












Δ : measurement
 : calculation
 : almanac data

clock slow : +WE
 clock fast : - WE
 GMT-z : add z
 GMT+z : subtract z




North, East : +
 South, West : -
 OFF the arc : +
 ON the arc : -

$$\text{atan2}(y, x) = \begin{cases} \text{atan}\left(\frac{y}{x}\right) & x > 0 \\ \text{atan}\left(\frac{y}{x}\right) + \pi & x < 0 \quad y \geq 0 \\ \text{atan}\left(\frac{y}{x}\right) - \pi & x < 0 \quad y < 0 \\ \pi/2 & x = 0 \quad y > 0 \\ -\pi/2 & x = 0 \quad y < 0 \\ \text{undefined} & x = 0 \quad y = 0 \end{cases}$$

$$\begin{aligned}
distance[nmi] &= \frac{S \cdot \Delta t}{3600} \\
Zn &= atan\,2(y, x) \\
DIP['] &= 1.758 \cdot \sqrt{h} \\
Ha &= Hs \pm IE - DIP \\
f &= \frac{p}{1010} \cdot \frac{283.15}{273.15 + T} \\
R['] &= \cot\left(Ha + \frac{7.31}{Ha + 4.4}\right) \\
P['] &= HP \cdot \cos(Ha) \\
\Delta Ho['] &= distance \cdot \cos(Zn - C) \\
Ho &= Ha - f \cdot R \pm SD + P + \Delta Ho \\
v_{corr}['] &= v \cdot (minutes_{UTC} + 0.5) / 60 \\
GHA &= GHA_{hour} + GHA_{inc} + SHA + v_{corr} \\
d_{corr}['] &= d \cdot (minutes_{UTC} + 0.5) / 60 \\
DEC &= DEC_{tab} + d_{corr} \\
y &= \sin(-GHA - \lambda_0) \cdot \cos DEC \\
x &= \cos \phi_0 \cdot \sin DEC - \sin \phi_0 \cdot \cos DEC \cdot \cos(-GHA - \lambda_0)
\end{aligned}$$

	Hs	=	°	'
	IE	±		'
	DIP	-		'
	Ha	=	°	'
	f · R	-		'
	SD	±		'
	P	+		'
	ΔHo	+		'
	Ho	=	°	'

	<i>tabular v</i>	
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	tabular DEC	=	o	'
	d_{corr}	+		'
	DEC	=	o	'

celestial body		date			time		
		year	month	day	hour	minute	second
☞	local date & time				GMT		WE
📅	UTC date & time						
📅	UTC time of fix						

📅	Δt	sec	t _{fix} - t _{UTC}	°3600+	°60+
☞	speed	knot	ded reckoning	lat (φ ₀)	° ' "
📅	distance	nmi		lon (λ ₀)	° ' "
📅	x		☞	course	° ' "
📅	y		📅	Zn	° ' "

☞	T	°C	
☞	p	mbar	
☞	h	meter	
📅	f		
📅	R	'	
☞	limb	lower: + SD	upper: - SD
📖	HP	'	
📖	HP _{Sun}	0.146569	'

📖	tabular v	
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📖	tabular d	
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☞	Hs	=	°	'
☞	IE	±		'
📅	DIP	-		'
📅	Ha	=	°	'
📅	f · R	-		'
📖	SD	±		'
📅	P	+		'
📅	ΔHo	+		'
📅	Ho	=	°	'

📖	GHA _{hour}	=	°	'
📖	GHA _{incr}	+	°	'
📖	SHA	+		'
📅	v _{corr}	+		'
📅	GHA	=	°	'

📖	tabular DEC	=	°	'
📅	d _{corr}	+		'
📅	DEC	=	°	'

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atan 2(y, x)=	atan $\left(\frac{y}{x}\right)$	x>0
	atan $\left(\frac{y}{x}\right)+\pi$	x<0 y≥0
	atan $\left(\frac{y}{x}\right)-\pi$	x<0 y<0
	π/2	x=0 y>0
	-π/2	x=0 y<0
	undefined	x=0 y=0

distance[nmi]	=	$\frac{S \cdot \Delta t}{3600}$
Zn	=	atan 2(y, x)
DIP[']	=	1.758 · √h
Ha	=	Hs ± IE − DIP
f	=	$\frac{p}{1010} \cdot \frac{283.15}{273.15 + T}$
R[']	=	cot $\left(Ha + \frac{7.31}{Ha + 4.4}\right)$
P[']	=	HP · cos(Ha)
Δ Ho[']	=	distance · cos(Zn − C)
Ho	=	Ha − f · R ± SD + P + Δ Ho
v _{corr} [']	=	v · (minutes _{UTC} + 0.5) / 60
GHA	=	GHA _{hour} + GHA _{inc} + SHA + v _{corr}
d _{corr} [']	=	d · (minutes _{UTC} + 0.5) / 60
DEC	=	DEC _{tab} + d _{corr}
y	=	sin(−GHA − λ ₀) · cos DEC
x	=	cos φ ₀ · sin DEC − sin φ ₀ · cos DEC · cos(−GHA − λ ₀)

celestial body		date			time		
		year	month	day	hour	minute	second
☞	local date & time				GMT		WE
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📅	Δt	sec	t _{fix} - t _{UTC}	°3600+	°60+
☞	speed	knot	ded reckoning	lat (φ ₀)	° ' "
📅	distance	nmi		lon (λ ₀)	° ' "
📅	x		☞	course	° ' "
📅	y		📅	Zn	° ' "

☞	T	°C	
☞	p	mbar	
☞	h	meter	
📅	f		
📅	R	'	
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📖	HP	'	
📖	HP _{Sun}		'

📖	tabular v	
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📖	tabular d	
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☞	Hs	=	°	'
☞	IE	±		'
📅	DIP	-		'
📅	Ha	=	°	'
📅	f · R	-		'
📖	SD	±		'
📅	P	+		'
📅	ΔHo	+		'
📅	Ho	=	°	'

📖	GHA _{hour}	=	°	'
📖	GHA _{incr}	+	°	'
📖	SHA	+	°	'
📅	v _{corr}	+		'
📅	GHA	=	°	'

📖	tabular DEC	=	°	'
📅	d _{corr}	+		'
📅	DEC	=	°	'

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y	=	sin(−GHA − λ ₀) · cos DEC
x	=	cos φ ₀ · sin DEC − sin φ ₀ · cos DEC · cos(−GHA − λ ₀)

celestial body	latitude	longitude	altitude	$\sin(\text{altitude})$
				A =
				B =
				C =

	x_n	y_n	z_n
	$\cos(\text{lat}) \cdot \cos(\text{lon})$	$\cos(\text{lat}) \cdot \sin(\text{lon})$	$\sin(\text{lat})$
GP 1			
GP 2			
GP 3			

	Px	Py	Pz
P =	$B \cdot x1 - A \cdot x2$	$B \cdot y1 - A \cdot y2$	$B \cdot z1 - A \cdot z2$

	Qx	Qy	Qz
Q =	$C \cdot x2 - B \cdot x3$	$C \cdot y2 - B \cdot y3$	$C \cdot z2 - B \cdot z3$

	x	y	z
V =	$Py \cdot Qz - Pz \cdot Qy$	$Pz \cdot Qx - Px \cdot Qz$	$Px \cdot Qy - Py \cdot Qx$
-V =			

	latitude	longitude
fix 1:		
fix 2:		

$d = \sqrt{x^2 + y^2} =$
$\text{lat} = \text{atan2}(z, d)$
$\text{lon} = \text{atan2}(y, x)$