Sistemas Baseados em Microprocessadores

Mestrado Integrado em Engenharia Eletrotécnica e de Computadores
Faculdade de Engenharia

Asynchronous Communications

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Synchronous vs Asynchronous...

The way **DATA** and **CLK** are sent and synchronized:

Synchronous

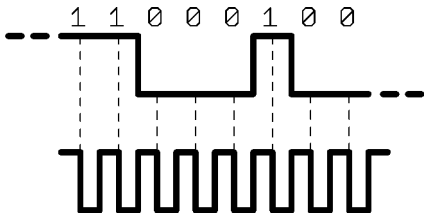
- CLK and DATA are generated by the sender and sent to the receiver
- Requires two separate communication channels
- Simple and fast

Asynchronous

- CLK is not sent, DATA has to include sync hooks
- Receiver uses a local CLK and has to synchronize with the received DATA
- Requires only one communication channel

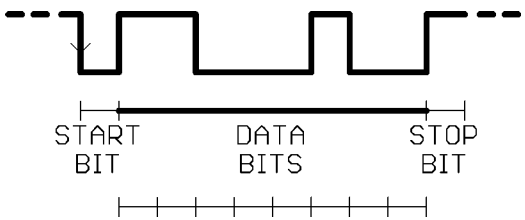
Asynchronous vs synchronous...

- Synchronous:



- Signals:
  - DATA+CLK
  - Others: CS,...
- Synchronization Rx-Tx
  - Guaranteed by CLK

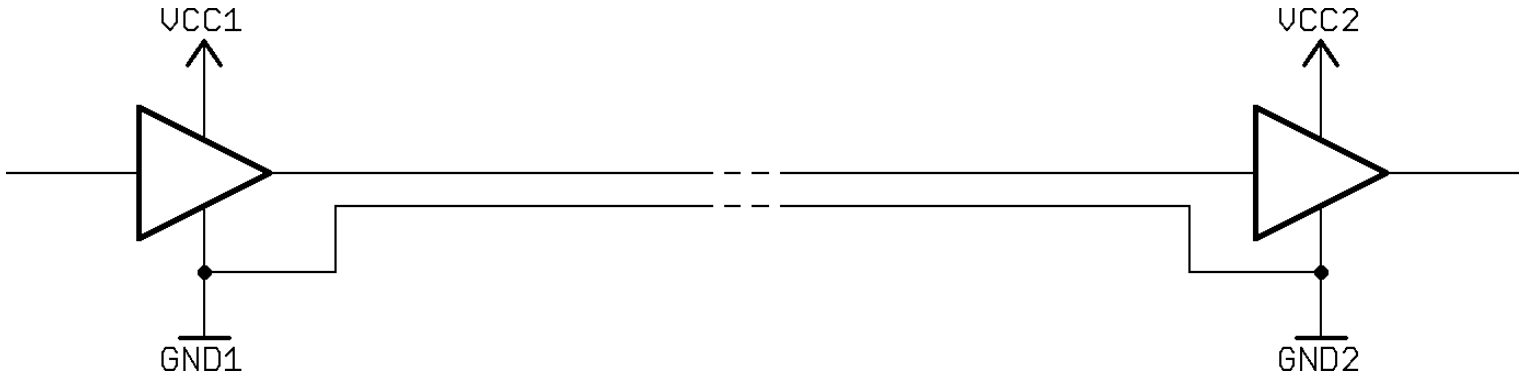
- Asynchronous:



