TECH TIME Helpful Tips for the Avionics Technician

BY AL INGLE

This month, we continue our series on serial busses. Having previously discussed their evolution, protocols, domain characteristics and a few representative types, we now focus on one of the most popular: ARINC 429.

ARINC 429

ARINC 429 is a copyrighted specification created by Aeronautical Radio Inc. The ARINC organization is the technical, publishing and support arm for the Airlines Electronic Engineering Committee (AEEC) groups. The AEEC was formed in 1949, and it is the leader in standardizing air transport avionics equipment. The AEEC standards define avionics fit, form, function and interfaces.

ARINC specifications are divided into four numbering systems and two basic types. These include the 400, 500, 600 and 700 series. The two groups are general design requirements (400 and 600) and terminal design standards or characteristics (500 and 700). A manufacturer may use the 400 series requirements for a system design, but each component in the system would meet the input/output specifications for the digital and analog information utilized. The same holds true for the 600 and corollary 700 series specifications.

Within the guidelines of ARINC specifications, there are a number of subgroups, other avionics organizations and private manufacturers, all of which publish information regarding the implementation of avionics systems. One example is the General Aviation Manufacturers Association (GAMA), which defines subgroup functionality.

The three most prevalent ARINC specifications are ARINC 419, ARINC 429 and ARINC 629. ARINC 419 is the oldest and considered obsolete, but it is still useful for maintenance support in legacy aircraft. ARINC 429 is by far the most popular, and ARINC 629 currently is limited to Boeing 777 aircraft.

ARINC 429, formally known as the Mark 33 digital information transfer system specification, defines the air transport industry's standard for the transfer of digital data. The specification calls for an "open-loop" design, which can be described as a simplex bus with multiple receivers. It is also called a "shout" or "broadcast" bus, whereby the transmitting line replaceable unit (LRU) is known as the source, while each receiving LRU is known as a sink. An LRU is not limited to one transmitter or receiver but can have multiple transmitters and receivers. Information is carried on a twisted, shielded pair with the shield grounded at both ends. Packets of information must be sent at intervals sufficient to provide a minimal rate of change of data, yet with sufficient repetition so the loss of a single-data packet would be of little consequence. To detect errors, odd parity indication is utilized with optional error checking.

A typical data set is comprised of one word encoded in either binary (BNR) or binary coded decimal (BCD). It is important to understand ARINC 429 is not a standard but a *specification*. This allows for a high degree of interoperability between LRUs; however, avionics manufacturers are not required to comply.

SPECIFICATIONS:

- Simplex, broadcast bus connected in Star or Bus Drop configuration. *(See Figure 1)*
- One transmitter and up to 20 receivers per bus; each terminal (LRU) can have multiple busses.
- Transmitter sends out 32-bit word, least significant bit (LSB) first; tri-state, return to zero (RZ)
- Transmission rate: Low speed (12.5 to 14.5 kHz) and high speed (100 kHz) +/- 1%.
- Receiver is not allowed to respond on the same bus where a transmission has occurred.
- An LRU on the ARINC 429 bus does not have an address but is programmed to listen for specific data words.
- The transmitted word begins with a label identifying the data of interest.
- Cabling consists of 78 Ω twisted, shielded pair with shield grounded at both ends.
- Source (transmitter) must be capable of handling a maximum load of 400 Ω.
- A receiver must have a minimum effective input impedance of 8 kΩ.
- Most systems designed for range of less than 175 feet (50+ meters).
- A data "one" is created by the transmitter when the rising edge goes from zero to 10+/- 1 positive volts; a data "zero" is created by the transmitter when the falling edge goes from zero to 10+/- 1 negative volts. *(See Figure 2)*
- The word overview consists of 8-bit label, 19-bit data area, odd parity bit, optional 2-bit source/destination identifier (SDI) and optional 2-bit sign status matrix. *(See Figure 3)*

