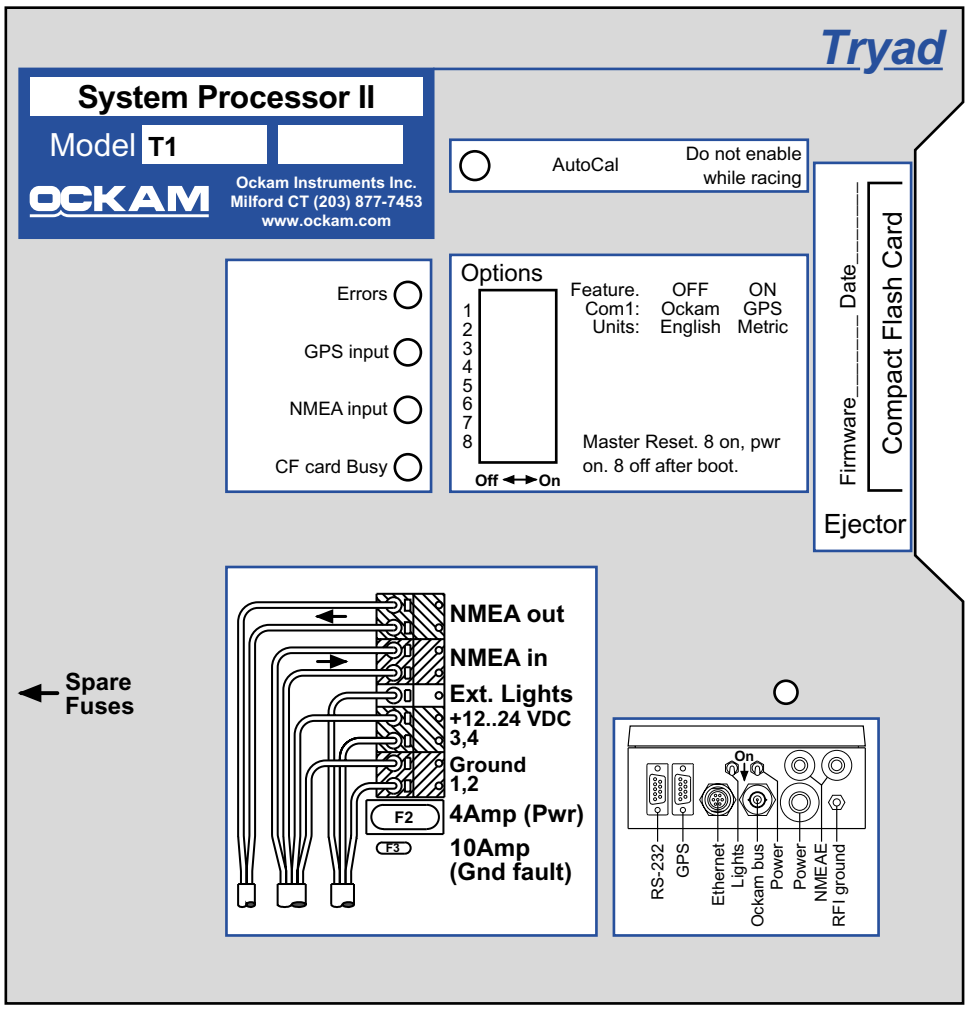
Document current with CPU.RTB dated 2/21/03



The Tryad T1 CPU is the brain of the Ockam system. It gathers information from various interface components, controllers and serial ports, calculates outputs, and sends data to displays and other data targets. The CPU also includes a clock and calendar which provides various timing functions to the system.

Specifications

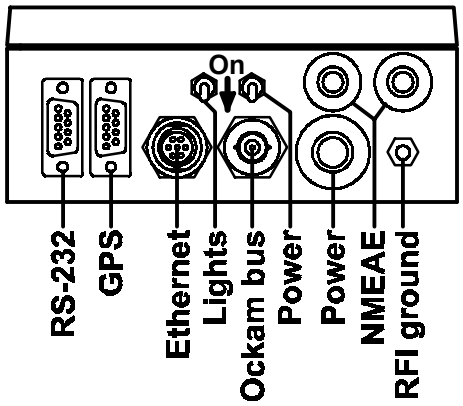
Dimensions:	12-1/2" W x 9" H x 4" D
Mounting:	#10-24 x 2" Bolts on 9-1/2" x 4-5/8" Ctrs.
Weight:	4 Lb.
Orientation:	Any
Accessories:	System Manual Mounting hardware
Power Requirements:	10.5 to 28 VDC at 7 watts plus requirements of all other modules.

Fuses:	Power: 4 AMP Miniblade automotive fuse Ground: 10 Amp Picofuse Signal: 250ma Picofuse	
Mating Connectors:	Power, Lights:	Pigtail (Terminal strip)
	Ockam Bus:	BNC Male (UG-88/U)
	Ethernet Bus:	EtherMate[1] system
	RS232:	DB9 female (DCE)
	GPS:	DB9 male (DTE)
	NMEA:	Pigtail (Terminal strip)
Features:	Two switches control power and lights, or may alternatively be controlled through the power cable wiring. Trouble lights aid in diagnosing signal and error problems.	

