

Current Loop Transmitter Configurations

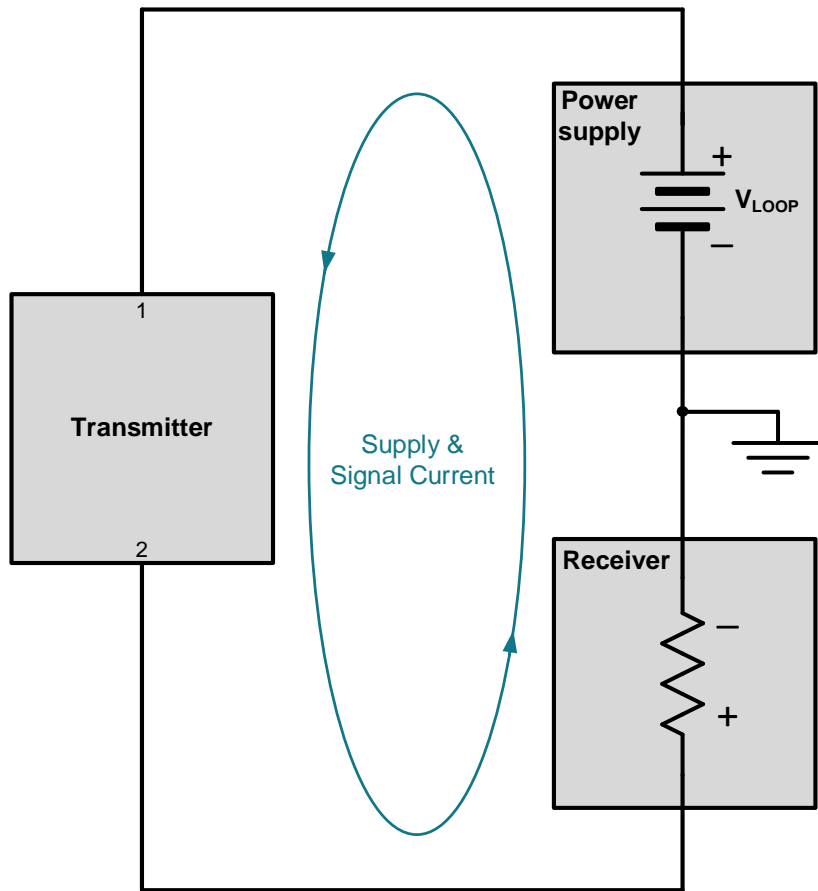
TI Precision Labs – Current Loop Transmitters

