levels. To preclude cross-correlation, users should perform a cross-correlation check on acquisition or reacquisition. One cross-correlation check is to compare the satellite position calculated from the broadcast ephemeris in Subframes 1, 2, and 3 with the satellite position calculated from a valid almanac and to reject signals when the difference is greater than 3,000 km.

Object Type: [Info-Only](#)

IS:

The code-division-multiple-access techniques that allow differentiation between SVs generally provide about 25 dB of margin between signals. This separation is generally sufficient to provide cross-correlation protection. However, some user integrations are able to track signals that are more than 25 dB below nominal power levels. To preclude cross-correlation, users should perform a cross-correlation check on acquisition or reacquisition. One cross-correlation check is to compare the satellite position calculated from the broadcast ephemeris in Subframes 1, 2, and 3 with the satellite position calculated from a valid almanac and to reject signals when the difference is greater than 3,000 km.

Object Type: Info-Only

Rationale:

3/9/2026 CRM #6 Add Cross-Correlation Advice (T. Anthony)

IS200-2407:

Insertion after object IS200-1325

Section Number:

3.2.1.5.2

WAS:

<INSERTED OBJECT>

Redlines:

Object Heading 3.2.1.5.2 [L2 CL-Code Cross-correlation Mitigation](#)

Object Type: [Header](#)

IS:

Object Heading 3.2.1.5.2 L2 CL-Code Cross-correlation Mitigation

Object Type: Header

Rationale:

3/9/2026 CRM #6 Add Cross-Correlation Advice (T. Anthony)

IS200-2408:

Insertion below object IS200-2407

Section Number:

3.2.1.5.2.0-1

WAS:

<INSERTED OBJECT>

Redlines:

To preclude cross-correlation on the L2C signal, users should perform a cross-correlation check on signal acquisition or reacquisition. One cross-correlation check for equipment that processes the data (L2-CL) and the pilot (L2-CM) components using a single tracking loop driven by the pilot signal is to check the PRN code number used for signal tracking with the PRN parameter broadcast in the CNAV messages.

Object Type: [Info-Only](#)

IS:

To preclude cross-correlation on the L2C signal, users should perform a cross-correlation check on signal acquisition or reacquisition. One cross-correlation check for equipment that processes the data (L2-CL) and the pilot (L2-CM) components using a single tracking loop driven by the pilot signal is to check the PRN code number used for signal tracking with the PRN parameter broadcast in the CNAV messages.

Object Type: Info-Only

Rationale:

3/9/2026 CRM #6 Add Cross-Correlation Advice (T. Anthony)

IS200-2041:

Section Number:

3.3.1.1.0-2

WAS:

The carrier frequencies for the L1 and L2 signals shall be coherently derived from a common frequency source within the SV. The nominal frequency of this source -- as it appears to an observer on the ground -- is 10.23 MHz. The SV carrier frequency and clock rates -- as they would appear to an observer located in the SV -- are offset to compensate for relativistic effects. The clock rates are offset by $\Delta f/f = -4.4647E-10$, equivalent to a change in the P-code chipping rate of 10.23 MHz offset by a $\Delta f = -4.5674E-3$ Hz. This is equal to 10.2299999954326 MHz.

Redlines:

The carrier frequencies for the L1 and L2 signals shall be coherently derived from a common frequency source within the SV. The nominal frequency of this source -- as it appears to an observer on the ground -- is 10.23 MHz. The SV carrier frequency and clock rates -- as they would appear to an observer located in the SV -- are offset to compensate for relativistic effects. The clock rates are offset by ~~$\Delta f/f = -4.4647E-10$~~ $\Delta f/f = -4.4647 \times 10^{-10}$, equivalent to a change in the P-code chipping rate of 10.23 MHz offset by a ~~$\Delta f = -4.5674E-3$~~ $\Delta f = -4.5674 \times 10^{-3}$ Hz. This is equal to 10.2299999954326 MHz.

IS:

The carrier frequencies for the L1 and L2 signals shall be coherently derived from a common frequency source within the SV. The nominal frequency of this source -- as it appears to an observer on the ground -- is 10.23 MHz. The SV carrier frequency and clock rates -- as they would appear to an observer located in the SV -- are offset to compensate for relativistic effects. The clock rates are offset by $\Delta f/f = -4.4647 \times 10^{-10}$, equivalent to a change in the P-code chipping rate of 10.23 MHz offset by a $\Delta f = -4.5674 \times 10^{-3}$ Hz. This is equal to 10.2299999954326 MHz.

Rationale:

2/26/2026 CRM #73: DOORS Team asked to have the System Verification Method changed to Inspection but it already was Inspection. (T. Anthony)

9/10/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

Also, replaced bit image delta characters with the Unicode delta character. (T. Anthony)

IS200-97:

Section Number:

3.3.2.1.0-1

WAS:

For PRN codes 1 through 37, the $P_i(t)$ pattern (P-code) is generated by the modulo-2 summation of two PRN codes, $X_1(t)$ and $X_2(t - iT)$, where T is the period of one P-code chip and equals $(1.023E7)^{-1}$ seconds, while i is an integer from 1 through 37. This allows the generation of 37 unique $P(t)$ code phases (identified in Table 3-1a) using the same basic code generator.

Expanded P-code PRN sequences, $P_i(t)$ where $38 \leq i \leq 63$, are described as follows:

$$P_i(t) = P_{i-37}(t + T) \text{ (where } T \text{ will equal 24 hours)}$$

therefore, the equation is

$$P_i(t) = P_{i-37x}(t + i * 24 \text{ hours}),$$

where i is an integer from 64 to 210, x is an integer portion of $(i-1)/37$.

As an example, the P-code sequence for PRN 38 is the same sequence as PRN 1 shifted 24 hours into a week (i.e. 1st chip of PRN 38 at beginning of week is the same chip for PRN 1 at 24 hours after beginning of week). The list of expanded P-code PRN assignments is identified in Table 3-1b.

Redlines:

For PRN codes 1 through 37, the $P_i(t)$ pattern (P-code) is generated by the modulo-2 summation of two PRN codes, $X_1(t)$ and $X_2(t - iT_p)$, where T_p is the period duration of one P-code chip ~~and equals $(1.023E7)^{-1}$ seconds~~, while i is an integer from 1 through 37. ~~This allows the generation of 37 unique $P(t)$ code phases (identified in Table 3-1a) using the same basic code generator.~~

Expanded P-code PRN sequences, $P_i(t)$ where $38 \leq i \leq 63$, are described as follows:

$$P_i(t) = P_{i-37}(t + T) \text{ (where } T \text{ will equal } 2486,400 \text{ hoursseconds)}$$

therefore, the equation is

$$P_i(t) = P_{i-37x}(t + i * 86,400 24i \text{ hours});$$

where

t is in units of seconds

i is an integer from 64 to 210;

x is an integer portion of $(i-1)/37$.

As an example, the P-code sequence for PRN 38 is the same sequence as PRN 1 shifted 24 hours into a week (i.e. 1st chip of PRN 38 at beginning of week is the same chip for PRN 1 at 24 hours after beginning of week). ~~The list of expanded P-code PRN assignments is identified in Table 3-1b.~~

IS:

For PRN codes 1 through 37, the $P_i(t)$ pattern (P-code) is generated by the modulo-2 summation of two PRN codes, $X_1(t)$ and $X_2(t - i T_P)$, where T_P is the duration of one P-code chip ($9.77517107 \times 10^{-8}$ seconds), while i is an integer from 1 through 37. This allows the generation of 37 unique $P(t)$ code phases (identified in Table 3-1a) using the same basic code generator.

Expanded P-code PRN sequences, $P_i(t)$ where $38 \leq i \leq 63$, are described as follows:

$$P_i(t) = P_{i-37}(t + 86,400 \text{ seconds})$$

therefore, the equation is

$$P_i(t) = P_{i-37x}(t + 86,400 i)$$

where

t is in units of seconds

i is an integer from 64 to 210

x is an integer portion of $(i-1)/37$

As an example, the P-code sequence for PRN 38 is the same sequence as PRN 1 shifted 24 hours into a week (i.e. 1st chip of PRN 38 at beginning of week is the same chip for PRN 1 at 24 hours after beginning of week). The list of expanded P-code PRN assignments is identified in Table 3-1b.

Rationale:

2/16/2026 CRM #1 Relabeled a P-code chip duration to T_P to remove ambiguity and defined " t " (T. Anthony)

2/16/2026 CRM #2 Redescribed the P-code chip duration with a proper period value, without the division used in the commenter's suggestion (T. Anthony)

8/21/2025: At TIM #1 SMEs requested that the rate for the P-code chip be deleted since this version was confusing but defined clearly elsewhere. This removed the need for dealing with power of 10 notation (T. Anthony)

8/5/2025 Normalize the notation for scalar value multiply, use only implied multiply. (T. Anthony)

IS200-157:

Section Number:

6.2.1.0-1

WAS:

User Range Accuracy (URA) is a statistical indicator of the GPS ranging accuracy obtainable with a specific signal and SV. URA provides a conservative RMS estimate of the user range error (URE) in the associated navigation data for the transmitting SV. It includes all errors for which the Space and Control Segments are responsible. Whether the integrity status flag is “0” or “1”, 4.42 times URA bounds the instantaneous URE with 1-(1e-5) per hour probability (‘legacy’ level of integrity assurance). When the integrity status flag is set to “1”, 5.73 times URA bounds the instantaneous URE with 1-(1e-8) per hour probability (‘enhanced’ level of integrity assurance). Integrity properties of the URA are specified with respect to the scaled (multiplied by either 4.42 or 5.73 as appropriate) upper bound values of the URA index or to the scaled composite of the upper bound values of all component URA indexes.

Redlines:

User Range Accuracy (URA) is a statistical indicator of the GPS ranging accuracy obtainable with a specific signal and SV for all errors for which the Space and Control Segments are responsible. There is a URA for LNAV and a second URA for CNAV. Nominal URA provides a conservative RMS estimate of the user range error (URE) in the associated navigation data for the ~~transmitting~~specific signal and SV. ~~Integrity~~ includes Assured ~~all~~URA errors (IAURA) is a statistical indicator for ~~which bounding~~ the ~~Space~~instantaneous ~~and URE~~ Control ~~obtainable~~ Segments with area responsible specific signal and SV. Whether the integrity status flag is “0” or “1”, ~~±~~4.42 times ~~URA~~IAURA bounds the instantaneous URE with 1-(~~1e1 × 10⁻⁵~~) per hour probability (‘legacy’ level of integrity assurance).- When the integrity status flag is set to ~~“1”~~, ~~±~~5.73 times ~~URA~~IAURA bounds the instantaneous URE with 1-(~~1e1 × 10⁻⁸~~) per hour probability (‘enhanced’ level of integrity assurance).- Integrity properties of the ~~URA~~IAURA are specified with respect to the scaled (multiplied by either ~~±~~4.42 or ~~±~~5.73 as appropriate) upper bound values of the URA index ~~or when using~~ the scaled LNAV composite Clock, Ephemeris, Integrity (CEI) data set or sum of an elevation-dependent URA and a non-elevation dependent URA developed using the upper bound values of ~~all the component~~associated URA indexes when using the CNAV CEI data set.

IS:

User Range Accuracy (URA) is a statistical indicator of the GPS ranging accuracy obtainable with a specific signal and SV for all errors for which the Space and Control Segments are responsible. There is a URA for LNAV and a second URA for CNAV. Nominal URA provides a conservative RMS estimate of the user range error (URE) in the associated navigation data for the specific signal and SV. Integrity Assured URA (IAURA) is a statistical indicator for bounding the instantaneous URE obtainable with a specific signal and SV. Whether the integrity status flag is “0” or “1”, ~~±~~4.42 times IAURA bounds the instantaneous URE with 1-(1 × 10⁻⁵) per hour probability (‘legacy’ level of integrity assurance). When the integrity status flag is set to “1”, ~~±~~5.73 times IAURA bounds the instantaneous URE with 1-(1 × 10⁻⁸) per hour probability (‘enhanced’ level of integrity assurance). Integrity properties of the IAURA are specified with respect to the scaled (multiplied by either ~~±~~4.42 or ~~±~~5.73 as appropriate) upper bound values of the URA index when using the LNAV Clock, Ephemeris, Integrity (CEI) data set or sum of an elevation-dependent URA and a non-elevation dependent URA developed using the upper bound values of the associated URA indexes when using the CNAV CEI data set.

Rationale:

3/10/2026 CRM #3 Negotiated the use of “±” where applicable to instantaneous error bounds and changed all use of “exceeds” to the unambiguous “goes outside the interval defined by” (T. Anthony)3/6/2026 CRM #32 Made suggested change to move the "error" description. (T. Anthony)

9/3/2025: Added IAURA definition and expanded on URA definition. (T. Anthony)

8/27/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

IS200-158:

Section Number:

6.2.1.0-2

WAS:

Note #1: URA applies over the transmission interval that is applicable to the LNAV/CNAV data from which the URA is read, for the worst-case location within the satellite footprint.

Redlines:

Note #1: URA applies over the ~~transmission~~curve fit interval that is applicable to the LNAV/CNAV data from which the URA index or indexes are read. IAURA applies over the curve fit interval that is applicable to the LNAV/CNAV data from which the URA index or indexes are read; for the worst-case location within the satellite footprint.

IS:

Note #1: URA applies over the curve fit interval that is applicable to the LNAV/CNAV data from which the URA index or indexes are read. IAURA applies over the curve fit interval that is applicable to the LNAV/CNAV data from which the URA index or indexes are read for the worst-case location within the satellite footprint.

Rationale:

9/3/2025: Redefines NOTE 1 in terms of IAURA. (T. Anthony)

IS200-159:

Section Number:

6.2.1.0-3

WAS:

Note #2: The URA for a particular signal may be represented by a single index in the LNAV data and by a composite of more than one index representing components of the total URA in the CNAV data. Specific URA indexes and formulae for calculating the total URA for each signal are defined in Appendix II for the LNAV message and Appendix III for the CNAV message.

Redlines:

Note #2: The URA for a particular signal ~~may be~~is represented by a single index in the LNAV data and by a composite of ~~more than one index~~indexes representing components of the total URA in the CNAV data.- Specific URA indexes and formulae for calculating the ~~total~~nominal URA/IAURA for each signal are defined in Appendix II for the LNAV ~~message~~CEI data set and Appendix III for the CNAV ~~message~~CEI data set.

IS:

Note #2: The URA for a particular signal is represented by a single index in the LNAV data and by a composite of indexes representing components of the total URA in the CNAV data. Specific URA indexes and formulae for calculating the nominal URA/IAURA for each signal are defined in Appendix II for the LNAV CEI data set and Appendix III for the CNAV CEI data set.

Rationale:

9/23/2025: At TIM #3 reworded "may be" to "is" and simplified "more than one index" to "indexes" (T. Anthony)

9/3/2025: Redefines NOTE 2 in terms of IAURA. (T. Anthony)

IS200-2140:

Insertion after object IS200-159

Section Number:

6.2.1.0-4

WAS:

<INSERTED OBJECT>

Redlines:

[Note #3: The LNAV URA index should be applied when using the LNAV Clock, Ephemeris, Integrity \(CEI\) data set. The CNAV URA indexes should be applied when using the CNAV CEI data set. See Section 6.2.9 for information on CEI data sets.](#)

Object Type: [Info-Only](#)

IS:

Note #3: The LNAV URA index should be applied when using the LNAV Clock, Ephemeris, Integrity (CEI) data set. The CNAV URA indexes should be applied when using the CNAV CEI data set. See Section 6.2.9 for information on CEI data sets.

Object Type: Info-Only

Rationale:

9/23/2025 At TIM #3 decided the notes would be more logical if this came before Note 33. So this is now Note #3 and IS200-1292 becomes Note #4 (T. Anthony)

9/3/2025: Redefines this Note in terms of applicability. (T. Anthony)

PRAT 2021-03 8/5/2023 Incorporate Core CEI changes from RFC-502 (T. Anthony)

IS200-1292:

Section Number:

6.2.1.0-5

WAS:

Note #3: The URA is not required to bound the instantaneous URE when: (a) an alert is issued to the users before the instantaneous URE exceeds either of the scaled URA bounds; or (b) if the integrity status flag is "0", an alert is issued to the users no more than 8.0 seconds after the instantaneous URE exceeds the 4.42 times URA bound; or (c) if the integrity status flag is "1", an alert is issued to the users no more than 8.0 seconds after the instantaneous URE exceeds the 4.42 times URA bound; or (d) if the integrity status flag is "1", an alert is issued to users no more than 5.2 seconds after the instantaneous URE exceeds the 5.73 times URA bound. In this context, an "alert" is defined as any indication or characteristic of the conveying signal, as specified elsewhere in this document, which signifies to users that the conveying signal may be invalid or should not be used, such as the health bits not indicating operational-healthy, broadcasting non-standard code, parity error, etc.

Redlines:

Note #34: The URA LNAV IAURA is not required to bound the instantaneous URE using the LNAV CEI data and the CNAV IAURA is not required to bound the instantaneous URE using the CNAV CEI data when:

(a) an alert is issued to the users before the instantaneous URE ~~exceeds either goes of~~ outside the ~~sealed~~ interval URA defined bounds by ± 4.42 times the IAURA; or

(b) if the integrity status flag is "0", an alert is issued to the users no more than 8.0 seconds after the instantaneous URE ~~exceeds goes outside~~ the interval defined by ± 4.42 times URA the bound IAURA; or

(c) if the integrity status flag is "1", both an alert is issued to the users no more than 8.0 seconds after the instantaneous URE ~~exceeds goes outside~~ the interval defined by ± 4.42 times URA bound; or (d) if the integrity either status of flag IAURA is values: "1", and an alert is issued to users no more than 5.2 seconds after the instantaneous URE ~~exceeds goes outside~~ the interval defined by ± 5.73 times URA the bound IAURA.