The hardware

The Tryad T1 CPU is a PC running on ships 12 to 24 VDC supply and coupled to hardware for driving the Ockam Bus. Program and data is stored on a removable CompactFlash card, which lets the owner easily upgrade software via a PC.

External Connections



RS-232: provides instrument data and control to PCs, and is the equivalent of an 050 interface. Default output is Ockam data, and input is keyboard commands. The data stream for this port is independent of the Ockam Bus, so keyboard commands to an 050 RS232 interface will not interfere. The data rate of this port is not limited to 480 (Ockam stream) or 960 (Ockam+NMEA streams) characters per second as they are with an RS232. Default setting is 9600 baud, 8 data bits, no parity and 1 stop bit.

Setting option switch #1 at power up will temporarily set the RS-232 port to 4800,N,8,1, and source GPS data. In other words, RS-232 would look like a GPS.

NOTE
The RS-232 port is NOT opto-isolated. Ensure that the attached computer shares the same ground as the Tryad processor.

[1] © Lumberg Inc. Also Turck/InterlinkBT.

GPS: is an RS-232 port that accepts an NMEA data stream (4800,N,8,1). This port is a superset of an 041 GPS interface (which is no longer supported). Wire the GPS with a DB9F, Signal (out-) on pin 2, and Ground on pin 5. The GPS out+ signal (if any) is not used.

NOTE
The GPS: port is NOT opto-isolated. Ensure that the attached GPS shares the same ground as the Tryad processor.

The version of T1 code that runs the AHRS gyro receives AHRS data on the GPS: port, and GPS is expected on the internal NMEA port.

Ethernet: This connector will provide Ethernet connection when activated.

Ockam bus This connector is a standard Ockam bus, supporting all Ockam hardware except:

041 GPS Interface. Replaced by the GPS: connector.
037 Polar interface. Replaced by polar file(s) in the Flash card.

Connect all Ockam system components together with coaxial cables, tees and junction boxes. No particular topology or termination is required. The connector is type BNC, and the cable is RG58C/U (stranded center conductor). It is available worldwide at most electronics component stores.

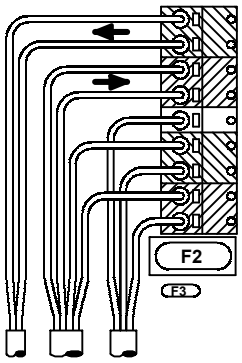
When powered up, the Ockam cable has +9.6 volts DC on the center conductor, and **BATTERY GROUND** on the shield. Be careful to insulate all Ockam Bus connectors from contact with hull or rigging.

RFI ground This contact is capacitively connected to the Ockam ground and provides an AC ground to reduce radio frequency interference. It should be directly connected to the closest major conducting part of the hull or keel with a substantial wire (#0 or larger). Flat braid copper is recommended.

Some boats have floating power systems. In these cases, the engine may not be grounded. Check before using the engine for RFI ground.

To minimize radio frequency interference (RFI), the Ockam Bus should be RF-grounded (i.e. shield connected thru a capacitor to the hull) at every available junction.

Internal Connections



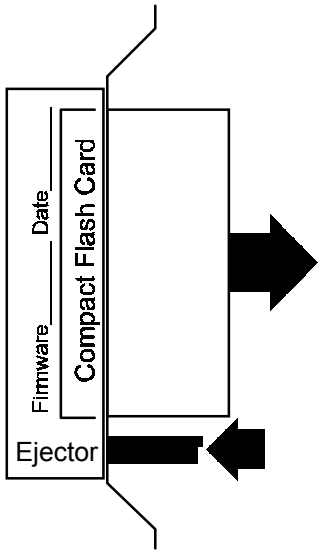
NMEA out Terminals 8 & 9 of the T1 terminal strip output a consolidated NMEA data stream (a **NMEA tap**®). Since GPS data is included in this stream, you probably do not want to route this to the GPS.

NMEA in Terminals 6 & 7 of the T1 terminal strip accept NMEA-0183 data for Heading or Depth. Spare power terminals (2 and 4) are provided for use by the NMEA device. If the AHRS build of CPU software is used, GPS connects here.

Lights(5), Power(4,3), Ground(2,1)

These connections go to the ship's power panel and provide power to the Ockam system. Voltage supply should be between 10.5 and 26 volts DC. The CPU draws about ½ amp at 12.6 volts. You can control the lights by connecting the "Lights" wire to a circuit breaker. Otherwise leave it disconnected, and control the lights with the external switch.

Program & data storage



The T1 processor runs code stored on it's CompactFlash card. This device is a solid-state disk with a DOS file system containing the T1 processor code as well as other data. You can buy "Compact Flash Readers" at camera and computer stores that will allow you to read and write to the card. Appendix C describes the contents of the disk in detail.

