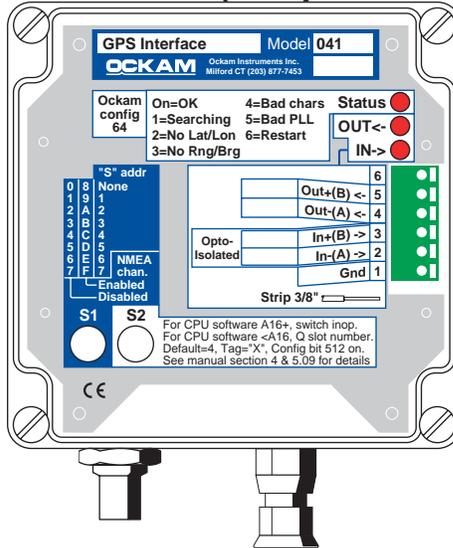# OCKAM
INSTRUMENTS, INC.

041 GPS Interface (001 processor only)

The 041C interface connects to the GPS and provides position, waypoint, magnetic variation and time information to the Ockam system. In addition, it can source a copy of GPS data on the NMEA channel of the Ockam bus cable. It can also output data to the GPS from two sources; NMEA sentences created from Ockam data, and text sent by an RS-232 interface. Ockam data outputs include VHW (speed and heading), DBT (depth), VDR (current) and VPW (VMG), HDG (heading), MWD (wind direction & true wind speed), RSA (rudder and tab), MWV (apparent and true wind angle & speed), VWL (logs), VWR (alt. apparent wind) and VWT (alt. true wind). These Ockam NMEA strings can be enabled to the NMEA channel as well. For GPS units which have the capability, NMEA strings sent from the RS-232 interface allow up and downloading waypoints and controlling GPS functions from the on-board PC.

Specifications

Dimensions:	4-3/4" W x 4-3/4" H x 2" D
Mounting:	Velcro™ or 10-24 x 5/8" on 4-5/16" x 3-1/2" Ctrs
Weight:	1 Lb.
Accessories:	10 Display Cards
Power Requirements:	45ma
Fuse:	250ma Picofuse (back board)
Mating Connections:	BUS: BNC Female GPS: Terminal strip
Compatible Devices:	Any Position sensor with NMEA output of position (GLL, GGA or RMC) and waypoint range and bearing (BWR, BWC, BER, BEC or RMB). Will also use time (ZDA), Cog/Sog (VTG or RMC) and magnetic variation (HDG, HVD, HVM or RMC) with system software revision 16.

CE The 041 GPS Interface complies with relevant sections of EU EN60945:1997 and EMC Directive 89/336/EEC.

Theory Of Operation

The 041C GPS interface provides the Ockam system with ship's position and waypoint range & bearing. When connected to a rev 16 system, it also provides time, Cog/Sog and magnetic variation. It replaces the functions of the 040 interface (configuration 64) and the 039 Lat/Lon interface (configuration 512). It also eliminates the need for the 045 NMEA driver by outputting NMEA sentences derived from Ockam data.
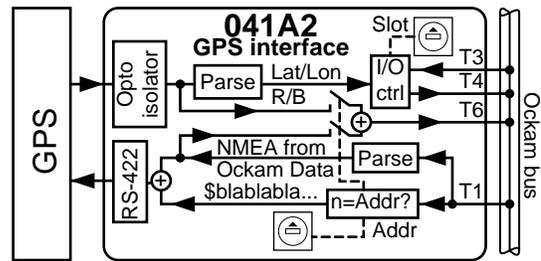
SLOT SWITCH
When the 041C interface is connected to older systems (with system software revision less than 16), the "Slot" switch of the 041 sets the address for the "Q" protocol whereby Lat/Lon is transferred. Each slot switch attached to an Ockam system must be set to a unique number (see Section 3 "Q interfaces"). When connected to system rev. 16 or later, the slot switch is inactive; Ship's position is transferred via the extended GPS protocol, new with system rev. 16.