In this context, an "alert" is defined as any indication or characteristic of the conveying signal, as specified elsewhere in this document, which signifies to users that the conveying signal may be invalid or should not be used, such as the health bits not indicating operational-healthy, broadcasting non-standard code, parity error, etc.

IS:

Note #4: The LNAV IAURA is not required to bound the instantaneous URE using the LNAV CEI data and the CNAV IAURA is not required to bound the instantaneous URE using the CNAV CEI data when:

(a) an alert is issued to the users before the instantaneous URE goes outside the interval defined by ± 4.42 times the IAURA; or

(b) if the integrity status flag is "0", an alert is issued to the users no more than 8.0 seconds after the instantaneous URE goes outside the interval defined by ± 4.42 times the IAURA; or

(c) if the integrity status flag is "1", both an alert is issued to the users no more than 8.0 seconds after the instantaneous URE goes outside the interval defined by ± 4.42 times either of IAURA values; and an alert is issued to users no more than 5.2 seconds after the instantaneous URE goes outside the interval defined by ± 5.73 times the IAURA.

In this context, an "alert" is defined as any indication or characteristic of the conveying signal, as specified elsewhere in this document, which signifies to users that the conveying signal may be invalid or should not be used, such as the health bits not indicating operational-healthy, broadcasting non-standard code, parity error, etc.

Rationale:

3/10/2026 CRM #3 Negotiated the use of “±” where applicable to instantaneous error bounds and changed all use of “exceeds” to the unambiguous “goes outside the interval defined by” (T. Anthony)

2/16/2026 CRM #4 added ± bounds to 4.4.2 and 5.73 factors in keeping with RFC-519 CRM #138 where the ± sign was weighed against "using absolute value". This is compatible with SPS PS (T. Anthony)

9/23/2025 At TIM #3 decided to clarify exactly how the LNAV and CNAV IAURAs apply and clarify about "instantaneous URA exceeds". Also, reversed Note 3 and Note 4, so this is now Note 4 (T. Anthony)

9/3/2025: Redefines NOTE 3 in terms of IAURA. (T. Anthony)

IS200-1513:

Section Number:

6.2.9.0-1

WAS:

The Clock, Ephemeris, Integrity (CEI) data set is the collection of SV-specific clock correction polynomial parameters, ephemeris parameters, and related parameters (health flags, URA parameters, time tags, etc.) needed to use the SV's broadcast signal(s) in the positioning service. The parameters in the CEI data set are explicitly listed in Table 6-I-1. The entire CEI data set is needed for maximum accuracy. However, the core CEI data set (parameters without NOTE1 in Table 6-I-1) is sufficient for an initial position solution. The t_{op} term provides the epoch time of week of the state data utilized for the core CEI data set.

Redlines:

The Clock, Ephemeris, Integrity (CEI) data set is the collection of SV-specific clock correction polynomial parameters, ephemeris parameters, and related parameters (health flags, URA parameters, time tags, etc.) needed to use the SV's broadcast signal(s) in the positioning service. The parameters in the CEI data set are explicitly listed in Table 6-I-1. The entire CEI data set is needed for maximum accuracy. However, the core [CNAV](#) CEI data set (parameters without ~~NOTE1~~[NOTE2](#) in Table 6-I-1) is sufficient for an initial position solution. ~~The t_{op} term provides the epoch time of week of the state data utilized for the~~[without core](#)[full CEI](#)~~accuracy data~~[and set](#)[integrity](#).

IS:

The Clock, Ephemeris, Integrity (CEI) data set is the collection of SV-specific clock correction polynomial parameters, ephemeris parameters, and related parameters (health flags, URA parameters, time tags, etc.) needed to use the SV's broadcast signal(s) in the positioning service. The parameters in the CEI data set are explicitly listed in Table 6-I-1. The entire CEI data set is needed for maximum accuracy. However, the core CNAV CEI data set (parameters without NOTE2 in Table 6-I-1) is sufficient for an initial position solution without full accuracy and integrity.

Rationale:

3/19/2026 CRM #9 At Govt AWG, combining NOTE2 and NOTE3 in the CEI Data Set Parameter table caused NOTE3 to be changed to NOTE2 in this paragraph. (T. Anthony)

2/16/2026 CRM #4 Clarified the accuracy of an initiation position of a CNAV solution somewhat differently than the commenter had suggested. (T. Anthony)

PRAT 2021-03 8/5/2023 Incorporate Core CEI changes from RFC-502 (T. Anthony)

IS200-1649:

Section Number:

6.2.9.1.0-1

WAS:

A Core CEI Data Set are the CEI parameters necessary for a satellite to be used for a position solution (non-almanac); broadcast to users with the shortest broadcast interval for CNAV -- see 30.3.4.1. The t_{op} term provides the epoch time of week of the state data utilized for CEI data, except for parameters marked with a NOTE1 in Table 6-I-1.

Redlines:

A Core CEI Data Set are the CEI parameters necessary for a satellite to be used for a position solution (non-almanac); ~~broadcast to~~ The user's t_{oc}/t_{oe} with terms provide the shortest reference broadcast Time interval Of Week for CNAV the -CEI see curve 30.3.4.1 fit. The t_{op} term provides the epoch time of week of the state data ~~utilized~~ used for ~~CEI predicting data, the~~ except CEI for curve parameters fit. Parameters marked with ~~a NOTE1~~ NOTE2 in Table 6-I-1 are properties of the SV and do not routinely change with CEI curve fits. For proper IAURA bounding, users must apply the CEI refinement parameters.

IS:

A Core CEI Data Set are the CEI parameters necessary for a satellite to be used for a position solution (non-almanac). The t_{oc}/t_{oe} terms provide the reference Time Of Week for the CEI curve fit. The t_{op} term provides the epoch time of week of the state data used for predicting the CEI curve fit. Parameters marked with NOTE2 in Table 6-I-1 are properties of the SV and do not routinely change with CEI curve fits. For proper IAURA bounding, users must apply the CEI refinement parameters.

Rationale:

3/19/2026 CRM #9 At Govt AWG, combining NOTE2 and NOTE3 in the CEI Data Set Parameter table caused NOTE3 to be changed to NOTE2 in this paragraph. (T. Anthony)

3/19/2026 During Govt AWG decided that "These parameters may not change with top, toe or toc." no longer serves any purpose and should be deleted. (T. Anthony)

3/19/2026 CRM #7 Option B was modified at the Government AWG to just its last sentence (T. Anthony)

3/9/2026 CRM #7 ISC Clarification (T. Anthony)

2/16/2026 CRM #5 Clarified what top, toc, and toe covers and what might indicate a change in ISC. (T. Anthony)

2/16/2026 CRM #8 Clarifies that ISC related terms don't routinely change with curve fit changes (T. Anthony)

PRAT 2021-03 8/5/2023 Incorporate Core CEI changes from RFC-502 (T. Anthony)

IS200-1639:

Section Number:

6.2.9.1-2

WAS:

Symbol	Parameter Name	Subframe	Message
SV Health	SV Health (6 bits)	1	N/A
IODC	Issue of Data, Clock	1	N/A
URA	URA Index	1	N/A
WN	Week Number	1	10
T _{GD}	Group Delay Differential	1	30
WN _{OP}	CEI Data Sequence Propagation Week Number	N/A	30
a _{f0}	SV Clock Bias Correction Coefficient	1	30-37
a _{f1}	SV Clock Drift Correction Coefficient	1	30-37
a _{f2}	Drift Rate Correction Coefficient	1	30-37
t _{oc}	Time of Clock	1	30-37
\sqrt{A}	Square Root of the Semi-Major Axis	2	N/A
Δn	Mean Motion Difference from Computed Value	2	N/A
Fit Interval Flag	Fit Interval Flag	2	N/A
e	Eccentricity	2	10
M ₀	Mean Anomaly at Reference Time	2	10
t _{oe}	Time of Ephemeris	2	10, 11
C _{rs}	Amplitude of the Sine Correction Term to the Orbit Radius	2	11
C _{uc}	Amplitude of Cosine Harmonic Correction Term to the Argument of Latitude	2	11
C _{us}	Amplitude of Sine Harmonic Correction Term to the Argument of Latitude	2	11
IODE	Issue of Data, Ephemeris	2, 3	N/A
ISF	Integrity Status Flag ^{NOTE1}	All	10
ω	Argument of Perigee	3	10
$\dot{\Omega}$	Rate of Right Ascension	3	N/A
$\Delta\dot{\Omega}$	Rate of Right Ascension Difference	N/A	11
Ω_0	Longitude of Ascending Node of Orbit Plane at Weekly Epoch	3	11
i ₀	Inclination Angle at Reference Time	3	11
IDOT	Rate of Inclination Angle	3	11
C _{ic}	Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination	3	11

Symbol	Parameter Name	Subframe	Message
C_{is}	Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination	3	11
C_{rc}	Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius	3	11
ΔA	Semi-major Axis Difference at Reference Time	N/A	10
\dot{A}	Change Rate in Semi-major Axis	N/A	10
Δn_0	Mean Motion Difference from Computed Value at Reference Time	N/A	10
$\Delta \dot{n}_0$	Rate of Mean Motion Difference from Computed Value	N/A	10
(L1/L2/L5)	Signal Health (3 bits)	N/A	10
URA _{ED}	Elevation Dependent User Range Accuracy	N/A	10
ISC _{L1C/A}	Inter-signal Correction	N/A	30
ISC _{L2C}	Inter-signal Correction	N/A	30
ISC _{L5I5}	Inter-signal Correction	N/A	30
ISC _{L5Q5}	Inter-signal Correction	N/A	30
t_{op}	CEI Data Sequence Propagation Time of Week	N/A	10, 30-37
URA _{NED0}	NED Accuracy Index	N/A	30-37
URA _{NED1}	NED Accuracy Change Index	N/A	30-37
URA _{NED2}	NED Accuracy Change Rate Index	N/A	30-37
Alert	Alert Flag ^{NOTE1}	All	All
<p>NOTE1: Parameters so indicated are for CEI Refinement – not limited to curve fit. Parameters not indicated are needed for/limited to curve fit.</p> <p>Updates to parameters in table shall prompt changes in t_{oe}/t_{oc} for CNAV and $t_{oe}/t_{oc}/IODC/IODE$ for LNAV. Any parameter marked with NOTE1 may be changed with or without a change in $t_{oe}/t_{oc}/IODC/IODE$.</p>			

Redlines:

Symbol	Parameter Name	Subframe	Message
SV Health	SV Health (6 bits)	1	N/A
IODC	Issue of Data, Clock	1	N/A
URA	URA Index	1	N/A
WN	Week Number	1	10
T _{GD}	Group Delay Differential ^{NOTE2}	1	30
WN _{OP}	CEI Data Sequence Propagation Week Number	N/A	30
a _{f0}	SV Clock Bias Correction Coefficient	1	30-37
a _{f1}	SV Clock Drift Correction Coefficient	1	30-37
a _{f2}	Drift Rate Correction Coefficient	1	30-37
t _{oc}	Time of Clock	1	30-37
\sqrt{A}	Square Root of the Semi-Major Axis	2	N/A
Δn	Mean Motion Difference from Computed Value	2	N/A
Fit Interval Flag	Fit Interval Flag	2	N/A
e	Eccentricity	2	10
M ₀	Mean Anomaly at Reference Time	2	10
t _{oe}	Time of Ephemeris	2	10, 11
C _{rs}	Amplitude of the Sine Correction Term to the Orbit Radius	2	11
C _{uc}	Amplitude of Cosine Harmonic Correction Term to the Argument of Latitude	2	11
C _{us}	Amplitude of Sine Harmonic Correction Term to the Argument of Latitude	2	11
IODE	Issue of Data, Ephemeris	2, 3	N/A
ISF	Integrity Status Flag ^{NOTE1}	All	10
ω	Argument of Perigee	3	10
$\dot{\Omega}$	Rate of Right Ascension	3	N/A
$\Delta\dot{\Omega}$	Rate of Right Ascension Difference	N/A	11
Ω_0	Longitude of Ascending Node of Orbit Plane at Weekly Epoch	3	11
i ₀	Inclination Angle at Reference Time	3	11
IDOT	Rate of Inclination Angle	3	11
C _{ic}	Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination	3	11
C _{is}	Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination	3	11
C _{rc}	Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius	3	11
ΔA	Semi-major Axis Difference at Reference Time	N/A	10
\dot{A}	Change Rate in Semi-major Axis	N/A	10

Symbol	Parameter Name	Subframe	Message
Δn_0	Mean Motion Difference from Computed Value at Reference Time	N/A	10
$\Delta \dot{n}_0$	Rate of Mean Motion Difference from Computed Value	N/A	10
(L1/L2/L5)	Signal Health (3 bits)	N/A	10
URA _{ED}	Elevation Dependent User Range Accuracy	N/A	10
ISC _{L1C/A}	Inter-signal Correction ^{NOTE2}	N/A	30
ISC _{L2C}	Inter-signal Correction ^{NOTE2}	N/A	30
ISC _{L5I5}	Inter-signal Correction ^{NOTE2}	N/A	30
ISC _{L5Q5}	Inter-signal Correction ^{NOTE2}	N/A	30
t_{op}	CEI Data Sequence Propagation Time of Week	N/A	10, 30-37
URA _{NED0}	NED Accuracy Index	N/A	30-37
URA _{NED1}	NED Accuracy Change Index	N/A	30-37
URA _{NED2}	NED Accuracy Change Rate Index	N/A	30-37
Alert	Alert Flag ^{NOTE1}	All	All
<p>Updates to parameters in this table will prompt changes in $t_{oe}/t_{oc}/IODC/IODE$ for LNAV and t_{oe}/t_{oc} for CNAV</p> <p>NOTE1: Updates to this parameter are independent of curve fit and may occur without updates to $t_{oe}/t_{oc}/IODC/IODE$ for LNAV or t_{oe}/t_{oc} for CNAV</p> <p>NOTE2: This parameter is for CEI Refinement and is independent of ephemeris estimation (state vector and curve fit) so it commonly remains constant across changes in $t_{oe}/t_{oc}/IODC/IODE$ for LNAV and t_{oe}/t_{oc} for CNAV</p> <p>NOTE1: Parameters so indicated are for CEI Refinement — not limited to curve fit. Parameters not indicated are needed for/limited to curve fit.</p> <p>Updates to parameters in table shall prompt changes in t_{oe}/t_{oc} for CNAV and $t_{oe}/t_{oc}/IODC/IODE$ for LNAV. Any parameter marked with NOTE1 may be changed with or without a change in $t_{oe}/t_{oc}/IODC/IODE$.</p>			

IS:

Symbol	Parameter Name	Subframe	Message
SV Health	SV Health (6 bits)	1	N/A
IODC	Issue of Data, Clock	1	N/A
URA	URA Index	1	N/A
WN	Week Number	1	10
T _{GD}	Group Delay Differential ^{NOTE2}	1	30
WN _{OP}	CEI Data Sequence Propagation Week Number	N/A	30
a _{f0}	SV Clock Bias Correction Coefficient	1	30-37
a _{f1}	SV Clock Drift Correction Coefficient	1	30-37
a _{f2}	Drift Rate Correction Coefficient	1	30-37
t _{oc}	Time of Clock	1	30-37
\sqrt{A}	Square Root of the Semi-Major Axis	2	N/A
Δn	Mean Motion Difference from Computed Value	2	N/A
Fit Interval Flag	Fit Interval Flag	2	N/A
e	Eccentricity	2	10
M ₀	Mean Anomaly at Reference Time	2	10
t _{oe}	Time of Ephemeris	2	10, 11
C _{rs}	Amplitude of the Sine Correction Term to the Orbit Radius	2	11
C _{uc}	Amplitude of Cosine Harmonic Correction Term to the Argument of Latitude	2	11
C _{us}	Amplitude of Sine Harmonic Correction Term to the Argument of Latitude	2	11
IODE	Issue of Data, Ephemeris	2, 3	N/A
ISF	Integrity Status Flag ^{NOTE1}	All	10
ω	Argument of Perigee	3	10
$\dot{\Omega}$	Rate of Right Ascension	3	N/A
$\Delta\dot{\Omega}$	Rate of Right Ascension Difference	N/A	11
Ω_0	Longitude of Ascending Node of Orbit Plane at Weekly Epoch	3	11
i ₀	Inclination Angle at Reference Time	3	11
IDOT	Rate of Inclination Angle	3	11
C _{ic}	Amplitude of the Cosine Harmonic Correction Term to the Angle of Inclination	3	11
C _{is}	Amplitude of the Sine Harmonic Correction Term to the Angle of Inclination	3	11
C _{rc}	Amplitude of the Cosine Harmonic Correction Term to the Orbit Radius	3	11
ΔA	Semi-major Axis Difference at Reference Time	N/A	10
\dot{A}	Change Rate in Semi-major Axis	N/A	10

Symbol	Parameter Name	Subframe	Message
Δn_0	Mean Motion Difference from Computed Value at Reference Time	N/A	10
$\Delta \dot{n}_0$	Rate of Mean Motion Difference from Computed Value	N/A	10
(L1/L2/L5)	Signal Health (3 bits)	N/A	10
URA _{ED}	Elevation Dependent User Range Accuracy	N/A	10
ISC _{L1C/A}	Inter-signal Correction ^{NOTE2}	N/A	30
ISC _{L2C}	Inter-signal Correction ^{NOTE2}	N/A	30
ISC _{L5I5}	Inter-signal Correction ^{NOTE2}	N/A	30
ISC _{L5Q5}	Inter-signal Correction ^{NOTE2}	N/A	30
t_{op}	CEI Data Sequence Propagation Time of Week	N/A	10, 30-37
URA _{NED0}	NED Accuracy Index	N/A	30-37
URA _{NED1}	NED Accuracy Change Index	N/A	30-37
URA _{NED2}	NED Accuracy Change Rate Index	N/A	30-37
Alert	Alert Flag ^{NOTE1}	All	All
<p>Updates to parameters in this table will prompt changes in $t_{oe}/t_{oc}/IODC/IODE$ for LNAV and t_{oe}/t_{oc} for CNAV</p> <p>NOTE1: Updates to this parameter are independent of curve fit and may occur without updates to $t_{oe}/t_{oc}/IODC/IODE$ for LNAV or t_{oe}/t_{oc} for CNAV</p> <p>NOTE2: This parameter is for CEI Refinement and is independent of ephemeris estimation (state vector and curve fit) so it commonly remains constant across changes in $t_{oe}/t_{oc}/IODC/IODE$ for LNAV and t_{oe}/t_{oc} for CNAV</p>			

Rationale:

3/19/2026 CRM #9 At Govt AWG, negotiated new notes which combined NOTE 2 & 3 and required modifying the NOTE3 reference from outside the table to NOTE2. (T. Anthony)

2/16/2026 CRM #10 Fixed Redlines by properly showing the added NOTE2 to SV Health (T. Anthony)

2/16/2026 CRM #11 NOTE2 was enhanced to make it relevant and was not deleted as requested by this CRM (T. Anthony)

PRAT 2021-03 8/5/2023 Incorporate Core CEI changes from RFC-502 (T. Anthony)

IS200-1006:

Section Number:

6.3.6.1.0-4

WAS:

<DELETE>

Redlines:

<DELETE>

IS:

<DELETED OBJECT>

Rationale:

Administrative changes as a result of the two-party review. This object was proposed to be deleted in RFC-00198, but utilizing placeholder text gets snuck in to the final document.