Presented by Katlynne Jones

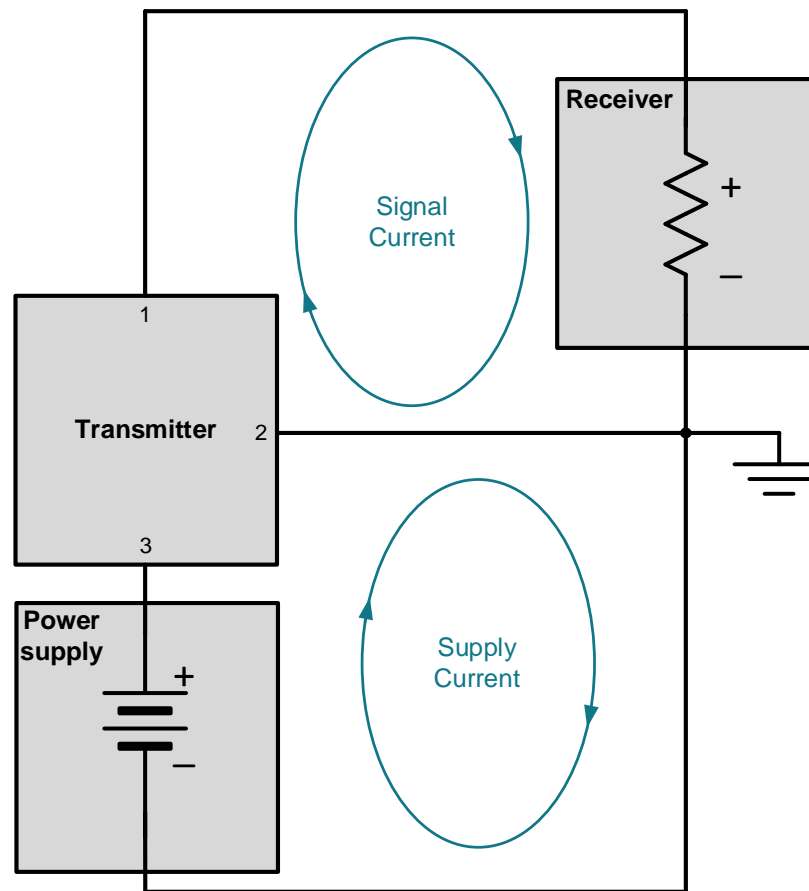
Prepared by Katlynne Jones

Transmitter configurations

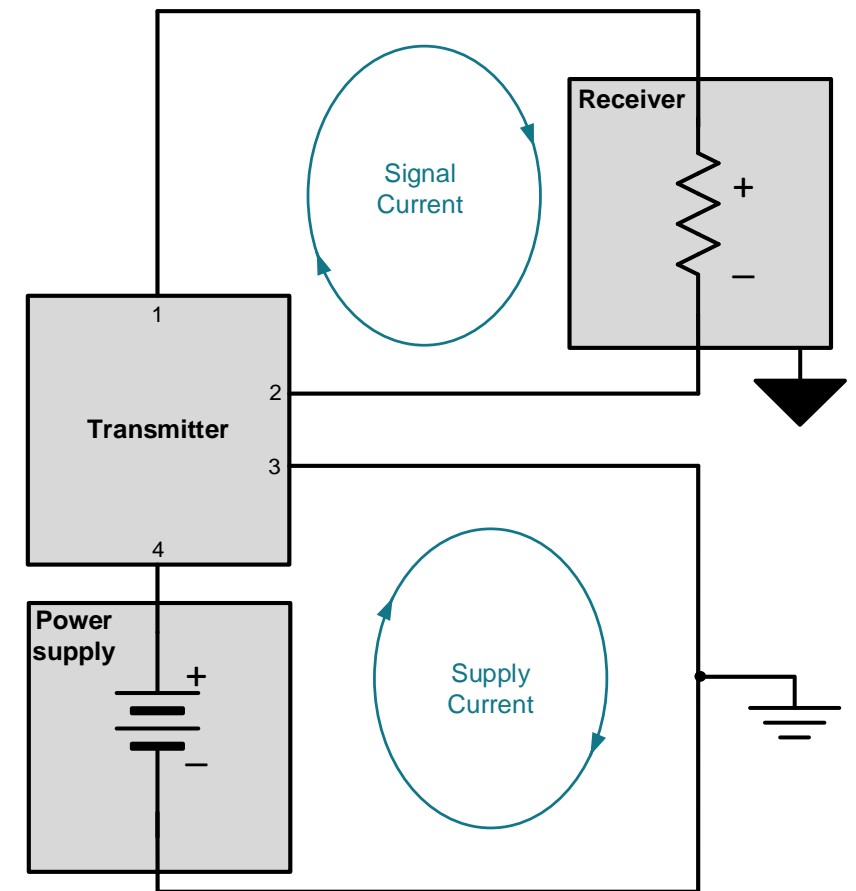
2-wire block diagram



3-wire block diagram



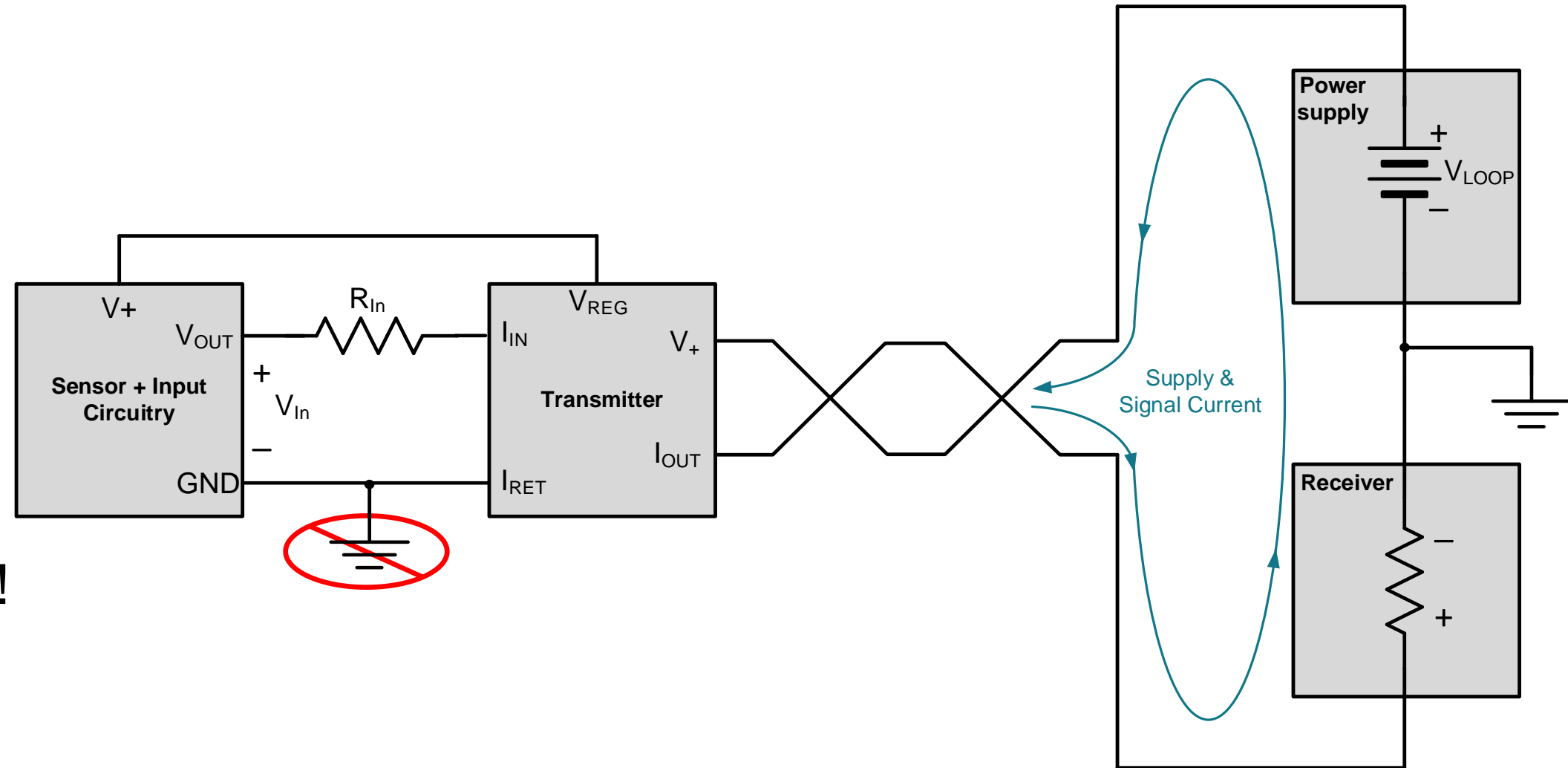
4-wire block diagram



2-wire transmitter

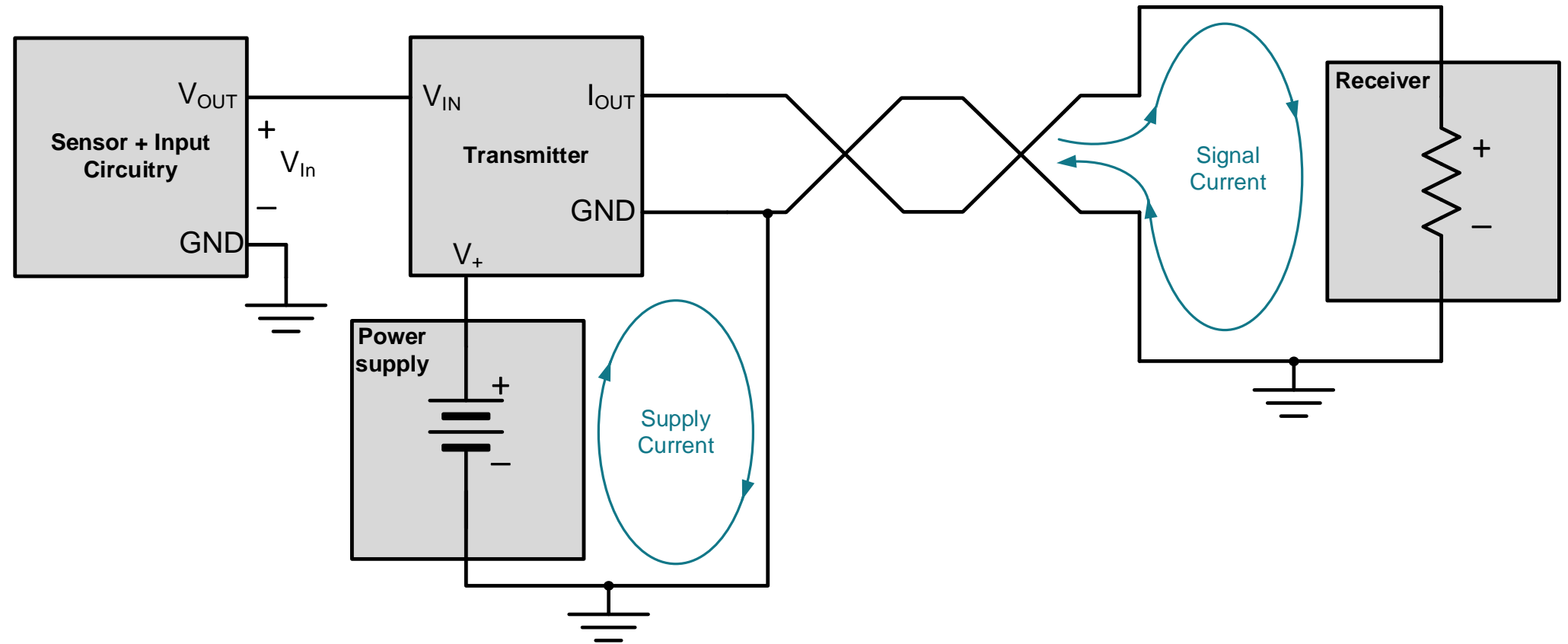
- 2-wire transmitter block diagram

- 2 wires create a loop that transmits the signal current and transmitter power
- I_{RET} cannot be grounded to V_{LOOP} !
- Transmitter, sensor, and input circuitry must consume $<4\text{mA}$