INPUT (Ship's position)
Ship's position data input can be one of the following NMEA sentences (parsed data shown underlined). The interface will send data from any of these that come in, so the GPS should be set to output only one of them. Check the documentation and pick the one with the highest resolution (the 041 will interpret to 5 decimal places in minutes).

```
$xxGGA,hhmmss,llll.ll,N,yyyyy.yy,W,dgpsflag,...
$xxGLL,llll.ll,N,yyyyy.yy,W[,hhmmss.ss]
$xxRMC,hhmmss,valid,llll.ll,N,yyyyy.yy,W,...  (See also CogSog & MagVar)
```

Ship's position is output using the Ockam "Q" protocol, wherein the 041 interface formats the data for end use, and the Ockam system passes it through to the display channel for use by on-board computers. This output is not intended for display, although output can be checked by setting an Ockam display to tag X (0X0XX000, only the right 4 digits will be displayed). Output is on tag "X" in signed degrees to 5 decimal places, no leading zeros, latitude on the prime tag and positive North and East.

X'41.24275	(Latitude output equivalent to 41°14.565'N)
X-73.03315	(Longitude output equivalent to 73°1.989'W)

Output occurs each time the GPS outputs a Lat/Lon sentence. When the sentence is received, Latitude is output, followed by Longitude. In older CPU revs, Longitude follows Latitude by one second, placing an upper limit on input of once every two seconds.

For CPU rev 16 and above, Latitude and longitude are output consecutively, allowing a higher thruput rate. However, having too high an output rate can prevent the other GPS data from being output at all. In addition, the differential flag of the GGA sentence is monitored, producing Error 79 if differential GPS drops out.

INPUT (Waypoint range & bearing)
Waypoint range and bearing can be from any one of the following (the Lat/Lons are waypoint position, not ship's position). Again, select the one with the best waypoint range and bearing resolution.

```
$xxBWR,hhmmss,llll.ll,N,yyyyy.yy,W,b.b,T,b.b,M,d.d,N,nnn
$xxBWC,hhmmss,llll.ll,N,yyyyy.yy,W,b.b,T,b.b,M,d.d,N,nnn
```

```
$xxBER,hhmmss,llll.ll,N,yyyyy.yy,W,b.b,T,b.b,M,d.d,N,nnn
$xxBEC,hhmmss,llll.ll,N,yyyyy.yy,W,b.b,T,b.b,M,d.d,N,nnn
$xxRMB,A,x.x,a,o..o,d..d,llll.ll,N,yyyyy.yy,W,d.d,b.b,v.v,X*nn
```

When the interface finds one of the waypoint range and bearing message, it sends it to the CPU. The system compares the reported waypoint position against its DR waypoint position. A large range difference (greater than 1/2 mile) causes the DR waypoint to be moved into agreement with the GPS waypoint. This is what happens when the GPS first reports a (new) waypoint, and results in error code 73.

Once the DR and GPS waypoints agree closely, the system tracks the rate and direction of motion between them, and uses this information to calculate current. The calculated current feeds back into the DR position, eventually stopping the relative motion. The process takes several minutes because the error accumulates fairly slowly.

Some GPS outputs bearing only in true while all OCKAM system functions are with respect to magnetic north, including WAYPOINT Range & Bearing. The system converts the GPS bearing output to magnetic by adding in the magnetic variation, which is a switch setting in the COMPASS interface. If your GPS reports its bearing in magnetic degrees, the variation is not used. If the bearing is true, you should set the compass switches (or calibration K7 on RS232 interfaces) to the local magnetic variation, or the system will not be able to do its current calculations correctly.

OTHER INPUT

With 001 revision A16 and above, other inputs are also transferred. In older 001 revisions (<A16), these inputs are not used.

COG/SOG

```
$xxVTG,ccc,T,ccc,M,sss,M,sss,K
$xxRMC,...,sss,ccc,...        (See also Lat/Lon & MagVar)
```

If VTG or RMC is output, the Ockam system will output COG/SOG on tag 'f', and calculate and display current on tag 'F'.