IS200-300:

Section Number:

20.3.3.1.0-3

WAS:

Bit 23 of each TLM word is the Integrity Status Flag (ISF). A "0" in bit position 23 indicates that the conveying signal is provided with the legacy level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal exceeds 4.42 times the upper bound value of the current broadcast URA index, for more than 5.2 seconds, without an accompanying alert, is less than $1\text{E-}5$ per hour. A "1" in bit-position 23 indicates that the conveying signal is provided with an enhanced level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal exceeds 5.73 times the upper bound value of the current broadcast URA index, for more than 5.2 seconds, without an accompanying alert, is less than $1\text{E-}8$ per hour. The probabilities associated with the nominal and lower bound values of the current broadcast URA index are not defined.

Redlines:

Bit 23 of each TLM word is the Integrity Status Flag (ISF). A "0" in bit position 23 indicates that the conveying signal is provided with the legacy level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal ~~exceeds~~goes outside the interval defined by ± 4.42 times the upper bound value of the current broadcast URA index, for more than 5.2 seconds, without an accompanying alert, is less than ~~$1\text{E}1 \times 10^{-5}$~~ per hour. A "1" in bit-position 23 indicates that the conveying signal is provided with an enhanced level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal ~~exceeds~~goes outside the interval defined by ± 5.73 times the upper bound value of the current broadcast URA index, for more than 5.2 seconds, without an accompanying alert, is less than ~~$1\text{E}1 \times 10^{-8}$~~ per hour. The probabilities associated with the nominal and lower bound values of the current broadcast URA index are not defined.

IS:

Bit 23 of each TLM word is the Integrity Status Flag (ISF). A "0" in bit position 23 indicates that the conveying signal is provided with the legacy level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal goes outside the interval defined by ± 4.42 times the upper bound value of the current broadcast URA index, for more than 5.2 seconds, without an accompanying alert, is less than 1×10^{-5} per hour. A "1" in bit-position 23 indicates that the conveying signal is provided with an enhanced level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal goes outside the interval defined by ± 5.73 times the upper bound value of the current broadcast URA index, for more than 5.2 seconds, without an accompanying alert, is less than 1×10^{-8} per hour. The probabilities associated with the nominal and lower bound values of the current broadcast URA index are not defined.

Rationale:

3/10/2026 CRM #3 Negotiated the use of “ \pm ” where applicable to instantaneous error bounds and changed all use of “exceeds” to the unambiguous “goes outside the interval defined by” (T. Anthony)

9/10/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

IS200-319:

Section Number:
20.3.3.3.1.3.0-4

WAS:

URA INDEX	URA (meters)		
0	0.00	< URA ≤	2.40
1	2.40	< URA ≤	3.40
2	3.40	< URA ≤	4.85
3	4.85	< URA ≤	6.85
4	6.85	< URA ≤	9.65
5	9.65	< URA ≤	13.65
6	13.65	< URA ≤	24.00
7	24.00	< URA ≤	48.00
8	48.00	< URA ≤	96.00
9	96.00	< URA ≤	192.00
10	192.00	< URA ≤	384.00
11	384.00	< URA ≤	768.00
12	768.00	< URA ≤	1536.00
13	1536.00	< URA ≤	3072.00
14	3072.00	< URA ≤	6144.00
15	6144.00	< URA ≤	(or no accuracy prediction is available - standard positioning service users are advised to use the SV at their own risk.)

Redlines:

URA INDEX	URA (meters)		
0	0.00	< URA ≤	2.40
1	2.40	< URA ≤	3.40
2	3.40	< URA ≤	4.85
3	4.85	< URA ≤	6.85
4	6.85	< URA ≤	9.65
5	9.65	< URA ≤	13.65
6	13.65	< URA ≤	24.00
7	24.00	< URA ≤	48.00
8	48.00	< URA ≤	96.00
9	96.00	< URA ≤	192.00
10	192.00	< URA ≤	384.00
11	384.00	< URA ≤	768.00
12	768.00	< URA ≤	1536.00
13	1536.00	< URA ≤	3072.00
14	3072.00	< URA ≤	6144.00
15	6144.00	< URA ≤	(or no accuracy prediction is available - standard positioning service users are advised to use the SV at their own risk.)

IS:

URA INDEX	URA (meters)		
0	0.00	< URA ≤	2.40
1	2.40	< URA ≤	3.40
2	3.40	< URA ≤	4.85
3	4.85	< URA ≤	6.85
4	6.85	< URA ≤	9.65
5	9.65	< URA ≤	13.65
6	13.65	< URA ≤	24.00
7	24.00	< URA ≤	48.00
8	48.00	< URA ≤	96.00
9	96.00	< URA ≤	192.00
10	192.00	< URA ≤	384.00
11	384.00	< URA ≤	768.00
12	768.00	< URA ≤	1536.00
13	1536.00	< URA ≤	3072.00
14	3072.00	< URA ≤	6144.00
15	6144.00	< URA	(or no accuracy prediction is available - standard positioning service users are advised to use the SV at their own risk.)

Rationale:

9/18/25: Administrative. Removed <= sign for 15 because it has no meaning if a URA prediction is not applicable. (T. Anthony)

9/3/2025 Reformatted for readability. (T. Anthony)

IS200-2025:

Section Number:

20.3.3.3.1.3.0-6

WAS:

For N = 1, 3, and 5, X should be rounded to 2.8, 5.7, and 11.3 meters, respectively.

The nominal URA value (X) is suitable for use as a conservative prediction of the RMS signal-in-space (SIS) range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement de-weighting, receiver autonomous integrity monitoring (RAIM), figure of merit (FOM) computations). Integrity properties of the URA are specified with respect to the scaled (multiplied by either 4.42 or 5.73 as appropriate) upper bound values of the URA index (see 20.3.3.1).

URA accounts for SIS contributions to user range error which include, but are not limited to, the following: LNAV LSB representation/truncation error; the net effect of LNAV clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1C/A, L1P(Y), L2P(Y), or dual-frequency P(Y) users who correct the code phase as described in Section 20.3.3.3.3; LNAV ephemeris error; anisotropic antenna errors; and signal deformation error. URA does not account for user range error contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

Redlines:

For N = 1, 3, and 5, X should be rounded to 2.8, 5.7, and 11.3 meters, respectively.

The nominal URA value (X) is suitable for use as a conservative prediction of the RMS signal-in-space (SIS) range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement de-weighting, receiver autonomous integrity monitoring (RAIM), figure of merit (FOM) computations).

Integrity properties of the URA ([IAURA](#)) are specified with respect to the scaled (multiplied by either ± 4.42 or ± 5.73 as appropriate) upper bound values of the URA index (see 20.3.3.1).

URA accounts for SIS contributions to user range error which include, but are not limited to, the following: LNAV LSB representation/truncation error; the net effect of LNAV clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1C/A, L1P(Y), L2P(Y), or dual-frequency P(Y) users who correct the code phase as described in Section 20.3.3.3.3; LNAV ephemeris error; anisotropic antenna errors; and signal deformation error. - URA does not account for user range error contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

IS:

For N = 1, 3, and 5, X should be rounded to 2.8, 5.7, and 11.3 meters, respectively.

The nominal URA value (X) is suitable for use as a conservative prediction of the RMS signal-in-space (SIS) range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement de-weighting, receiver autonomous integrity monitoring (RAIM), figure of merit (FOM) computations).

Integrity properties of the URA (IAURA) are specified with respect to the scaled (multiplied by either ± 4.42 or ± 5.73 as appropriate) upper bound values of the URA index (see 20.3.3.1).

URA accounts for SIS contributions to user range error which include, but are not limited to, the following: LNAV LSB representation/truncation error; the net effect of LNAV clock correction polynomial error and code phase error in the transmitted signal for single-frequency L1C/A, L1P(Y), L2P(Y), or dual-frequency P(Y) users who correct the code phase as described in Section 20.3.3.3.3; LNAV ephemeris error; anisotropic antenna errors; and signal deformation error. URA does not account for user range error contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

Rationale:

3/10/2026 CRM #3 Negotiated the use of “ \pm ” where applicable to instantaneous error bounds and changed all use of “exceeds” to the unambiguous “goes outside the interval defined by” (T. Anthony)

9/3/2025: Worked IAURA into the integrity properties (T. Anthony)

IS200-1925:

Section Number:

20.3.3.3.1.0-4

WAS:

The orbit parameters (e , \sqrt{A} , E_k) used here are described in discussions of data contained in subframes 2 and 3, while F is a constant whose value is

$$F = \frac{-2\sqrt{\mu}}{c^2} = -4.442807633 (10)^{-10} \frac{\text{sec}}{\sqrt{\text{meter}}},$$

where

$$\mu = 3.986005 \times 10^{14} \frac{\text{meters}^3}{\text{second}^2} = \text{value of Earth's universal gravitational parameters}$$

$$c = 2.99792458 \times 10^8 \frac{\text{meters}}{\text{second}} = \text{speed of light.}$$

Redlines:

The orbit parameters (e , \sqrt{A} , E_k) used here are described in discussions of data contained in subframes 2 and 3, while F is a constant whose value is

$$F = -4.442807633 (\times 10)^{-10};$$

where

$$\mu = 3.986005 \times 10^{14} \frac{\text{meters}^3}{\text{second}^2} = \text{value of Earth's universal gravitational parameters}$$

$$c = 299,792,458 \frac{\text{meters}}{\text{second}} = \text{speed of light.}$$

IS:

The orbit parameters (e , \sqrt{A} , E_k) used here are described in discussions of data contained in subframes 2 and 3, while F is a constant whose value is

$$F = \frac{-2\sqrt{\mu}}{c^2} = -4.442807633 \times 10^{-10}$$

where

$$\mu = 3.986005 \times 10^{14} \frac{\text{meters}^3}{\text{second}^2} = \text{value of Earth's universal gravitational parameters}$$

$$c = 299,792,458 \frac{\text{meters}}{\text{second}} = \text{speed of light}$$

Rationale:

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-366:

Section Number:
20.3.3.4.3.1.0-4

WAS:

Parameter	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
IODE	8			(see text)
C_{rs}	16*	2^{-5}		meters
Δn	16*	2^{-43}		semi-circles/sec
M_0	32*	2^{-31}		semi-circles
C_{uc}	16*	2^{-29}		radians
e	32	2^{-33}	0.0 to 0.03	dimensionless
C_{us}	16*	2^{-29}		radians
\sqrt{A}	32	2^{-19}	2530 to 8192	$\sqrt{\text{meters}}$
t_{oc}	16	2^4	0 to 604,784	seconds
C_{ic}	16*	2^{-29}		radians
Ω_0	32*	2^{-31}		semi-circles
C_{is}	16*	2^{-29}		radians
i_0	32*	2^{-31}		semi-circles
C_{rc}	16*	2^{-5}		meters
ω	32*	2^{-31}		semi-circles
$\dot{\Omega}$	24*	2^{-43}	-6.33E-07 to 0	semi-circles/sec
IDOT	14*	2^{-43}		semi-circles/sec
<p>* Parameters so indicated shall be two's complement, with the sign bit (+ or -) occupying the MSB; ** See Figure 20-1 for complete bit allocation in subframe; *** Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor.</p>				

Redlines:

Parameter	No. of Bits**NOTE2	Scale Factor (LSB)	Valid Range***NOTE3	Units
IODE	8			(see text)
C _{rs}	16*NOTE1	2 ⁻⁵		meters
Δn	16*NOTE1	2 ⁻⁴³		semi-circles/sec
M ₀	32*NOTE1	2 ⁻³¹		semi-circles
C _{uc}	16*NOTE1	2 ⁻²⁹		radians
e	32	2 ⁻³³	0.0 to 0.03	dimensionless
C _{us}	16*NOTE1	2 ⁻²⁹		radians
√A	32	2 ⁻¹⁹	2530 to 8192	√meters
t _{oe}	16	2 ⁺⁴	0 to 604,784	seconds
C _{ic}	16*NOTE1	2 ⁻²⁹		radians
Ω ₀	32*NOTE1	2 ⁻³¹		semi-circles
C _{is}	16*NOTE1	2 ⁻²⁹		radians
i ₀	32*NOTE1	2 ⁻³¹		semi-circles
C _{rc}	16*NOTE1	2 ⁻⁵		meters
ω	32*NOTE1	2 ⁻³¹		semi-circles
Ω̇	24*NOTE1	2 ⁻⁴³	-6.33 × 10 ⁻⁷ E- 07 to 0	semi-circles/sec
IDOT	14*NOTE1	2 ⁻⁴³		semi-circles/sec

NOTE1:* Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB

NOTE2:** See Figure 20-10 for complete bit allocation in subframe

NOTE3:*** Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor*

IS:

Parameter	No. of Bits ^{NOTE2}	Scale Factor (LSB)	Valid Range ^{NOTE3}	Units
IODE	8			(see text)
C _{rs}	16 ^{NOTE1}	2 ⁻⁵		meters
Δn	16 ^{NOTE1}	2 ⁻⁴³		semi-circles/sec
M ₀	32 ^{NOTE1}	2 ⁻³¹		semi-circles
C _{uc}	16 ^{NOTE1}	2 ⁻²⁹		radians
e	32	2 ⁻³³	0.0 to 0.03	dimensionless
C _{us}	16 ^{NOTE1}	2 ⁻²⁹		radians
√A	32	2 ⁻¹⁹	2530 to 8192	√meters
t _{oe}	16	2 ⁺⁴	0 to 604,784	seconds
C _{ic}	16 ^{NOTE1}	2 ⁻²⁹		radians
Ω ₀	32 ^{NOTE1}	2 ⁻³¹		semi-circles
C _{is}	16 ^{NOTE1}	2 ⁻²⁹		radians
i ₀	32 ^{NOTE1}	2 ⁻³¹		semi-circles
C _{rc}	16 ^{NOTE1}	2 ⁻⁵		meters
ω	32 ^{NOTE1}	2 ⁻³¹		semi-circles
Ω̇	24 ^{NOTE1}	2 ⁻⁴³	-6.33 × 10 ⁻⁷ to 0	semi-circles/sec
IDOT	14 ^{NOTE1}	2 ⁻⁴³		semi-circles/sec
NOTE1: Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB				
NOTE2: See Figure 20-10 for complete bit allocation in subframe				
NOTE3: Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor				

Rationale:

11/26/2025 CRM #18 Added "+" to the exponent for the power of 2 to be consistent with the #3 Description of Change on the cover page which involves normalizing the power of 10 notation across the public documents. (T. Anthony)
9/10/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)
Also, replace asterisk based notes with NOTE_n (T. Anthony)

IS200-367:

Section Number:
20.3.3.4.3.1.0-6

WAS:

$\mu = 3.986005 \times 10^{14} \text{ meters}^3/\text{sec}^2$	WGS 84 value of the earth's gravitational constant for GPS user
$\dot{\Omega}_e = 7.2921151467 \times 10^{-5} \text{ rad/sec}$	WGS 84 value of the earth's rotation rate
$A = (\sqrt{A})^2$	Semi-major axis
$n_0 = \sqrt{\frac{\mu}{A^3}}$	Computed mean motion (rad/sec)
$t_k = t - t_{oe}^*$	Time from ephemeris reference epoch
$n = n_0 + \Delta n$	Corrected mean motion
$M_k = M_0 + nt_k$	Mean anomaly
	Kepler's equation ($M_k = E_k - e \sin E_k$) may be solved for Eccentric anomaly (E_k) by iteration:
$E_0 = M_k$	- Initial Value (radians)
$E_j = E_{j-1} + \frac{M_k - E_{j-1} + e \sin E_{j-1}}{1 - e \cos E_{j-1}}$	- Refined Value, minimum of three iterations, (j=1,2,3)
$E_k = E_j$	- Final Value (radians)
$v_k = 2 \tan^{-1} \left(\sqrt{\frac{1+e}{1-e}} \tan \frac{E_k}{2} \right)$	True Anomaly (unambiguous quadrant)
<p>* t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light). Furthermore, t_k shall be the actual total time difference between the time t and the epoch time t_{oe}, and must account for beginning or end of week crossovers. That is, if t_k is greater than 302,400 seconds, subtract 604,800 seconds from t_k. If t_k is less than -302,400 seconds, add 604,800 seconds to t_k.</p>	