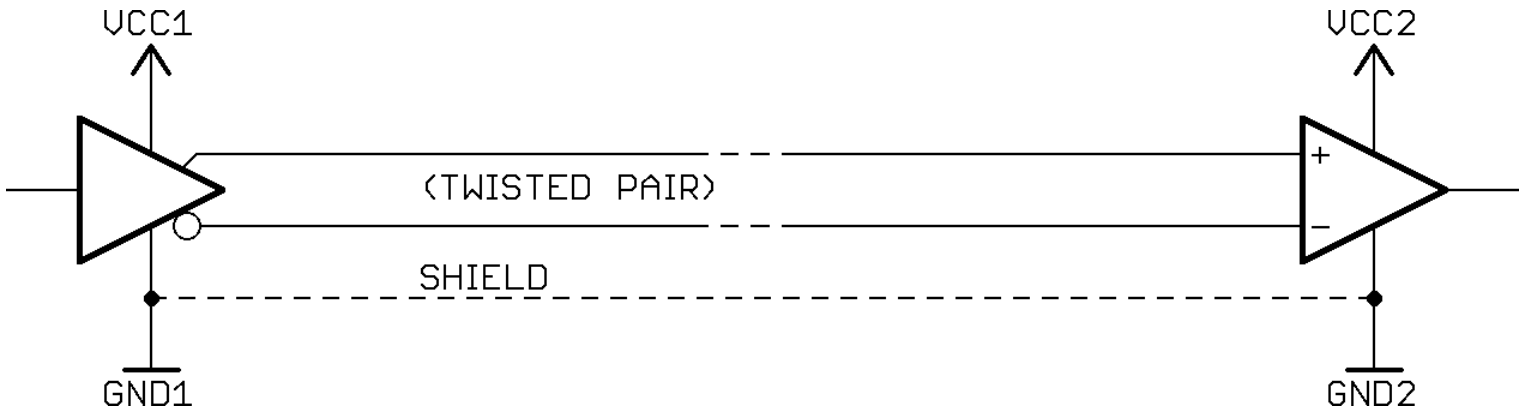
- Signals:
  - Only DATA
- Bits:
  - Syncronization bits
  - Data bits
- Synchronization Rx-Tx ?

Non-differential vs Differential

Non-differential



Differential



Non-differential vs Differential

Non-differential

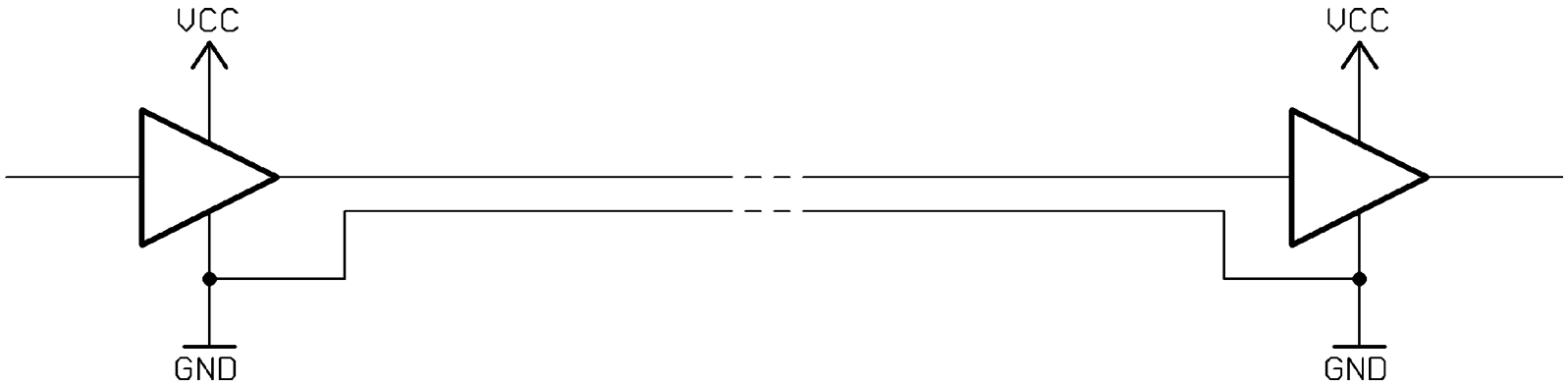
- Each logic signal maps to a single electrical signal
- There must be a common voltage reference
- Short distances (noise and attenuation)
- Danger:
  GND voltage differences!