Magnetic Variation

```
$xxHDG,hhh,ddd,E,vvv,E
$xxHVD,vvv,E
$xxHVM,vvv,E
$xxHVD,vvv,D,E          (Trimble proprietary)
$xxHVM,vvv,D,E          (Trimble proprietary)
$xxRMC,...,vvv,...      (See also Lat/Lon & CogSog)
```

If one of the above sentences is output, the Ockam system outputs this magnetic variation (on tag 'o') in place of the compass interface switch setting. The format will have two decimal places instead of the one place output from the compass interface.

TIME

```
$xxZDA,hhmmss.ss,ddd,mmm,yyyy,lzh,lzm
```

On startup, if ZDA is output, the Ockam system will resync it's clock to the mm:ss portion of the GPS clock (maintaining local time offset).

OUTPUT to GPS (and NMEA channel) from Ockam data

The 041 also outputs Ockam data in NMEA format, eliminating the need to attach an 045 NMEA driver. Since this function is output only, it does not have a configuration value or slot switch setting.

```
$IIDBT,<depth_keel>,f,,M,,F
$IIHDG,<heading>,,,,
$IIMWD,,T,<wind direction>,M,<true wind speed>,N,,M
$IIMWV,<app wind angle 0-359>,R,<app wind speed>,N,A
$IIMWV,<true wind angle 0-359>,T,<true wind speed>,N,A
$IIRSA,<rudder angle>,A,<trimtab angle>,A
$IIVDR,,T,<current set>,M,<current drift>,N
$IIVHW,,T,<heading>,M,<boatspeed>,N,,K
$IIVLW,<perm.log>,N,<trip log>,N
$IIVPW,<VMG>,N,,M
$IIVWR,<app wind angle 0-180>,L/R,<app wind speed>,N,,M,,K
$IIVWT,<true wind angle 0-180>,L/R,<true wind speed>,N,,M,,K
```

Output of each sentence will occur if the required data is available on the Ockam bus, e.g. the DBT sentence will output only if an 028 Depth interface is attached. The format for the data is the same as that on the Ockam displays (see section 2). The "POCKAM" sentence is a so-called proprietary sentence, and is included so there will always be something going out regardless of which interfaces are attached to the system. These sentences will also appear on the NMEA channel if enabled (see "Data on the NMEA channel" below).

OUTPUT to GPS from computer

In addition to the above, the 050 RS-232 interface can also send data to the GPS (if wiring is provided between the 041 output and the GPS input and the GPS understands what's being said). The 041 monitors the Ockam data channel for frames of the form

> @S*n*D<anything_but_null>

where "@S*n*" specifies a command to serial interface *n* and "D" specifies data to be sent to the GPS (S and D can be upper or lower case). Everything following "D" will be sent to the GPS. The value of *n* is specified switch S1 of the interface which also controls the initial state of NMEA channel output.

S1 setting	Address for @S commands	Initial NMEA channel state
0	**Not addressable**	**Disabled**
1-7	**1-7 (and 0)**	**Disabled**
8	**Not addressable**	**GPS & Ockam Enabled**
9-F	**1-7 (and 0)**	**GPS & Ockam Enabled**

Note: sending "@S0..." specifies all addressable "S" interfaces (i.e. 1-7 and 9-F).

GPS data on the NMEA channel

The 041 interface can source data onto the Ockam NMEA channel (T6), which is a channel unused by the Ockam system per se. If enabled, all NMEA sentences coming from the GPS (and NMEA sentences created from Ockam data) are copied onto this channel. Initial control of this function is by switch S1 (see table above), with subsequent control (to addressable interfaces) by

@SnE0	Disable all data -> NMEA channel
@SnE1	Enable GPS data -> NMEA channel
@SnE2	Enable Ockam data -> NMEA channel
@SnE3	Enable GPS and Ockam data -> NMEA channel

Note

Setting S1 to 0 permanently disables GPS data on the NMEA channel because the interface will not respond to @S commands. Setting S1 to 8 permanently enables GPS and Ockam data on the NMEA channel, preventing other interfaces (including the 050D RS-232 interface) from using the channel because the 041 can not be disabled except by resetting S1 and re-powering the system.