AUTOCAL If a file named AUTOCAL.DAT is present on the drive, it will provide up to 4 input and 2 output auxiliary calibration tables. See Appendix A for details.

POLAR The Tryad now supports polar functions by using the standard Ockam ESP polar file format which replaces the 037 Polar interface. If an appropriately formatted file set exists in the root directory of the drive, the system will configure as an 037 would have. See below for details on how the polar file set works.

Operation

Providing power to the CPU is all that is needed to start the Ockam system.

The Tryad is a PC.
After power on, it takes 30 seconds before anything appears to happen.

Polar file set (T1 code dated 9/17/02 or later)

The 037 Polar interface hardware is no longer supported. Instead, the Tryad system uses polar "***.TPO**" files, which contain static speed and angle data predicting boat performance. For example, the file would supply the answer to "In 12 knots, what should my upwind boatspeed and angle be?" e.g. "7.65 knots at 46.5 degrees true".

These files are derived from the Velocity Prediction Program ("VPP") which is part of the IMS rating system. A VPP service will supply the polar data as a worksheet (WKS or WK1 file), which allows you to view, plot and modify the data. You can then use the CVTPO utility to convert between the worksheet and TPO formats.

If the Compact Flash card contains (only) a file named **POLAR.TPO**, it will be loaded, and the system will use the data in 6 outputs. See below for a detailed description of these outputs.

Multiple polar files are also supported. If a file named **POLAR.IDX** containing a list of TPO file names is found in the root directory, Option 3 (Polar number) indexes the list to specify the file. If the index is out of range, or the file doesn't exist or is corrupted, the Tryad will try for POLAR.TPO.

Example: Suppose file POLAR.IDX contains the following

```
polar1.tpo

;Blank lines don't count
;and lines beginning with ';'
;are comments and don't count either

c:\polars\polar2.tpo
c:\polar3.tpo
```

If the default polar number (=0) is in effect, the Tryad will attempt to load "`polar1.tpo`" (in the root of the Compact flash). Issuing the command "O3=2" will switch the polar to file "`polar2.tpo`" (in subdirectory "Polars"), and throw a single error 116 (LoadPolar request). If the load fails, permanent error 117 will be posted, and Tryad will try for default "POLAR.TPO". Success will cancel error 117 and set bit 16 of the Configuration.

Tryad will also output the polar filename (less path) as item #14 (PL:) of the 'Tryad status' list (see below).

Resetting the system

To MASTER RESET the system to factory defaults (or to your saved defaults, see below);

1. Turn the system power off.
2. Turn DIP switch #8 on (to the right).
3. Turn the system power on and wait for booting to complete.
4. Confirm that error 12 is up (proof of master reset).
5. Turn DIP switch #8 off (to the left).

System parameters

The T1 maintains a set of parameters that control the details of operation of the system, for example, averaging times for all the outputs. These numbers are initially set to factory settings and saved to file CPU.OID on the Compact Flash card.

The parameters can be changed by sending various commands to the system via an RS-232 connection. When any parameter is changed, a timer starts running, and after a certain period, the CPU.OID file is updated. (Flash memory can be written only a certain number of times. The timer limits the number of writes to the flash card.)

You can also customize the initialized values by creating a DEFAULT.OID file which contains the various parameters set the way you want (as opposed to the factory setting). To do this, set the parameters the way you want them and then;

- Turn the system off, put the Compact Flash card in a PC and copy CPU.OID to DEFAULT.OID, then return the card to the Tryad. Or...

- Issue the command SET DEFAULT<cr>. The system will create a DEFAULT.OID based on the current settings and throw a single error 115 as proof.

When the system is MASTER RESET (as described above), if a DEFAULT.OID file exists, it is used instead of the factory settings. If you want to return to factory settings, delete the file DEFAULT.OID on the flash card and MASTER RESET.

T1 Command port (RS232 port)

The factory default setting for the T1 RS232 port is 9600 baud, no parity, 1 stop bit, and it outputs Ockam data and receives commands (see below). The port can also be set up in other ways to accommodate different situations.

NMEA mode

Turning Option Switch 1 on before powering up forces the port settings to 4800 baud, 8 data bits, and NMEA data.

This mode provides a clean way to port the GPS into a PC without the necessity of changing any wiring. In other words, if you want to run a charting program and need GPS input, you do not need to disconnect the GPS from the T1 and reconnect it to the PC. Instead, turn Option Switch 1 on and power up. The RS232 port will then look like a GPS.

!Sn<cr>

```
n=0: No output        n=1: Ockam output (default);
n=2: NMEA output      n=3: Both Ockam and NMEA
```

This command controls what data format comes out of the RS232 port.

- Some programs expect Ockam data format (`!S1<cr>`), while others require NMEA-0183 (`!S2<cr>`). OckamSoft drivers can accept both (`!S3<cr>`).
- See the troubleshooting guide for an example.
- See the note below regarding saving changes.

!B<baud><cr>

```
<baud>=4800, 9600(default), 19200 or 38400
```

This command changes the baud rate of the RS232 port.