Differential

- Each logic signal maps to two electrical signals
- Voltage difference is the relevant parameter
- Long distances (noise is cancelled)
- Disadvantage:
  double the cable needs

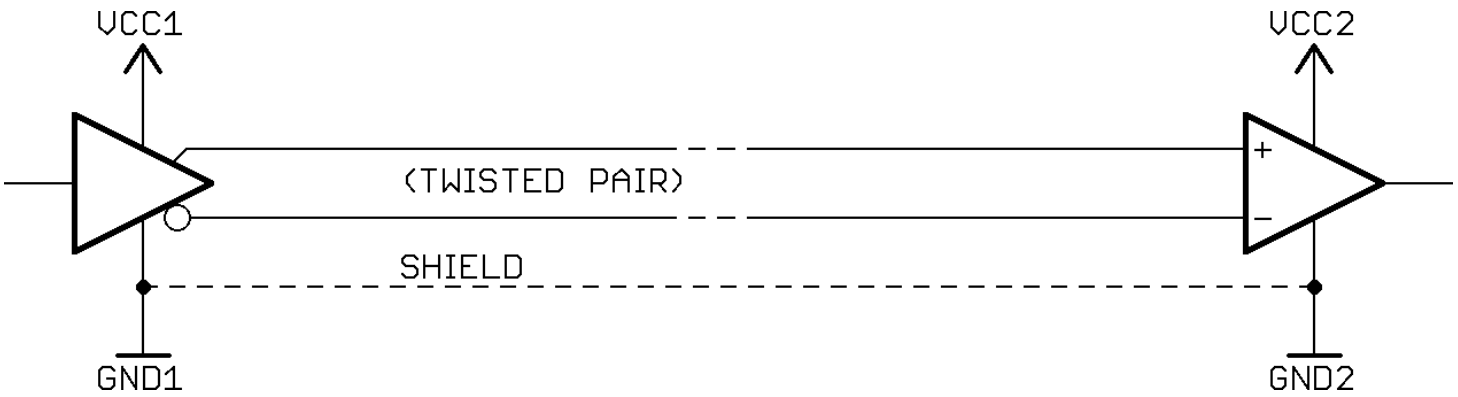
Non differential transmission

- Signals have a common reference (GND)
- Additive noise and attenuation >> short distances
- Danger: voltage difference between grounds!



