Instrumentation Bus for an I-36

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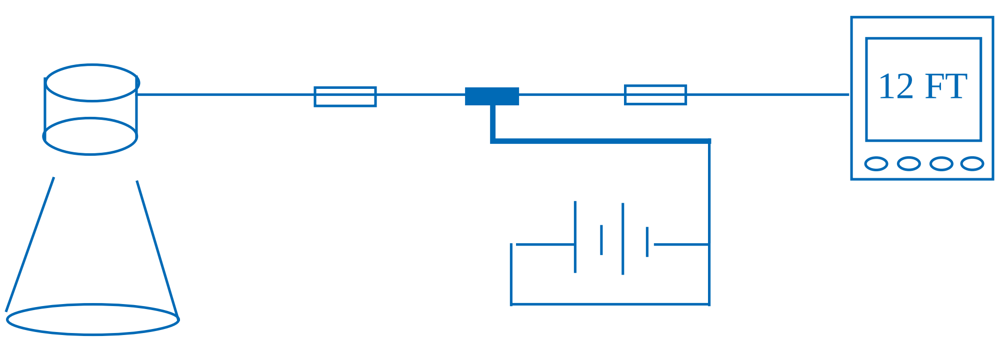

Instrumentation Bus for an I-36

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During the summer of 2006 some friends invited me aboard their sailboat to troubleshoot the loss of wind readings at their conning station. What I discovered was a faulty display panel. In the process, I observed a multitude of SeaTalk faults which did not help me isolate the cause of their problem. The faults provided no bus address information. This lead me to investigate instrumentation busses.

Figure 1 - Combi Speed-Depth Measurement System

I did not have an instrumentation bus on my I-36, but when my depth system started to fail, I decided to replace the configuration with a NMEA 2000 Controller Area Network. I selected a NMEA 2000 network because it is an OPEN, nonproprietary, “plug-n-play”, instrumentation standard. This means that in the future I can add a variety of manufacturers’ sensors and displays to the instrumentation bus. I did not like being “slaved” to a single manufacturer who may discontinue their product line; require its removal for upgrade; or turnover the product to a competitor with a different proprietary communication protocol. Moreover, the segmentation of the bus facilitates fault isolation.

“NMEA” stands for the National Marine Electronics Association. Founded in 1957 by marine electronic suppliers to improve relationships with electronic manufacturers, NMEA created an interface standard for digital data exchange between different marine electronic products in the early 1980s. The NMEA 0183 interface standard has been widely adopted by marine electronics manufacturers. My Garmin GPS unit uses the NMEA 0183 interface standard. A drawback of the NMEA 0183 standard, however, is that its sensor data can be transmitted in one of several different “sentences” which leads to display interoperability problems. NMEA 2000 clarifies this situation.

Once I’d decided on how to interchange data between the depth sensor and the display, I needed to select a transducer manufacturer. Airmar manufacturers a 3-in-1 transducer (depth, speed, and temperature) which came with bronze thru-hull. It operates at 235 kHz, can sound depths between 1.6-230 feet, and has a data update rate of once per second. Next, I had to decide on a single integrated display or several dedicated instrument panels. Color or monochrome? I chose a single, monochrome, liquid crystal display.

Figure 2 - Maretron NMEA 2000 Depth Measurement System

Major NMEA 2000 display manufacturers are

Lowrance, Maretron, Raymarine, SimRad. I opted for Maretron because their package included an Airmar transducer, 33 ft. of cable and a 6" LCD display.

The next decision was the location for the new 3-in-1 transducer. At first, I thought I'd put it in place of the speed impeller through-hull. This proved to be problematic for several reasons. I couldn't remove the existing speed impeller thru-hull. Cutting a new one inboard of the old one would surely cause transducer beam interference from the keel. My attention then focused on the old transducer location. It was far enough forward that the keel would not interfere with the transducer's echo-ranging. The location was further inboard, so that heeling would have a minimal effect on the speed paddlewheel.

Figure 3 - Combi speed impeller near the keel

Fig 4 - Combi transducer forward of keel

Fig 4 - Old transducer interior

Fig 5 - Old tranducer thru-hull

Fig 6 - Old transducer removed

It takes courage to cut a hole below the waterline of one's boat. I enlarged the transducer through-hull using a 2" diameter hole saw with a 2.5" depth. I had to purchase a hole saw with a deep enough cavity. The extra depth was necessary because the cut had to be made on an angle and the old transducer had a protrusion offsetting it from the hull. I put a small boat plug in the old hole to center the drill for the cut. The plug I removed after the cut filled the saw cavity. When I fitted the thru-hull tube, it fit perfectly. I saw that I would have to fair the offset mounting to conform to the through-hull's bottom flange.

Fig 7 - Enlarged thru-hull

A liberal coating of 3-M 5200 caulk was applied around the through-hull housing fitting, interior wooden backing plate, interior hull nut, and the bronze flange. I also sealed the old speed impeller blanking plug into the old speed thru-hull with two beads of 5200 around the cylindrical insert. As the new transducer's

Fig 8 - New bronze transducer thru-hull

Fig 8 - New transducer exterior

Fig 9 - New transducer interior

caulk began to set, the interior hull nut was tightened until caulk squeezed out from beneath the bottom thru-hull flange. The caulk was smoothed off inside and outside. After the caulk was set, marine epoxy resin and fiberglass cloth was used to fill in the hull area above the base of the bronze through-hull. After the epoxy fairing had dried, sanding, and more 5200 were used to smooth out small gaps. Next, anti-fouling paint was applied over the epoxy and carefully to the transducer insert and paddlewheel, so as not to impede their movement. The interior compartment, beneath the holding tank, is shown here with the new transducer installed.