- A single error 118 is thrown to acknowlege the change.
- See the note below regarding saving changes.
- Use this command carefully; after changing the port baud rate, you must then set the PC baud rate to the same value before communications can be reestablished.

!Wn<cr>

```
n=0: 8 databits (default)  n=1: 7 databits
```

This command changes the word length of the RS232 port.

- A single error 118 is thrown to acknowledge the change.
- See the note below regarding saving changes.
- Use this command carefully; after changing the port word length, you must then set the PC word length to the same value before communications can be reestablished.

Saving changes

The port settings (!S, !B and !W) change the behavior of the port immediately. However, it may be many seconds before the changes are written permanently (see the note above concerning writing to flash memory). You will know when they have been saved when you see a single instance of error 120.

The Option Switch 1 trick to force 4800,N,8,1/NMEA does

not change the saved settings for the port. If you turn the T1 on with S1 off, the port reverts to the saved settings.

Commands

Commands may be entered thru the RS232 port on the T1 and/or via an RS232 interface attached to the Ockam Bus.

An=<sec> Set averaging.
If sec>0, select classic Ockam Avg of <sec>.
If sec=0 there is no averaging.
If sec<0, select Butterworth filter Avg of <-sec>.

0 Vs	11 BtPol	22 unused
1 Va	12 Polars	23 Ms
2 Ba	13 Targets	24 Vmc
3 Heel	14 Mt	25 Barometer
4 Vt	15 CrsSLL	26 Va Axial
5 Bt	16 CrsPLL	27 Trim
6 Vmg	17 VsLL	28 Seastate
7 dMt	18 BtU	29 Pitch rate
8 dVt	19 BtD	30 Current speed
9 MtLL	20 TSLL	31 Target Angle
10 VtPol	21 TPLL	

Ctrl-E Make Bt narrower (-) by 0.5 degree (UnHead).
Ctrl-F Make Bt wider (+) by 0.5 degree (UnLift).

Ln=m Enable (m=1) or disable (m=0) Autocal function n.

n	AutoCal function
1	CalVa
2	CalUW
3	CalLee
4	CalVs
5	CalBt
6	CalVt

O1=Time Format 0=HH:MM (default), 1=MM:SS, 2=HH:MM:SS
+4 displays UTC instead of local time

O2=Polar format Controls format for Polar and Target outputs.
0 Output is knots (default).
1 Output is difference (e.g. Boatspeed-Polar).
2 Output is percentage (100*Boatspeed/Polar).

O3=Polar number Selects amongst polar files (see Polar File Set above).
Default is ‘0’ (which is equivalent to ‘1’ for the T1).

O4=True wind offset. Sort of like apparent wind offset except applied to the true wind. Affects True wind angle and Wind direction.

O5,6: Reef & Flat 0 to 1.00 (defaults = 1.00)
Adjusts upwash directly: Upwash=$Reef^2$*Flat*f(Ba). Not generally used.

O7=Current Calculation
- 0 Current calculation is disabled.
- 1 Current calculation is enabled (default).

O8=Mast height 0 to 200 (ft. Default is 0)
Corrects true wind for pitch and roll rate. Roll rate causes an athwartships apparent wind disturbance, and pitch causes a longitudinal disturbance. With rate sensors (particularly the AHRS), these disturbances can be removed.

O9=Lighting 0 to 9 (Default is 9)
Some displays have adjustable lighting. This is how you adjust it for the entire system.

O10=VmcFlags Bit field: controls options for Vmc and Opposite tack.
- 1 0=Use GPS Wpt Brg as Vmc rhumbline
  1= Use O11 as Vmc rhumbline
- 2 0=Use current in Opp tack (Opp tRack)
  2=No use current in Opp tack
- 4 0=Use polar target angle for Opp tack (if available)
  4=Use actual Bt for Opp tack

O11=Vmc rhumbline when (O10 & 1) = 1.

O12=Units Bitfield: controls output units as follows:
- 1 Temperature: 0=ºF, 1=ºC.
- 2 Depth: 0=Feet, 2=Meters.
- 4 - unused at the moment -
- 8 Barometer: 0=In. Hg, 8=Millibars.

O13 Unused at the moment. Was stopwatch as seconds.

O14=Current speed update limit (kt. Default is 0.1)
Sets the maximum current speed is allowed to change per current calculation iteration (i.e. per CogSog input from the GPS).

O15=Current speed percent (0 to 1.0)
Sets the percentage of new calculated current to apply to the existing current. O15=0 will prevent current update; O15=1

will apply 100% of the new calculated current to the existing current. Sort of an average.

O16 Enables GPS COG to replace heading+leeway and SOG to replace boatspeed.

O16=	Boatspeed source	Track source
0	Paddle	Compass+leeway
1	SOG	Compass+leeway
2	Paddle	COG
3	SOG	COG

O17=Compass lubber offset.
O18=Compass deviation amplitude.
O19=Compass deviation phase.