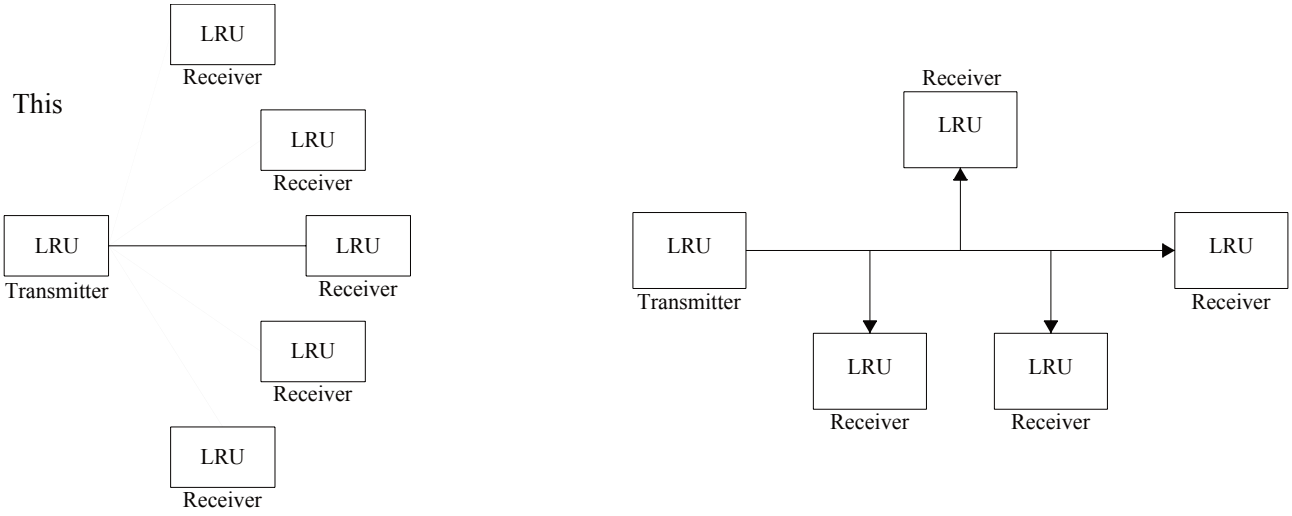
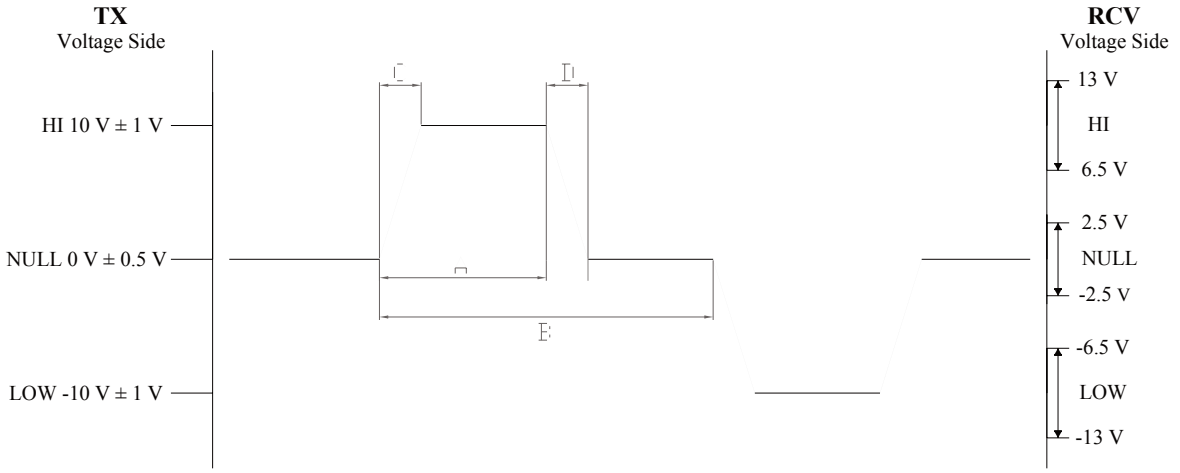


Figure 1: Star Topology for LRU Wiring (left) and Bus Drop Topology for LRU Wiring (right)



LTR	Parameter	High Speed	Low Speed
-	Bit Rate	100KBPS ±1%	12-14.5 KBPS
A	1st half of pulse	5 µsec ±5%	B/2 ±5%
B	Full pulse cycle	10 µsec ±2.5%	1/Bit Rate µsec ±2.5%
C	Pulse Rise Time	1.5 ±0.5µsec	10±5 µsec
D	Pulse Fall Time	1.5 ±0.5µsec	10±5 µsec

Figure 2: ARINC 429 Waveform Characteristic (top) and ARINC 429 Output Signal Tolerances (bottom)

P	SSM?	Most Significant Data									DATA - 19 bits										Least Significant Data		SDI?		8-Bit Octal Label							
32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
MSB														32-Bit ARINC 429 Word																	LSB

1 The Sign/Status Matrix (SSM) provides sign, direction, or status information.
2 SDI identifies the source and directs which receiver (sinks) should recognize data.

Figure 3- 32-Bit ARINC Word

REFERENCES:
"ARINC 429 Commentary," SBS Technologies; Doc PN: 501-429842-00, pages 1-19.

Next Month: More Serial Busses