Fig 10 - Transducer connected to bus via a terminated tee connector

The next stage was to run the instrumentation bus cable. I made up a connector to attach the cable to a bus tee. Each NMEA 2000 device requires a bus tee. The instrumentation bus contains five stranded wires surrounded by a braided shield in a neoprene-like jacket. The diameter of the cable is about 1/4 inch. On the inside of the connector, the assembly had color-coded dots to assure that I attached the correct bus wires to the connector socket screws. A stripping tool and a small screwdriver were needed to prepare the wires and assemble the connector. A grommet over the cable, within the connector, makes the assembly waterproof. I attached the 3 connection tee to the cable connector and attached a pre-made resistance termination connector to the end of the tee. A terminator is used at either end of the bus. The transducer connector plugged into the remaining tee plug. The connectors are keyed and knurled metal rings are tightened to keep the connector from slipping out of the tee. I ran the bus cable along the port side storage bins to the quarterberth and crossed over the engine compartment to the power panel on the port side. A power tap supplies 12VDC to the bus. I installed a new 10A circuit breaker for the instrumentation bus. I connected the power tap tee leads from the circuit breaker to the instrumentation bus. I used ring terminals on the power tap leads to make it easier to connect them to the circuit breaker panel busses. The power tee has separate supply leads for two power sources, but I chose to use a single circuit breaker as the +12VDC supply. The power tee has two bus interface connections. One connection goes to the transducer bus segment; the other goes to the display bus segment.

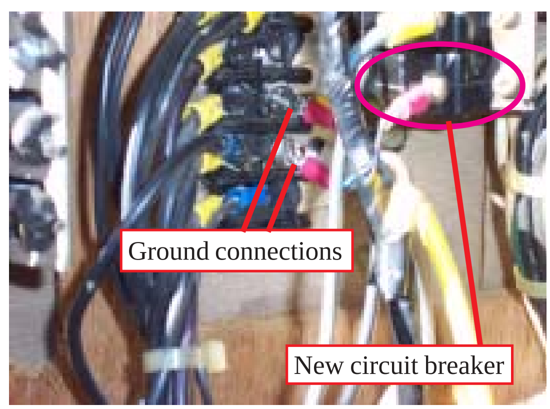

Fig 11 - Power tee connection to circuit breaker panel

From the power tap, the display segment goes to another connector with terminator, located beneath the cockpit. The display cable is fed up through the wheel pedestal guard to the back side of the multifunction display. This proved to be a difficult task. Initially, I planned to route the cable through the center of the pedestal, but it was too tight. I then decided to drill a hole in the cockpit floor beneath the starboard pedestal guard foot, feed the cable up through the pedestal guard rail and cut a rectangular opening in the rail with a Dremel cutting disk. I put a small metal cowl over this opening to prevent water infiltration. The pedestal guard foot on the cockpit floor was hollow; so I inserted a cutoff PVC pipe into the rail from beneath, caulked the guard foot at the cockpit floor to prevent water infiltration.

Fig 12 - Power tee connection to display and transducer

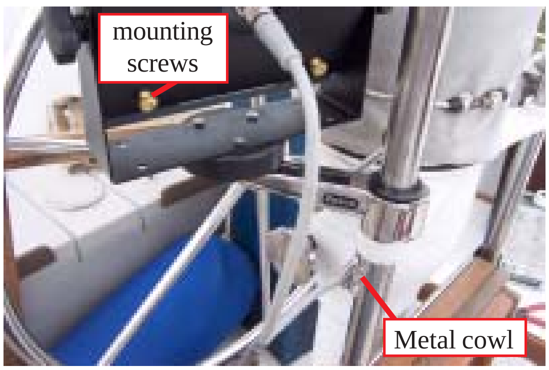

Fig 13 - Display mounting screws & connector

The liquid crystal display is mounted in a swivel stand with gimbal screws on each side which allows the display to tilt. I positioned the display swivel on a 3 inch long GPS mounting arm attached to the starboard side of the pedestal guard rail. Thru-bolts attach the stand to the mounting arm. The display mount can rotate on the pedestal rail; or the display can swivel back and forth to reduce sun glare. The display can be unmounted easily from its stand for storage inside the cabin.

The instrumentation display measures 6.8” x 5.75” x 1.25”. It comes with a cover and provides several display formats. Up to eight favorites can be brought up manually or automatically. In auto mode, the display format change interval can be adjusted to display for up to 180 seconds. Display formats allow full screen, 1/2 screens, 1/3 screens, or quarter screens. There are four levels of backlit intensity. The display consumes less than 350 milliamps when backlit.

Fig 14 - Half screen display

Fig 15 - Quarter screen display

The trip log reset and transducer depth offset are entered via the display. A visual and audible depth alarm setting are also available at the display. Three of the available display parameters (depth, speed, temperature, and trip log) are shown above in a couple of display panel formats.

Depth-speed visibility has been improved; and the new network can be expanded.