Rdg=Compass sensor reading:
Heading = Rdg+O17+O18*SIN(Rdg+O19)

O20=Windweight 0.50 to 1.50

Changes in wind gradient and density can sometimes prevent boats from making (and sometimes too easily exceed) their target speeds. Option 20 may help correct this by adjusting the true wind speed input to the polar function. The wind value used to access the polar curves is the product of Option 20 and measured true wind speed.

O21=CalcOpts Sets a bit field which controls calculation:

1	Set prohibits ZDA from setting the CPU clock.
2	Set turns on retro-apparent (see below).
4	Set disables roll rate in true wind calculation
8	Set disables pitch rate in true wind calculation
16	Set disables yaw rate in true wind calculation
32	Set disables Hazen upwash rolloff function. 1 is used for all Bt.
64	Set causes Lat/Lon to output in CookPos form.
128	Set disables the frogeye filter.
256	Set disables pitch rate in apparent.
512	Set disables roll rate in apparent.
1024	Debug: Reverse roll correction to true wind
2048	Debug: Reverse pitch correction to true wind
4096	Debug: Reverse yaw correction to true wind

O22=AHRSflags Sets a bit field which controls AHRS output:

1	Set disables heel output.
2	Set disables pitch output.
4	Set disables heading output.
8	Set disables roll rate output.
16	Set disables pitch rate output.

	32 Set disables yaw rate output.
O23=Speedup	Sets the processing loop rate 1 4 Hz. (Standard Ockam Rate) 2 8 Hz.
Q<tag>=n[,m]	Queries for internal values. Output is to <tag> n=1 Outputs program revision. 2 Outputs system flags. 3,m Outputs average m (see A= command). 4,m Outputs option m (see O= command). 5 Outputs disabled tags as a string. 6,m Outputs current Autocal[m] value
SAVE DEFAULT	Saves the current settings (averages, options, etc.) as the default values on master reset. Throws error 115 if successful.
U@=Sn...	Commands to interfaces (gets put onto the Ockam bus as "@Sn...<0>"). Some interfaces can receive commands via the Ockam bus. They will have a switch that sets their address number ('n' in the command). The command code(s) that follow will be documented for that particular interface. The CPU GPS interface is addressed by n='0'.

QuikCal® correction

This is a calibration that adds or subtracts from the *magnitude* of the true wind angle. If the true wind angle is too narrow (too small in magnigude), wind direction will head when you tack. If it's too wide (too large in magnitude), you will be lifted when you tack. QuikCal adds or subtracts an adjustable number of degrees from the magnitude of the true wind angle; for a positive 2.0 QuikCal, 21 degrees becomes 23, and –21 degrees becomes -23.

QuikCal uses the "Controller card" model; the operator presses an "UnLift" or "UnHead" button on a controller card (or Matryx cal page) to change a variable that directly widens or narrows true wind angle. So if you find yourself being headed, press the "UnHead" button and vice versa.

There are separate upwind and downwind corrections, and the relevant one is displayed on tag 'e' and changed by the control codes. Ctrl-E makes the number more negative (UnLift) and Ctrl-F more positive (UnHead), by ½ degree (i.e. 1 degree of Head/Lift) per hit. The correction value can also be directly set by K11 (upwind) and K12 (downwind).

To make a 005 operate ***QuikCal***®, install software 005X (6/22/01) and make a double-button card (like stopwatch) with magnets **`11X11Y10`**. Matryx rev 1.20 has a controller page for ***QuikCal***®.

Variables

Most variables are the same as the old system, except that, in order to conserve bus bandwidth, a “frog eye” filter is used. Each variable is calculated at it’s appointed rate and only output if it changes, or 4 seconds have elapsed since the last output. This filter can be disabled if desired (see Option 21).

There are also at least two outputs for variables; the Ockam bus, and the Serial Port COM1:. Variables can be enabled or disabled on each output using the ‘E’ command.

Core Variables

Boatspeed. This variable normally comes from a boatspeed interface connected to one or two paddlewheel sensors. The interface includes calibration screws for speed, offset (corrects boatspeed tack-to-tack) and leeway. The cal screws may also be overridden by keyboard commands if desired. In addition, an “AutoCal” correction matrix may be included for more detailed calibration of this variable. GPS speed-over-ground (SOG) may also be substituted for the sensor value. When SOG substitutes for boatspeed, there is no requirement for a boatspeed interface.

Apparent wind angle and speed. These come from a masthead interface connected to an analog (i.e. B&G or equivalent) or sonic masthead sensor. The interface includes calibration screws for angle offset, wind speed, upwash and upwash slope. The cal screws may also be overridden by keyboard commands if desired. In addition, “AutoCal” correction matrices may be included for more detailed calibration of these two variables.

Apparent wind angle and speed may also be back calculated from true by setting Option 21 appropriately.

Heading normally comes from the heading interface connected to a compass sensor. There are two types of sensor available; a standard 2D sensor (heading only), or a 3D sensor (heading plus pitch and heel). In addition, course-over-ground (COG) may be substituted for heading if required (not recommended for high precision use).