Installation

1. Check the unit documentation and procure any necessary plug or hardware which might be required to attach the interface to the GPS. Also check to see if input to the GPS can be used to advantage (e,g, speed & heading data can sometimes help GPS performance). Determine which pins or terminals will connect to the 041 interface: two GPS->interface wires (and two interface->GPS wires, if needed) will be required.

2. Connect the GPS and the interface as shown below. If the designation is not clear, check the voltage between the "+" and "-" pair of wires with the GPS running (the "+" wire should be positive with respect to the "-" wire).

Signal	NMEA designation	Voltage	041 Interface
Shield			**Ground (1)**
GPS out -	**OUT "A"**	**-**	**In- (2)**
GPS out +	**OUT "B"**	**+**	**In+ (3)**
GPS in -	**IN "A"**	**-**	**Out- (4)**
GPS in +	**IN "B"**	**+**	**Out+ (5)**

3. Connect the interface and power up both the GPS and the system. Follow the checkout instructions below to prove that the interface is performing OK.

4. Mount the interface.

Checkout

1. Be sure the onboard computer is not sending waypoint data. If unsure, turn it off.

2. Reset the Ockam system (see section 3) to ensure no tags are disabled, and that GPS waypoint data is enabled.

3. Put a route into the GPS.

4. Check that the Waypoint range & bearing display is alternating and giving the same data as the GPS (within .1 mile). Switch to another waypoint (more than 1/2 mile from the first) and check again.

5. Check that ship's position is being delivered. Set an Ockam display to tag X (0X0XX000). Since only the right 4 digits are displayed, and the number is degrees, not minutes, you can not compare values. However, if the display flips between numbers, the Lat/Lon is probably OK.

Troubleshooting

1. Check the <u>OUT</u> and <u>IN</u> LED's in the upper right corner of the interface. Both should be flashing, indicating that data is going in both directions (output from the interface will happen even if it is not connected to the GPS).

2. Check the <u>Status</u> LED in the upper right corner of the interface. It is normally on.

   If the Error LED is off, there is no power to the interface. Check the Ockam bus wiring between the interface and the system CPU.

   a. blink indicates that the interface has not heard valid data from the GPS since power-up. During this phase the interface periodically swaps the input wires looking for valid NMEA data. Once it has decided that the input wires are OK, it will no longer give this error. Check the wiring between the interface and the GPS, and any GPS setup that might have to be done before output happens.

   b. blinks indicate no matches with data. The GPS is not sending any recognizable data to the interface.

   c. blinks indicate bad characters (framing, parity or overrun errors). Swap the GPS->interface wires and restart the Ockam system.

3, If you have access to an onboard computer and an 050D RS232 interface, you can view the GPS data directly. Set the 041 interface S1 to 8 (always enabled) and the 050D interface S2 to NMEA streamer. Connect the 050D to the computer running a terminal emulator at 4800 baud, No parity, 8 data bits and 1 stop bit. You should then see NMEA data coming from the 041 interface. Check that the data looks OK, and that the required sentences are there and showing data.

Technical Data
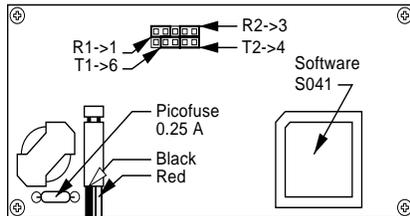
The 041 GPS interface uses the A3240 back board and requires 4 jumpers to be set to the correct locations as shown to the left. Also shown is the location for the interface fuse (spares are located inside the CPU box) and the correct polarity for the bus connector.

Model 041 GPS Interface Revision History

Rev	Date	Change
A1	5/23/95	First release
A2	4/4/96	S041A2. Add Ockam NMEA data to NMEA channel output. Fix input selection for Trimble Ntxxx
B1	7/30/96	Software 041B1
C1	9/19/97	Unisyn compatible software S041C1
C2	2/13/98	S041C2 fix Lat/Lon X' tag when used with old CPU software.
C3	11/16/98	Handle 5 or more decimal digits of L/L input (hires surveying GPS's)
D1	1/13/99	Add handling of RMC (for Valid, L/L,CogSog & MagVar)