TECH TIME Helpful tips for the Avionics Technician

BY AL INGLE

This month, we begin a new series on serial busses. Topics covered will be the evolution from the parallel transfer of information to serial, the methods used, the time and frequency domains, and common serial busses found in our industry.

Why has our society, in general, and aviation, in particular, embraced the use of serial busses? Because of its advantages in weight reduction, reliability, information capacity and integrity. Two common uses of parallel busses found in our legacy aircraft are frequency tuning and transponder Mode C altitude (Gillham) codes. It takes 11 conductors to represent an aircraft's pressure altitude in 100-foot increments from -1000 feet to 51,000+ feet. Ten conductors are needed for the data and one for the signal return (common).

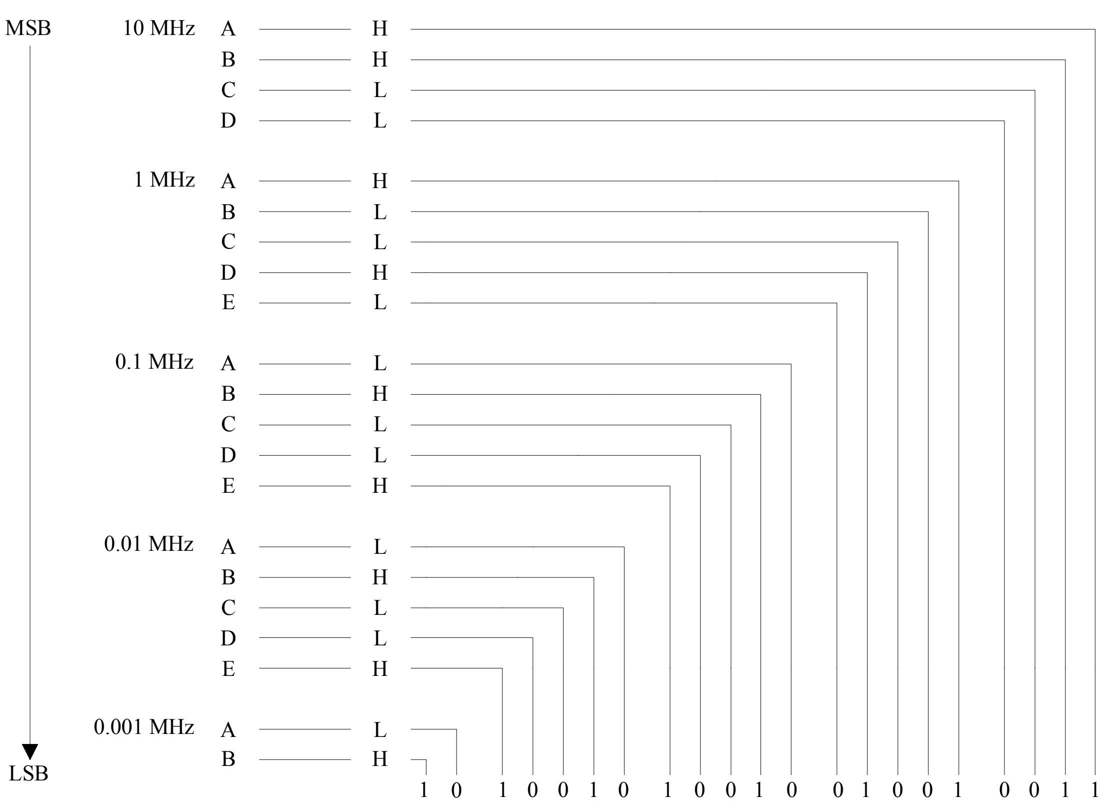
Likewise, to tune a 720-channel communications transceiver using the ARINC 2-out-of-5 method, you typically need at least 15 conductors: four for the 10s MHz; four for the one's MHz; four for the hundred's KHz; two for the 25 KHz spacing; and a common return. A Gables "Y" version universal comm control head has provisions for 21 tuning lines.

Now, imagine an aircraft with two coms, two navs, ADF(s), remote glideslopes and DME just as a base installation with all data carried one bit per wire. It is not uncommon for older business jets to have wire bundles 2 inches in diameter.

Every conductor adds a corresponding weight and potential for failure. A significant number of repairs in parallel data wired aircraft comes from intermittent or incorrect frequency channeling and transponder Mode A/C errors. Most importantly, there is no integrity test using parallel data transfer. When a pilot tunes a radio or an altitude reporting device presents an altitude at its rear connector, there is no assurance this information gets to its destination unaltered.

One result of unreliability within the Air Traffic Control Radar Beacon System (ATCRBS) was the implementation of the two-year tests and inspections required by §91.411/.413. With the advent of all solid-state transponders, MEMS (MicroElectroMechanical Systems) transducers and serial busses, the previous problems, for the most part, have been eliminated.