Position, COG/SOG, Magnetic Variation, Waypoint Range & Bearing and Time come from a GPS.

Heel. Heel is very important for correcting wind triangle geometry, and for calculating leeway. For low-tech systems, the masthead interface supplies heel angle from a pendulum. Mid-tech systems get it from a 3-d compass like the Honeywell HMR3000, while the high-techest ones can attach a Crossbow AHRS gyro.

Pitch. Pitch provides sea state information. A 3-d compass or Crossbow AHRS are required for this input.

Pitch, Roll, Yaw rates. The Tryad can also source heading from a 6dof or 9dof gyro-stabilized attitude and heading reference system (AHRS). Both sensors can be simultaneously connected and controlled to select the desired functions from each.

Depth Surface, Depth Keel. These functions could come from a T2 interface where there are no keel or transducer depth adjustments, or from a full T3 depth interface. In the former case, there is no way to adjust for surface or keel depths, so the Depth Keel function is disabled, and error 53 is thrown.

True Wind

True wind angle and Speed. These variables are calculated from Boatspeed and Apparent wind, and therefore depend on those calibrations. In addition, there are "AutoCal" correction matrices to allow direct true wind corrections to be applied before wind direction is calculated. The QuikCal correction is also applied here (see above).

Wind Direction Is True Wind Angle plus Heading. Heading comes from a compass (2D or 3D sensor plus the 032 Heading interface, and/or the Crossbow AHRS), or GPS COG (not recommended).

Polars

By including polar information on Tryad (see 'Polar file set' above), optimum performance speed and angle is available for the system.

Polar speed is the theoretical boatspeed at the current true wind conditions. For example, if you are beam reaching in 12 knots, Tryad would look in the current polar file at 12 knots and 90º true (or whatever your current true wind angle was), and determine that the boatspeed should be, say, 9.87 knots.

Polar speed changes with both sailing angle and windspeed.

Target speed is the optimum up or downwind boatspeed and Target angle is the optimum true wind angle to sail at the current true wind speed. For example, if you are in 12 knots and heading upwind (true windangle<90º), Tryad would report that the optimum upwind boatspeed should be 6.78 knots, at an angle of 44.6º. Your actual sailing angle has no effect on targets except in that sailing at greater than 90 degrees switches targets to the downwind optimum.

Target speed and angle changes only with windspeed.

With polars, Opposite track is the Target angle on the other tack with current applied; in other words, the bearing of where the boat will be going on the opposite tack. Without polars, the system reflects your present true wind angle.

Time to the Laylines is the time to the two points at which you must tack for the mark without overstanding. These are calculated from waypoint range and bearing, wind direction, current and target speed and angle.

Retro-Apparent

Normally, apparent wind functions (Va and Ba) are displayed as the masthead sensor is read. However, if (CalcOptions & 0x2), then they are back calculated from wind direction and true wind speed.

Tags

These tags are “VARINFO” types which have controls for enabling per output channel, averaging and other stuff.

+	Linear	Axial Va (Sonic masthd only)
^	Linear	Trim (bow up/down)
<	Angle	Target Angle [19.90]
~	Linear	SeaState
A	Linear	Va
a	Linear	Vt
B	Linear	Vs
b	Linear	Vmg
C	Direction	Ms
c	Direction	Mt
D	Angle	Ba
d	Angle	Bt
E	Angle	Mrot
e	Linear	*Total Bt correction*
e’	Linear	*Total Vt correction*
F	Direction	CURD
F'	Linear	CURS
f	Linear	Vmc
G	Linear	Tair
G'	Linear	Tsea
g	Linear	Barometer Trend
g'	Linear	Barometer Pressure
H	Angle	Heel
h	Angle	Leeway
I	Linear	Cal Vs Master
i	Linear	Cal Vs Offset
J	Angle	Cal Ba Offset
j	Linear	Cal Va
K	Linear	Cal Lee
k	Linear	Cal Upwash
k'	Linear	Cal Upwash slope
L	Linear	Permanent Log
l	Linear	Reset Log
O	Direction	Opposite Track
o	Angle	MagVar
P	Linear	Polar
p	Linear	Target
Q	Misc	Time Stbd Layline
q	Misc	Time Port Layline
R	Direction	Waypoint Brg
R'	Linear	Waypoint Range
r	Direction	Back Brg
r'	Linear	Back Range
T	Misc	Time
t	Misc	Stopwatch
U	Linear	COG
U'	Direction	SOG
V	Angle	dMt
v	Linear	dVt
w	Linear	Depth Keel
W	Linear	Depth Surface
X	Misc	Position
Y	Angle	Rudder
y	Angle	TrimTab
Z	Misc	Configuration
Z’	Misc	*Program Rev*
z	Misc	Errors
*	Misc	Lights

These tags are ad-hoc – inline coded (no controls, no averaging).

