data set (reference 20.3.4.5). The reference time for UTC data (t_{ot}) shall be referenced to the start of that week whose number (WN_t) is given in word eight of page 18 in subframe 4. The WN_t value consists of eight bits which shall be a modulo 256 binary representation of the GPS week number (see paragraph 6.2.4) to which the t_{ot} is referenced. The user must account for the truncated nature of this parameter as well as truncation of WN, WN_t, and WN_{LSF} due to rollover of full week number (see paragraph 3.3.4(b)). The CS shall manage these parameters such that the absolute value of the difference between the untruncated WN and WN_t values shall not exceed 127.

b. Whenever the user's current time falls within the time span of six hours prior to the effectivity time to six hours after the effectivity time, proper accommodation of the leap second event with a possible week number transition is provided by the following expression for UTC:

$$t_{UTC} = W[\text{modulo } (86400 + \Delta t_{LSF} - \Delta t_{LS})], \text{ seconds;}$$

where

$$W = (t_E - \Delta t_{UTC} - 43200) \text{ [modulo } 86400] + 43200, \text{ seconds;}$$

and the definition of Δt_{UTC} (as given in 20.3.3.5.2.4a above) applies throughout the transition period. Note that when a leap second is added, unconventional time values of the form 23:59:60.xxx are encountered. Some user equipment may be designed to approximate UTC by decrementing the running count of time within several seconds after the event, thereby promptly returning to a proper time indication. Whenever a leap second event is encountered, the user equipment must consistently implement carries or borrows into any year/week/day counts.

c. Whenever the effectivity time of the leap second event, as indicated by the WN_{LSF} and DN values, is in the "past" (relative to the user's current time), and the user’s current time does not fall in the time span as given above in 20.3.3.5.2.4b, the relationship previously given for t_{UTC} in 20.3.3.5.2.4a above is valid except that the value of Δt_{LSF} is substituted for Δt_{LS}. The CS will coordinate the update of UTC parameters at a future upload so as to maintain a proper continuity of the t_{UTC} time scale.

20.3.3.5.2.5 Ionospheric Model.

The "two frequency" (L1 and L2) user shall correct the time received from the SV for ionospheric effect by utilizing the time delay differential between L1 and L2 (reference paragraph 20.3.3.3.3.3). The "one frequency" user, however, may use the model given in Figure 20-4 to make this correction. It is estimated that the use of this model will provide at least a 50 percent reduction in the single - frequency user's RMS error due to ionospheric propagation effects. During extended operations, or for the SVs in the Autonav mode if the CS is unable to upload the SVs, the use of this model will yield unpredictable results.

20.3.3.5.2.6 NMCT Data.

For each SV, the ERD value in the NMCT is an estimated pseudorange error. Each ERD value is computed by the CS and represents the radial component of the satellite ephemeris error minus the speed of light times the satellite clock error. The satellite ephemeris and clock errors are computed by subtracting the broadcast from current estimates. Therefore, the ERD value may be used as follows to correct the user's measured pseudorange:

$$PR_c = PR - ERD$$

where,

PR_c = pseudorange corrected with the ERD value from the NMCT

PR = measured pseudorange.

Note that as described above, the ERD values are actually error estimates rather than differential corrections and so are subtracted rather than added in the above equation.

The ionospheric correction model is given by

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

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 20.3.3.3.3.2),

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

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

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

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

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

Figure 20-4. Ionospheric Model (Sheet 1 of 3)

Other equations that must be solved are

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

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

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

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

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

where

$0 \le t < 86400$: therefore, if $t \ge 86400$ seconds, subtract 86400 seconds;

if $t < 0$ seconds, add 86400 seconds.

Figure 20-4. Ionospheric Model (Sheet 2 of 3)

The terms used in computation of ionospheric delay are as follows:

- Satellite Transmitted Terms

α_n	-	the coefficients of a cubic equation representing the amplitude of the vertical delay (4 coefficients - 8 bits each)
β_n	-	the coefficients of a cubic equation representing the period of the model (4 coefficients - 8 bits each)

- Receiver Generated Terms

E	-	elevation angle between the user and satellite (semi-circles)
A	-	azimuth angle between the user and satellite, measured clockwise positive from the true North (semi-circles)
ϕ_u	-	user geodetic latitude (semi-circles) WGS 84
λ_u	-	user geodetic longitude (semi-circles) WGS 84
GPS time	-	receiver computed system time

- Computed Terms

X	-	phase (radians)
F	-	obliquity factor (dimensionless)
t	-	local time (sec)
ϕ_m	-	geomagnetic latitude of the earth projection of the ionospheric intersection point (mean ionospheric height assumed 350 km) (semi-circles)
λ_i	-	geodetic longitude of the earth projection of the ionospheric intersection point (semi-circles)
ϕ_i	-	geodetic latitude of the earth projection of the ionospheric intersection point (semi-circles)
ψ	-	earth's central angle between the user position and the earth projection of ionospheric intersection point (semi-circles)

Figure 20-4. Ionospheric Model (Sheet 3 of 3)