UTM - INVERSE Projection

0.1 Notations and Definitions (as per Map projections - A Working Manual, USGS Professional Paper 1395, John P. Snyder)

0.1.1 Required Input:

φ	Latitude of point (positive north) Comment (B) Angles in radians
φ_1	Latitude at CM that has same N coordinate as point
λ	Longitude of point (positive east) Comment (L) Western longs negative
φ_o	Latitude of Grid Origin Comment (Bo, for UTM this is = zero)
λ_o	Longitude of Central Meridian (=Grid Origin) Comment (Lo)
k_o	Scale factor at the Central Parallel Comment Note: Sets the secant depth
N_f	False Northing of the Grid Origin Comment [m]
E_f	False Easting of the Grid Origin Comment [m]
a	Ellipsoid semi-major axis Comment [m]
f	Flattening of the ellipsoid
Z	Desired projection zone ID Comment Note: Used as look-up index

0.1.2 Intermediate calculated values

R_1	Mapping Radius at latitude φ_1
e	First eccentricity of the ellipsoid = $\sqrt{2f - f^2}$

0.1.3 Desired Output

φ	Latitude of point
λ	Longitude of point
k	Grid scale factor at point
γ	Convergency angle at point Comment (C)

0.2 Calculate Zone Constants (none calculated for UTM)

0.3 Calculate Inverse Coversion Computation

$$e'^2 = e^2/(1-e^2)$$
$$e_1 = (1-\sqrt{1-e^2})/(1+\sqrt{1-e^2})$$

$$m_1 = (1-e^2/4-3e^4/64-5e^6/256)\,\varphi_0$$
$$m_2 = (3e^2/8+3e^4/32+45e^6/1024)\sin(2\varphi_0)$$
$$m_3 = (15e^4/256+45e^6/1024)\sin(4\varphi_0)$$
$$m_4 = (35e^6/3072)\sin(6\varphi_0)$$
$$M_0 = a[m_1-m_2+m_3-m_4]$$

$$M = M_0 + (y-N_f)/k_0$$
$$\mu = M/(a(1-e^2/4-3e^4/64-5e^6/256))$$

$$\varphi_1 = \mu + (3e_1/2-27e_1^3/32)\sin(2\mu)$$
$$+ (21e_1^2/16-55e_1^4/32)\sin(4\mu)$$
$$+ (151e_1^3/96)\sin(6\mu)$$
$$+ (1097e_1^4/512)\sin(8\mu)$$
$$C_1 = e'^2\cos^2(\varphi_1)$$
$$T_1 = \tan^2(\varphi_1)$$
$$w = 1-e^2\sin^2(\varphi_1)$$
$$sw = \sqrt{w}$$
$$N_1 = a/sw$$
$$sw = \sqrt{w}$$
$$R_1 = a(1-e^2)/(sw*sw*sw)$$
$$D = (x-E_f)/(N_1 k_0)$$

$$\varphi = \varphi_1 - (N_1\tan(\varphi_1)/R_1)$$
$$*(D^2/2 - (5+3T_1+10C_1-4C_1^2-9e'^2)D^4/24$$
$$+(61+90T_1+298C_1+45T_1^2-252e'^2-3C_1^2)D^6/720$$

$$\lambda = \lambda_0$$
$$+[D-(1+2T_1+C_1)D^3/6$$
$$+ (5-2C_1+28T_1-3C_1^2+8e'^2+24T_1^2)D^5/120]/\cos(\varphi_1)$$