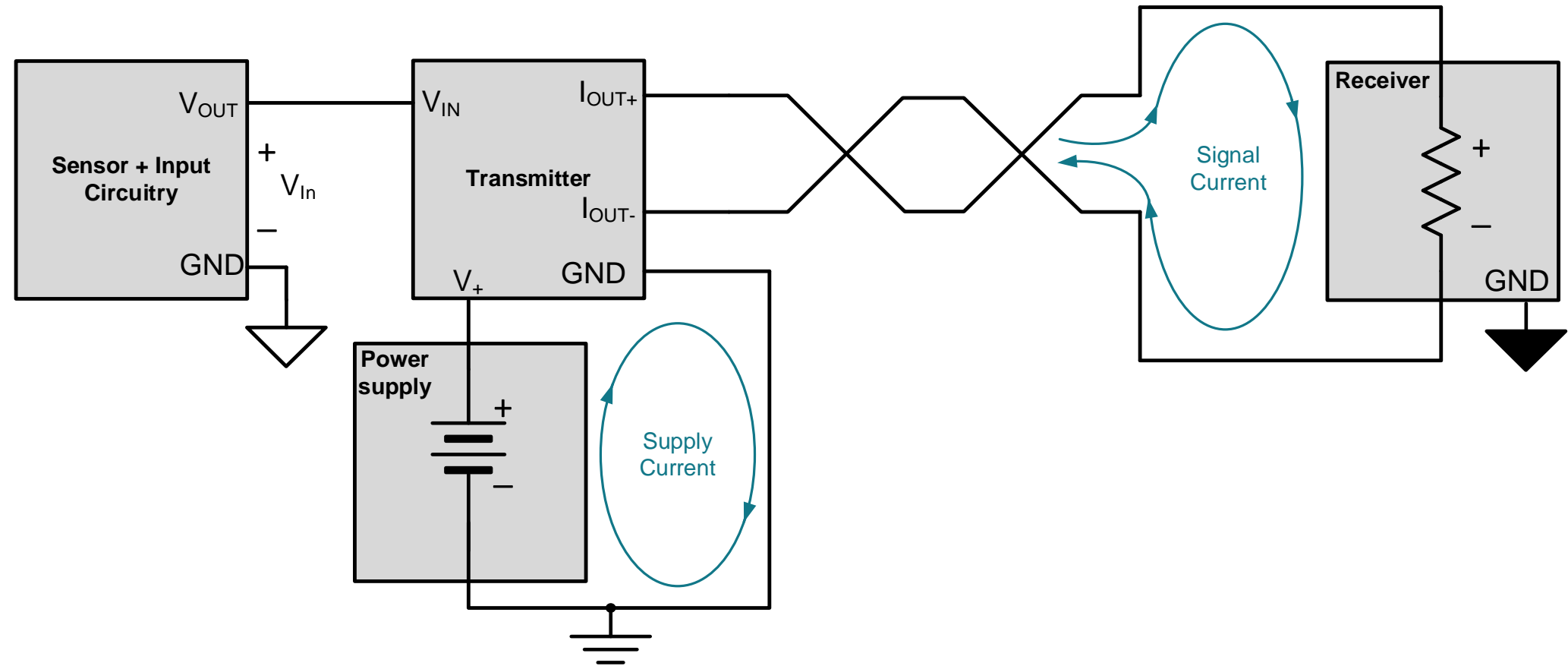
3-wire transmitter

- 3-wire transmitter block diagram
 - 3 wires create separate loops for the signal current and transmitter power
 - Transmitter ground is shared with the receiver
 - Can use 0-20mA, or 0-24mA ranges as well

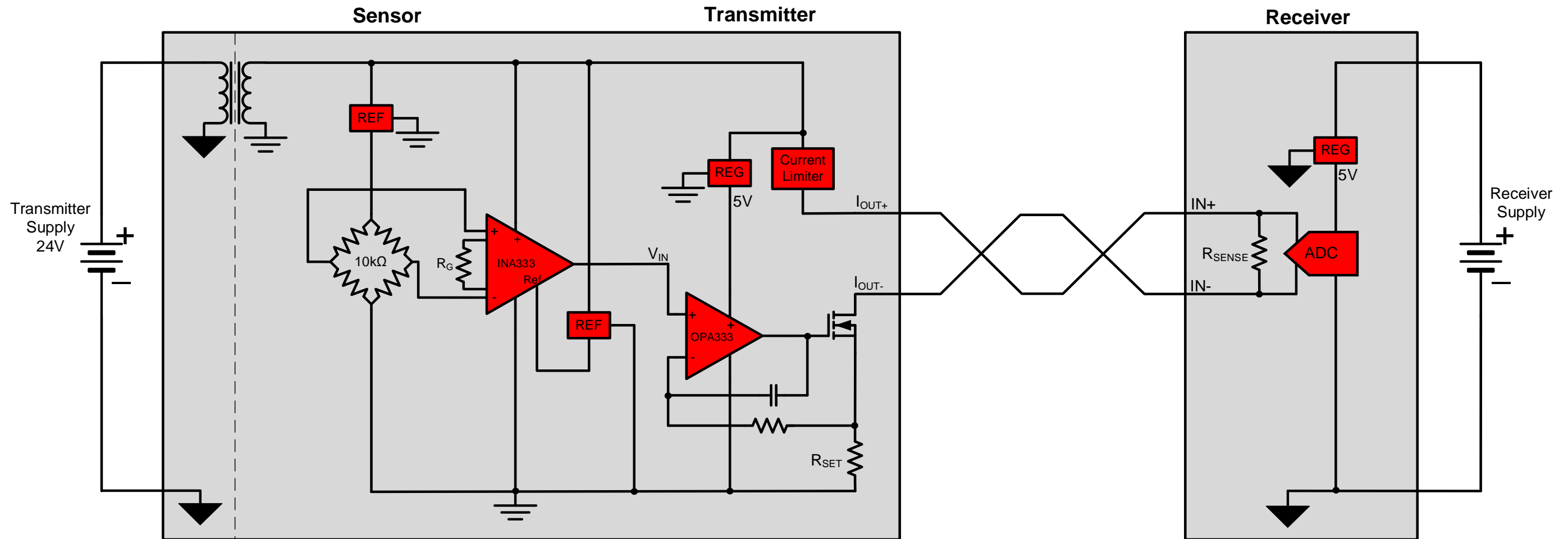


4-wire transmitter

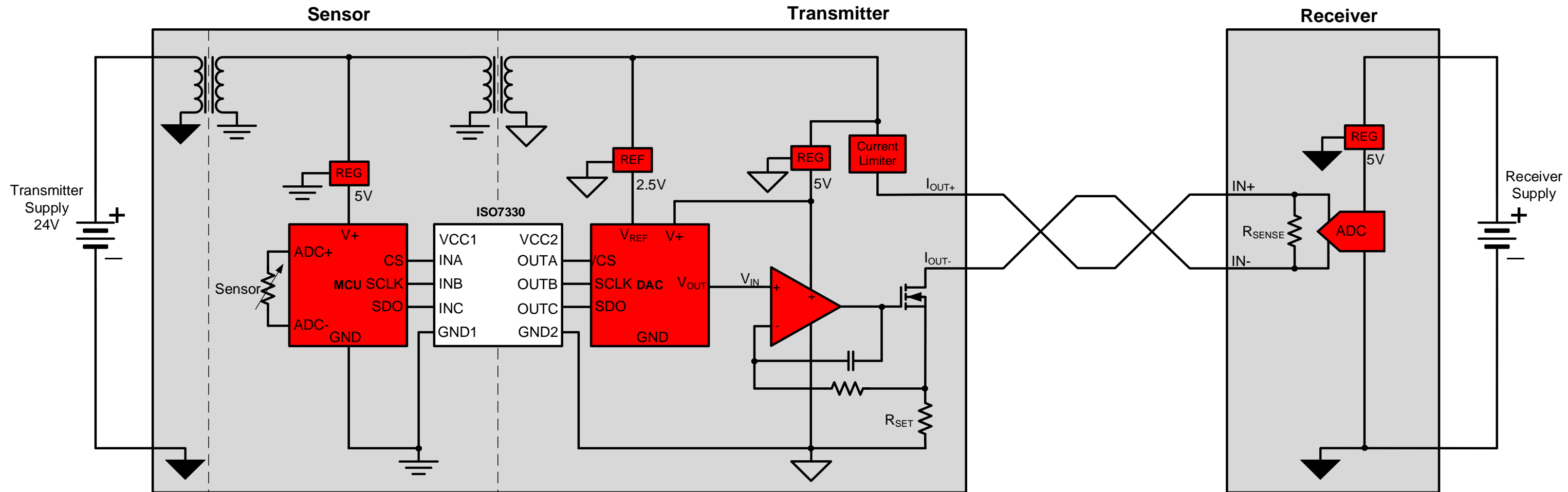
- 4-wire transmitter block diagram
 - 4 wires create separate loops for the signal current and transmitter power
 - Can use 0-20mA, or 0-24mA ranges as well
 - Additional isolation schemes