Differential transmission

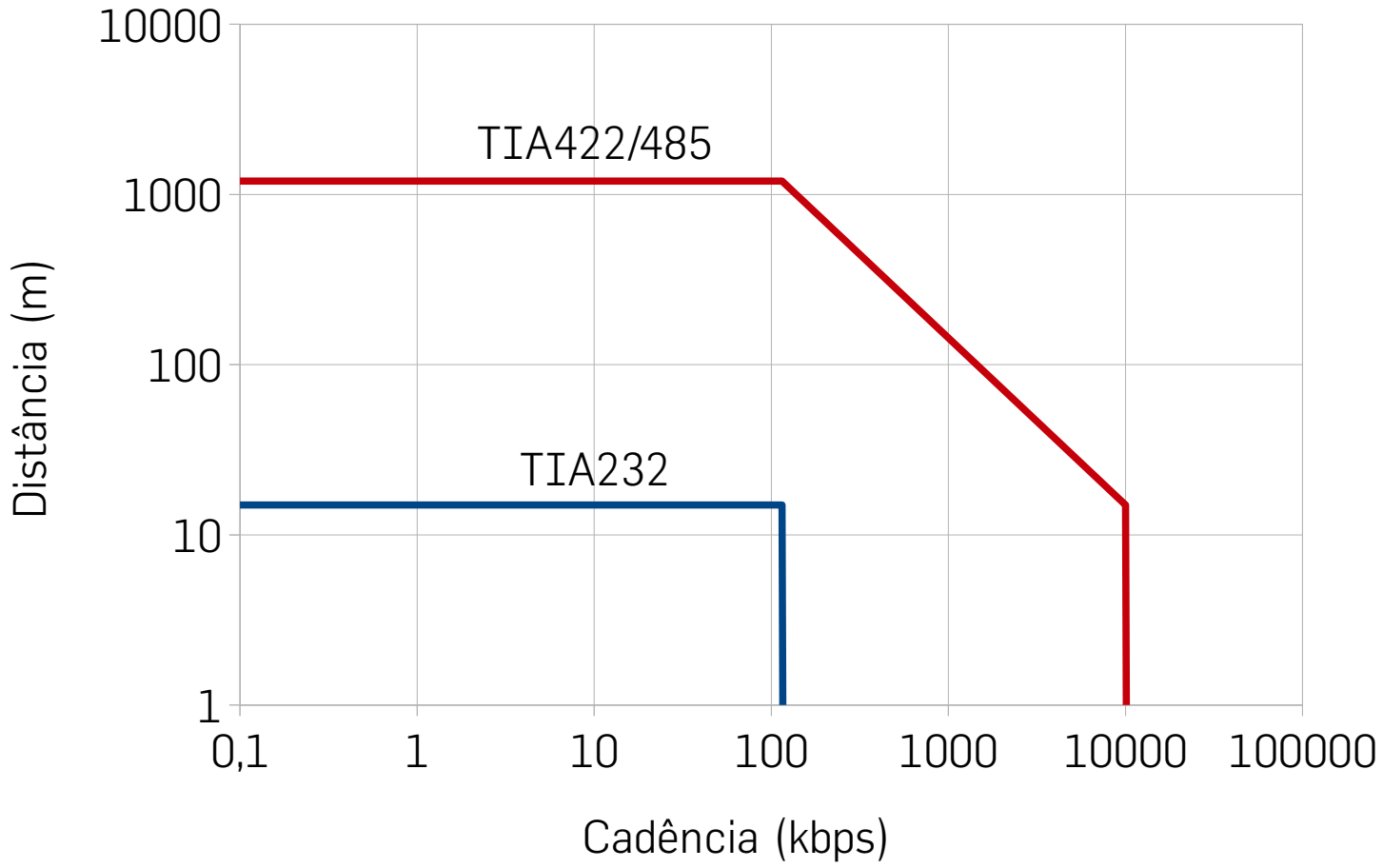
- Each logic signal coded as two electrical signals
- Voltage difference is the relevant parameter
- Noise and attenuation cancel >> long distances
- Danger: voltage differences between grounds!