‘ ‘	MISC	Tyad status multiplex output (see below)
’:’	MISC	vi[] Averages multiplex output (was synopsis)
’,’	MISC	Ticker (‘,’<cr><lf><1/4 sec#><0>)
’0’	LINEAR	Polar query response (P=<angle><speed><cr>)
<tag>	whatever	Q<tag>= response
<tag>	whatever	U<tag>=<whatever>
’X’	MISC	Ships pos (X’<lat><0> X<lon><0>) (O21 &= ~0x40)
’x’	MISC	Cook ship’s pos (x<lat>,<lon><0>) (O21 |= 0x40)
<tag>	whatever	Q interface output

Error Codes

11*	ROM Checksum
12*	Master Reset (defaults reloaded)
13	Bad Keyboard Cmd
14	Bad Eval Stack
15	Background falling behind
16	Keyboard buffer overflow
17	One or more tags disabled
18	Calculations falling behind
19	Extra interface characters detected
21	Boatspeed missing
22	Boatspeed Error Report
23	2 Vs Input with selector=1
24	2 Boatspeed with No Heel
25	Large Vs Differential
26	Vs & Va Incompatible Revs
27	Using Gps Sog For Boatspeed
31	Va Missing
32	Va Error Report
33	S1 Out Of Bounds
34	S2 Out Of Bounds
35	S3 Out Of Bounds
36	Heel sign wrong
37	Mast Rotation Error
38	Mast rotation missing
39	Sonic & No 3dHdg = No Heel
41	Heading missing
42	Heading error report
43	Heading sensor in Cal mode
44	NMEA Hdg with Hdg interface attached
47	Using COG for heading+leeway
51	Depth missing
52	Depth error report
53	No Depth Keel
54	NMEA Depth with Depth intf attached
61	Polar missing
62	Polar error report
63	Polar number trouble
71	GPS missing
72	GPS Bad chars
73	No waypoint
74	No current
75	No lat/lon
76	No COG/SOG
77	Manual current
78	Manual waypoint
79	No differential gps
80	GPS error flag
81	Rudder missing
82	Rudder error report
91	Barometer/Temperature missing
92	Barometer error report
95	Q interface missing
96	Q interface error report
101	Q interface missing
102	Q interface error
103	Q interface bad characters
104	Q interface bad init data
105*	Q interface no room in buffer pool
114	No Autocal is loaded (L= command)
115	SAVE DEFAULT command completed
116	LoadPolar() called (eg Option 3)
117*	LoadPolar() failed
120	Settings written to CF card
124	ZDA time set disabled
125	Retro-apparent enabled
126	Sonic error report
130	AHRS missing
131	Bad AHRS data
132	AHRS in Cal mode
134*	Bad CF read
135*	Bad CF write
301	Low Buffer pool
302	DSPOUT full
303	COMOUT full
304	CMD full
305	GPSIN full
306	GPSOUT full
307	NMEAIN full
308	NMEAOUT full
309	HICHANOUT full

(* indicates permanent error)

Tryad Status

Several important status parameters are output on tag ' ' (space). The format is ID:value, where ID designates the parameter whose value is given; for example, CP:15 says that the processor is 85% idle. The list is output one item/second. This list will probably grow over time.

ID:	Description
C1:	Percentage of COM1: being used
CP:	Percentage of the processor being used
OB:	Percentage of Ockam Bus being used
VA:	Current CalVa autocal value (or 'off')
UW:	Current CalUW autocal value (or 'off')
LE:	Current CalLee autocal value (or 'off')
VS:	Current CalVs autocal value (or 'off')
BT:	Current CalBt autocal value (or 'off')
VT:	Current CalVt autocal value (or 'off')
SY:	Code build: 0=Retail, 1=Debug, 2=AHRS, 4=Quad Serial
GP:	GPS flags: 8=Manual Wpt, 32=Manual Current, 256=Have Lat/Lon, 512=Have Waypoint, 1024=Have Cog/Sog.
BP:	Available mailboxes (system resource)
RV:	Software revision, e.g. "20.00"
OS:	Option switches (the DIP switches on the panel)
PL:	Name of the polar file in use

Each parameter outputs 1/second, round robbin. Therefore the utilization represents the average over 14 seconds (at the moment).

Averages Multiplex

Outputs the vi[] averages at 1/second rate. Output is "DR:<rev>" followed by "n:<AvSec>". The order and range are the same as for An= command.

Appendix A: Autocal

Autocal is implemented for 4 inputs and 2 outputs as 6 structs (binary) in file AUTOCAL.DAT. Each table is f(x,y), and can contain a maximum of 15 rows and columns. The user specifies Row and column independent variable values and tags.

NOTE

The contents of Tryad Autocal tables are ADDED TO the relevant calibration screw (or Kn=) value. This is different behaveour from OckamSoft 3 AutoCal operation where the AutoCal REPLACED the screw value by actually issuing Kn= commands.

This means that for the Tryad, you should modify your OS3 AutoCal table values by subtracting your "standard" screw cal value (if relevant) from each element of the table.