Redlines:

$\mu = 3.986005 \times 10^{14} \text{ meters}^3/\text{sec}^2$ $\dot{\Omega}_e = 7.2921151467 \times 10^{-5} \text{ rad/sec}$ $A = (\sqrt{A})^2$ $n_0 = \sqrt{\frac{\mu}{A^3}}$ $t_k = t - t_{oe}^*$ $n = n_0 + \Delta n$ $M_k = M_0 + n t_k$	<p>WGS 84 value of the earth's gravitational constant for GPS user</p> <p>WGS 84 value of the earth's rotation rate</p> <p>Semi-major axis</p> <p>Computed mean motion (rad/sec)</p> <p>Time from ephemeris reference epoch NOTE 1</p> <p>Corrected mean motion</p> <p>Mean anomaly</p>
<p>Kepler's equation ($M_k = E_k - e \sin E_k$) may be solved for Eccentric anomaly (E_k) by iteration:</p>	
$E_0 = M_k$ $E_j = E_{j-1} + \frac{M_k - E_{j-1} + e \sin E_{j-1}}{1 - e \cos E_{j-1}}$ $E_k = E_j$ $v_k = 2 \tan^{-1} \left(\sqrt{\frac{1+e}{1-e}} \tan \left(\frac{E_k}{2} \right) \right)$	<p>—Initial Value (radians)</p> <p>—Refined Value, minimum of three iterations, (j=1,2,3)</p> <p>—Final Value (radians)</p> <p>True Anomaly (unambiguous quadrant)</p>
<p>NOTE 1* t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light). Furthermore, t_k shall be the actual total time difference between the time t and the epoch time t_{oe}, and must account for beginning or end of week crossovers. That is, if t_k is greater than 302,400 seconds, subtract 604,800 seconds from t_k. If t_k is less than -302,400 seconds, add 604,800 seconds to t_k.</p>	

IS:

$\mu = 3.986005 \times 10^{+14} \text{ meters}^3/\text{sec}^2$ $\dot{\Omega}_e = 7.2921151467 \times 10^{-5} \text{ rad/sec}$ $A = (\sqrt{A})^2$ $n_0 = \sqrt{\frac{\mu}{A^3}}$ $t_k = t - t_{oe}$ $n = n_0 + \Delta n$ $M_k = M_0 + nt_k$	<p>WGS 84 value of the earth's gravitational constant for GPS user</p> <p>WGS 84 value of the earth's rotation rate</p> <p>Semi-major axis</p> <p>Computed mean motion (rad/sec)</p> <p>Time from ephemeris reference epoch^{NOTE 1}</p> <p>Corrected mean motion</p> <p>Mean anomaly</p>
<p>Kepler's equation ($M_k = E_k - e \sin E_k$) may be solved for Eccentric anomaly (E_k) by iteration:</p>	
$E_0 = M_k$	<p>Initial Value (radians)</p>
$E_j = E_{j-1} + \frac{M_k - E_{j-1} + e \sin E_{j-1}}{1 - e \cos E_{j-1}}$	<p>Refined Value, minimum of three iterations, (j=1,2,3)</p>
$E_k = E_j$	<p>Final Value (radians)</p>
$v_k = 2 \tan^{-1} \left(\sqrt{\frac{1+e}{1-e}} \tan \left(\frac{E_k}{2} \right) \right)$	<p>True Anomaly (unambiguous quadrant)</p>
<p>NOTE 1: t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light). Furthermore, t_k shall be the actual total time difference between the time t and the epoch time t_{oe}, and must account for beginning or end of week crossovers. That is, if t_k is greater than 302,400 seconds, subtract 604,800 seconds from t_k. If t_k is less than -302,400 seconds, add 604,800 seconds to t_k.</p>	

Rationale:

10/29/2025 CRM #15 Removed dashes from Kepler's Equation related formula Descriptions (T. Anthony)
 8/21/2025: At TIM #1, SMEs asked for NOTE identifiers to replace asterisks (T. Anthony)
 8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)
 PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-368:

Section Number:

20.3.3.4.3.1.0-8

WAS:

$\Phi_k = v_k + \omega$		Argument of Latitude
$\delta u_k = c_{us} \sin 2\Phi_k + c_{uc} \cos 2\Phi_k$	Argument of Latitude Correction Radius Correction Inclination Correction	} Second Harmonic
$\delta r_k = c_{rs} \sin 2\Phi_k + c_{rc} \cos 2\Phi_k$		
$\delta i_k = c_{is} \sin 2\Phi_k + c_{ic} \cos 2\Phi_k$		
$u_k = \Phi_k + \delta u_k$		Corrected Argument of Latitude
$r_k = A(1 - e \cos E_k) + \delta r_k$		Corrected Radius
$i_k = i_0 + \delta i_k + (\text{IDOT}) t_k$		Corrected Inclination
$x_k' = r_k \cos u_k$	}	Positions in orbital
$y_k' = r_k \sin u_k$		
$\Omega_k = \Omega_0 + (\dot{\Omega} - \dot{\Omega}_e) t_k - \dot{\Omega}_e t_{oe}$		Corrected longitude of ascending node.
$x_k = x_k' \cos \Omega_k - y_k' \cos i_k \sin \Omega_k$	}	Earth-fixed
$y_k = x_k' \sin \Omega_k + y_k' \cos i_k \cos \Omega_k$		
$z_k = y_k' \sin i_k$		

Redlines:

$\Phi_k = v_k + \omega$	Argument of Latitude
$\delta u_k = e_{C_{us}} \sin 2\Phi_k + e_{C_{uc}} \cos 2\Phi_k$ Argument of Latitude Correction $\delta r_k = e_{C_{rs}} \sin 2\Phi_k + e_{C_{rc}} \cos 2\Phi_k$ Radius Correction $\delta i_k = e_{C_{is}} \sin 2\Phi_k + e_{C_{ic}} \cos 2\Phi_k$ Inclination Correction	} Second Harmonic
$u_k = \Phi_k + \delta u_k$	Corrected Argument of Latitude
$r_k = A(1 - e \cos E_k) + \delta r_k$	Corrected Radius
$i_k = i_0 + \delta i_k + (IDOT) t_k$	Corrected Inclination
$x_k' = r_k \cos u_k$ } $y_k' = r_k \sin u_k$ }	Positions in orbital
$\Omega_k = \Omega_0 + (\dot{\Omega} - \dot{\Omega}_e) t_k - \dot{\Omega}_e t_{oc}$	Corrected longitude of ascending node.
$x_k = x_k' \cos \Omega_k - y_k' \cos i_k \sin \Omega_k$ } $y_k = x_k' \sin \Omega_k + y_k' \cos i_k \cos \Omega_k$ } $z_k = y_k' \sin i_k$ }	Earth-fixed

IS:

$\Phi_k = v_k + \omega$	Argument of Latitude
$\delta u_k = C_{us} \sin 2\Phi_k + C_{uc} \cos 2\Phi_k$ Argument of Latitude Correction $\delta r_k = C_{rs} \sin 2\Phi_k + C_{rc} \cos 2\Phi_k$ Radius Correction $\delta i_k = C_{is} \sin 2\Phi_k + C_{ic} \cos 2\Phi_k$ Inclination Correction	} Second Harmonic
$u_k = \Phi_k + \delta u_k$	Corrected Argument of Latitude
$r_k = A(1 - e \cos E_k) + \delta r_k$	Corrected Radius
$i_k = i_0 + \delta i_k + (IDOT) t_k$	Corrected Inclination
$x_k' = r_k \cos u_k$ } $y_k' = r_k \sin u_k$ }	Positions in orbital
$\Omega_k = \Omega_0 + (\dot{\Omega} - \dot{\Omega}_e) t_k - \dot{\Omega}_e t_{oc}$	Corrected longitude of ascending node.
$x_k = x_k' \cos \Omega_k - y_k' \cos i_k \sin \Omega_k$ } $y_k = x_k' \sin \Omega_k + y_k' \cos i_k \cos \Omega_k$ } $z_k = y_k' \sin i_k$ }	Earth-fixed

Rationale:

Administrative Change: 9/11/2025 Capitalize the Cxx parameters and space out the multiplied terms for easier reading.
(T. Anthony)

IS200-1726:

Section Number:
20.3.3.4.3.1.0-10

WAS:

Element/Equation	Description
<u>SV Velocity</u>	
$\dot{E}_k = n / (1 - e \cos E_k)$	Eccentric Anomaly Rate
$\dot{v}_k = \dot{E}_k \sqrt{1 - e^2} / (1 - e \cos E_k)$	True Anomaly Rate
$(di_k / dt) = (IDOT) + 2 \dot{v}_k (c_{is} \cos 2\phi_k - c_{ic} \sin 2\phi_k)$	Corrected Inclination Angle Rate
$\dot{u}_k = \dot{v}_k + 2\dot{v}_k (c_{us} \cos 2\phi_k - c_{uc} \sin 2\phi_k)$	Corrected Argument of Latitude Rate
$\dot{r}_k = eA\dot{E}_k \sin E_k + 2\dot{v}_k (c_{rs} \cos 2\phi_k - c_{rc} \sin 2\phi_k)$	Corrected Radius Rate
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	Longitude of Ascending Node Rate
$\dot{x}'_k = \dot{r}_k \cos u_k - r_k \dot{u}_k \sin u_k$	In- plane x velocity
$\dot{y}'_k = \dot{r}_k \sin u_k + r_k \dot{u}_k \cos u_k$	In- plane y velocity
$\dot{x}_k = -x'_k \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - \dot{y}'_k \sin \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth- Fixed x velocity (m/s)
$\dot{y}_k = x'_k \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth- Fixed y velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + y'_k (di_k / dt) \cos i_k$	Earth- Fixed z velocity (m/s)

Redlines:

Element/Equation	Description
<u>SV Velocity</u>	
$\dot{E}_k = n / (1 - e \cos E_k)$	Eccentric Anomaly Rate
$\dot{v}_k = \dot{E}_k \sqrt{1 - e^2} / (1 - e \cos E_k)$	True Anomaly Rate
$(di_k / dt) = (\text{IDOT}) + 2 \dot{v}_k (eC_{is} \cos 2\phi_k - eC_{ic} \sin 2\phi_k)$	Corrected Inclination Angle Rate
$\dot{u}_k = \dot{v}_k + 2\dot{v}_k (eC_{us} \cos 2\phi_k - eC_{uc} \sin 2\phi_k)$	Corrected Argument of Latitude Rate
$\dot{r}_k = eA\dot{E}_k \sin E_k + 2\dot{v}_k (eC_{rs} \cos 2\phi_k - eC_{rc} \sin 2\phi_k)$	Corrected Radius Rate
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	Longitude of Ascending Node Rate
$\dot{x}'_k = \dot{r}_k \cos u_k - r_k \dot{u}_k \sin u_k$	In- plane x velocity
$\dot{y}'_k = \dot{r}_k \sin u_k + r_k \dot{u}_k \cos u_k$	In- plane y velocity
$\dot{x}_k = -x'_k \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - \dot{y}'_k \sin \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth- Fixed x velocity (m/s)
$\dot{y}_k = x'_k \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth- Fixed y velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + y'_k (di_k / dt) \cos i_k$	Earth- Fixed z velocity (m/s)

IS:

Element/Equation	Description
<u>SV Velocity</u>	
$\dot{E}_k = n / (1 - e \cos E_k)$	Eccentric Anomaly Rate
$\dot{v}_k = \dot{E}_k \sqrt{1 - e^2} / (1 - e \cos E_k)$	True Anomaly Rate
$(di_k / dt) = (IDOT) + 2 \dot{v}_k (C_{is} \cos 2\phi_k - C_{ic} \sin 2\phi_k)$	Corrected Inclination Angle Rate
$\dot{u}_k = \dot{v}_k + 2\dot{v}_k (C_{us} \cos 2\phi_k - C_{uc} \sin 2\phi_k)$	Corrected Argument of Latitude Rate
$\dot{r}_k = eA\dot{E}_k \sin E_k + 2\dot{v}_k (C_{rs} \cos 2\phi_k - C_{rc} \sin 2\phi_k)$	Corrected Radius Rate
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	Longitude of Ascending Node Rate
$\dot{x}'_k = \dot{r}_k \cos u_k - r_k \dot{u}_k \sin u_k$	In- plane x velocity
$\dot{y}'_k = \dot{r}_k \sin u_k + r_k \dot{u}_k \cos u_k$	In- plane y velocity
$\dot{x}_k = -x'_k \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - \dot{y}'_k \sin \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth- Fixed x velocity (m/s)
$\dot{y}_k = x'_k \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth- Fixed y velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + y'_k (di_k / dt) \cos i_k$	Earth- Fixed z velocity (m/s)

Rationale:

Administrative Change: 9/11/2025 Capitalize the Cxx parameters and space out the multiplied terms for easier reading. (T. Anthony)

IS200-370:

Section Number:

20.3.3.4.3.2.0-1

WAS:

The sensitivity of the SV's antenna phase center position to small perturbations in most ephemeris parameters is extreme. The sensitivity of position to the parameters \sqrt{A} , C_{rc} and C_{rs} is about one meter/meter. The sensitivity of position to the angular parameters is on the order of 10^8 meters/semicircle, and to the angular rate parameters is on the order of 10^{12} meters/semicircle/second. Because of this extreme sensitivity to angular perturbations, the value of π used in the curve fit is given here. π is a mathematical constant, the ratio of a circle's circumference to its diameter.

Redlines:

The sensitivity of the SV's antenna phase center position to small perturbations in most ephemeris parameters is extreme. The sensitivity of position to the parameters \sqrt{A} , C_{rc} and C_{rs} is about one meter/meter. The sensitivity of position to the angular parameters is on the order of ~~10^8~~ 1×10^8 meters/semicircle, and to the angular rate parameters is on the order of ~~10^{12}~~ 1×10^{12} meters/semicircle/second. Because of this extreme sensitivity to angular perturbations, the value of ~~π~~ π used in the curve fit is given here. π is a mathematical constant, the ratio of a circle's circumference to its diameter.

IS:

The sensitivity of the SV's antenna phase center position to small perturbations in most ephemeris parameters is extreme. The sensitivity of position to the parameters \sqrt{A} , C_{rc} and C_{rs} is about one meter/meter. The sensitivity of position to the angular parameters is on the order of 1×10^8 meters/semicircle, and to the angular rate parameters is on the order of 1×10^{12} meters/semicircle/second. Because of this extreme sensitivity to angular perturbations, the value of π used in the curve fit is given here. π is a mathematical constant, the ratio of a circle's circumference to its diameter.

Rationale:

10/29/2025 CRM #12 Fixed square root of A by restoring the bit image (T. Anthony)

9/30/2025: Administrative. Replaced PI with Unicode for sustainability. (T. Anthony)

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony).

IS200-397:

Section Number:
20.3.3.5.1.2.0-7

WAS:

Parameter	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
e	16	2^{-21}	0.0 to 0.03	dimensionless
t_{oa}	8	2^{12}	0 to 602,112	seconds
δ_i ****	16*	2^{-19}		semi-circles
$\dot{\Omega}$	16*	2^{-38}	-1.19E-07 to 0	semi-circles/sec
\sqrt{A}	24	2^{-11}	2530 to 8192	$\sqrt{\text{meters}}$
Ω_0	24*	2^{-23}		semi-circles
ω	24*	2^{-23}		semi-circles
M_0	24*	2^{-23}		semi-circles
a_{f0}	11*	2^{-20}		seconds
a_{f1}	11*	2^{-38}		sec/sec

* Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB;

** See Figure 20-1 for complete bit allocation in subframe;

*** Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor;

**** Relative to $i_0 = 0.30$ semi-circles.

Redlines:

Parameter	No. of Bits ***NOTE2	Scale Factor (LSB)	Valid Range ***NOTE3	Units
e	16	2 ⁻²¹	0.0 to 0.03	dimensionless
t _{oa}	8	2 ^{±12}	0 to 602,112	seconds
δ _r ***NOTE4	16 NOTE1	2 ⁻¹⁹		semi-circles
$\dot{\Omega}$	16 NOTE1	2 ⁻³⁸	-1.19 × 10 ⁻⁷ E-7 to 0	semi-circles/sec
\sqrt{A}	24	2 ⁻¹¹	2530 to 8192	$\sqrt{\text{meters}}$
Ω ₀	24 NOTE1	2 ⁻²³		semi-circles
ω	24 NOTE1	2 ⁻²³		semi-circles
M ₀	24 NOTE1	2 ⁻²³		semi-circles
a _{f0}	11 NOTE1	2 ⁻²⁰		seconds
a _{f1}	11 NOTE1	2 ⁻³⁸		sec/sec

~~NOTE1:*~~ Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB;

~~NOTE2:**~~ See Figure 20-10 for complete bit allocation in subframe;

~~NOTE3:***~~ Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor;

~~NOTE4:****~~ Relative to i₀ = 0.30 semi-circles.