4-wire transmitter power isolated application

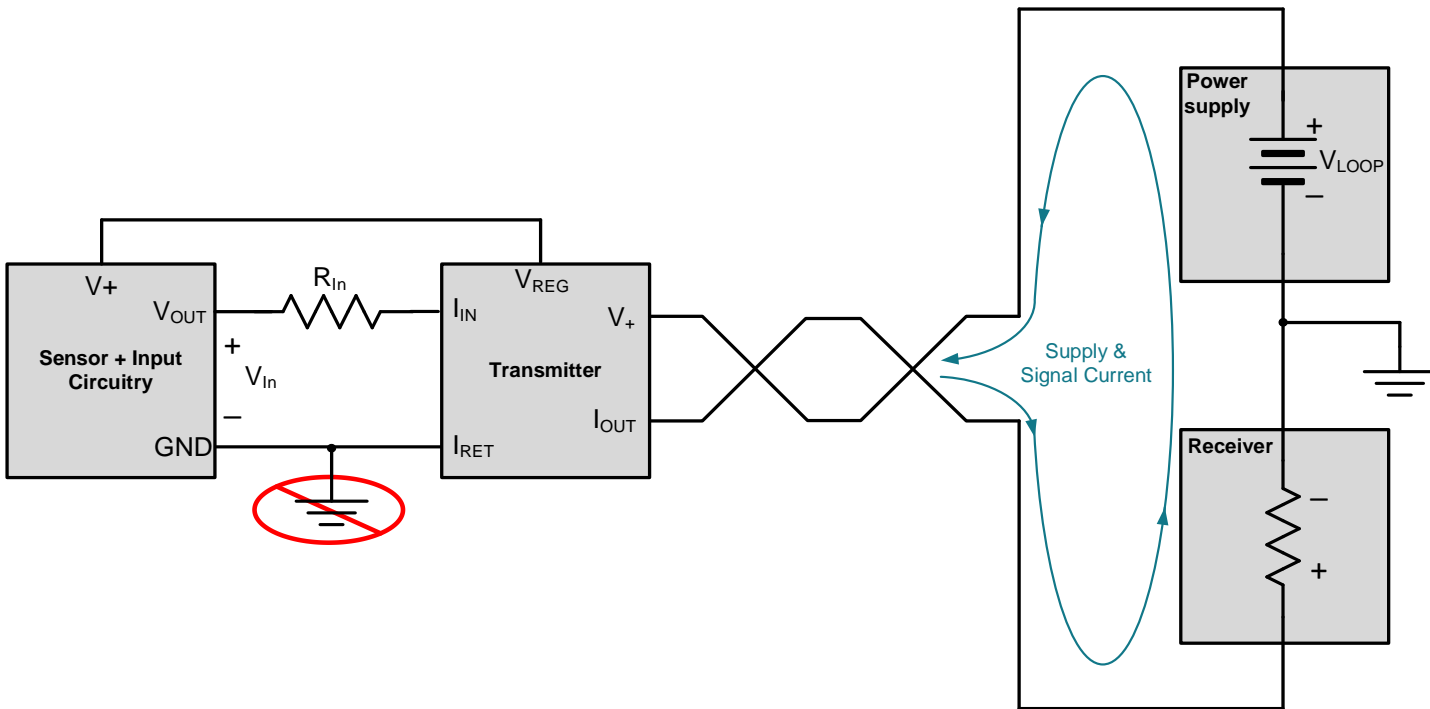


4-wire transmitter fully isolated application

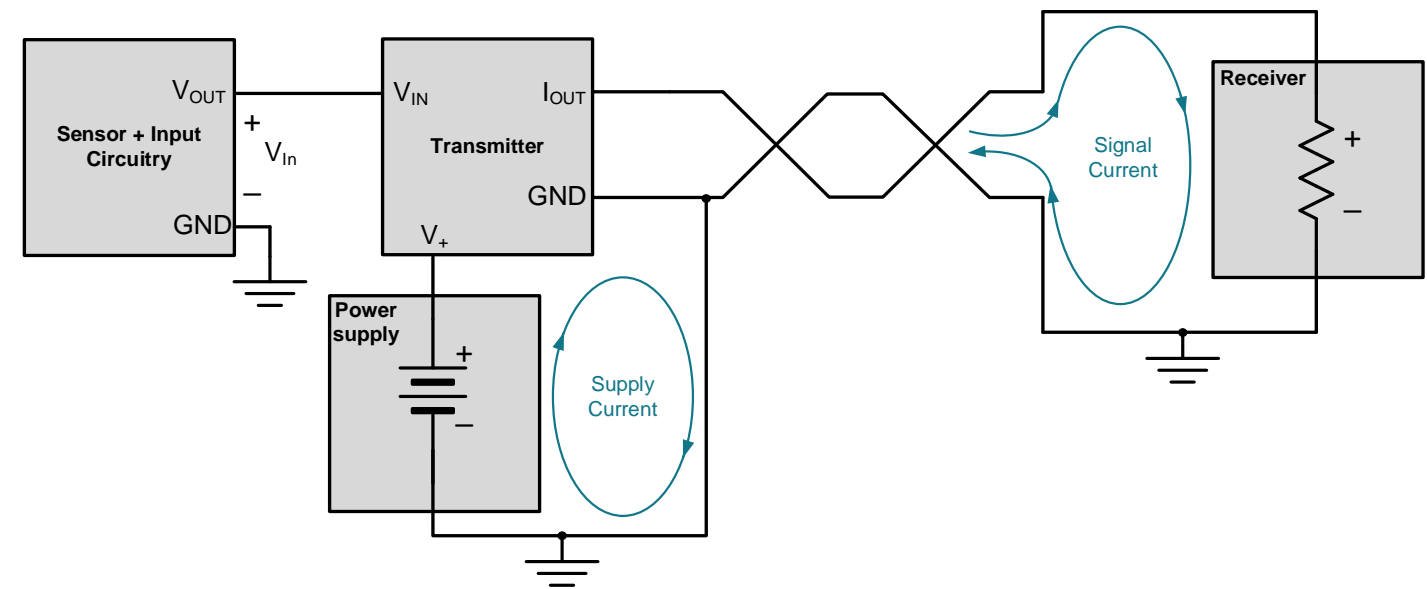


2-wire vs. 3-wire transmitters

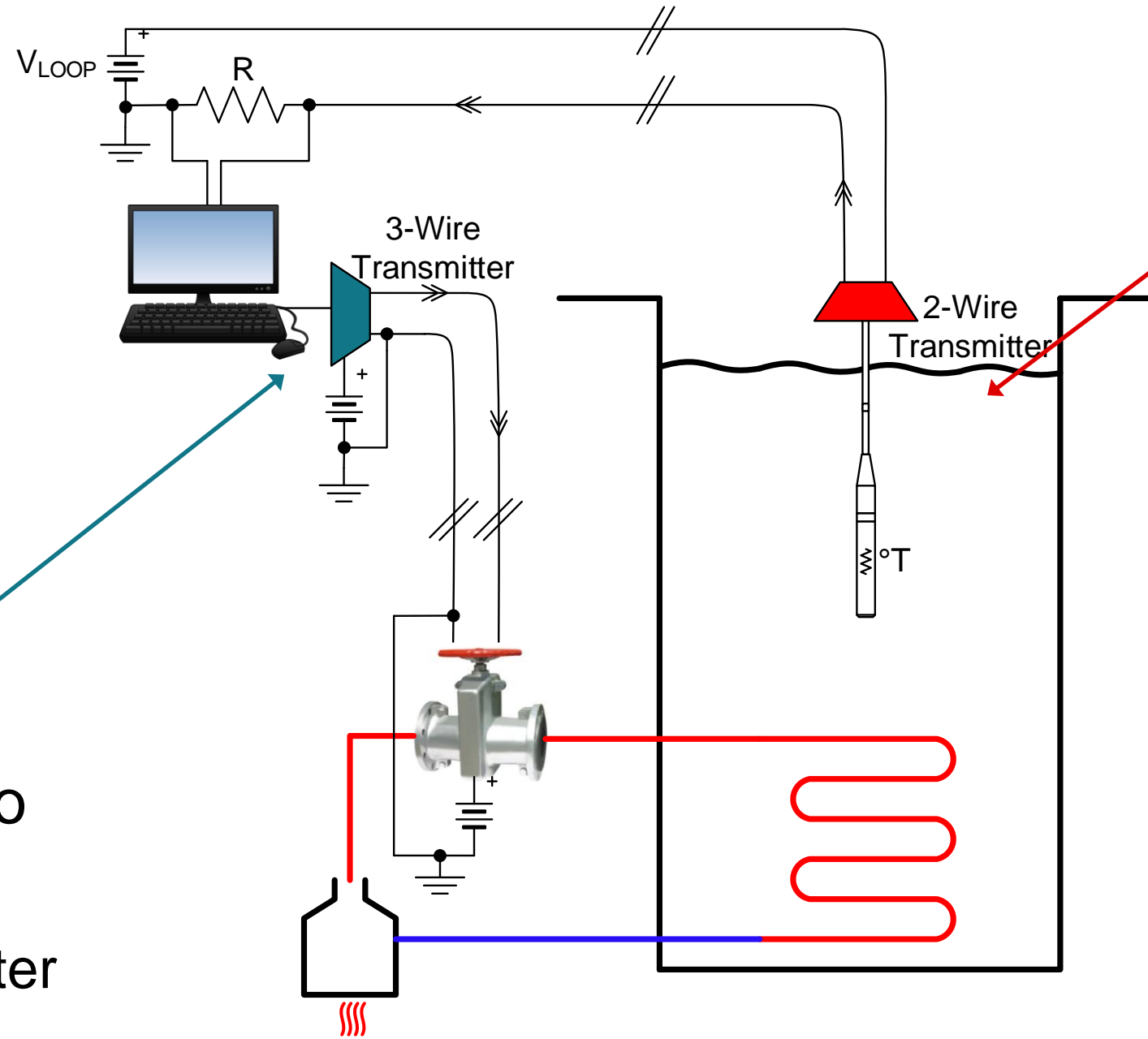
2-Wire transmitter



3-Wire transmitter



