

Structured Electronic Design

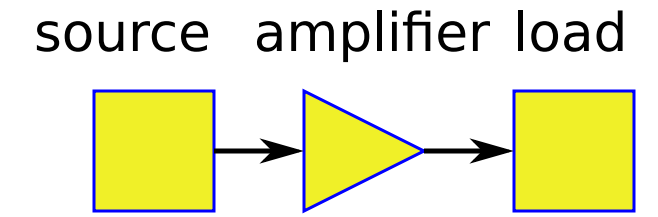
EE3C11
Amplifier Types

Anton J.M. Montagne

Source and load information

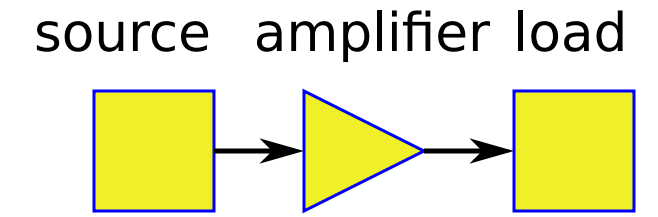
Source and load information

Accurate copying of information from source to load:
A stepwise, orthogonal design approach



Source and load information

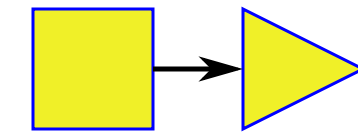
Accurate copying of information from source to load:
A stepwise, orthogonal design approach



Accurate copying of information
from source to input port

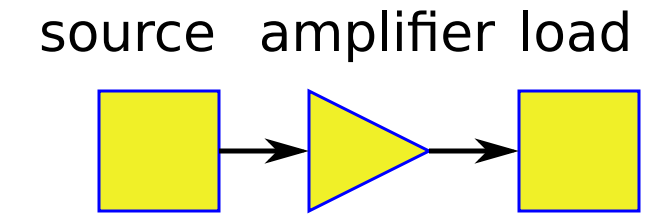


Input port requirements



Source and load information

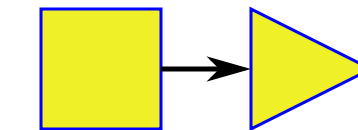
Accurate copying of information from source to load:
A stepwise, orthogonal design approach



Accurate copying of information
from source to input port



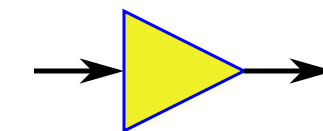
Input port requirements



Accurate copying of information
from input port to output port

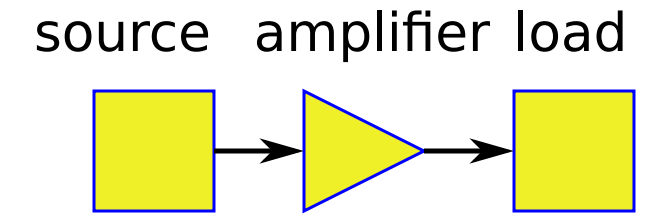


Transfer requirements



Source and load information

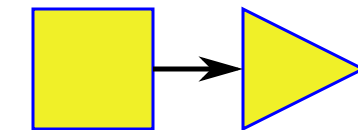
Accurate copying of information from source to load:
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Accurate copying of information from source to input port



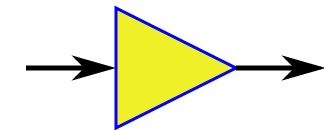
Input port requirements



Accurate copying of information from input port to output port



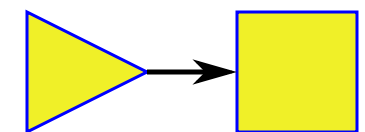
Transfer requirements



Accurate copying of information from output port to load

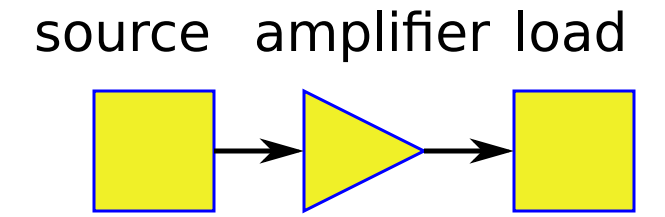


Output port requirements



Source and load information

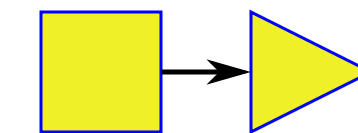
Accurate copying of information from source to load:
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Accurate copying of information from source to input port