IS:

Parameter	No. of Bits ^{NOTE2}	Scale Factor (LSB)	Valid Range ^{NOTE3}	Units
e	16	2^{-21}	0.0 to 0.03	dimensionless
t _{oa}	8	2^{+12}	0 to 602,112	seconds
δ_i ^{NOTE4}	16 ^{NOTE1}	2^{-19}		semi-circles
$\dot{\Omega}$	16 ^{NOTE1}	2^{-38}	-1.19×10^{-7} to 0	semi-circles/sec
\sqrt{A}	24	2^{-11}	2530 to 8192	$\sqrt{\text{meters}}$
Ω_0	24 ^{NOTE1}	2^{-23}		semi-circles
ω	24 ^{NOTE1}	2^{-23}		semi-circles
M ₀	24 ^{NOTE1}	2^{-23}		semi-circles
a ₀	11 ^{NOTE1}	2^{-20}		seconds
a _{f1}	11 ^{NOTE1}	2^{-38}		sec/sec

NOTE1: Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB

NOTE2: See Figure 20-10 for complete bit allocation in subframe

NOTE3: Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor

NOTE4: Relative to $i_0 = 0.30$ semi-circles

Rationale:

8/27/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

8/21/2025: At TIM #1, SMEs asked for NOTE identifiers to replace asterisks (T. Anthony)

IS200-450:

Section Number:

20.3.3.5.2.6.0-4

WAS:

The ionospheric correction model is given by

$$T_{\text{iono}} = \begin{cases} F * \left[5.0 * 10^{-9} + (\text{AMP}) \left(1 - \frac{x^2}{2} + \frac{x^4}{24} \right) \right], & |x| < 1.57 \\ F * (5.0 * 10^{-9}) & , |x| \geq 1.57 \end{cases} \quad (\text{sec})$$

where

T_{iono} is referred to the L1 frequency; if the user is operating on the L2 frequency, the correction term must be multiplied by γ (reference paragraph 20.3.3.3.2),

$$\text{AMP} = \begin{cases} \sum_{n=0}^3 \alpha_n \phi_m^n, & \text{AMP} \geq 0 \\ \text{if AMP} < 0, \text{ AMP} = 0 \end{cases} \quad (\text{sec})$$

$$x = \frac{2\pi (t - 50400)}{\text{PER}} \quad (\text{radians})$$

$$\text{PER} = \begin{cases} \sum_{n=0}^3 \beta_n \phi_m^n, & \text{PER} \geq 72,000 \\ \text{if PER} < 72,000, \text{ PER} = 72,000 \end{cases} \quad (\text{sec})$$

$$F = 1.0 + 16.0 [0.53 - E]^3$$

and α_n and β_n are the satellite transmitted data words with $n = 0, 1, 2,$ and $3.$

Redlines:

The ionospheric correction model is given by

$$T_{\text{iono}} = \begin{cases} F \left[5.0 \times 10^{-9} + (\text{AMP}) \left(1 - \frac{x^2}{2} + \frac{x^4}{24} \right) \right], & |x| < 1.57 \\ F \left[5.0 \times 10^{-9} \right], & |x| \geq 1.57 \end{cases} \quad (\text{sec})$$

where

T_{iono} is referred to the L1 frequency; if the user is operating on the L2 frequency, the correction term must be multiplied by γ (reference paragraph 20.3.3.3.2),

$$\text{AMP} = \begin{cases} \sum_{n=0}^3 \alpha_n \varphi_m^n, & \text{AMP} \geq 0 \\ \text{if AMP} < 0, \text{ AMP} = 0 \end{cases} \quad (\text{sec})$$

$$x = \frac{2\pi (t - 50,400)}{\text{PER}} \quad (\text{radians})$$

$$\text{PER} = \begin{cases} \sum_{n=0}^3 \beta_n \varphi_m^n, & \text{PER} \geq 72,000 \\ \text{if PER} < 72,000, \text{ PER} = 72,000 \end{cases} \quad (\text{sec})$$

$$F = 1.0 + 16.0 [0.53 - E]^3$$

and α_n and β_n are the satellite transmitted data words with $n = 0, 1, 2,$ and 3 .

IS:

The ionospheric correction model is given by

$$T_{\text{iono}} = \begin{cases} F \left[5.0 \times 10^{-9} + (\text{AMP}) \left(1 - \frac{x^2}{2} + \frac{x^4}{24} \right) \right], & |x| < 1.57 \\ F \left[5.0 \times 10^{-9} \right], & |x| \geq 1.57 \end{cases} \text{ (sec)}$$

where

T_{iono} is referred to the L1 frequency; if the user is operating on the L2 frequency, the correction term must be multiplied by γ (reference paragraph 20.3.3.3.2),

$$\text{AMP} = \begin{cases} \sum_{n=0}^3 \alpha_n \varphi_m^n, & \text{AMP} \geq 0 \\ \text{if AMP} < 0, \text{ AMP} = 0 \end{cases} \text{ (sec)}$$

$$x = \frac{2\pi (t - 50,400)}{\text{PER}} \text{ (radians)}$$

$$\text{PER} = \begin{cases} \sum_{n=0}^3 \beta_n \varphi_m^n, & \text{PER} \geq 72,000 \\ \text{if PER} < 72,000, \text{ PER} = 72,000 \end{cases} \text{ (sec)}$$

$$F = 1.0 + 16.0 [0.53 - E]^3$$

and α_n and β_n are the satellite transmitted data words with $n = 0, 1, 2,$ and 3 .

Rationale:

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-451:

Section Number:
20.3.3.5.2.6.0-6

WAS:

Other equations that must be solved are

$$\phi_m = \phi_i + 0.064 \cos(\lambda_i - 1.617) \quad (\text{semi-circles})$$

$$\lambda_i = \lambda_u + \frac{\psi \sin A}{\cos \phi_i} \quad (\text{semi-circles})$$

$$\phi_i = \begin{cases} \phi_u + \psi \cos A, & |\phi_i| \leq 0.416 \\ \text{if } \phi_i > +0.416, \text{ then } \phi_i = +0.416 \\ \text{if } \phi_i < -0.416, \text{ then } \phi_i = -0.416 \end{cases} \quad (\text{semi-circles})$$

$$\psi = \frac{0.0137}{E + 0.11} - 0.022 \quad (\text{semi-circles})$$

$$t = 4.32 (10^4) \lambda_i + \text{GPS time} \quad (\text{sec})$$

where

$0 \leq t < 86400$: therefore, if $t \geq 86400$ seconds, subtract 86400 seconds;
if $t < 0$ seconds, add 86400 seconds.

Redlines:

Other equations that must be solved are

$$\phi_m = \phi_i + 0.064 \cos(\lambda_i - 1.617) \quad (\text{semi-circles})$$

$$\lambda_i = \lambda_u + \frac{\psi \sin A}{\cos \phi_i} \quad (\text{semi-circles})$$

$$\phi_i = \begin{cases} \phi_u + \psi \cos A, & |\phi_i| \leq 0.416 \\ \text{if } \phi_i > +0.416, \text{ then } \phi_i = +0.416 \\ \text{if } \phi_i < -0.416, \text{ then } \phi_i = -0.416 \end{cases} \quad (\text{semi-circles})$$

$$\psi = \frac{0.0137}{E=0.11} - 0.022 \quad (\text{semi-circles})$$

$$t = 4.32 \times (10^{+4}) \lambda_i + \text{GPS time} \quad (\text{sec})$$

where

$0 \leq t < 86,400$: therefore, if $t \geq 86,400$ seconds, subtract 86,400 seconds;
if $t < 0$ seconds, add 86,400 seconds.

IS:

Other equations that must be solved are

$$\phi_m = \phi_i + 0.064 \cos(\lambda_i - 1.617) \quad (\text{semi-circles})$$

$$\lambda_i = \lambda_u + \frac{\psi \sin A}{\cos f_i} \quad (\text{semi-circles})$$

$$\varphi_i = \left\{ \begin{array}{l} \varphi_u + \psi \cos A, \quad |\varphi_i| \leq 0.416 \\ \text{if } \varphi_i > +0.416, \text{ then } \varphi_i = +0.416 \\ \text{if } \varphi_i < -0.416, \text{ then } \varphi_i = -0.416 \end{array} \right\} \quad (\text{semi-circles})$$

$$\psi = \frac{0.0137}{E=0.11} - 0.022 \quad (\text{semi-circles})$$

$$t = 4.32 \times 10^{+4} \lambda_i + \text{GPS time} \quad (\text{sec})$$

where

$0 \leq t < 86,400$: therefore, if $t \geq 86,400$ seconds, subtract 86,400 seconds;
if $t < 0$ seconds, add 86,400 seconds.

Rationale:

10/29/2025 CRM #13 normalized the font on the "t =" line as requested (T. Anthony)

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-460:

Section Number:

20.3.4.3.0-1

WAS:

The speed of light used by the CS for generating the data described in the above paragraphs is

$$c = 2.99792458 \times 10^8 \text{ meters per second}$$

which is the official WGS 84 speed of light. The user shall use the same value for the speed of light in all computations.

Redlines:

The speed of light used by the CS for generating the data described in the above paragraphs is

$$c = \del{2.99792458 \times 10^8} \underline{299,792,458} \text{ meters per second}$$

which is the official WGS 84 speed of light. The user shall use the same value for the speed of light in all computations.

IS:

The speed of light used by the CS for generating the data described in the above paragraphs is

$$c = 299,792,458 \text{ meters per second}$$

which is the official WGS 84 speed of light. The user shall use the same value for the speed of light in all computations.

Rationale:

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-1943:

Section Number:

30.3.3.1.1.0-8

WAS:

Bit 272 of Message Type 10 is the Integrity Status Flag (ISF). A "0" in bit position 272 indicates that the conveying signal is provided with the legacy level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal exceeds 4.42 times the current broadcast IAURA value, for more than 5.2 seconds, without an accompanying alert, is less than $1\text{E-}5$ per hour. A "1" in bit-position 272 indicates that the conveying signal is provided with an enhanced level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal exceeds 5.73 times the current broadcast IAURA value, for more than 5.2 seconds, without an accompanying alert, is less than $1\text{E-}8$ per hour. The probabilities associated with the nominal and lower bound values of the current broadcast UR_{ED} index, UR_{NED} indexes, and related URA values are not defined.

Redlines:

Bit 272 of Message Type 10 is the Integrity Status Flag (ISF). A "0" in bit position 272 indicates that the conveying signal is provided with the legacy level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal ~~exceeds~~goes outside the interval defined by ± 4.42 times the current broadcast IAURA value, for more than 5.2 seconds, without an accompanying alert, is less than ~~$1\text{E-}5$~~ 1×10^{-5} per hour. A "1" in bit-position 272 indicates that the conveying signal is provided with an enhanced level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal ~~exceeds~~goes outside the interval defined by ± 5.73 times the current broadcast IAURA value, for more than 5.2 seconds, without an accompanying alert, is less than ~~$1\text{E-}8$~~ 1×10^{-8} per hour. The probabilities associated with the nominal and lower bound values of the current broadcast UR_{ED} index, UR_{NED} indexes, and related URA values are not defined.

IS:

Bit 272 of Message Type 10 is the Integrity Status Flag (ISF). A "0" in bit position 272 indicates that the conveying signal is provided with the legacy level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal goes outside the interval defined by ± 4.42 times the current broadcast IAURA value, for more than 5.2 seconds, without an accompanying alert, is less than 1×10^{-5} per hour. A "1" in bit-position 272 indicates that the conveying signal is provided with an enhanced level of integrity assurance. That is, the probability that the instantaneous URE of the conveying signal goes outside the interval defined by ± 5.73 times the current broadcast IAURA value, for more than 5.2 seconds, without an accompanying alert, is less than 1×10^{-8} per hour. The probabilities associated with the nominal and lower bound values of the current broadcast UR_{ED} index, UR_{NED} indexes, and related URA values are not defined.

Rationale:

3/10/2026 CRM #3 Negotiated the use of “ \pm ” where applicable to instantaneous error bounds and changed all use of “exceeds” to the unambiguous “goes outside the interval defined by” (T. Anthony)

PRAT 2020-03 9/10/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-1946:

Section Number:

30.3.3.1.1.4.0-6

WAS:

For each URA_{ED} index (N), users may compute a nominal URA_{ED} value (X) as given by:

- If the value of N is 6 or less, but more than -16, $X = 2^{(1 + N/2)}$,
- If the value of N is 6 or more, but less than 15, $X = 2^{(N - 2)}$,
- N = -16 or N = 15 shall indicate the absence of an accuracy prediction and shall advise the standard positioning service user to use that SV at his own risk.

For N = 1, 3, and 5, X should be rounded to 2.8, 5.7, and 11.3 meters, respectively.

The nominal URA_{ED} value (X) is suitable for use as a conservative prediction of the RMS ED range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement deweighting, RAIM, FOM computations). Integrity properties of the $IAURA_{ED}$ are specified with respect to the scaled (multiplied by either 4.42 or 5.73 as appropriate) upper bound values of the broadcast URA_{ED} index (see 30.3.3.1.1).

For the nominal URA_{ED} value and the $IAURA_{ED}$ value, users may compute an adjusted URA_{ED} value as a function of SV elevation angle (E), for $E \geq 0$, as follows:

$$\begin{aligned} \text{Adjusted Nominal } URA_{ED} &= \text{Nominal } URA_{ED} (\sin(E+90 \text{ degrees})) \\ \text{Adjusted } IAURA_{ED} &= IAURA_{ED} (\sin(E+90 \text{ degrees})) \end{aligned}$$

URA_{ED} and $IAURA_{ED}$ account for SIS contributions to user range error which include, but are not limited to, the following: CNAV LSB representation/truncation error, CNAV alongtrack ephemeris errors, and crosstrack CNAV ephemeris errors. URA_{ED} and $IAURA_{ED}$ do not account for user range error contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

Redlines:

For each URA_{ED} index (N), users may compute a nominal URA_{ED} value (X) as given by:

- • If the value of N is 6 or less, but more than -16, $X = 2^{(1 + N/2)}$,
- • If the value of N is 6 or more, but less than 15, $X = 2^{(N - 2)}$,
- • N = -16 or N = 15 shall indicate the absence of an accuracy prediction and shall advise the standard positioning service user to use that SV at his own risk.

For N = -15, 1, 3, and 5, X should be rounded to .01, 2.8, 5.7, and 11.3 meters, respectively.

The nominal URA_{ED} value (X) is suitable for use as a conservative prediction of the RMS ED range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement deweighting, RAIM, FOM computations). Integrity properties of the $IAURA_{ED}$ are specified with respect to the scaled (multiplied by either ± 4.42 or ± 5.73 as appropriate) upper bound values of the broadcast URA_{ED} index (see 30.3.3.1.1).

For the nominal URA_{ED} value and the $IAURA_{ED}$ value, users may compute an adjusted URA_{ED} value as a function of SV elevation angle (E), for $E \geq 0$, as follows:

$$\begin{aligned} \text{Adjusted Nominal } URA_{ED} &= \text{Nominal } URA_{ED} \cos(\sin(E+90 \text{ degrees})) \\ \text{Adjusted } IAURA_{ED} &= IAURA_{ED} \cos(\sin(E+90 \text{ degrees})) \end{aligned}$$

URA_{ED} and $IAURA_{ED}$ account for SIS contributions to user range error which include, but are not limited to, the following: CNAV LSB representation/truncation error, CNAV ~~along-track~~ along-track ephemeris errors, and ~~cross-track~~ cross-track CNAV ephemeris errors. URA_{ED} and $IAURA_{ED}$ do not account for user range error contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

IS:

For each URA_{ED} index (N), users may compute a nominal URA_{ED} value (X) as given by:

- If the value of N is 6 or less, but more than -16, $X = 2^{(1 + N/2)}$,
- If the value of N is 6 or more, but less than 15, $X = 2^{(N - 2)}$,
- N = -16 or N = 15 shall indicate the absence of an accuracy prediction and shall advise the standard positioning service user to use that SV at his own risk.

For N = -15, 1, 3, and 5, X should be rounded to .01, 2.8, 5.7, and 11.3 meters, respectively.

The nominal URA_{ED} value (X) is suitable for use as a conservative prediction of the RMS ED range errors for accuracy-related purposes in the pseudorange domain (e.g., measurement deweighting, RAIM, FOM computations). Integrity properties of the $IAURA_{ED}$ are specified with respect to the scaled (multiplied by either ± 4.42 or ± 5.73 as appropriate) upper bound values of the broadcast URA_{ED} index (see 30.3.3.1.1).

For the nominal URA_{ED} value and the $IAURA_{ED}$ value, users may compute an adjusted URA_{ED} value as a function of SV elevation angle (E), for $E \geq 0$, as follows:

$$\begin{aligned} \text{Adjusted Nominal } URA_{ED} &= \text{Nominal } URA_{ED} \cos E \\ \text{Adjusted } IAURA_{ED} &= IAURA_{ED} \cos E \end{aligned}$$

URA_{ED} and $IAURA_{ED}$ account for SIS contributions to user range error which include, but are not limited to, the following: CNAV LSB representation/truncation error, CNAV along-track ephemeris errors, and cross-track CNAV ephemeris errors. URA_{ED} and $IAURA_{ED}$ do not account for user range error contributions due to the inaccuracy of the broadcast ionospheric data parameters used in the single-frequency ionospheric model or for other atmospheric effects.

Rationale:

2/16/2026 CRM #4 added \pm bounds to 4.4.2 and 5.73 factors in keeping with RFC-519 CRM #138 where the \pm sign was weighed against "using absolute value". This is compatible with SPS PS (T. Anthony)

10/29/2025 CRM #14 Removed "Degrees" from inside the "cos" input parameter and adjusted parentheses as applicable (T. Anthony)

9/3/2025 Simplified the sinusoidal formulas from $\sin(E+90)$ to $\cos(E)$ per stakeholder request (T. Anthony)

IS200-551:

Section Number:

30.3.3.1.3.0-3

WAS:

The sensitivity of the SV's position to small perturbations in most ephemeris parameters is extreme. The sensitivity of position to the parameters A , C_{rc-n} , and C_{rs-n} is about one meter/meter. The sensitivity of position to the angular parameters is on the order of 10^8 meters/semi-circle, and to the angular rate parameters is on the order of 10^{12} meters/semi-circle/second. Because of this extreme sensitivity to angular perturbations, the value of π used in the curve fit is given here. π is a mathematical constant, the ratio of a circle's circumference to its diameter. Here π is taken as 3.1415926535898.

