AA LINK COAXIAL LINE STANDARDS

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Abstract

The Automatic Acknowledge (AA) Link is used in the Department of Computer Science at Edinburgh University for medium speed data transmission (less than 24k chars/s) between any combination of computers and peripheral devices. This paper is limited as far as possible to the description of the standards applying to the coaxial cable which forms the standard interface.

Cable	75 ohm coaxial 'economy' or better.
Connectors	75 ohm and 50 ohm BNC plug on ends of cable. Mating BNC socket on cards or through panels.
Signal	0 volts quiescent 3 to 5 volts active.
Termination	75 ohm at both ends.
Character Rate	Up to 24,000 characters per second.
Baud Rate	264k baud.
Clock Rate	Normally 8 times the Baud Rate.

Data and Control Format.

Data flows from a transmitter through a single coaxial cable to a receiver and control flows from the receiver through the same cable to the transmitter.

The data format is derived from the 11 bit serial asynchronous character standard used by teleprinters , consisting of 1 start bit , 8 data bits , and two stop bits. The AA link standard differs from the 20 mA current loop teleprinter standard as follows :-

1. The quiescent state of the line is the same as the disconnected or line break state.
2. At least two stop bits are used and the line is used for reverse transmission of the Automatic Acknowledge control pulse during the stop bits.

The start bit is active (+4v) and is equivalent to a Logical 0 data bit.

The stop bits are quiescent (0v) and are equivalent to Logical 1 data bits.

The control format is very simple consisting of a single pulse (active) of at least 1 bit duration and starting 1/2 bit time after the end of the last data bit.

Timing Diagram.

Transmitter Signal

```
  ..........................                  ..........................           ...
  .   ,                    ,                  .   ,                    ,           .
  .   ,                    ,                  .   ,                    ,           .
...   ,,,,,,,,,,,,,,,,,,,,,,.................     ,,,,,,,,,,,,,,,,,,,,,,........TTTT.
```

Receiver Signal

```
                              ....RRRRRRR.                                    .....
                              .          .                                    .   .
                              .          .                                    .   .
...............................          ..........................................  .........
```

Signal on Transmitter End of Cable

```
  ..........................                  ..........................           ...
  .   ,                    , ....RRRRRRR. .   ,                    , .....         .
  .   ,                    , .          . .   ,                    , .    .        .
...   ,,,,,,,,,,,,,,,,,,,,,,.           ...   ,,,,,,,,,,,,,,,,,,,,,,...   ..TTTT.
  A                          B          C A                          B    C        A
  Start    8 Data             AA Pulse     Start      8 Data          AA Pulse
```

```
...       Definite Signal Level
,,,       Data Dependant Signal Level
RRR       Receiver Controlled Delay
TTT       Transmitter Controlled Delay
```

Data bits are not shown to scale.

The signal seen at the transmitter end is different to that seen at the receiver end in that the AA pulse is attenuated by the coaxial cable.

Significant Timing Edges.

A. The rising edge of the start bit initiates the receiver cycle.

B. The rising edge of the AA pulse indicates to the transmitter that the receiver is connected and working. If this edge does not occur within a certain time (the AA delay) after the middle of the first stop bit, as timed by the transmitter, then a flag is set in the transmitter indicating that the receiver is not connected or not operating or not listening.

C. The trailing edge of the AA pulse indicates that the receiver has dealt with the preceding character and is ready to receive another. The time between this edge and the rising edge of the start bit of the next character is at least one half bit time.

Variable Times

The duration of the AA pulse is at least one bit time but can be longer due to delay by the receiver in disposing of the acknowledged character. This delay can be infinite.

The duration of the gap between the trailing edge of an AA pulse and the rising edge of the next start bit is at least one half bit time but can be longer due to delay by the transmitter in sending the next character. This delay also can be infinite.

In general all times should be regarded as having a possible error of + or − 1/4 bit time. The start bit however must be at least 7/8 bit long so that receivers can check for noise on the line. This check is made by testing the start bit to be at least 3/4 bit long.

A reset delay is implemented in some receivers such that the receiver does not listen to the line during the delay. This has the effect of disconnecting the receiver as seen by the transmitter for the period of the delay. The reset delay is between 100 ms and 300 ms

The AA delay is between 1 sec. and 3 sec.

Initialised States.

The transmitter is initialised such that it will not transmit onto a line which is already active due to the receiver.

The receiver is initialised to listen to the line but may have the reset delay implemented , in which case it will appear to be disconnected for the period of the delay following initialisation and before reaching its initialised state

In general the transmitter is the active device and the receiver the passive device, that is, the receiver, while having control of the rate of transmission cannot initiate a transmission.

Miscellaneous.

Cables are marked at both ends with an arrow indicating the direction of flow of Data. No other standard markings or colour are specified but in any given installation local standards of identifying cables may apply.

At the Department of Computer Science at Edinburgh University black and grey cables are normally used but white cable is reserved for connecting flying leads from receivers and for connecting receivers to data exchanges.

If pairs of links (transmitter/receiver) are implemented on one board then for vertically mounted boards the upper connection should be used for the transmitter and on horizontally mounted boards the left connection (looking at the board) should be used for the transmitter.

Similarly, when passing through panels the top or left connection as seen from the 'outside' should be used for the transmitter.

Line Driving and Receiving parameters are as specified for Signetics 8T13 Dual Line Driver and 8T14 Triple Line Receiver ICs.

The required clock rate can be obtained by binary division of the output of a 4.224 MHz. Crystal Oscillator.

Data Standards.

Two types of transmission are recognised: binary (that is, arbitrary eight-bit values) and ASCII coded text. There is no hardware difference between these two forms of transmission. Binary transmission is used for communication with special-purpose devices or software where the informaton transmitted is not text or is not coded in ASCII. In the case of binary transmission, there is no provision for forward control (that is, from sender to receiver): in particular, there is no convention for the detection of the end of the transmission. End-of-transmission must therefore be detected by the receiver on the basis of timeout, operator intervention or special knowledge of the format of the data -- or some combinaton of these.

ASCII transmission implies conformity to the ASCII standard as regards interpretation of graphics and controls. The following points are stressed:

1. CR means Carriage Return
2. LF means Line Feed
3. Newline is represented by CR followed by LF
4. EOT means End-Of-Transmission
5. NUL and DEL codes are not significant

For ASCII transmission it is desirable that parity should be generated by the transmitting end and checked at the receiving end. It is recognised, however, that for some computers the expense in time or space of generating and checking parity would be unacceptably high. When it is used, parity should be even.

It is not a requirement of link interfacing and software handling that any control characters other than those mentioned above should be honoured. In particular it is not mandatory for a receiver to have a buffer capable of accommodating a complete line. Accordingly, where line-editing facilities are required, these should be implemented at the transmitting end and carried out before transmission.

While a binary transmission may end as a result of transmitter and receiver stopping simultaneously (by virtue of a private convention), an ASCII transmission must be terminated either by the transmitter sending and the receiver accepting the EOT code or by the receiver using the reset delay to simulate disconnexion. The second method, which is also applicable to binary transmission, is used for abnormal termination induced by the receiving end and in general requires operator intervention at the transmitting end to interpret the significance of the line condition.