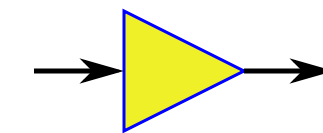
Input port requirements



Accurate copying of information from input port to output port



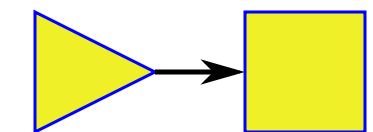
Transfer requirements



Accurate copying of information from output port to load



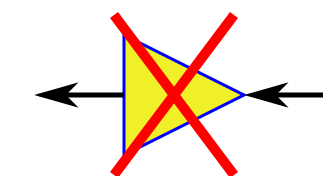
Output port requirements



No information transfer from load to source

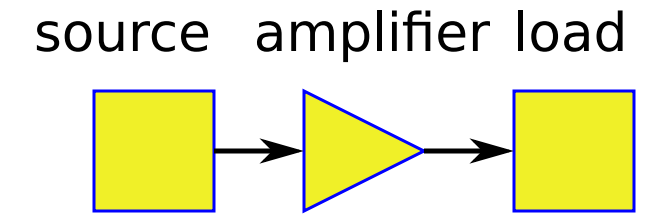


Unilateral behavior



Source and load information

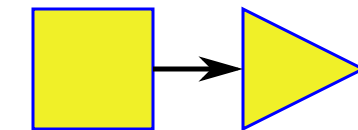
Accurate copying of information from source to load:
A stepwise, orthogonal design approach



Accurate copying of information from source to input port



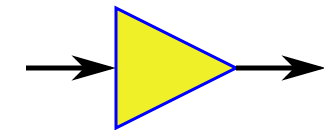
Input port requirements



Accurate copying of information from input port to output port



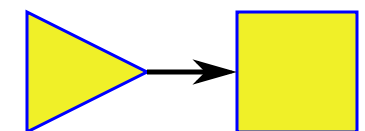
Transfer requirements



Accurate copying of information from output port to load



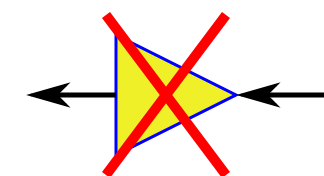
Output port requirements



No information transfer from load to source



Unilateral behavior



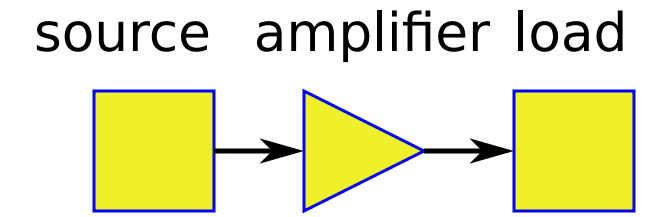
No information transfer from / to power source to signal source and / or load



Power port can be omitted in functional model of the amplifier

Source and load information

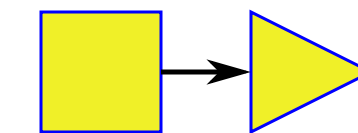
Accurate copying of information from source to load:
A stepwise, orthogonal design approach



Accurate copying of information from source to input port



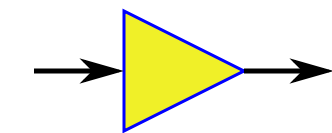
Input port requirements



Accurate copying of information from input port to output port



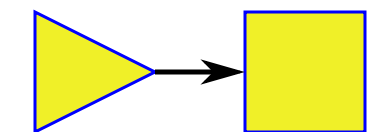
Transfer requirements



Accurate copying of information from output port to load



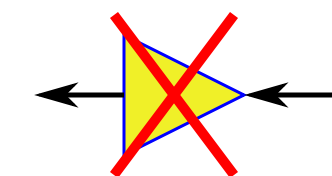
Output port requirements



No information transfer from load to source



Unilateral behavior



No information transfer from / to power source to signal source and / or load



Power port can be omitted in functional model of the amplifier

Input port requirements

Input port requirements

Accurate copying of information from source to input port

Input port requirements

Accurate copying of information from source to input port

Input information from sensors

Input port requirements

Accurate copying of information from source to input port

Input information from sensors

Which electrical quantity (open-circuit voltage or short-circuit current) shows the best correspondence with the primary information at the input of the sensor?

Input port requirements

Accurate copying of information from source to input port

Input information from sensors

Which electrical quantity (open-circuit voltage or short-circuit current) shows the best correspondence with the primary information at the input of the sensor?

Dynamic microphone

Open-circuit voltage shows best correspondence with sound pressure

Impedance
input port

∞

Electrical
quantity
input port

V

Input port requirements

Accurate copying of information from source to input port

Input information from sensors

Which electrical quantity (open-circuit voltage or short-circuit current) shows the best correspondence with the primary information at the input of the sensor?

		Impedance input port	Electrical quantity input port
Dynamic microphone	Open-circuit voltage shows best correspondence with sound pressure	∞	V
PIN diode light sensor	Short-circuit current shows best correspondence with light intensity	0	I

Input port requirements

Accurate copying of information from source to input port

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PIN diode light sensor	Short-circuit current shows best correspondence with light intensity	0	I
Piezo accelerometer	Short-circuit current shows best correspondence with acceleration	0	I

Input port requirements

Accurate copying of information from source to input port

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		Impedance input port	Electrical quantity input port
Dynamic microphone	Open-circuit voltage shows best correspondence with sound pressure	∞	V
PIN diode light sensor	Short-circuit current shows best correspondence with light intensity	0	I
Piezo accelerometer	Short-circuit current shows best correspondence with acceleration	0	I
Transmission line	Should be driven from and/or terminated with linear resistance. Voltage across or current through termination can be used as input quantity	R_c	V or I

Input port requirements

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Output port requirements

Output port requirements

Accurate copying of information from output port to load

Output port requirements

Accurate copying of information from output port to load

Output information to actuators

Output port requirements

Accurate copying of information from output port to load

Output information to actuators

Which electrical quantity (driving voltage or driving current) shows the best correspondence with the information at the output of the actuator?