Typical 4-20mA applications



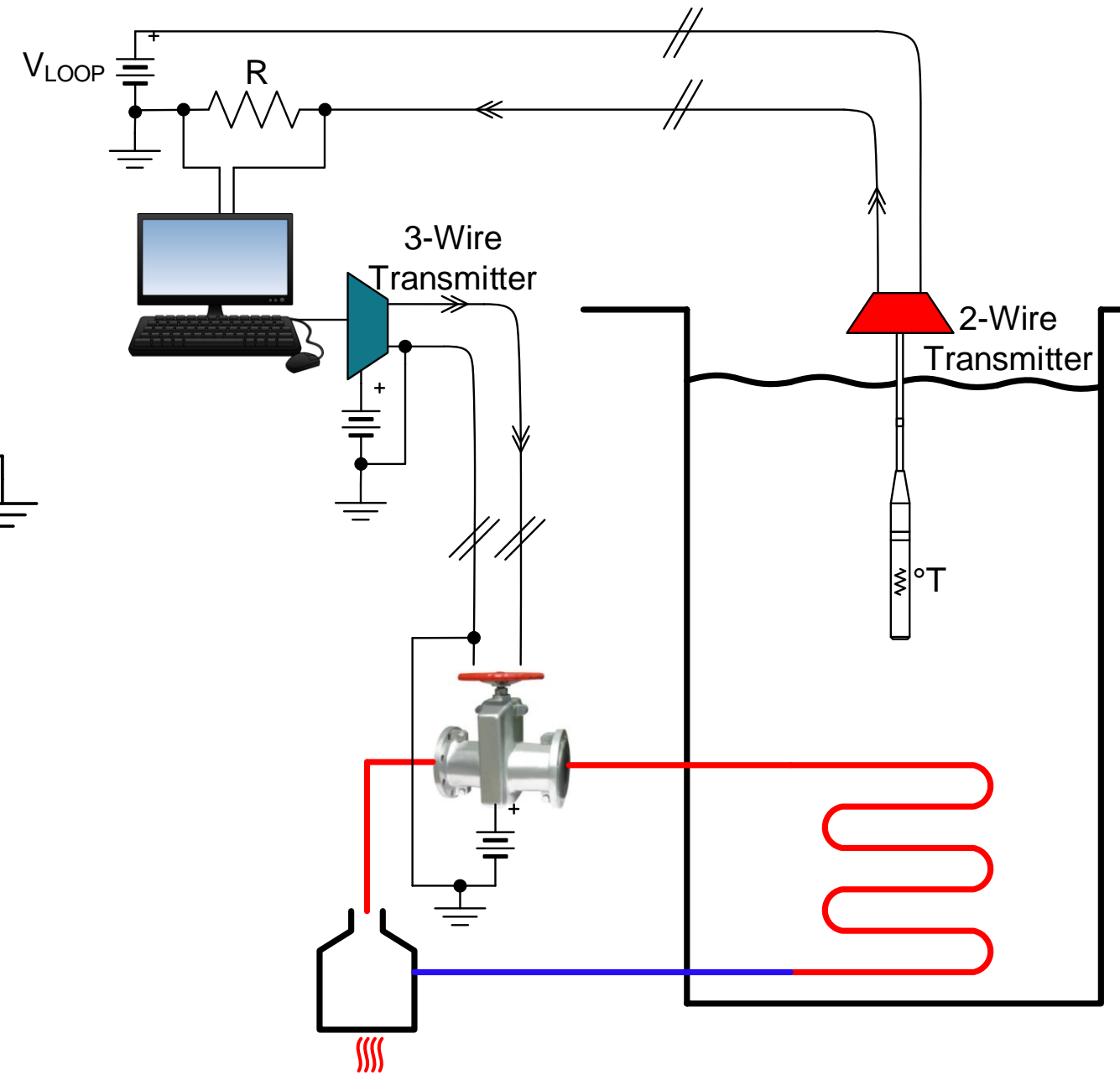
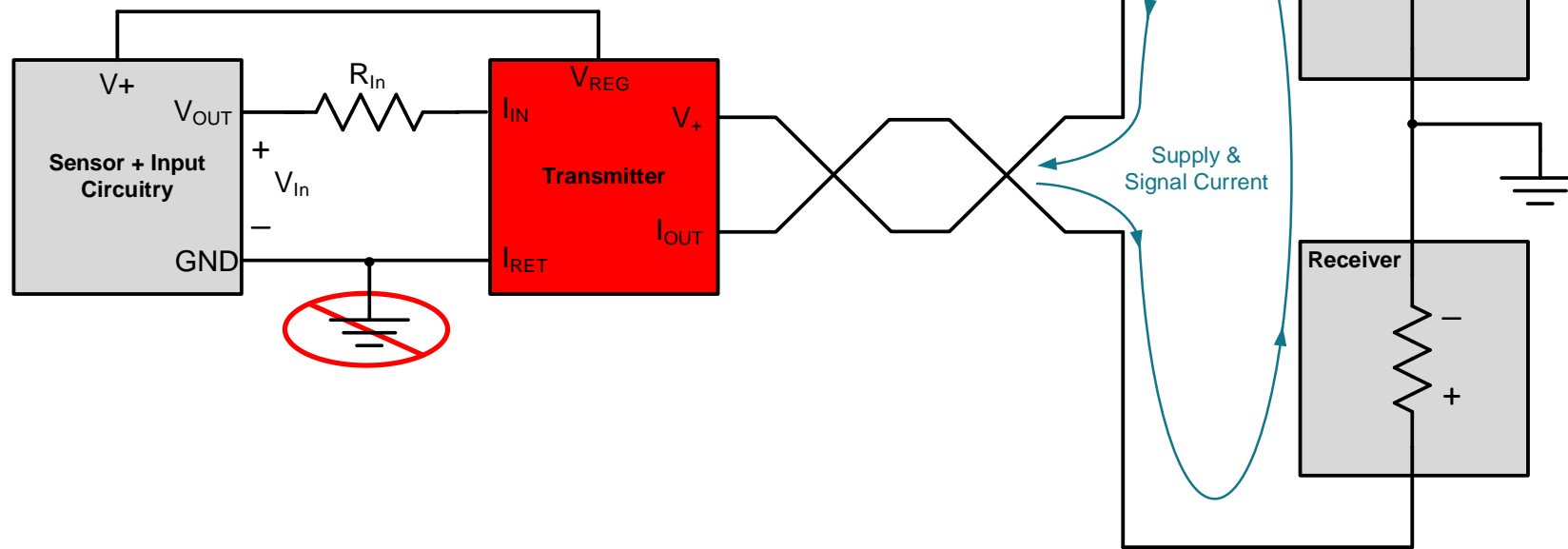
Transmit control signals from a control station out to a remote device.

- Valve, actuator, heater
- 3-wire transmitter

Report a process variable from a remote sensor to a control station.

