

## The Data Communications Interface

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Uses the services provided by the physical layer  
Provides services to the network layer  
Particularly visible as like from Host to Network

## Asynchronous and Synchronous Transmission

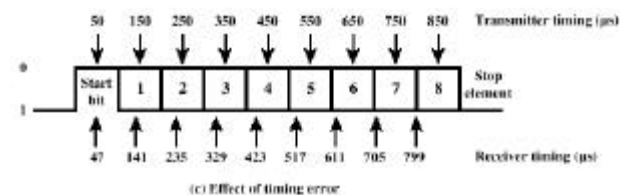
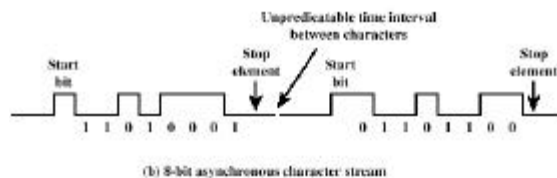
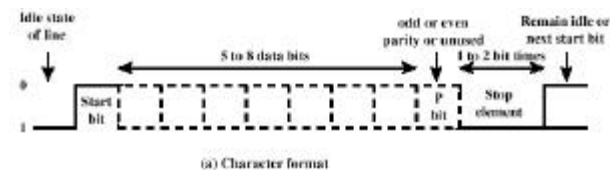
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- Transmitter and receiver need to be synchronised
  - more of a problem because data is not being sent continuously
- Two classes of solutions
  - Asynchronous
  - Synchronous

## Asynchronous

- Data transmitted one character at a time
  - 5 to 8 bits
  - (old-fashioned solution - but it could be useful for 16 bit Unicode characters too)
- Timing only needs maintained within each character
  - so actual clocks need not be matched precisely
- Resynchronise with each character

## Asynchronous (diagram)



## Asynchronous - Behavior

- In a steady stream, interval between characters is uniform (length of stop element)
- In idle state, receiver looks for transition 1 to 0
- Then samples next N intervals (char length)
- Then looks for next 1 to 0 for next char
- Old technique, originally designed for teletypes
  - Simple
  - Cheap
  - Overhead of 2 or 3 bits per char (~20%)
  - Good for data with large gaps (keyboard)

## Synchronous - Bit Level

- Block of data transmitted without start or stop bits
- But clocks must be synchronized
- Can use separate clock line
  - Good over short distances
- Embed clock signal in data
  - Manchester encoding
  - (each 1 or 0 results in some form of transition)

## Synchronous - Block Level

- Need to indicate start and end of block
- Use preamble and postamble
  - e.g. series of SYN (hex 16) characters
    - 00010110
  - Header usually contains data length
- More efficient (lower overhead) than async

## The V24 or EIA RS 232 Interface

- Data processing devices (or data terminal equipment, DTE) do not (usually) include data transmission facilities
- Need an interface called data circuit terminating equipment (DCE)
  - e.g. modem, NIC
- DCE transmits bits on medium
- DCE communicates data and control info with DTE
  - Done over interchange circuits
  - Clear interface standards required

## Characteristics of Interface

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- Mechanical
  - Connection plugs
- Electrical
  - Voltage, timing, encoding
- Functional
  - Data, control, timing, grounding
- Procedural
  - Sequence of events

## V.24/EIA-232-F

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- ITU-T v.24
- Only specifies functional and procedural
  - References other standards for electrical and mechanical
- EIA-232-F (USA)
  - RS-232
  - Mechanical ISO 2110
  - Electrical v.28
  - Functional v.24
  - Procedural v.24

## Mechanical Specification

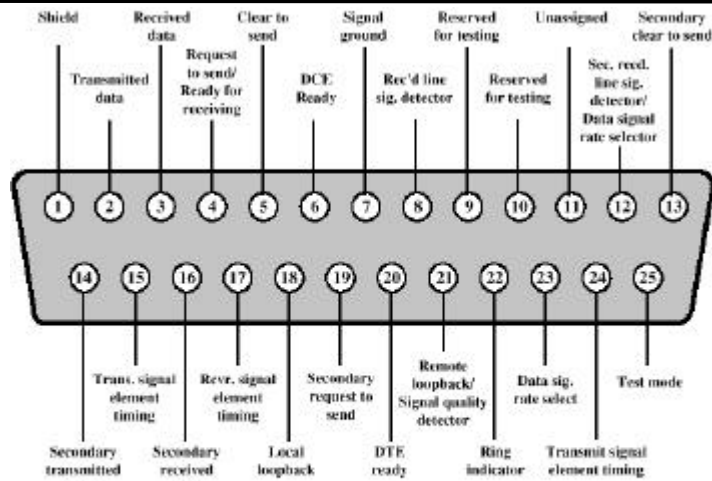


Figure 6.5 Pin Assignments for V.24/EIA-232 (DTE Connector Face)

## Electrical Specification

- Digital signals
- Values interpreted as data or control, depending on circuit
- More than -3v is binary 1, more than +3v is binary 0 (NRZ-L)
- Signal rate < 20kbps
- Distance < 15m