Redlines:

The sensitivity of the SV's position to small perturbations in most ephemeris parameters is extreme. The sensitivity of position to the parameters A , C_{rc-n} , and C_{rs-n} is about one meter/meter. The sensitivity of position to the angular parameters is on the order of ~~108~~ 1×10^8 meters/semi-circle, and to the angular rate parameters is on the order of ~~1012~~ 1×10^{12} meters/semi-circle/second. Because of this extreme sensitivity to angular perturbations, the value of ~~π~~ π used in the curve fit is given here. ~~π~~ π is a mathematical constant, the ratio of a circle's circumference to its diameter. Here ~~π~~ π is taken as 3.1415926535898.

IS:

The sensitivity of the SV's position to small perturbations in most ephemeris parameters is extreme. The sensitivity of position to the parameters A , C_{rc-n} , and C_{rs-n} is about one meter/meter. The sensitivity of position to the angular parameters is on the order of 1×10^8 meters/semi-circle, and to the angular rate parameters is on the order of 1×10^{12} meters/semi-circle/second. Because of this extreme sensitivity to angular perturbations, the value of π used in the curve fit is given here. π is a mathematical constant, the ratio of a circle's circumference to its diameter. Here π is taken as 3.1415926535898.

Rationale:

9/30/2025: Administrative. Replaced PI with Unicode for sustainability. (T. Anthony)

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-553:

Section Number:
30.3.3.1.3.0-7

WAS:

	Parameter	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
t_{oe}	Ephemeris data reference time of week	11	300	0 to 604,500	seconds
Ω_{0-n}	Longitude of Ascending Node of Orbit Plane at Weekly Epoch	33*	2^{-32}		semi-circles
$\dot{\Delta\Omega}^{****}$	Rate of right ascension difference	17*	2^{-44}		semi-circles/sec
i_{0-n}	Inclination angle at reference time	33*	2^{-32}		semi-circles
IDOT	Rate of inclination angle	15*	2^{-44}		semi-circles/sec
C_{is-n}	Amplitude of the sine harmonic correction term to the angle of inclination	16*	2^{-30}		radians
C_{ic-n}	Amplitude of the cosine harmonic correction term to the angle of inclination	16*	2^{-30}		radians
C_{rs-n}	Amplitude of the sine correction term to the orbit radius	24*	2^{-8}		meters
C_{rc-n}	Amplitude of the cosine correction term to the orbit radius	24*	2^{-8}		meters
C_{us-n}	Amplitude of the sine harmonic correction term to the argument of latitude	21*	2^{-30}		radians
C_{uc-n}	Amplitude of the cosine harmonic correction term to the argument of latitude	21*	2^{-30}		radians
<p>* Parameters so indicated are two's complement, with the sign bit (+ or -) occupying the MSB;</p> <p>** See Figure 30-1 and Figure 30-2 for complete bit allocation in Message Types 10 and 11;</p> <p>*** Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor.</p> <p>**** Relative to $\dot{\Omega}_{REF} = -2.6 \times 10^{-9}$ semi-circles/second.</p>					

Redlines:

Parameter	No. of Bits**NOTE1 E2	Scale Factor (LSB)	Valid Range***N OTE3	Units
t _{oe}	11	300	0 to 604,500	seconds
Ω _{0-n}	33*NOTE1	2 ⁻³²		semi-circles
ΔΩ̇****	17*NOTE1	2 ⁻⁴⁴		semi-circles/sec
i _{0-n}	33*NOTE1	2 ⁻³²		semi-circles
IDOT	15*NOTE1	2 ⁻⁴⁴		semi-circles/sec
C _{is-n}	16*NOTE1	2 ⁻³⁰		radians
C _{ic-n}	16*NOTE1	2 ⁻³⁰		radians
C _{rs-n}	24*NOTE1	2 ⁻⁸		meters
C _{rc-n}	24*NOTE1	2 ⁻⁸		meters
C _{us-n}	21*NOTE1	2 ⁻³⁰		radians
C _{uc-n}	21*NOTE1	2 ⁻³⁰		radians
NOTE1:*	Parameters so indicated are two's complement, with the sign bit (+ or -) occupying the MSB			
NOTE2:**	See Figure 30-1 and Figure 30-2 for complete bit allocation in Message Types 10 and 11			
NOTE3:***	Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor			
NOTE4:****	Relative to Ω̇ _{REF} = -2.6 × 10 ⁻⁹ semi-circles/second			

IS:

Parameter		No. of Bits ^{NOTE2}	Scale Factor (LSB)	Valid Range ^{NOTE3}	Units
t_{oe}	Ephemeris data reference time of week	11	300	0 to 604,500	seconds
Ω_{0-n}	Longitude of Ascending Node of Orbit Plane at Weekly Epoch	33 ^{NOTE1}	2 ⁻³²		semi-circles
$\Delta\dot{\Omega}$	Rate of right ascension difference ^{NOTE4}	17 ^{NOTE1}	2 ⁻⁴⁴		semi-circles/sec
i_{0-n}	Inclination angle at reference time	33 ^{NOTE1}	2 ⁻³²		semi-circles
IDOT	Rate of inclination angle	15 ^{NOTE1}	2 ⁻⁴⁴		semi-circles/sec
C_{is-n}	Amplitude of the sine harmonic correction term to the angle of inclination	16 ^{NOTE1}	2 ⁻³⁰		radians
C_{ic-n}	Amplitude of the cosine harmonic correction term to the angle of inclination	16 ^{NOTE1}	2 ⁻³⁰		radians
C_{rs-n}	Amplitude of the sine correction term to the orbit radius	24 ^{NOTE1}	2 ⁻⁸		meters
C_{rc-n}	Amplitude of the cosine correction term to the orbit radius	24 ^{NOTE1}	2 ⁻⁸		meters
C_{us-n}	Amplitude of the sine harmonic correction term to the argument of latitude	21 ^{NOTE1}	2 ⁻³⁰		radians
C_{uc-n}	Amplitude of the cosine harmonic correction term to the argument of latitude	21 ^{NOTE1}	2 ⁻³⁰		radians

NOTE1: Parameters so indicated are two's complement, with the sign bit (+ or -) occupying the MSB
NOTE2: See Figure 30-1 and Figure 30-2 for complete bit allocation in Message Types 10 and 11
NOTE3: Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor
NOTE4: Relative to $\dot{\Omega}_{REF} = -2.6 \times 10^{-9}$ semi-circles/second

Rationale:

8/21/2025: At TIM #1, SMEs asked for NOTE identifiers to replace asterisks (T. Anthony)

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-554:

Section Number:
30.3.3.1.3.0-9

WAS:

Element/Equation	Description
$\mu = 3.986005 \times 10^{14} \text{ meters}^3/\text{sec}^2$ $\dot{\Omega}_e = 7.2921151467 \times 10^{-5} \text{ rad/sec}$ $A_0 = A_{\text{REF}} + \Delta A^*$ $A_k = A_0 + (\dot{A}) t_k$ $n_0 = \sqrt{\frac{\mu}{A_0^3}}$ $t_k = t - t_{oe}^{**}$ $\Delta n_A = \Delta n_0 + \frac{1}{2} \Delta \dot{n}_0 t_k$ $n_A = n_0 + \Delta n_A$ $M_k = M_0 + n_A t_k$ $E_0 = M_k$ $E_j = E_{j-1} + \frac{M_k - E_{j-1} + e \sin E_{j-1}}{1 - e \cos E_{j-1}}$ $E_k = E_j$ $v_k = 2 \tan^{-1} \left(\sqrt{\frac{1+e}{1-e}} \tan \frac{E_k}{2} \right)$	<p>WGS 84 value of the earth's gravitational constant for GPS user</p> <p>WGS 84 value of the earth's rotation rate</p> <p>Semi-Major Axis at reference time</p> <p>Semi-Major Axis</p> <p>Computed Mean Motion (rad/sec)</p> <p>Time from ephemeris reference time</p> <p>Mean motion difference from computed value</p> <p>Corrected Mean Motion</p> <p>Mean Anomaly</p> <p>Kepler's equation ($M_k = E_k - e \sin E_k$) may be solved for Eccentric Anomaly (E_k) by iteration:</p> <ul style="list-style-type: none"> - Initial Value (radians) - Refined Value, minimum of three iterations, (j=1,2,3) -Final Value (radians) <p>True Anomaly (unambiguous quadrant)</p>
<p>* $A_{\text{REF}} = 26,559,710$ meters</p> <p>** t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light). Furthermore, t_k shall be the actual total difference between the time t and the epoch time t_{oe}, and must account for beginning or end of week crossovers. That is if t_k is greater than 302,400 seconds, subtract 604,800 seconds from t_k. If t_k is less than -302,400 seconds, add 604,800 seconds to t_k.</p>	

Redlines:

Element/Equation	Description
$\mu = 3.986005 \times 10^{14}$ meters ³ /sec ²	WGS 84 value of the earth's gravitational constant for GPS user
$\dot{\Omega}_e = 7.2921151467 \times 10^{-5}$ rad/sec	WGS 84 value of the earth's rotation rate
$A_0 = A_{REF} + \Delta A$ NOTE1*	Semi-Major Axis at reference time NOTE1
$n_0 = \sqrt{\frac{\mu}{A_0^3}}$	Computed Mean Motion at reference time (rad/sec)
$t_k = t - t_{oe}$	Time from ephemeris reference time NOTE2
$A_k = A_0 + (\dot{A}) t_k$	Semi-Major Axis
$t_k = t - t_{oe} - \Delta t_k$	Time from ephemeris reference time
$\Delta n_A = \Delta n_0 + \frac{1}{2} \Delta \dot{n}_0 t_k$	Mean motion difference from computed value
$n_A = n_0 + \Delta n_A$	Corrected Mean Motion
$n'_0 = n_0 + \Delta n_0$	Corrected Mean Motion at reference time
$n_k = n'_0 + \Delta \dot{n}_0 t_k$	Mean Motion
$M_k = M_0 + \int_{t_{oe}}^t n_k dt$ $= M_0 + n'_0 t_k + \Delta \dot{n}_0 t_k^2 / 2$	Mean Anomaly
$M_k = M_0 + n_A t_k$	
Kepler's equation ($M_k = E_k - e \sin E_k$) may be solved for Eccentric Anomaly (E_k) by iteration	
$E_0 = M_k$	—Initial Value (radians)
$E_j = E_{j-1} + \frac{M_k - E_{j-1} + e \sin E_{j-1}}{1 - e \cos E_{j-1}}$	—Refined Value, minimum of three iterations, (j=1,2,3)
$E_k = E_j$	—Final Value (radians)
$v_k = 2 \tan^{-1} \left(\sqrt{\frac{1+e}{1-e}} \tan \left(\frac{E_k}{2} \right) \right)$	True Anomaly (unambiguous quadrant)

NOTE1: * $A_{REF} = 26,559,710$ meters

NOTE2: ** t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light). Furthermore, t_k shall be the actual total difference between the time t and the epoch time t_{oe} , and must account for beginning or end of week crossovers. That is if t_k is greater than 302,400 seconds, subtract 604,800 seconds from t_k . If t_k is less than -302,400 seconds, add 604,800 seconds to t_k .

IS:

Element/Equation	Description
$\mu = 3.986005 \times 10^{14} \text{ meters}^3/\text{sec}^2$	WGS 84 value of the earth's gravitational constant for GPS user
$\dot{\Omega}_e = 7.2921151467 \times 10^{-5} \text{ rad/sec}$	WGS 84 value of the earth's rotation rate
$A_0 = A_{\text{REF}} + \Delta A$	Semi-Major Axis at reference time ^{NOTE1}
$n_0 = \sqrt{\frac{\mu}{A_0^3}}$	Computed Mean Motion at reference time(rad/sec)
$t_k = t - t_{oe}$	Time from ephemeris reference time ^{NOTE2}
$A_k = A_0 + (\dot{A}) t_k$	Semi-Major Axis
$n'_0 = n_0 + \Delta n_0$	Corrected Mean Motion at reference time
$n_k = n'_0 + \Delta \dot{n}_0 t_k$	Mean Motion
$M_k = M_0 + \int_{t_{oe}}^t n_k dt$ $= M_0 + n'_0 t_k + \Delta \dot{n}_0 t_k^2/2$	Mean Anomaly
Kepler's equation ($M_k = E_k - e \sin E_k$) may be solved for Eccentric Anomaly (E_k) by iteration	
$E_0 = M_k$	Initial Value (radians)
$E_j = E_{j-1} + \frac{M_k - E_{j-1} + e \sin E_{j-1}}{1 - e \cos E_{j-1}}$	Refined Value, minimum of three iterations, (j=1,2,3)
$E_k = E_j$	Final Value (radians)
$v_k = 2 \tan^{-1} \left(\sqrt{\frac{1+e}{1-e}} \tan \left(\frac{E_k}{2} \right) \right)$	True Anomaly (unambiguous quadrant)
NOTE1: $A_{\text{REF}} = 26,559,710$ meters	
NOTE2: t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light). Furthermore, t_k shall be the actual total difference between the time t and the epoch time t_{oe} , and must account for beginning or end of week crossovers. That is if t_k is greater than 302,400 seconds, subtract 604,800 seconds from t_k . If t_k is less than -302,400 seconds, add 604,800 seconds to t_k .	

Rationale:

10/29/2025 CRM #15 Removed dashes from Kepler's Equation related formula Descriptions (T. Anthony)

8/21/2025: At TIM #1, SMEs asked for NOTE identifiers to replace asterisks (T. Anthony)

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

8/19/2025: Mean Motion equation correction from $\delta\dot{n}_k$ to $\delta\dot{n}_0$ (T. Anthony)

PRAT 2025-02, Pre-RFC-1445 8/5/2025 Responds to Eccentric Anomaly Rate Fix. (T. Anthony)

Replaced Mean Motion difference from computed value and Corrected Mean Motion with Corrected Mean Motion at reference time and Mean Motion.

Also replace the Mean Anomaly equation.

IS200-555:

Section Number:
30.3.3.1.3.0-11

WAS:

Element/Equation *	Description
$\Phi_k = v_k + \omega_n$ $\delta u_k = C_{us-n} \sin 2\Phi_k + C_{uc-n} \cos 2\Phi_k$ $\delta r_k = C_{rs-n} \sin 2\Phi_k + C_{rc-n} \cos 2\Phi_k$ $\delta i_k = C_{is-n} \sin 2\Phi_k + C_{ic-n} \cos 2\Phi_k$	Argument of Latitude Argument of Latitude Correction Radial Correction Inclination Correction } Second Harmonic Perturbations
$u_k = \Phi_k + \delta u_k$	Corrected Argument of Latitude
$r_k = A_k(1 - e_n \cos E_k) + \delta r_k$	Corrected Radius
$i_k = i_{o-n} + (\text{IDOT})t_k + \delta i_k$	Corrected Inclination
$x_k' = r_k \cos u_k$ $y_k' = r_k \sin u_k$ }	Positions in orbital plane
$\dot{\Omega} = \dot{\Omega}_{\text{REF}} + \Delta\dot{\Omega} \quad \text{***}$	Rate of Right Ascension
$\Omega_k = \Omega_{0-n} + (\dot{\Omega} - \dot{\Omega}_e) t_k - \dot{\Omega}_e t_{oe}$	Corrected Longitude of Ascending Node
$x_k = x_k' \cos \Omega_k - y_k' \cos i_k \sin \Omega_k$ $y_k = x_k' \sin \Omega_k + y_k' \cos i_k \cos \Omega_k$ $z_k = y_k' \sin i_k$ }	Earth-fixed coordinates of SV antenna phase center
*** $\dot{\Omega}_{\text{REF}} = -2.6 \times 10^{-9}$ semi-circles/second.	