Output port requirements

Accurate copying of information from output port to load

Output information to actuators

Which electrical quantity (driving voltage or driving current) shows the best correspondence with the information at the output of the actuator?

Dynamic loudspeaker

Sound pressure shows best correspondance with the driving voltage

Impedance
output port

0

Electrical
quantity
output port

V

Output port requirements

Accurate copying of information from output port to load

Output information to actuators

Which electrical quantity (driving voltage or driving current) shows the best correspondence with the information at the output of the actuator?

Dynamic loudspeaker	Sound pressure shows best correspondance with the driving voltage
LED	Illumination shows best correspondence with the driving current

Impedance
output port

0

∞

Electrical
quantity
output port

V

I

Output port requirements

Accurate copying of information from output port to load

Output information to actuators

Which electrical quantity (driving voltage or driving current) shows the best correspondence with the information at the output of the actuator?

		Impedance output port	Electrical quantity output port
Dynamic loudspeaker	Sound pressure shows best correspondance with the driving voltage	0	V
LED	Illumination shows best correspondence with the driving current	∞	I
Piezo actuator	Force shows the best correspondence with the charge, hence with the driving current	∞	I

Output port requirements

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Amplifier types

Amplifier types

no amplifier type

Z_i Z_o

Amplifier types

no	amplifier type
1	Voltage amplifier

Z_i	Z_o
∞	0

Amplifier types

no	amplifier type	Z_i	Z_o
1	Voltage amplifier	∞	0
2	Transadmittance amplifier	∞	∞

Amplifier types

no	amplifier type	Z_i	Z_o
1	Voltage amplifier	∞	0
2	Transadmittance amplifier	∞	∞
3	Voltage input, finite nonzero output impedance	∞	Z_o

Amplifier types

no	amplifier type	Z_i	Z_o
1	Voltage amplifier	∞	0
2	Transadmittance amplifier	∞	∞
3	Voltage input, finite nonzero output impedance	∞	Z_o
4	Transimpedance amplifier	0	0

Amplifier types

no	amplifier type	Z_i	Z_o
1	Voltage amplifier	∞	0
2	Transadmittance amplifier	∞	∞
3	Voltage input, finite nonzero output impedance	∞	Z_o
4	Transimpedance amplifier	0	0
5	Current amplifier	0	∞

Amplifier types

no	amplifier type	Z_i	Z_o
1	Voltage amplifier	∞	0
2	Transadmittance amplifier	∞	∞
3	Voltage input, finite nonzero output impedance	∞	Z_o
4	Transimpedance amplifier	0	0
5	Current amplifier	0	∞
6	Current input, finite nonzero output impedance	0	Z_o

Amplifier types

no	amplifier type	Z_i	Z_o
1	Voltage amplifier	∞	0
2	Transadmittance amplifier	∞	∞
3	Voltage input, finite nonzero output impedance	∞	Z_o
4	Transimpedance amplifier	0	0
5	Current amplifier	0	∞
6	Current input, finite nonzero output impedance	0	Z_o
7	Finite nonzero input impedance, voltage output	Z_i	0

Amplifier types

no	amplifier type	Z_i	Z_o
1	Voltage amplifier	∞	0
2	Transadmittance amplifier	∞	∞
3	Voltage input, finite nonzero output impedance	∞	Z_o
4	Transimpedance amplifier	0	0
5	Current amplifier	0	∞
6	Current input, finite nonzero output impedance	0	Z_o
7	Finite nonzero input impedance, voltage output	Z_i	0
8	Finite nonzero input impedance, current output	Z_i	∞

Amplifier types

no	amplifier type	Z_i	Z_o
1	Voltage amplifier	∞	0
2	Transadmittance amplifier	∞	∞
3	Voltage input, finite nonzero output impedance	∞	Z_o
4	Transimpedance amplifier	0	0
5	Current amplifier	0	∞
6	Current input, finite nonzero output impedance	0	Z_o
7	Finite nonzero input impedance, voltage output	Z_i	0
8	Finite nonzero input impedance, current output	Z_i	∞
9	Finite nonzero input and output impedance	Z_i	Z_o

Amplifier types

no	amplifier type	Z_i	Z_o
1	Voltage amplifier	∞	0
2	Transadmittance amplifier	∞	∞
3	Voltage input, finite nonzero output impedance	∞	Z_o
4	Transimpedance amplifier	0	0
5	Current amplifier	0	∞
6	Current input, finite nonzero output impedance	0	Z_o
7	Finite nonzero input impedance, voltage output	Z_i	0
8	Finite nonzero input impedance, current output	Z_i	∞
9	Finite nonzero input and output impedance	Z_i	Z_o