Some standards

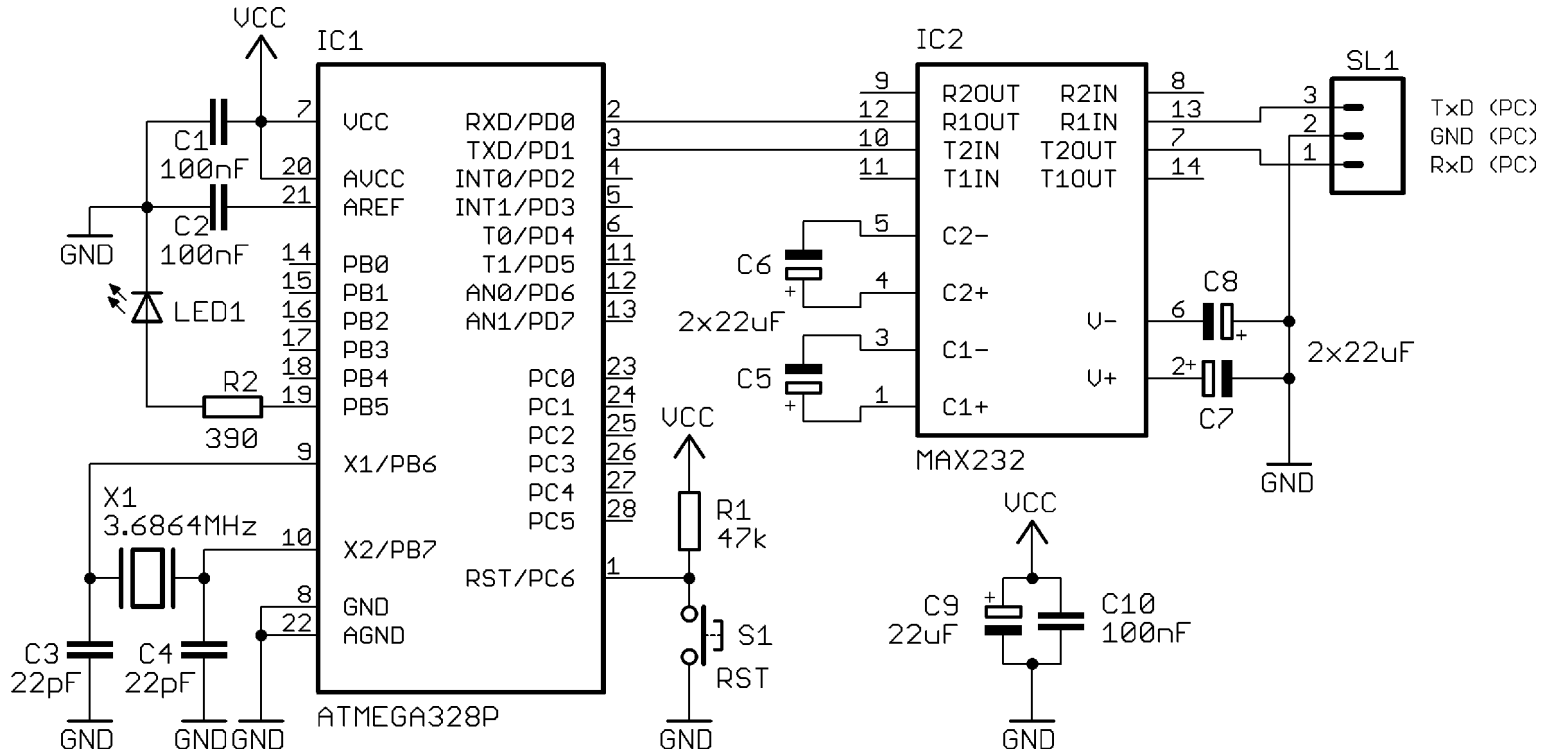
	TIA232	TIA422	TIA485
Connection	Unipolar	Differential	Differential
Topology	Peer to peer	Multidrop (10)	Multidrop (32)
		One master	Multimaster
Max speed	115kbps	10Mbps	10Mbps
Max distance	15m	1200m	1200m
Low level	V > 3V	dV > 200mV	dV > 200mV
High level	V < -3V	dV < -200mV	dV < -200mV