Redlines:

Element/Equation *	Description
$\Phi_k = v_k + \omega_n$ $\delta u_k = C_{us-n} \sin 2\Phi_k + C_{uc-n} \cos 2\Phi_k$ $\delta r_k = C_{rs-n} \sin 2\Phi_k + C_{rc-n} \cos 2\Phi_k$ $\delta i_k = C_{is-n} \sin 2\Phi_k + C_{ic-n} \cos 2\Phi_k$	Argument of Latitude Argument of Latitude Correction Radial Correction Inclination Correction } Second Harmonic Perturbations
$u_k = \Phi_k + \delta u_k$ $r_k = A_k(1 - e_n \cos E_k) + \delta r_k$ $i_k = i_{0-n} + (\text{IDOT}) t_k + \delta i_k$	Corrected Argument of Latitude Corrected Radius Corrected Inclination
$x_k' = r_k \cos u_k$ $y_k' = r_k \sin u_k$ }	Positions in orbital plane
$\dot{\Omega} = \dot{\Omega}_{\text{REF}} + \Delta\dot{\Omega} \text{ ***}$ $\Omega_k = \Omega_{0-n} + (\Omega - \Omega_e) t_k - \Omega_e t_{0e}$	Rate of Right Ascension NOTE3 Corrected Longitude of Ascending Node
$x_k = x_k' \cos \Omega_k - y_k' \sin \Omega_k$ $y_k = x_k' \sin \Omega_k + y_k' \cos \Omega_k$ $z_k = y_k' \sin i_k$ }	Earth-fixed coordinates of SV antenna phase center
NOTE3:*** $\dot{\Omega}_{\text{REF}} = -2.6 \times 10^{-9}$ semi-circles/second	

IS:

Element/Equation	Description
$\Phi_k = v_k + \omega_n$ $\delta u_k = C_{us-n} \sin 2\Phi_k + C_{uc-n} \cos 2\Phi_k$ $\delta r_k = C_{rs-n} \sin 2\Phi_k + C_{rc-n} \cos 2\Phi_k$ $\delta i_k = C_{is-n} \sin 2\Phi_k + C_{ic-n} \cos 2\Phi_k$	Argument of Latitude Argument of Latitude Correction Radial Correction Inclination Correction } Second Harmonic Perturbations
$u_k = \Phi_k + \delta u_k$ $r_k = A_k(1 - e_n \cos E_k) + \delta r_k$ $i_k = i_{0-n} + (\text{IDOT}) t_k + \delta i_k$	Corrected Argument of Latitude Corrected Radius Corrected Inclination
$\left. \begin{aligned} x_k' &= r_k \cos u_k \\ y_k' &= r_k \sin u_k \end{aligned} \right\}$	Positions in orbital plane
$\dot{\Omega} = \dot{\Omega}_{\text{REF}} + \Delta \dot{\Omega}$ $\Omega_k = \Omega_{0-n} + (\Omega - \Omega_e) t_k - \Omega_e t_{0e}$	Rate of Right Ascension ^{NOTE3} Corrected Longitude of Ascending Node
$\left. \begin{aligned} x_k &= x_k' \cos \Omega_k - y_k' \sin \Omega_k \\ y_k &= x_k' \sin \Omega_k + y_k' \cos \Omega_k \\ z_k &= y_k' \sin i_k \end{aligned} \right\}$	Earth-fixed coordinates of SV antenna phase center
NOTE3: $\dot{\Omega}_{\text{REF}} = -2.6 \times 10^{-9}$ semi-circles/second	

Rationale:

8/21/2025: At TIM #1, SMEs asked for NOTE identifiers to replace asterisks (T. Anthony)

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-1729:

Section Number:

30.3.3.1.3.0-12

WAS:

Table 30-II. Broadcast Navigation User Equations (sheet 3 of 4)

Redlines:

Table 30-II. ~~—~~ Broadcast Navigation User Equations (sheet 3 of 4)

IS:

Table 30-II. Broadcast Navigation User Equations (sheet 3 of 4)

Rationale:

8/2/2025 Replace the tab with a space inside “30 – II” which is the convention across the Interface Specifications and ICDs. (T. Anthony)

IS200-1730:

Section Number:
30.3.3.1.3.0-13

WAS:

Element/Equation	Description
<u>SV Velocity</u>	
$\dot{E}_k = n / (1 - e \cos E_k)$	Eccentric Anomaly Rate
$\dot{v}_k = \dot{E}_k \sqrt{1 - e^2} / (1 - e \cos E_k)$	True Anomaly Rate
$(di_k / dt) = (IDOT) + 2 \dot{v}_k (c_{is} \cos 2\phi_k - c_{ic} \sin 2\phi_k)$	Corrected Inclination Angle Rate
$\dot{u}_k = \dot{v}_k + 2\dot{v}_k (c_{us} \cos 2\phi_k - c_{uc} \sin 2\phi_k)$	Corrected Argument of Latitude Rat
$\dot{r}_k = \dot{A}(1 - e \cos(E_k)) + A e \sin(E_k) \dot{E}_k + 2(c_{rs} \cos(2\phi_k) - c_{rc} \sin(2\phi_k)) \dot{v}_k$	Corrected Radius Rate for CNAV
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	Longitude of Ascending Node Rate
$\dot{x}'_k = \dot{r}_k \cos u_k - r_k \dot{u}_k \sin u_k$	In- plane x velocity
$\dot{y}'_k = \dot{r}_k \sin u_k + r_k \dot{u}_k \cos u_k$	In- plane y velocity
$\dot{x}_k = -x'_k \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - y'_k \sin \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth- Fixed x velocity (m/s)
$\dot{y}_k = x'_k \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth- Fixed y velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + y'_k (di_k / dt) \cos i_k$	Earth- Fixed z velocity (m/s)

Redlines:

Element/Equation	Description
SV Velocity	
$\dot{E}_k = \frac{n_k}{1 - e \cos E_k}$	Eccentric Anomaly Rate
$\dot{\nu}_k = \dot{E}_k \sqrt{1 - e^2} / (1 - e \cos E_k)$	True Anomaly Rate
$(di_k / dt) = (\text{IDOT}) + 2 \dot{\nu}_k (eC_{is} \cos 2\phi_k - eC_{ic} \sin 2\phi_k)$	Corrected Inclination Angle Rate
$\dot{u}_k = \dot{\nu}_k + 2\dot{\nu}_k (eC_{us} \cos 2\phi_k - eC_{uc} \sin 2\phi_k)$	Corrected Argument of Latitude Rat
$\dot{r}_k = \dot{A}(1 - e \cos(E_k)) + A_k e \sin(E_k) \dot{E}_k + 2 (eC_{rs} \cos(2\phi_k) - eC_{rc} \sin(2\phi_k)) \dot{\nu}_k$	Corrected Radius Rate for CNAV
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	Longitude of Ascending Node Rate
$\dot{x}'_k = \dot{r}_k \cos u_k - r_k \dot{u}_k \sin u_k$	In- plane x velocity
$\dot{y}'_k = \dot{r}_k \sin u_k + r_k \dot{u}_k \cos u_k$	In- plane y velocity
$\dot{x}_k = -\dot{x}'_k \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - \dot{y}'_k \sin \Omega_k \cos i_k - \dot{y}'_k (\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth- Fixed x velocity (m/s)
$\dot{y}_k = \dot{x}'_k \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - \dot{y}'_k (\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth- Fixed y velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + \dot{y}'_k (di_k / dt) \cos i_k$	Earth- Fixed z velocity (m/s)

IS:

Element/Equation	Description
SV Velocity	
$\dot{E}_k = \frac{n_k}{1 - e \cos E_k}$	Eccentric Anomaly Rate
$\dot{\nu}_k = \dot{E}_k \sqrt{1 - e^2} / (1 - e \cos E_k)$	True Anomaly Rate
$(di_k / dt) = (IDOT) + 2 \dot{\nu}_k (C_{is} \cos 2\phi_k - C_{ic} \sin 2\phi_k)$	Corrected Inclination Angle Rate
$\dot{u}_k = \dot{\nu}_k + 2\dot{\nu}_k (C_{us} \cos 2\phi_k - C_{uc} \sin 2\phi_k)$	Corrected Argument of Latitude Rat
$\dot{r}_k = \dot{A}(1 - e \cos(E_k)) + A_k e \sin(E_k) \dot{E}_k + 2 (C_{rs} \cos(2\phi_k) - C_{rc} \sin(2\phi_k)) \dot{\nu}_k$	Corrected Radius Rate for CNAV
$\dot{\Omega}_k = \dot{\Omega} - \dot{\Omega}_e$	Longitude of Ascending Node Rate
$\dot{x}'_k = \dot{r}_k \cos u_k - r_k \dot{u}_k \sin u_k$	In-plane x velocity
$\dot{y}'_k = \dot{r}_k \sin u_k + r_k \dot{u}_k \cos u_k$	In-plane y velocity
$\dot{x}_k = -\dot{x}'_k \dot{\Omega}_k \sin \Omega_k + \dot{x}'_k \cos \Omega_k - \dot{y}'_k \sin \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \cos \Omega_k \cos i_k - (di_k / dt) \sin \Omega_k \sin i_k)$	Earth-fixed x velocity (m/s)
$\dot{y}_k = \dot{x}'_k \dot{\Omega}_k \cos \Omega_k + \dot{x}'_k \sin \Omega_k + \dot{y}'_k \cos \Omega_k \cos i_k - y'_k (\dot{\Omega}_k \sin \Omega_k \cos i_k + (di_k / dt) \cos \Omega_k \sin i_k)$	Earth-fixed y velocity (m/s)
$\dot{z}_k = \dot{y}'_k \sin i_k + y'_k (di_k / dt) \cos i_k$	Earth-fixed z velocity (m/s)

Rationale:

10/29/2025 CRM #16 "In-plane" and "Earth-fixed" is correct English use of hyphens for compound adjectives (T. Anthony)

Administrative Change: 9/11/2025 Capitalize the Cxx parameters and space out the multiplied terms for easier reading. (T. Anthony)

8/19/2025: Corrected Radius Rate for CNAV equation changed "A" to A-sub-k (T. Anthony)

PRAT 2025-02, Pre-RFC-1445 8/5/2025 Responds to Eccentric Anomaly Rate Fix. (T. Anthony)

Adjusted the Eccentric Anomaly Rate equation

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-610:

Section Number:
30.3.3.4.6.2.1.0-3

WAS:

Parameter	No. of Bits**	Scale Factor (LSB)	Valid Range***	Units
t_{oa}	8	2^{12}	0 to 602,112	seconds
e	11	2^{-16}	0.0 to 0.03	dimensionless
δ_i^{****}	11*	2^{-14}		semi-circles
$\dot{\Omega}$	11*	2^{-33}	-1.19E-07 to 0	semi-circles/sec
\sqrt{A}	17	2^{-4}	2530 to 8192	$\sqrt{\text{meters}}$
Ω_0	16*	2^{-15}		semi-circles
ω	16*	2^{-15}		semi-circles
M_0	16*	2^{-15}		semi-circles
a_{θ}	11*	2^{-20}		seconds
a_{Γ}	10*	2^{-37}		sec/sec

* Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB;

** See Figure 30-10 for complete bit allocation in Message Type 37;

*** Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor;

**** Relative to $i_0 = 0.30$ semi-circles.

Redlines:

Parameter	No. of Bits**NOTE2	Scale Factor (LSB)	Valid Range***NOTE3	Units
t_{oa}	8	2^{+12}	0 to 602,112	seconds
e	11	2^{-16}	0.0 to 0.03	dimensionless
δ_r ****NOTE4	11 NOTE1	2^{-14}		semi-circles
$\dot{\Omega}$	11 NOTE1	2^{-33}	$-1.19 \times 10^{-7}E-7$ to 0	semi-circles/sec
\sqrt{A}	17	2^{-4}	2530 to 8192	$\sqrt{\text{meters}}$
Ω_0	16 NOTE1	2^{-15}		semi-circles
ω	16 NOTE1	2^{-15}		semi-circles
M_0	16 NOTE1	2^{-15}		semi-circles
a_{f0}	11 NOTE1	2^{-20}		seconds
a_{f1}	10 NOTE1	2^{-37}		sec/sec

NOTE1:* Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB;

NOTE2:** See Figure 30-10 for complete bit allocation in message type 37;

NOTE3:*** Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor;

NOTE4:**** Relative to $i_0 = 0.30$ semi-circles.

IS:

Parameter	No. of Bits ^{NOTE2}	Scale Factor (LSB)	Valid Range ^{NOTE3}	Units
t_{oa}	8	2^{+12}	0 to 602,112	seconds
e	11	2^{-16}	0.0 to 0.03	dimensionless
δ_i^{NOTE4}	11 ^{NOTE1}	2^{-14}		semi-circles
$\dot{\Omega}$	11 ^{NOTE1}	2^{-33}	-1.19×10^{-7} to 0	semi-circles/sec
\sqrt{A}	17	2^{-4}	2530 to 8192	$\sqrt{\text{meters}}$
Ω_0	16 ^{NOTE1}	2^{-15}		semi-circles
ω	16 ^{NOTE1}	2^{-15}		semi-circles
M_0	16 ^{NOTE1}	2^{-15}		semi-circles
a_{θ}	11 ^{NOTE1}	2^{-20}		seconds
a_{fl}	10 ^{NOTE1}	2^{-37}		sec/sec
<p>NOTE1: Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB</p> <p>NOTE2: See Figure 30-10 for complete bit allocation in message type 37</p> <p>NOTE3: Unless otherwise indicated in this column, valid range is the maximum range attainable with indicated bit allocation and scale factor</p> <p>NOTE4: Relative to $i_0 = 0.30$ semi-circles</p>				

Rationale:

11/26/20205 CRM #18 Added "+" to the exponent for the power of 2 to be consistent with the #3 Description of Change on the cover page which involves normalizing the power of 10 notation across the public documents. (T. Anthony)
8/27/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)
8/27/2025: At TIM #1, SMEs asked for NOTE identifiers to replace asterisks (T. Anthony)

IS200-1617:

Section Number:

30.3.3.4.6.2.1.0-6

WAS:

Table 30-VI. Reduced Almanac Parameters *****

Redlines:

Table 30-VI. Reduced Almanac ~~Parameters *****~~ Parameters^{NOTE5}

IS:

Table 30-VI. Reduced Almanac Parameters^{NOTE5}

Rationale:

8/28/2025 Caught up in the transition of asterisk notes to NOTEn. (T. Anthony)

IS200-612:

Section Number:
30.3.3.4.6.2.1.0-7

WAS:

Parameter	No. of Bits	Scale Factor (LSB)	Valid Range **	Units
δ_A ***	8 *	2^{+9}	**	meters
Ω_0	7 *	2^{-6}	**	semi-circles
Φ_0 ****	7 *	2^{-6}	**	semi-circles

* Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB;
 ** Valid range is the maximum range attainable with indicated bit allocation and scale factor;
 *** Relative to $A_{ref} = 26,559,710$ meters;
 **** $\Phi_0 =$ Argument of Latitude at Reference Time = $M_0 + \omega$;
 ***** Relative to following reference values:
 $e = 0$
 $\delta_i = +0.0056$ semi-circles ($i = 55$ degrees)
 $\dot{\Omega} = -2.6 \times 10^{-9}$ semi-circles/second.

Redlines:

Parameter	No. of Bits NOTE1	Scale Factor (LSB)	Valid Range NOTE2	Units
δ_A NOTE3 ***	8 *	2^{+9}	—**	meters
Ω_0	7 *	2^{-6}	—**	semi-circles
Φ_0 NOTE4 ****	7 *	2^{-6}	—**	semi-circles

[NOTE1](#):* Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB;
[NOTE2](#):** Valid range is the maximum range attainable with indicated bit allocation and scale factor;
[NOTE3](#):*** Relative to $A_{ref} = 26,559,710$ meters;
[NOTE4](#):**** $\Phi_0 =$ Argument of Latitude at Reference Time = $M_0 + \omega$;
[NOTE5](#):***** Relative to following reference values:
 $e = 0$
 $\delta_i = +0.0056$ semi-circles ($i = 55$ degrees)
 $\dot{\Omega} = -2.6 \times \del{x} 10^{-9} semi-circles/second.$

IS:

Parameter	No. of Bits ^{NOTE1}	Scale Factor (LSB)	Valid Range ^{NOTE2}	Units
δ_A ^{NOTE3}	8	2^{+9}	—	meters
Ω_0	7	2^{-6}	—	semi-circles
Φ_0 ^{NOTE4}	7	2^{-6}	—	semi-circles

NOTE1: Parameters so indicated shall be two's complement with the sign bit (+ or -) occupying the MSB;
 NOTE2: Valid range is the maximum range attainable with indicated bit allocation and scale factor;
 NOTE3: Relative to $A_{ref} = 26,559,710$ meters;
 NOTE4: $\Phi_0 =$ Argument of Latitude at Reference Time = $M_0 + \omega$;
 NOTE5: Relative to following reference values:
 $e = 0$
 $\delta_i = +0.0056$ semi-circles ($i = 55$ degrees)
 $\dot{\Omega} = -2.6 \times 10^{-9}$ semi-circles/second.

Rationale:

8/21/2025: At TIM #1, SMEs asked for NOTE identifiers to replace asterisks (T. Anthony)

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-623:

Section Number:
30.3.3.5.1.1.0-8

WAS:

Element/Equation		Description
$t_{diff} = (t - t_{EOP} + 604800(WN - WN_{ot}))$	[seconds]	Compute difference between GPS time and EOP reference time
$UT1 = t + 604800*WN + \Delta UTGPS + \Delta UTGPS*t_{diff}/86400$	[seconds]	Compute UT1 at GPS time
$x_p = PM_X + PM_X*t_{diff}/86400$	[arc-seconds]	Polar Motion in the x-axis
$y_p = PM_Y + PM_Y*t_{diff}/86400$	[arc-seconds]	Polar Motion in the y-axis
GPS system time (t) is expressed in seconds since start of current GPS week, and WN is the current week number expressed in number of weeks since GPS epoch. The divisor 86400 converts rates per day to rates per second.		

Redlines:

Element/Equation	Units	Description
$t_{diff} = (t - t_{EOP} + 604,800(WN - WN_{ot}))$	seconds	Compute difference between GPS time and EOP reference time
$UT1 = t + 604,800*WN + \Delta UTGPS + \Delta UTGPS*t_{diff}/86,400$	seconds	Compute UT1 at GPS time
$x_p = PM_X + PM_X*t_{diff}/86,400$	arc-seconds	Polar Motion in the x-axis
$y_p = PM_Y + PM_Y*t_{diff}/86,400$	arc-seconds	Polar Motion in the y-axis
GPS system time (t) is expressed in seconds since start of current GPS week, and WN is the current week number expressed in number of weeks since GPS epoch. The divisor 86,400 converts rates per day to rates per second.		

IS:

Element/Equation	Units	Description
$t_{diff} = (t - t_{EOP} + 604,800(WN - WN_{ot}))$	seconds	Compute difference between GPS time and EOP reference time
$UT1 = t + 604,800 WN + \Delta UT_{GPS} + \Delta UT_{GPS} t_{diff}/86,400$	seconds	Compute UT1 at GPS time
$x_p = PM_X + \dot{PM}_X t_{diff}/86,400$	arc-seconds	Polar Motion in the x-axis
$y_p = PM_Y + \dot{PM}_Y t_{diff}/86,400$	arc-seconds	Polar Motion in the y-axis
GPS system time (t) is expressed in seconds since start of current GPS week, and WN is the current week number expressed in number of weeks since GPS epoch. The divisor 86,400 converts rates per day to rates per second.		

Rationale:

8/5/2025 Normalize the notation for scalar value multiply, use only implied multiply. (T. Anthony)

IS200-1966:

Section Number:

30.3.3.7.4.0-4

WAS:

The quasi-Keplerian elements are then corrected by

$$\begin{aligned} A_c &= A_i + \Delta A \\ e_c &= (\alpha_c^2 + \beta_c^2)^{1/2} \\ i_c &= i_i + \Delta i \\ \Omega_c &= \Omega_i + \Delta \Omega \\ \omega_c &= \tan^{-1}(\beta_c/\alpha_c) \\ M_{0-c} &= \gamma_c - \omega_c + \Delta M_0 \end{aligned}$$

where ΔA , Δi and $\Delta \Omega$ are provided in the EDC data packet of the Message Type 34 or 14 and ΔM_0 is obtained from

$$\Delta M_0 = \frac{-3}{2} \left(\frac{\mu}{A_0^3} \right)^{\frac{1}{2}} \left(\frac{\Delta A_0}{A_0} \right) \left[(t_{oe} + WN_{oe} * 604,800) - (t_{OD} + WN * 604,800) \right]$$

where $WN(oe)$ is the week number associated with the $t(oe)$ and WN is the current week number.