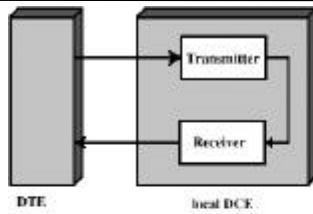
## More recent standards:RS449

- RS449 gives the physical information, and refers to
- RS422 and RS423
- RS423: single-ended voltage specification
  - does away with necessity for negative-going signals
- RS422: balanced lines for each circuit
- fewer lines, can be balanced data

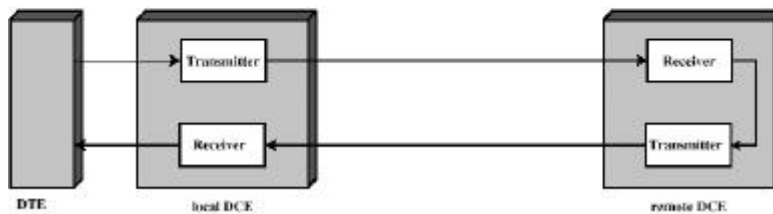
## Functional Specification

- (See acetates)

## Local and Remote Loopback



(a) Local loopback Testing

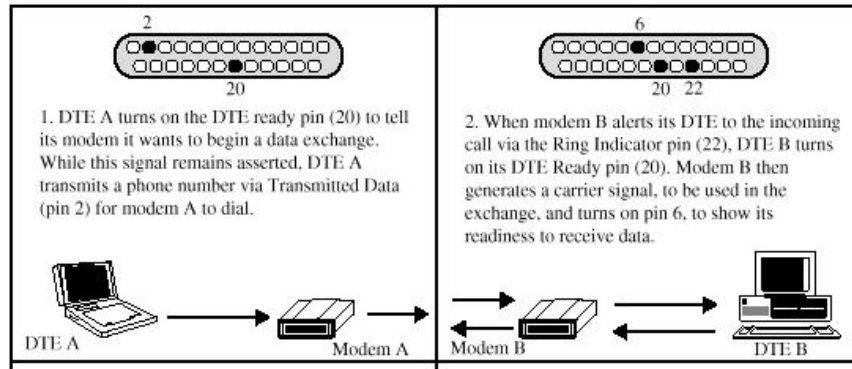


(b) Remote loopback Testing

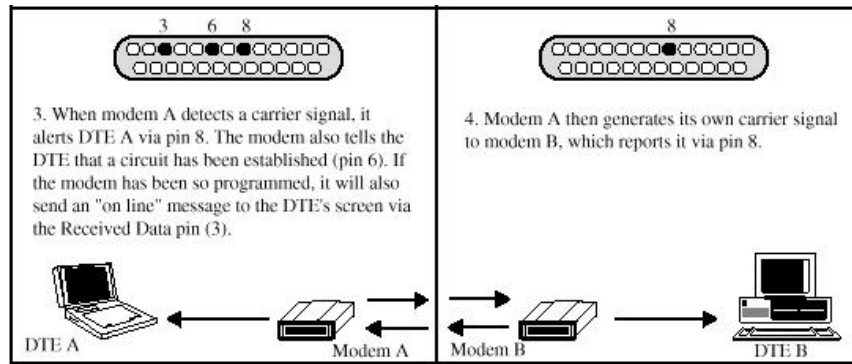
## Procedural Specification

- E.g. Asynchronous private line modem
- When turned on and ready, modem (DCE) asserts DCE ready
- When DTE ready to send data, it asserts Request to Send
  - Also inhibits receive mode in half duplex
- Modem responds when ready by asserting Clear to send
- DTE sends data
- When data arrives, local modem asserts Receive Line Signal Detector and delivers data

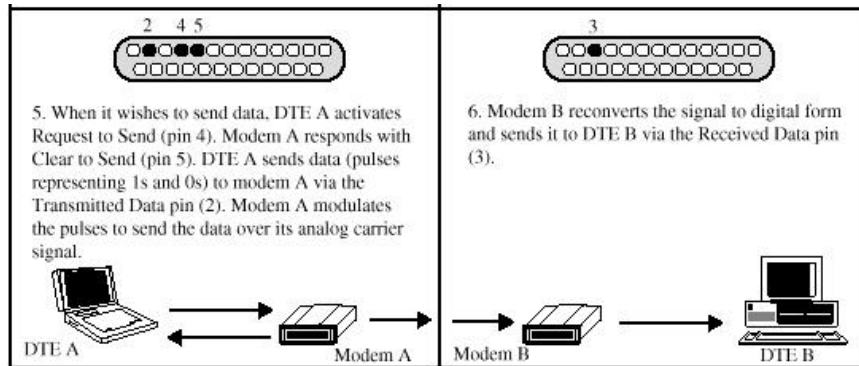
## Dial Up Operation (1)



## Dial Up Operation (2)



## Dial Up Operation (3)



## Null Modem