Speed versus distance



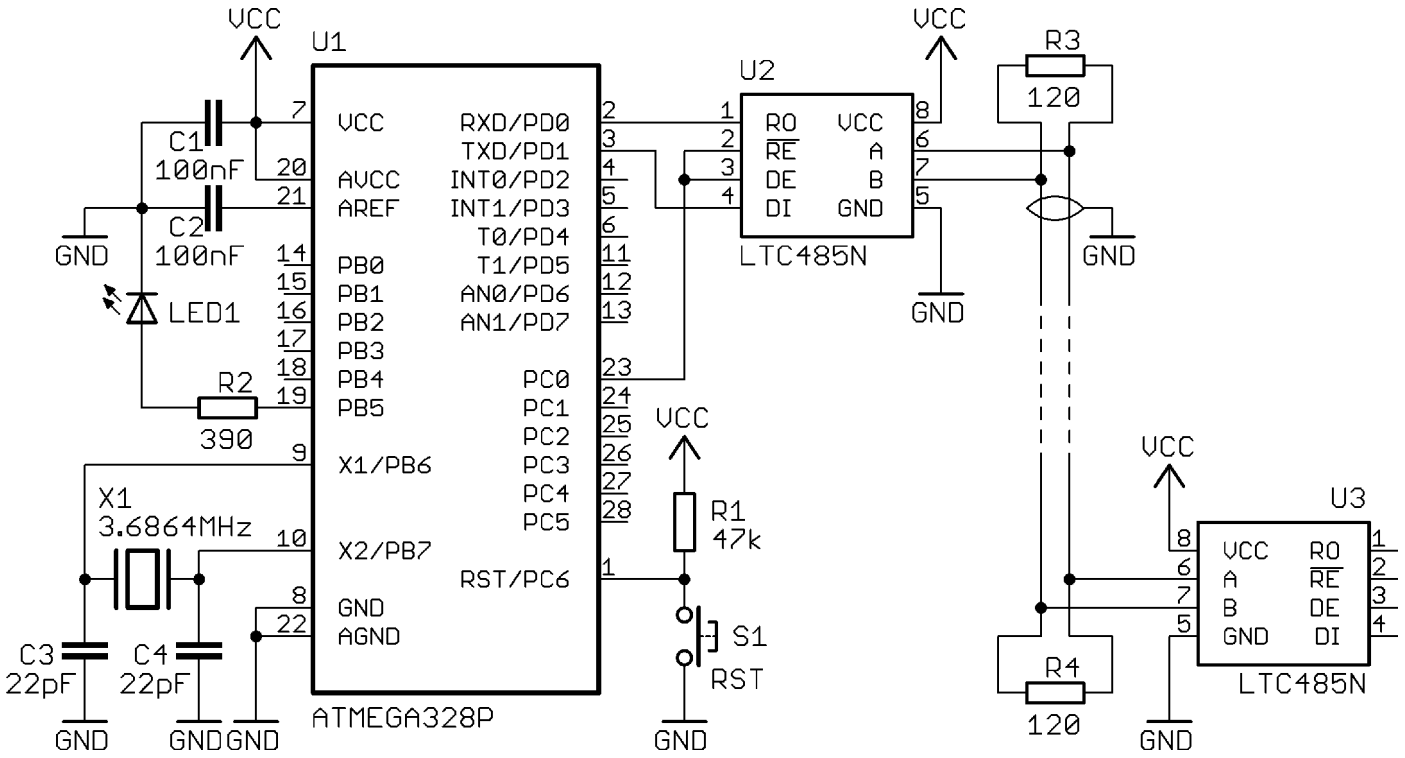
Typical TIA232 Interface

- Non differential, medium distances (<15m)
- 0: 3..15V, 1: -15..-3V



Typical TIA485 Interface

- Differential, Large distances (>1000m)
- 0: dV>0,2V, 1: dV < -0,2V



Multi-processor Communications

- Requires an additional data bit
- Two frame types:
  - Address frame, if a 9th data bit is one
  - Data frame, if a 9th data bit is zero
- Two interrupt handling cases:
  - All the frames generate interrupt requests
  - Only the address frames generate interrupt requests

Multi-processor Systems

- Master-slave
  - Centralized around a master node
  - No slave takes the initiative to talk
  - The slaves only talk to the master
- Multi-master
  - Probabilistic (listen before talk)
    - Ex: CSMA-CD
  - Deterministic (all nodes can talk)
    - Ex: token passing

Master-slave system

- In the idle state, slaves only listen to ADDR frames
- To communicate:
  - The master sends an ADDR frame; all slaves receive it
  - The addressed slave reconfigures itself to see all frames, all the others continue in idle mode
  - The addressed slave receives all the DATA frames; all other slaves ignore them
  - After receiving the last DATA frame the addressed slave enters idle mode again

Probabilistic multi-master systems

- Rules:
  - Before talking, each node waits for the communication medium to be free (nobody is talking)
  - If the medium is free, the node starts transmitting
  - In case of a collision, the node stops, waits some time and tries again
- Problemas:
  - A node can, sometimes, never find a free slot to talk
  - Back-off strategy

Deterministic multi-master systems

- Rules:
  - All nodes pass a token in a *logical* ring
  - The node that has the token must either transmit or pass the token to the following node in the ring
- Problems:
  - Ring (re)configuration
  - Token Recovery

Any Questions?

To probe further:

- Texas Instruments, The RS485 Design Guide