The corrected quasi-Keplerian elements above are applied to the user algorithm for determination of antenna phase center position in Section 30.3.3.1.3, Table 30-II.

Redlines:

<not available>

IS:

The quasi-Keplerian elements are then corrected by

$$\begin{aligned}
 A_c &= A_i + \Delta A \\
 e_c &= (\alpha_c^2 + \beta_c^2)^{1/2} \\
 i_c &= i_i + \Delta i \\
 \Omega_c &= \Omega_i + \Delta \Omega \\
 \omega_c &= \tan^{-1} (\beta_c / \alpha_c) \\
 M_{0-c} &= \gamma_c - \omega_c + \Delta M_0
 \end{aligned}$$

where ΔA , Δi and $\Delta \Omega$ are provided in the EDC data packet of the message type 34 or 14 and ΔM_0 is obtained from

$$\Delta M_0 = -\frac{3}{2} \sqrt{\frac{\mu}{A_0^3}} \left(\frac{\Delta A_0}{A_0} \right) [(t_{oe} + 604,800 WN_{oe}) - (t_{OD} - 604,800 WN)]$$

where WN_{oe} is the week number associated with the t_{oe} and WN is the current week number.

The corrected quasi-Keplerian elements above are applied to the user algorithm for determination of antenna phase center position in Section 30.3.3.1.3, Table 30-II.

Rationale:

12/10/2025 CRM #23 Normalize the notation for scalar value multiply, use only implied multiply. Now matches IS705-1721 (T. Anthony)

Administrative fix 12/10/2025 Many parameters needed to have their Greek letters redone in Unicode. Also some of the terms for the formula were redone because the square root was used many places, but was 1/2 power here. (T. Anthony)

IS200-654:

Section Number:

30.3.3.7.5.0-1

WAS:

The $UDRA_{op-D}$ and \dot{UDRA} shall give the differential user range accuracy for the SV. It must be noted that the two parameters provide estimated accuracy after both clock and ephemeris DC are applied. The $UDRA_{op-D}$ and \dot{UDRA} indices are signed, two's complement integers in the range of +15 to -16 and has the following relationship:

<u>Index Value</u>	<u>$UDRA_{op-D}$ (meters)</u>	<u>\dot{UDRA} (10^{-6} m/sec)</u>
15	6144.00 < $UDRA_{op-D}$ ≤ 6144.00	
14	3072.00 < $UDRA_{op-D}$ ≤ 6144.00	3072.00
13	1536.00 < $UDRA_{op-D}$ ≤ 3072.00	1536.00
12	768.00 < $UDRA_{op-D}$ ≤ 1536.00	768.00
11	384.00 < $UDRA_{op-D}$ ≤ 768.00	384.00
10	192.00 < $UDRA_{op-D}$ ≤ 384.00	192.00
9	96.00 < $UDRA_{op-D}$ ≤ 192.00	96.00
8	48.00 < $UDRA_{op-D}$ ≤ 96.00	48.00
7	24.00 < $UDRA_{op-D}$ ≤ 48.00	24.00
6	13.65 < $UDRA_{op-D}$ ≤ 24.00	13.65
5	9.65 < $UDRA_{op-D}$ ≤	13.65 9.65
4	6.85 < $UDRA_{op-D}$ ≤	9.65 6.85
3	4.85 < $UDRA_{op-D}$ ≤	6.85 4.85
2	3.40 < $UDRA_{op-D}$ ≤	4.85 3.40
1	2.40 < $UDRA_{op-D}$ ≤	3.40 2.40
0	1.70 < $UDRA_{op-D}$ ≤	2.40 1.70
-1	1.20 < $UDRA_{op-D}$ ≤	1.70 1.20
-2	0.85 < $UDRA_{op-D}$ ≤	1.20 0.85
-3	0.60 < $UDRA_{op-D}$ ≤	0.85 0.60
-4	0.43 < $UDRA_{op-D}$ ≤	0.60 0.43
-5	0.30 < $UDRA_{op-D}$ ≤	0.43 0.30
-6	0.21 < $UDRA_{op-D}$ ≤	0.30 0.21
-7	0.15 < $UDRA_{op-D}$ ≤	0.21 0.15
-8	0.11 < $UDRA_{op-D}$ ≤	0.15 0.11
-9	0.08 < $UDRA_{op-D}$ ≤	0.11 0.08
-10	0.06 < $UDRA_{op-D}$ ≤	0.08 0.06
-11	0.04 < $UDRA_{op-D}$ ≤	0.06 0.04
-12	0.03 < $UDRA_{op-D}$ ≤	0.04 0.03
-13	0.02 < $UDRA_{op-D}$ ≤	0.03 0.02
-14	0.01 < $UDRA_{op-D}$ ≤	0.02 0.01
-15	$UDRA_{op-D}$ ≤	0.01 0.005
-16	No accuracy prediction available—use at own risk	

For any time, t_k , other than t_{op-D} , $UDRA$ is found by,

$$UDRA = UDRA_{op-D} + \dot{UDRA}(t_k - t_{op-D})$$

Redlines:

The $UDRA_{op-D}$ and $UDRA$ shall give the differential user range accuracy for the SV. It must be noted that the two parameters provide estimated accuracy after both clock and ephemeris DC are applied. The $UDRA_{op-D}$ and $UDRA$ indices are signed, two's complement integers in the range of +15 to -16 and has the following relationship:

Index Value	$UDRA_{op-D}$ (meters)		$UDRA$ (1×10^{-6} meters/sec)
15	6144.00	< $UDRA_{op-D}$	6144.00
14	3072.00	< $UDRA_{op-D} \leq$ 6144.00	3072.00
13	1536.00	< $UDRA_{op-D} \leq$ 3072.00	1536.00
12	768.00	< $UDRA_{op-D} \leq$ 1536.00	768.00
11	384.00	< $UDRA_{op-D} \leq$ 768.00	384.00
10	192.00	< $UDRA_{op-D} \leq$ 384.00	192.00
9	96.00	< $UDRA_{op-D} \leq$ 192.00	96.00
8	48.00	< $UDRA_{op-D} \leq$ 96.00	48.00
7	24.00	< $UDRA_{op-D} \leq$ 48.00	24.00
6	13.65	< $UDRA_{op-D} \leq$ 24.00	13.65
5	9.65	< $UDRA_{op-D} \leq$ 13.65	9.65
4	6.85	< $UDRA_{op-D} \leq$ 9.65	6.85
3	4.85	< $UDRA_{op-D} \leq$ 6.85	4.85
2	3.40	< $UDRA_{op-D} \leq$ 4.85	3.40
1	2.40	< $UDRA_{op-D} \leq$ 3.40	2.40
0	1.70	< $UDRA_{op-D} \leq$ 2.40	1.70
-1	1.20	< $UDRA_{op-D} \leq$ 1.70	1.20
-2	0.85	< $UDRA_{op-D} \leq$ 1.20	0.85
-3	0.60	< $UDRA_{op-D} \leq$ 0.85	0.60
-4	0.43	< $UDRA_{op-D} \leq$ 0.60	0.43
-5	0.30	< $UDRA_{op-D} \leq$ 0.43	0.30
-6	0.21	< $UDRA_{op-D} \leq$ 0.30	0.21
-7	0.15	< $UDRA_{op-D} \leq$ 0.21	0.15
-8	0.11	< $UDRA_{op-D} \leq$ 0.15	0.11
-9	0.08	< $UDRA_{op-D} \leq$ 0.11	0.08
-10	0.06	< $UDRA_{op-D} \leq$ 0.08	0.06
-11	0.04	< $UDRA_{op-D} \leq$ 0.06	0.04
-12	0.03	< $UDRA_{op-D} \leq$ 0.04	0.03
-13	0.02	< $UDRA_{op-D} \leq$ 0.03	0.02
-14	0.01	< $UDRA_{op-D} \leq$ 0.02	0.01
-15		$UDRA_{op-D} \leq$ 0.01	0.005
-16	No accuracy prediction available—use at own risk		

For any time, t_k , other than t_{op-D} , $UDRA$ is found by,

$$UDRA = UDRA_{op-D} + UDRA (t_k - t_{op-D})$$

IS:

The $UDRA_{op-D}$ and $UDRA$ shall give the differential user range accuracy for the SV. It must be noted that the

two parameters provide estimated accuracy after both clock and ephemeris DC are applied. The $UDRA_{op-D}$ and $UDRA$ indices are signed, two's complement integers in the range of +15 to -16 and has the following relationship:

Index Value	$UDRA_{op-D}$ (meters)		$UDRA$ (1×10^{-6} meters/sec)
15	6144.00	< $UDRA_{op-D}$	6144.00
14	3072.00	< $UDRA_{op-D} \leq$ 6144.00	3072.00
13	1536.00	< $UDRA_{op-D} \leq$ 3072.00	1536.00
12	768.00	< $UDRA_{op-D} \leq$ 1536.00	768.00
11	384.00	< $UDRA_{op-D} \leq$ 768.00	384.00
10	192.00	< $UDRA_{op-D} \leq$ 384.00	192.00
9	96.00	< $UDRA_{op-D} \leq$ 192.00	96.00
8	48.00	< $UDRA_{op-D} \leq$ 96.00	48.00
7	24.00	< $UDRA_{op-D} \leq$ 48.00	24.00
6	13.65	< $UDRA_{op-D} \leq$ 24.00	13.65
5	9.65	< $UDRA_{op-D} \leq$ 13.65	9.65
4	6.85	< $UDRA_{op-D} \leq$ 9.65	6.85
3	4.85	< $UDRA_{op-D} \leq$ 6.85	4.85
2	3.40	< $UDRA_{op-D} \leq$ 4.85	3.40
1	2.40	< $UDRA_{op-D} \leq$ 3.40	2.40
0	1.70	< $UDRA_{op-D} \leq$ 2.40	1.70
-1	1.20	< $UDRA_{op-D} \leq$ 1.70	1.20
-2	0.85	< $UDRA_{op-D} \leq$ 1.20	0.85
-3	0.60	< $UDRA_{op-D} \leq$ 0.85	0.60
-4	0.43	< $UDRA_{op-D} \leq$ 0.60	0.43
-5	0.30	< $UDRA_{op-D} \leq$ 0.43	0.30
-6	0.21	< $UDRA_{op-D} \leq$ 0.30	0.21
-7	0.15	< $UDRA_{op-D} \leq$ 0.21	0.15
-8	0.11	< $UDRA_{op-D} \leq$ 0.15	0.11
-9	0.08	< $UDRA_{op-D} \leq$ 0.11	0.08
-10	0.06	< $UDRA_{op-D} \leq$ 0.08	0.06
-11	0.04	< $UDRA_{op-D} \leq$ 0.06	0.04
-12	0.03	< $UDRA_{op-D} \leq$ 0.04	0.03
-13	0.02	< $UDRA_{op-D} \leq$ 0.03	0.02
-14	0.01	< $UDRA_{op-D} \leq$ 0.02	0.01
-15	$UDRA_{op-D} \leq$ 0.01		0.005
-16	No accuracy prediction available—use at own risk		

For any time, t_k , other than t_{op-D} , $UDRA$ is found by,

$$UDRA = UDRA_{op-D} + UDRA (t_k - t_{op-D})$$

Rationale:

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-674:

Section Number:

30.3.4.3.0-1

WAS:

The speed of light used by the CS for generating the data described in the above paragraphs is

$$c = 2.99792458 \times 10^8 \text{ meters per second}$$

which is the official WGS 84 speed of light. The user shall use the same value for the speed of light in all computations.

Redlines:

The speed of light used by the CS for generating the data described in the above paragraphs is

$$c = \del{2.99792458} \times \u{299,792,458} \del{+08} \text{ meters per second}$$

which is the official WGS 84 speed of light. The user shall use the same value for the speed of light in all computations.

IS:

The speed of light used by the CS for generating the data described in the above paragraphs is

$$c = 299,792,458 \text{ meters per second}$$

which is the official WGS 84 speed of light. The user shall use the same value for the speed of light in all computations.

Rationale:

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

IS200-678:

Section Number:

30.3.5.1.0-1

WAS:

Twenty-four bits of CRC parity will provide protection against burst as well as random errors with a probability of undetected error $\leq 2^{-24} = 5.96 \times 10^{-8}$ for all channel bit error probabilities ≤ 0.5 . The CRC word is calculated in the forward direction on a given message using a seed of 0. The sequence of 24 bits (p_1, p_2, \dots, p_{24}) is generated from the sequence of information bits (m_1, m_2, \dots, m_{276}) in a given message. This is done by means of a code that is generated by the polynomial

$$g(X) = \sum_{i=0}^{24} g_i X^i$$

where

$$g_i = 1 \quad \text{for } i = 0, 1, 3, 4, 5, 6, 7, 10, 11, 14, 17, 18, 23, 24$$

$$= 0 \quad \text{otherwise}$$

Redlines:

Twenty-four bits of CRC parity will provide protection against burst as well as random errors with a probability of undetected error $\leq 2^{-24} = 5.96 \times 10^{-8}$ for all channel bit error probabilities ≤ 0.5 . The CRC word is calculated in the forward direction on a given message using a seed of 0. The sequence of 24 bits (p_1, p_2, \dots, p_{24}) is generated from the sequence of information bits (m_1, m_2, \dots, m_{276}) in a given message. This is done by means of a code that is generated by the polynomial

$$g(X) = \sum_{i=0}^{24} g_i X^i$$

where

$$g_i = 1 \quad \text{for } i = 0, 1, 3, 4, 5, 6, 7, 10, 11, 14, 17, 18, 23, 24$$

$$= 0 \quad \text{otherwise}$$

IS:

Twenty-four bits of CRC parity will provide protection against burst as well as random errors with a probability of undetected error $\leq 2^{-24} = 5.96 \times 10^{-8}$ for all channel bit error probabilities ≤ 0.5 . The CRC word is calculated in the forward direction on a given message using a seed of 0. The sequence of 24 bits (p_1, p_2, \dots, p_{24}) is generated from the sequence of information bits (m_1, m_2, \dots, m_{276}) in a given message. This is done by means of a code that is generated by the polynomial

$$g(X) = \sum_{i=0}^{24} g_i X^i$$

where

$$g_i = 1 \quad \text{for } i = 0, 1, 3, 4, 5, 6, 7, 10, 11, 14, 17, 18, 23, 24$$

$$= 0 \quad \text{otherwise}$$

Rationale:

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

Administrative fix 8/5/2025 Replaced less than or equal signs with Unicode characters (T. Anthony)

IS200-1981:

Section Number:

30.3.5.1.0-5

WAS:

This code has the following characteristics:

- 1) It detects all single bit errors per code word.
- 2) It detects all double bit error combinations in a codeword because the generator polynomial $g(X)$ has a factor of at least three terms.
- 3) It detects any odd number of errors because $g(X)$ contains a factor $1+X$.
- 4) It detects any burst error for which the length of the burst is ≤ 24 bits.
- 5) It detects most large error bursts with length greater than the parity length $r = 24$ bits. The fraction of error bursts of length $b > 24$ that are undetected is:
 - a) $2^{-24} = 5.96 \times 10^{-8}$, if $b > 25$ bits.
 - b) $2^{-23} = 1.19 \times 10^{-7}$, if $b = 25$ bits.

Redlines:

This code has the following characteristics:

- 1) It detects all single bit errors per code word.
- 2) It detects all double bit error combinations in a codeword because the generator polynomial $g(X)$ has a factor of at least three terms.
- 3) It detects any odd number of errors because $g(X)$ contains a factor $1+X$.
- 4) It detects any burst error for which the length of the burst is ~~\leq~~ 24 bits.
- 5) It detects most large error bursts with length greater than the parity length $r = 24$ bits. The fraction of error bursts of length $b > 24$ that are undetected is:
 - a) $2^{-24} = 5.96$ ~~\times~~ 10^{-8} , if $b > 25$ bits~~.~~
 - b) $2^{-23} = 1.19$ ~~\times~~ 10^{-7} , if $b = 25$ bits~~.~~

IS:

This code has the following characteristics:

- 1) It detects all single bit errors per code word.
- 2) It detects all double bit error combinations in a codeword because the generator polynomial $g(X)$ has a factor of at least three terms.
- 3) It detects any odd number of errors because $g(X)$ contains a factor $1+X$.
- 4) It detects any burst error for which the length of the burst is ≤ 24 bits.
- 5) It detects most large error bursts with length greater than the parity length $r = 24$ bits. The fraction of error bursts of length $b > 24$ that are undetected is:
 - a) $2^{-24} = 5.96 \times 10^{-8}$, if $b > 25$ bits
 - b) $2^{-23} = 1.19 \times 10^{-7}$, if $b = 25$ bits

Rationale:

8/21/2025: Converted the exponential notation to CSE Manual standard. (T. Anthony)

PRAT 2020-03 8/5/2025 Normalize the use of scientific notation across the public GPS interface documents. (T. Anthony)

CP Status = 'In Review': 46

of inserted requirements: 0
of modified requirements: 8
of deleted requirements: 0
of TBDs: 0
of TBRs: 0
of (added/modified) effectivities: 0
of VCRM additions: 0
of VCRM modifications: 0
of VCRM deletions: 0
of descriptive texts: 21
of (added/modified) tables: 13
of (added/modified) figures: 2