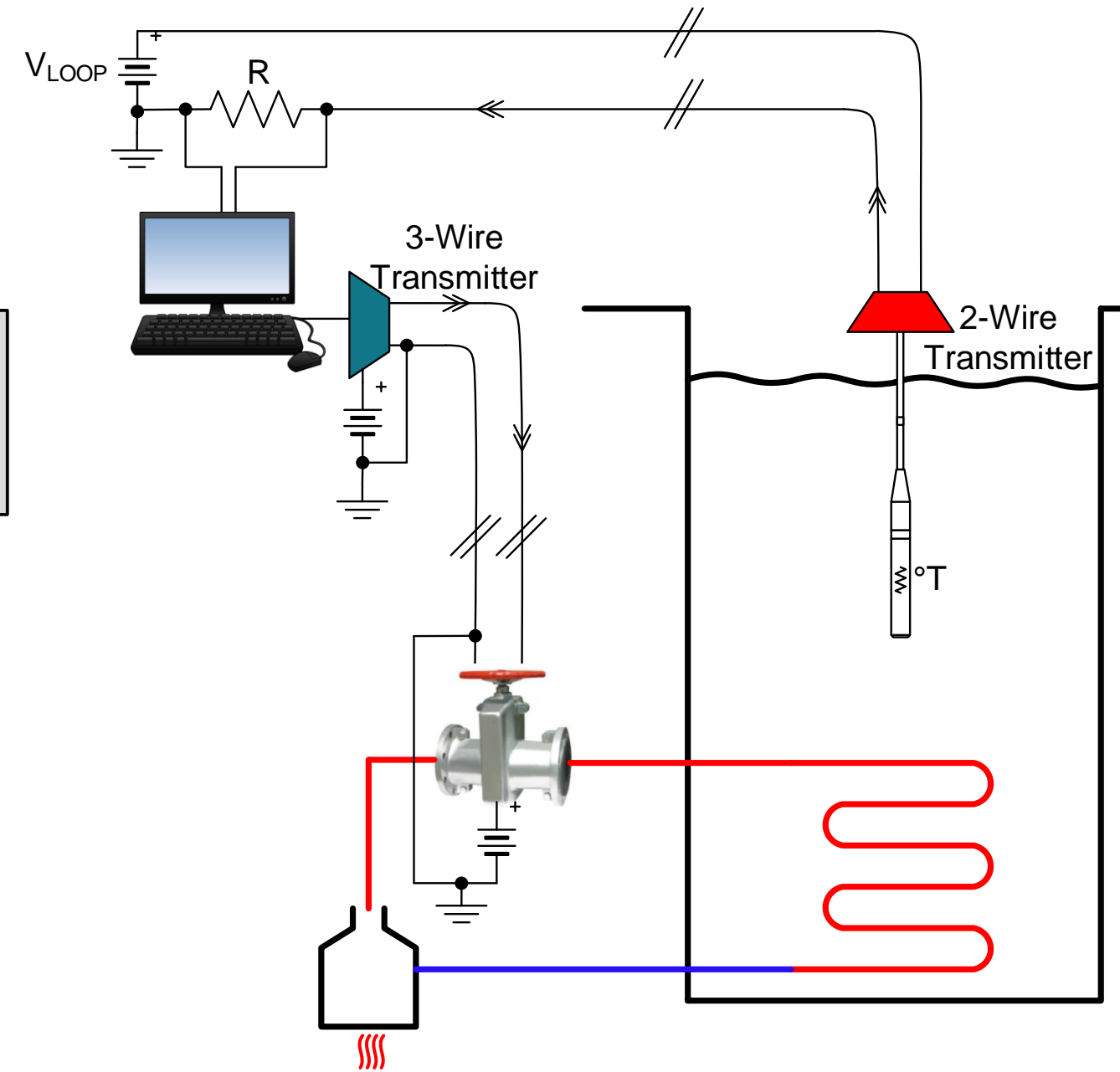
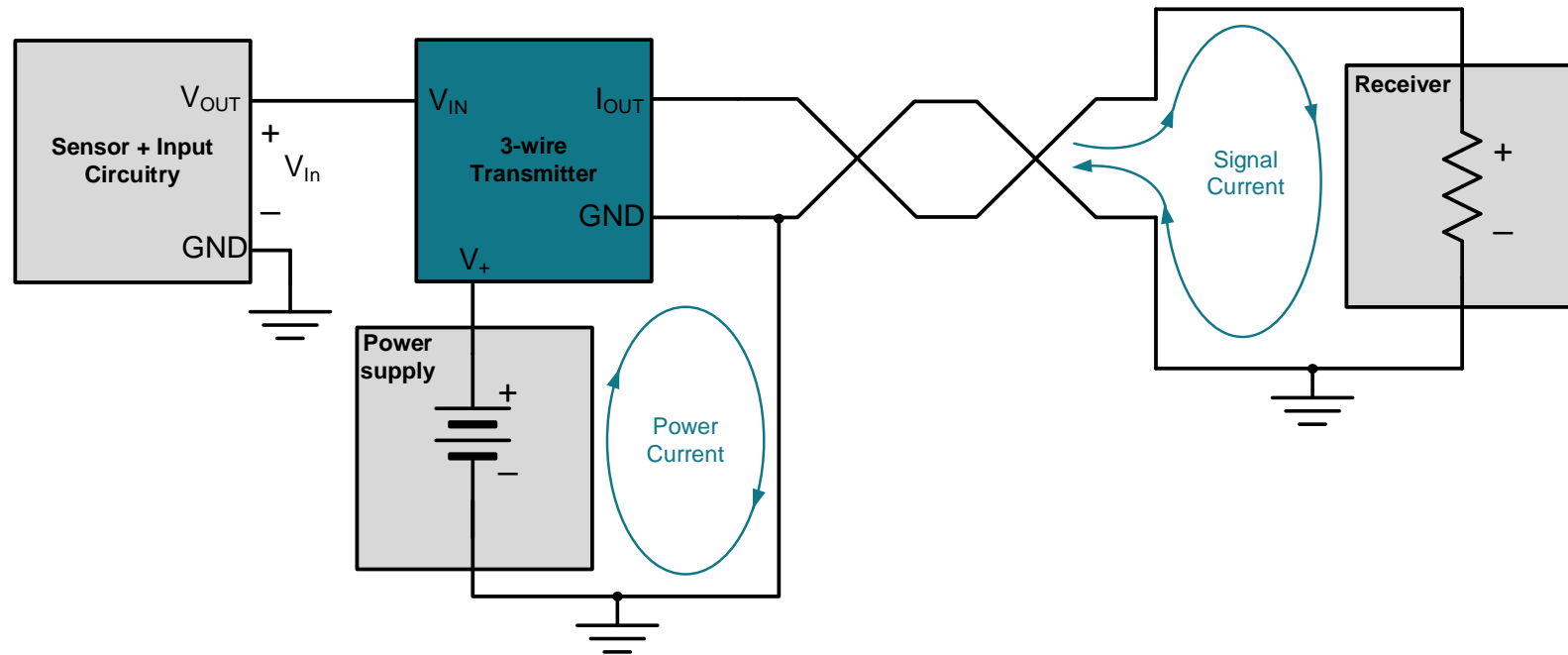
- Temperature, humidity, ambient light
- 2-wire transmitter

Why use 2-wire



Report a process variable from a remote sensor to a control station.

