OCKAM INSTRUMENTS, INC.

Reconstructing Basic Inputs from SYNOPSIS

The SYNOPSIS frame (tag ':') is a collection of the boatspeed, wind and heading transducer data, unchanged by the system. In current systems, synopsis is disabled by default. You can enable it by sending the command D:=1.

The first 14 characters of the string are Hexadecimal ASCII data (2 ASCII characters representing an 8-bit binary value). The string looks like this;

null:aabbccddeeffgghhh**null**

where		
	:	SYNOPSIS tag
	aa	Port boatspeed counter modulo 256
	bb	Starboard boatspeed counter modulo 256
	cc	Apparent windspeed counter modulo 256
	dd	V1 voltage of the wind angle sensor (FF=0°, 00=180°)
	ee	V2 voltage of the wind angle sensor (FF=120°, 00=-60°)
	ff	V3 voltage of the wind angle sensor (FF=-120°,00=60°)
	gg	Heel voltage (80=0 heel)
	hhh	Heading (BCD chars, Eg '359' is 359 degs)

Also used are the following calibration settings:
cal windspeed, cal wind angle offset, cal upwash
cal boatspeed master, cal boatspeed offset, cal leeway

For example, to convert these hexadecimal components into decimal in BASIC, you might use the following code fragment;

```
S$="?:"+SPACE$(15)
CALL SIO(S$)
PVScount = VAL("&H"+LEFT$(S$,2))
SVScount = VAL("&H"+MID$(S$,3,2))
VAcount = VAL("&H"+MID$(S$,5,2))
V1 = VAL("&H"+MID$(S$,7,2))
V2 = VAL("&H"+MID$(S$,9,2))
V3 = VAL("&H"+MID$(S$,11,2))
HeelRdg = VAL("&H"+MID$(S$,13,2))
Hdg = VAL(RIGHT$(S$,3))
```

SPEEDS

The port and starboard boatspeeds and apparent wind speed are calculated from their counter values (aa, bb and cc) as follows:

1 Calculate the counter difference (modulo 256) divided by 0.25 (Cycles per second).

PVShz = Port boatspeed input frequency

$$= \frac{[aa_n - aa_{n-1} + 256] \text{ MOD } 256}{0.25}$$

SVShz = Starboard boatspeed input frequency

$$= \frac{[bb_n - bb_{n-1} + 256] \text{ MOD } 256}{0.25}$$

VAhz = Apparent windspeed input frequency

$$= \frac{[cc_n - cc_{n-1} + 256] \text{ MOD } 256}{0.25}$$

Then, $aa_{n-1} = aa_n$; $bb_{n-1} = bb_n$; $cc_{n-1} = cc_n$

Note! if you do not read SYNOPSIS every quarter second, then you must divide by the time interval between readings, and if you delay too long, the difference will overflow (how long depends on how many pulses per second are being received).

2 Divide the frequency by the nominal calibration determined by the “Signature” setting of the interface (See the appropriate manual section, e.g. section 5.04 for Boatspeed).

$$PVSraw = \frac{PVShz}{7.00 \frac{Hz}{Knot}}$$ in knots (assuming Signet Paddle)

$$SVSraw = \frac{SVShz}{7.00 \frac{Hz}{Knot}}$$ in knots (assuming Signet Paddle)

$$VAraw = \frac{VAhz}{1.096 \frac{Hz}{Knot}}$$ in knots (assuming B&G sensor)

3 If the result is not zero (i.e. the paddle is turning), add the Y intercept value (0.5 knot for paddles and 1 knot for anemometers). **This is modeled in the system software and can be modified to suit your needs based on sensor testing.**

IF PVSraw > 0 THEN PVSraw = PVSraw + 0.50

IF SVSraw > 0 THEN SVSraw = SVSraw + 0.50

IF VAraw > 0 THEN VAraw = VAraw + 1.00

4 Calculate the calibration factors.

PVScal = CAL Vs Master – CAL Vs Offset
SVScal = CAL Vs Master + CAL Vs Offset
VAcal = CAL Windspeed

Note! For single paddle inputs, PVScal is applied if heel is positive and SVScal is applied if heel is negative.

5 Adjust the speed by the cal number

PVS = PVScal • PVSraw
SVS = SVScal • SVSraw
VA = VAcal • VAraw

HEEL and HEEL RATE

Heel is linear with the gg hex component of SYNOPSIS, with the full counter range (256 counts) corresponding to the full angular range of the heel element (330 degrees). It is used to correct the windspeed and angle readings for heel effects and to calculate leeway. In addition, the Heel Rate is needed in order to correct apparent wind angle for roll rate.

The sign of heel is conveyed by the red switch in the masthead interface, which is not available from synopsis, so a sign change may be needed. The sign of heel can be inferred from the sign of the apparent wind angle. Remember to divide by the correct Δt if you do not read SYNOPSIS every quarter second.

$$\text{Heel} = \frac{330 \text{ deg.}}{256 \text{ count}} \bullet (\text{HeelRdg} - 128) \bullet \text{Sign} \qquad \text{(in degrees)}$$

$$\text{HeelRate} = \frac{\text{Heel}_n - \text{Heel}_{n-1}}{0.25} \qquad \text{(in degrees/sec)}$$

APPARENT WIND ANGLE

The apparent wind angle (dd, ee and ff) are calculated as follows;

1 Convert the hex values to decimal numbers (V1=dd, V2=ee and V3=ff), and calculate the electrical angle

$$BaRaw = ArcTan\left(\frac{\sqrt{3}(V2 - V3)}{2V1 - V2 - V3}\right)$$

2 Correct for the electrical angle error due to sawtooth waveform (all but B&G 213 masthead).

$$BaRaw = BaRaw - 1.4° \bullet SIN(3BaRaw)$$

3 Correct for Wind Angle Offset and Mast Angle (if Mast Angle Interface is present).

$$BaRaw = BaRaw + CAL\ Windangle\ Offset + Mast\ Angle$$

Note! This is where Mast Twist would be introduced.

4 Correct for Roll Rate (see Heel).

$$VaLong = Va \bullet COS(BaRaw)$$

$$VaAthw = Va \bullet SIN(BaRaw) + \frac{2\pi\ rad \bullet 3600\frac{sec}{hr}}{6072\frac{ft}{nm} \bullet 360\ deg} \bullet HeelRate \bullet MastHeight$$

$$Ba = ArcTan\left(\frac{VaAthw}{VaLong}\right)$$

$$Va = \sqrt{VaAthw^2 + VaLong^2}$$

5 Compensate for upwash.

$$UPWASH = CALUp \bullet REEF^2 \bullet FLAT \bullet SIN^{2.5}(0.6(180-|Ba|)) \quad \text{in deg}$$

$$Ba = Ba + SIGN(Ba) \bullet UPWASH$$

HEADING

The last 3 characters of SYNOPSIS are heading in BCD format, i.e. “000” thru “359”.