Fuel Flow Instrument Caution

Carl Denk (OH) - Fuel flow instruments seem to be one of the latest gadgets, along with Lorans and GPSs. If planning to implement the Fuel Flow's alarm function that calculates endurance based on time/distance to a waypoint received from a navigation device such as a Loran/GPS (below I will refer to GPS, but the same applies to Lorans, etc), the interface needs to be thoroughly investigated. Also if at a later date you decide to change the navigation device, it is likely that the compatibility will vanish!

The normal mode of conversation between the devices is through an "RS-232" serial interface (a pair of wires, one signal out, and the other ground or return. This is where the commonality ends! Specifications to be considered are:

1: Signal level: Real RS-232 is plus 12 volts and minus 12 volts. Avionics typically operate at plus 5 volts and zero volts. Some computers will accept either, many will not! With avionics type equipment, this probably will not be a problem.

2: Baud Rate: This is how fast the data is transmitted. 300 to 28.8k baud is common on computers, the avionics must both have exactly the same baud rate probably 1200 or 9600 baud. My II MORROW 820 Flybuddy GPS uses only 9600, I understand the II MORROW 600 series is programmable at numerous bauds from 1200 to 38.4k.

3: Data Bits: This is the quantity of binary (0 or 1's) digits used to describe the data character, and usually is either 7 or 8. The 820 GPS is 8 Data Bits. It must match exactly.

4: Stop Bits: This is mandatory timing space length, usually one, which is the case of the 820 GPS. It must match exactly.

5: Parity: This is a one bit primitive error checking number, and can be even, odd, on none. The 820 GPS is none.

If all the above are correct the data transmitted over the wire should be received as understandable information, but does not guarantee anything. First the GPS probably will set a flag in the data to say that it thinks the data good, i.e. no red light on the GPS signaling loss of satellite position. Also dashes or other characters will be transmitted instead of bad data. The fuel flow instrument should check the data for flags, out of range (too large or small) numbers, and correct order of data (sentence structure), before it sets the fuel flow endurance feature flag.

The sentence structure is a potential problem, since the data stream transmitted and expected must match exactly. The first several parts of the 820 GPS sentence in part are:
AN423215
Latitude North 42°32.15'
BY814523
Longitude West 81°45.23'
C056
Magnetic Track 056°
D215
Ground Speed 215 Knots

and it goes on for more than 11 items. There are non-printing control characters interspersed at various spots to better define the data. This sentence is transmitted (over the wire) regularly at specific intervals usually once every second or two. The fuel flow may watch this interval and use it as an additional check on valid data. Therefore both the sentence structure and timing are critical and must match exactly.

A caution related to all navigation receivers, if the transmittal interval time is long (several seconds), and the device connected has it's own internal delays, then the device, a moving map display could lag by 5 or more seconds which translates to 0.3 mile inaccuracy in position, not good for finding an airport in poor visibility.

As if this isn't enough, there is still the possibility of defects, and dimensional tolerance type problems that will prevent things from working correctly.

Now for my experience with DPS instruments MINI-FUELWATCH, a very nicely crafted instrument. The installation went smoothly, with the flow sensor installed between the Bendix RS5A injector throttle body and the distribution block. The LCD display is readable under all lighting conditions, which I can't say for the ULTIMATE SCANNER next door. The warnings that are dependent on the GPS output have never worked.

1: Before the DPS unit was ordered, the II MORROW installation RS-232 data was faxed to DPS, with the reply that this was "ARNAV" specification output, and was compatible with the FUELWATCH!

2: After several phone conversations with DPS, as a last effort, hoping not to send the unit back, I opened the case, and traced the RS-232 input, only to find missing components. Another phone call resulted in directions to install a diode and resistor which I installed. It still doesn't work. A fax in each direction netted different component locations to install. I followed directions, it still doesn't work.

3: Phone conversation with DPS: I don't have time to do now, but later I can modify the FUELWATCH program to accomodate changes necessary to make the unit work.

4: The unit was sent back to DPS with a computer file of the GPS output. This verified that GPS manual and instructions did match, for what the GPS was saying, while on the ground with 3d position (no speed or distance to waypoint information).

5: Received FAX from DPS indicating refund of the $20 for the GPS interface. The bottom line in my book is the info was provided prior to order, it's not my fault DPS didn't pay attention to details. Apparently the only inconsistency is the time interval of data transmission, which probably is easily fixed.

6. Recently the unit has become intermittent. I will pull it after the OKCGIG.