Why use 3-wire

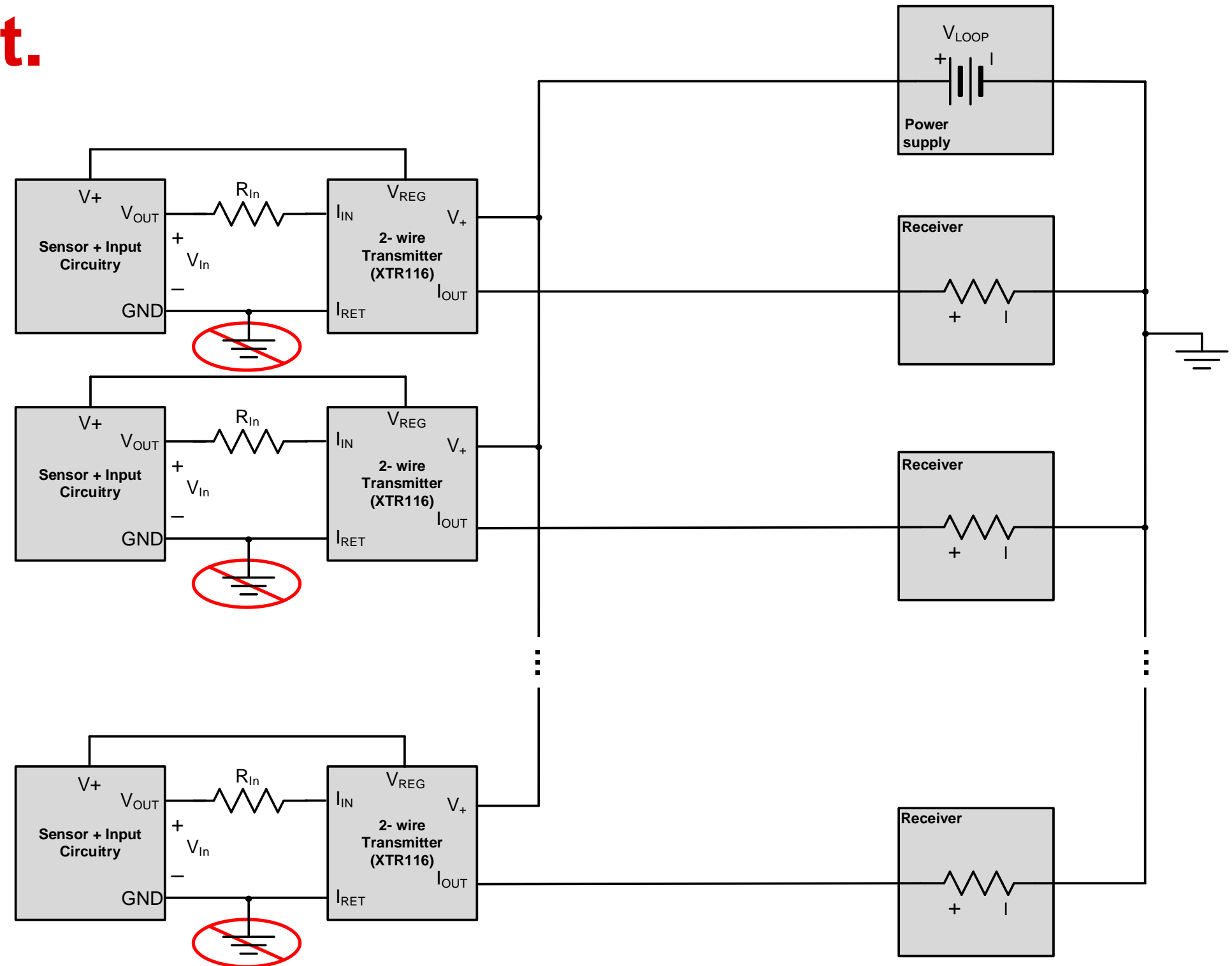


Transmit control signals from a control station out to a remote device.

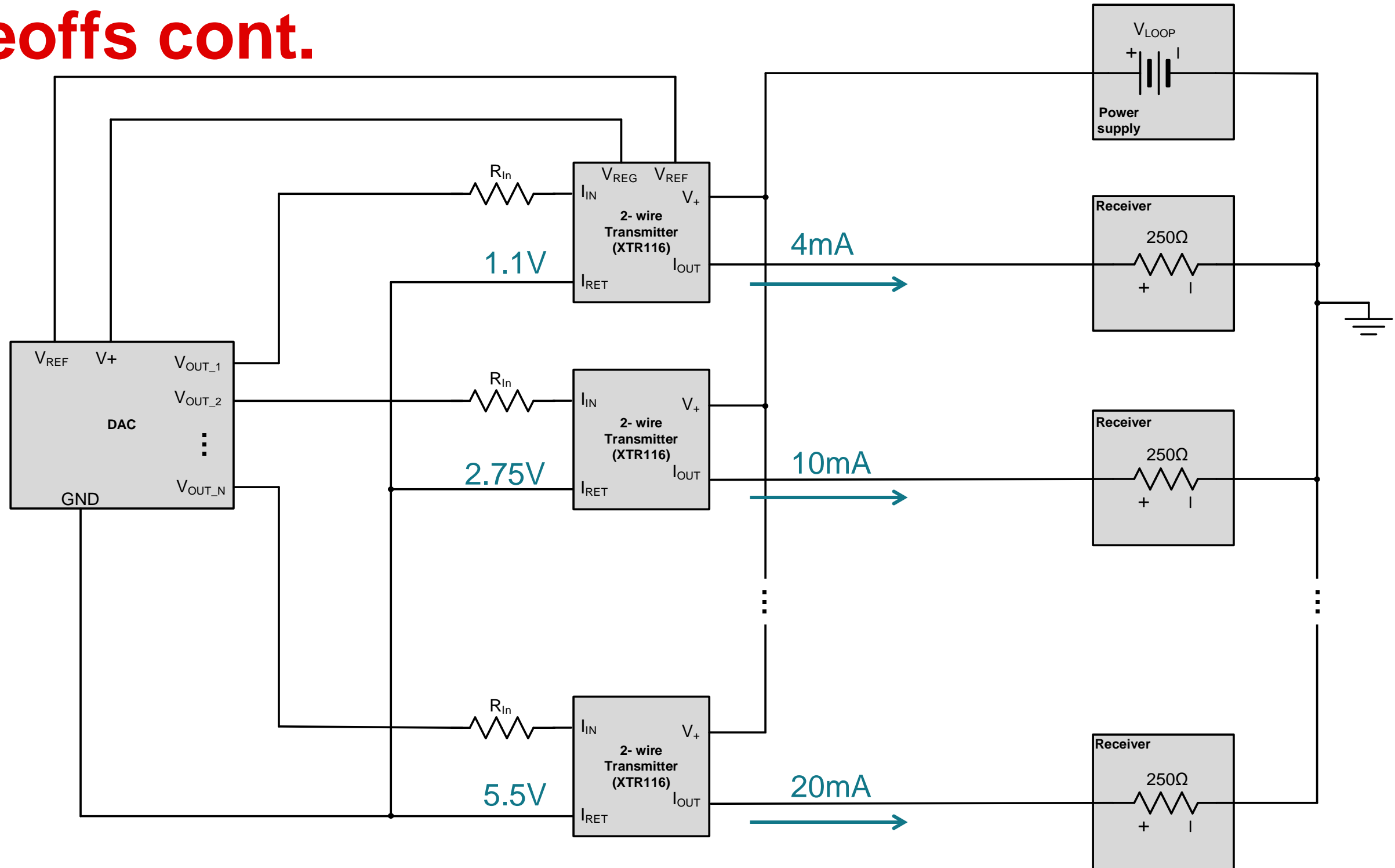
Tradeoffs

- Cost
 - 2-wire tends to be lower cost. 3-wire requires a third cable and if locally powered, requires an additional supply.
- Design
 - More considerations in designing a 2-wire transmitter when supplying the driving circuitry from the transmitter.
 - 4mA current budget
 - Must not connect I_{RET} to V_{LOOP} ground
 - Cannot connect multiple 2-wire transmitters to sensors or DACs with multiple outputs.