Cal Leeway
Leeway=-(CalLeeway+**AcalAdjLeeCal()**)*Heel/Vs^2
RangeName=CALLEE

Cal Upwash
Ba=BaMeasured+
(CalUpwash+**AcalAdjUpwCal()**+CalUpSlope*(Vt-12))*
sign(Ba)*Hazen(Ba)*Reef^2*Flat;
RangeName=CALUW

Cal Va
Va=CalVa*(1+**AcalAdjVaCal()**)*(counts/dT+offset).
RangeName=CALVA

Cal Vs
Vs=CalVsMaster*(1+**AcalAdjVsCal()**)*(counts/dT+offset)
RangeName=CALVS

The 2 following are "output cals" which are applied during the calculation of true wind. They can be used to remove any errors remaining after the Cal functions are used.

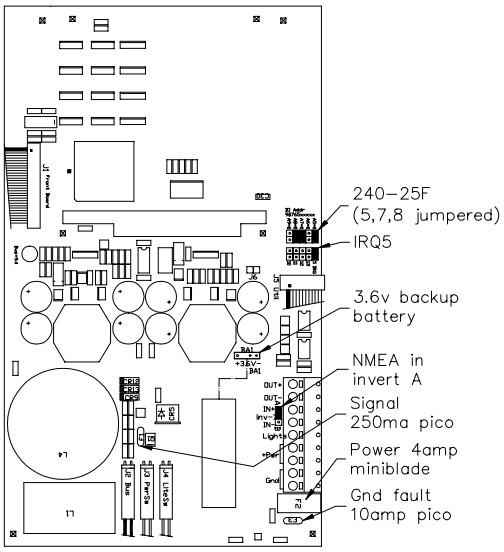
Bt
Bt'=Bt+sign(Bt)*(**AcalAdjBt()** + QuikCal)
RangeName=CALBT

Vt
Vt'=Bt+sign(Bt)***AcalAdjVt()**
RangeName=CALVT

The file is created by app CVTACAL.EXE. Remember that the tables are all "zero-based"; that is, default output (eg when a table is disabled) will be zero.

Appendix B: Jumper settings & Fuses

There are 3 jumper sets on the main board. The top right two (240-25F and IRQ5) should not be changed without specific instructions.



Normally reversing the NMEA wires is all that is needed to get the correct polarity on this signal. The NMEA in jumper set allows inversion of the NMEA signal for the case where reversing the wires does not work.

The 3.6volt backup battery connects to the jumper indicated.

There are 3 fuses that might have to be replaced.

Power a 4 amp miniblade, available at car parts stores.

Gnd fault a 10 amp picofuse that protects the circuit board in situations where an Ockam bus cable accidentally touches a live voltage.

Signal a 250ma picofuse that protects the circuit board from a stuck signal transistor.

Appendix C: Contents of the Compact-Flash disk

Dos & Utilities

C:\DOS\	(80 files, 2.8MB) DOS 6.22 lives here.
DRVSPACE.BIN	(ReadOnly,Hidden) DOS file.
IO.SYS	(ReadOnly,Hidden) DOS file.
MSDOS.SYS	(ReadOnly,Hidden) DOS file.
<path>	C:\UTILS;C:\DOS;
AUTOEXEC.BAT	Runs CPU.EXE or CTTY AUX for manual file maintenance.
BOOT.COM	Programmatically reboots the PC104.
COMMAND.COM	DOS file.
CONFIG.SYS	Configuration file (virtually unused)
RTTBOOT.COM	Loader program for protected mode files (like CPU.RTB).
SETUP.COM	Allows changing BIOS settings from the DOS prompt. Settings do not take effect until reboot.
XTCLK.COM	DOS clock <--> battery-backed clock

CPU files

CPU.OID	This is CPU.EXE's "remembered variables", similar to the battery-backed RAM on the old processor.

DEFAULT.OID	If available, this file will be used during Master Reset. You might want to save a copy of CPU.OID as DEFAULT.OID after setting averages and flags as you like them.
AUTOCAL.DAT	(User supplied) This is the 6 autocal tables used by CPU to adjust inputs to get a good wind triangle solution.
BOOTS.TXT	(Created by CPU.RTB) Log of startups and other debugging information.
CPU.BAT	Runs CPU.RTB
CPU.RTB	This is the instrument program. There will be frequent updates for this one.
POLAR.TPO	(User supplied) default Polar file.
POLAR.IDX	(User supplied) Polar index file, specifying multiple polars.
TESTOPT.EXE	Senses option switches into return code to allow branching within a batch file based on CPU option switch settings. Also sets COM1:19200,N,8,1.

AUTOEXEC.BAT

```
set path=C:\utils;C:\dos;
rem If Option 1 on, go directly to DOS
testopt 1
rem if errorlevel 1 goto :talk
rem Otherwise, run main program
:run
cpu
BOOT
:talk
ctty aux
```

CONFIG.SYS

```
stacks=0,0
rem NOT FOR RTOS32 device=c:\dos\himem.sys /verbose
rem NOT FOR RTOS32 device=c:\dos\emm386.exe 64 /verbose
```

CPU.BAT

```
rttboot cpu.rtb
```