Below, in Figure 1, is the wiring diagram utilizing ARINC 2/5 channeling for 118.000 MHz:



	A	B	C	D	E
0		X			X
1	X	X			
2	X		X		
3		X	X		
4		X		X	
5			X	X	
6			X		X
7				X	X
8	X			X	
9	X				X

ARINC 2/5

Figure 1 ARINC 2/5 Channeling 118.000 MHz

Referring to Figure 1, by convention we will call the "10s of MHz" conductors more significant in status than the fractional MHz, and the "10s of MHz A" as the most significant conductor of all, or most significant bit (MSB). Therefore, the "0.001 MHz B" has the lowest status and is the least significant bit (LSB). If we take the tuning logic levels corresponding to 118.000 MHz as shown and represent this data horizontally, it takes on the characteristics of a serial pulse train.

Now allow this data to flow from left to right across the horizontal (time) axis as shown in Figure 2 below:

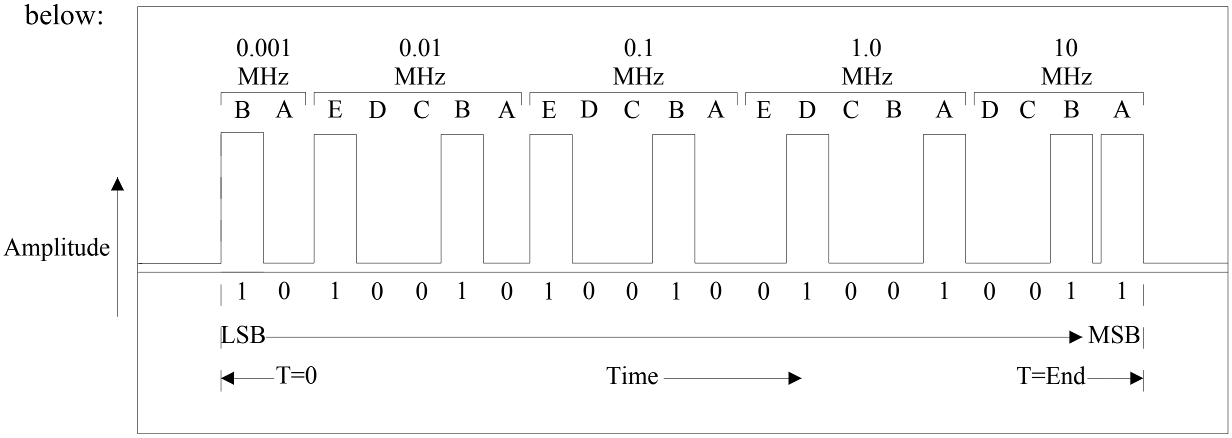


Figure 2 Data Train in Time

This is the basis of a serial bus as shown in the *Time Domain*. An oscilloscope is a good example of a device measuring in the Time Domain. It measures the amplitude of a signal on the vertical axis at a given point in time on the horizontal axis.

It is interesting to note that data is still processed in parallel at the microprocessor level; it is only converted to serial for transfer on the aircraft wiring and then converted back to parallel at its destination. See Figure 3 below:

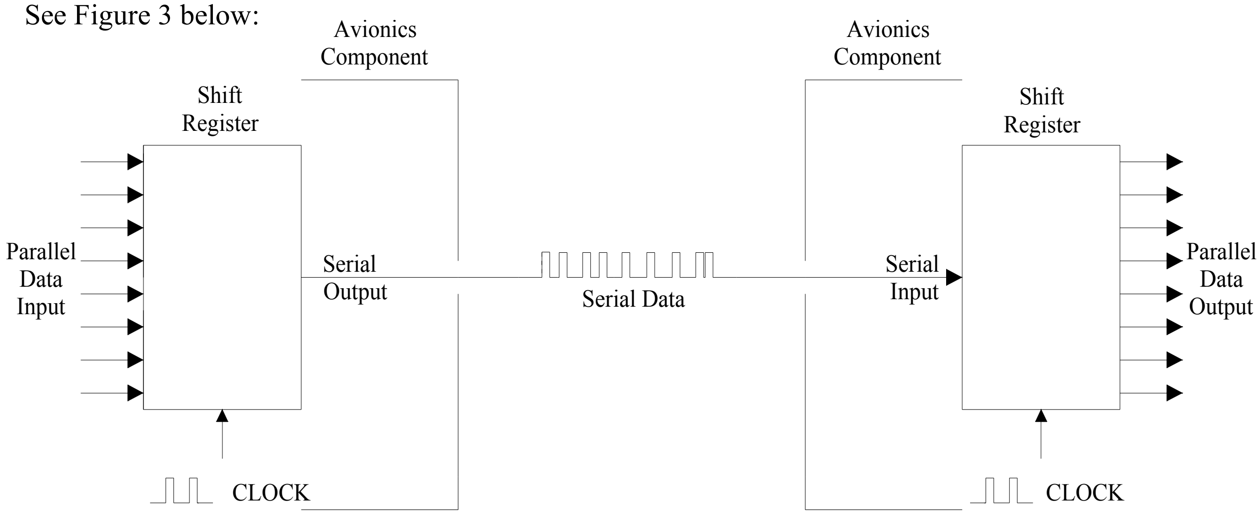


Figure 3 Serial Data Conversion

To transfer this data in language microprocessors can use, namely high and low states or 1s and 0s, we must have some method of synchronizing between communicating parties to prevent corruption. There are many methods of ensuring accurate and complete data transfer, which we will explore in our next installment.

Next Month: More Serial Busses