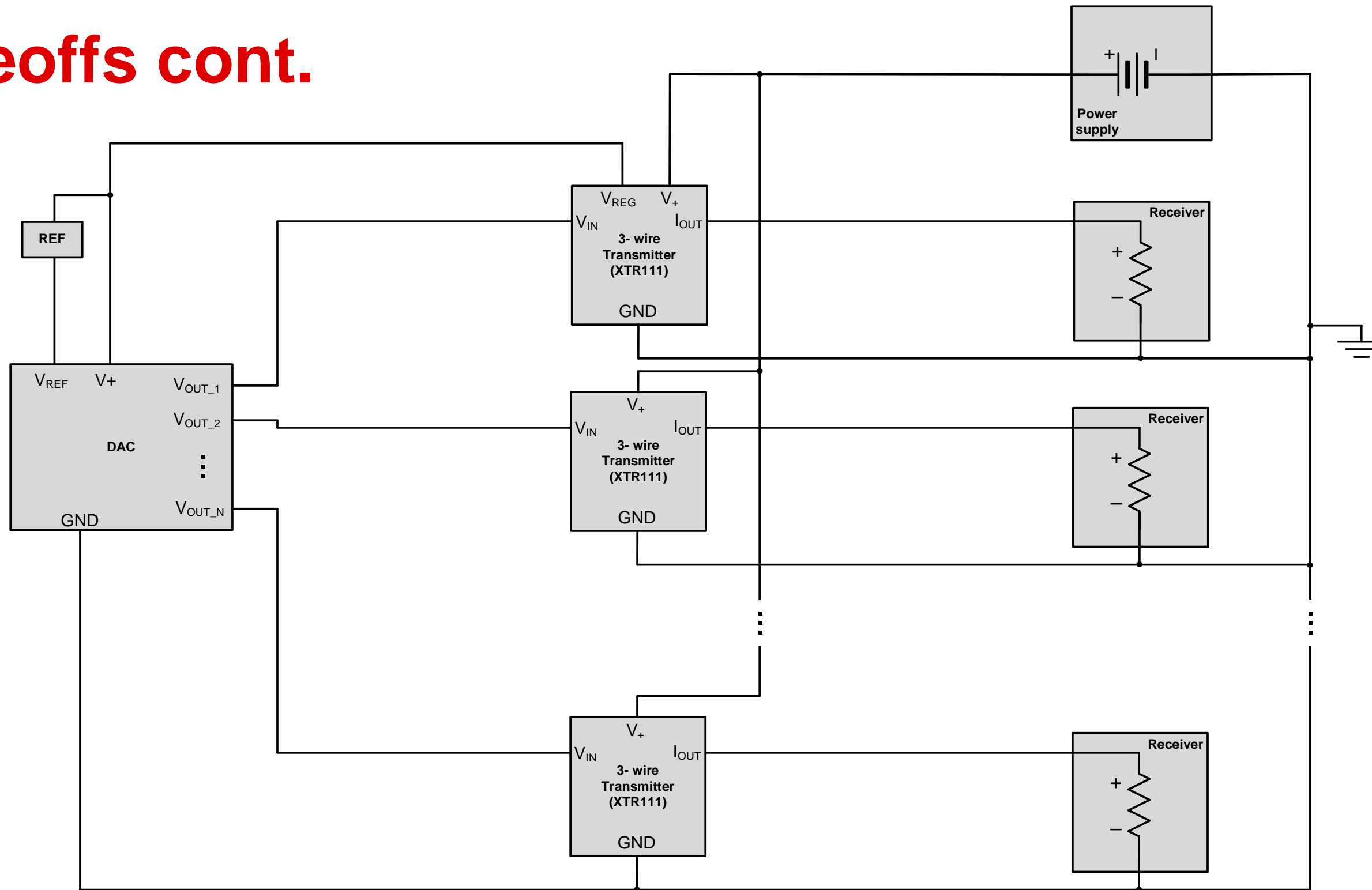
Tradeoffs cont.



Tradeoffs cont.



Tradeoffs cont.



Thanks for your time!
Please try the quiz.

To find more Current Transmitter technical resources and search products, visit:

<https://www.ti.com/amplifier-circuit/special-function/4-20ma-signal-conditioners.html>

Quiz: Current Loop Transmitter Configurations

TI Precision Labs – Current Loop Transmitters

Presented by Katlynn Jones

Prepared by Katlynn Jones

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Question

1. Which type of transmitter has a current budget of 4mA?
 - a) 2-wire transmitter
 - b) 3-wire transmitter
 - c) 4-wire transmitter
 - d) None of the above

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Answer

1. Which type of transmitter has a current budget of 4mA?
 - a) **2-wire transmitter**
 - b) 3-wire transmitter
 - c) 4-wire transmitter
 - d) None of the above

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Question

2. Which type of transmitter can provide isolation schemes such as, fully isolated, power-isolated, and output-isolated?
- a) 2-wire transmitter
 - b) 3-wire transmitter
 - c) 4-wire transmitter
 - d) None of the above

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Answer

2. Which type of transmitter can provide isolation schemes such as, fully isolated, power-isolated, and output-isolated?
- a) 2-wire transmitter
 - b) 3-wire transmitter
 - c) 4-wire transmitter**
 - d) None of the above

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Question

3. The XTR117, a 2 wire transmitter, is supplying a sensor that consumes 3.72mA of current. Taking into account the max quiescent current of the XTR117 over temperature, does this transmitter meet the current budget discussed in the video?
- a) Yes
 - b) No

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Answer

3. The XTR117, a 2 wire transmitter, is supplying a sensor that consumes 3.72mA of current. Taking into account the max quiescent current of the XTR117 over temperature, does this transmitter meet the current budget discussed in the video?

- a) Yes
- b) No

The XTR117 has a max quiescent current of 250 μ A over temperature. Adding this to the 3.72mA of the sensor, the design does meet the current budget limit of 4mA.

		MIN	TYP	MAX	
POWER SUPPLY					
Specified Voltage Range	V+		+24		V
Operating Voltage Range		+7.5		+40	V
Quiescent Current	I _Q		130	200	μ A
Over Temperature				250	μ A
$T_A = -40^{\circ}\text{C to } +125^{\circ}\text{C}$					

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Question

4. The XTR116, a 2 wire transmitter, is supplying a sensor that consumes 3.72mA of current. Taking into account the max quiescent current of the XTR116 over temperature, does this transmitter meet the current budget discussed in the video?
- a) Yes
 - b) No

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Answer

4. The XTR116, a 2 wire transmitter, is supplying a sensor that consumes 3.72mA of current. Taking into account the max quiescent current of the XTR116 over temperature, does this transmitter meet the current budget discussed in the video?

- a) Yes
- b) No

The XTR116 has a max quiescent current of 300 μ A over temperature. Adding this to the 3.72mA of the sensor, the design is over the current budget limit of 4mA.

		MIN	TYP	MAX				
POWER SUPPLY	V+							
Specified			+24		*	*		V
Voltage Range		+7.5		+36	*	*	*	V
Quiescent Current			200	250		*	*	μ A
Over Temperature, -40°C to +85°C			240	300		*	*	μ A

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Question

5. Which transmitter would be best suited for sending data from a submersible temperature sensor to a control station?
- a) 2-wire transmitter
 - b) 3-wire transmitter
 - c) 4-wire transmitter
 - d) None of the above

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Answer

5. Which transmitter would be best suited for sending data from a submersible temperature sensor to a control station?
- a) **2-wire transmitter**
 - b) 3-wire transmitter
 - c) 4-wire transmitter
 - d) None of the above

A 2-wire transmitter is loop supplied and would be able to provide power to a submersible temperature sensor.

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Question

6. Which transmitter would be best suited for sending control signals to a heater to adjust the temperature in the room?
- a) 2-wire transmitter
 - b) 3-wire transmitter
 - c) 4-wire transmitter
 - d) None of the above

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Answer

6. Which transmitter would be best suited for sending control signals to a heater to adjust the temperature in the room?
- a) 2-wire transmitter
 - b) 3-wire transmitter**
 - c) 4-wire transmitter
 - d) None of the above

A heater won't require power to be sent from the control station. A 3-wire transmitter can be positioned near the control station or the heater and share that local supply.

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Question

7. What other common current output ranges are available to 3-wire and 4-wire transmitters? Select all that apply:
- a) 0-20mA
 - b) 0-24mA
 - c) 0-36mA
 - d) 0-100mA

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Answer

7. What other common current output ranges are available to 3-wire and 4-wire transmitters? Select all that apply:

- a) 0-20mA
- b) 0-24mA
- c) 0-36mA
- d) 0-100mA

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Question

8. True/False: You cannot connect multiple 3-wire transmitters to sensors or DACs with multiple outputs without isolation.

Quiz: 2-wire vs. 3-wire 4-20mA Transmitters ||

Answer

8. True/**False**: You cannot connect multiple 3-wire transmitters to sensors or DACs with multiple outputs without isolation.

False: You can connect multiple 3-wire transmitters to sensors or DACs with multiple outputs without isolation. You cannot connect multiple 2-wire transmitters together without isolation. This is because the IRETs of each transmitter are floating and cannot be connected together or to any other ground in the system.

Thanks for your time!

To find more Current Transmitter technical resources and search products, visit:

<https://www.ti.com/amplifier-circuit/special-function/4-20ma-signal-conditioners.html>