

Application Suggestions for X2Y® Technology

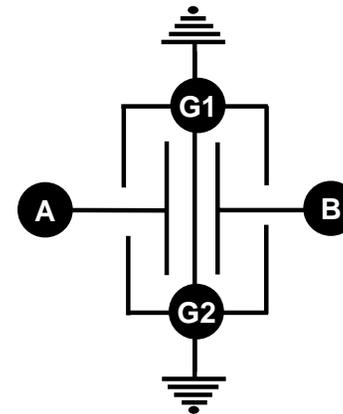
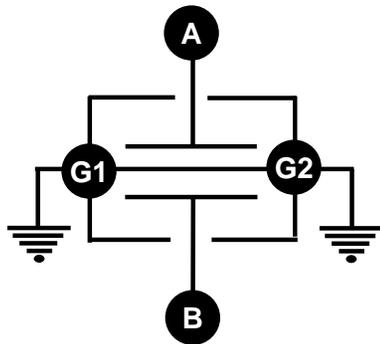
The following slides show applications that would benefit from balanced, low inductance X2Y devices. X2Y devices can offer a significant performance improvement and lower costs through component removal and PC board area reduction.

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X2Y Schematic

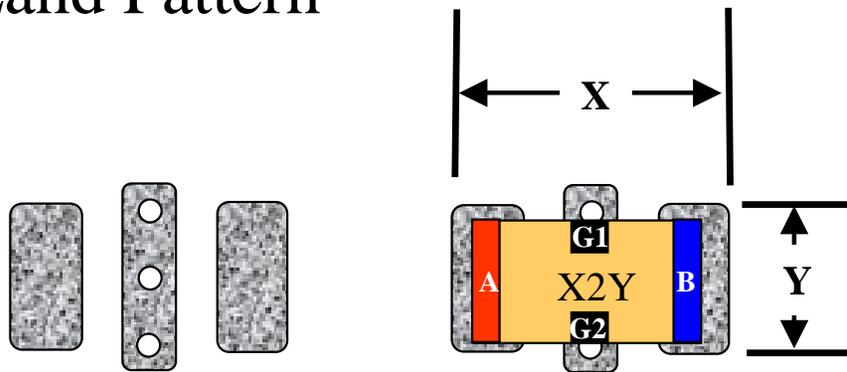
The X2Y component will be represented in these notes by the following two circuit schematics.



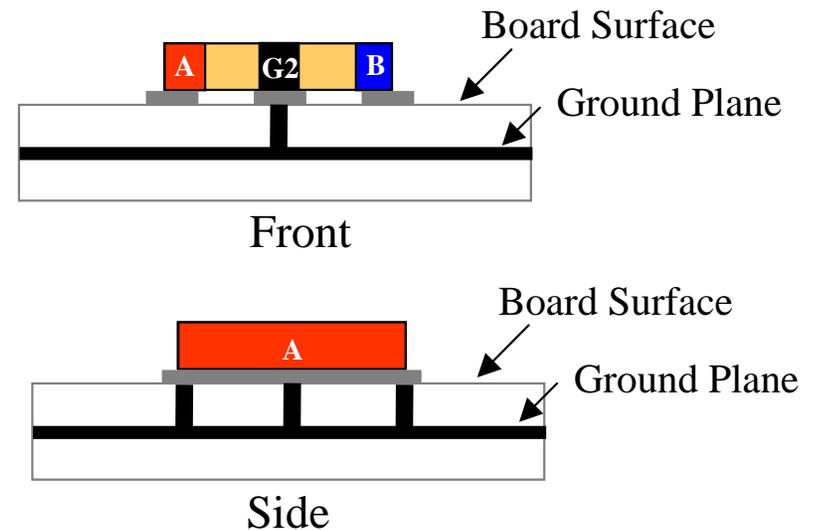
Mounting Pad Layout

The land pattern required for using X2Y on a PCB board is the same for all illustrated applications. A continuous pad under the G1 and G2 terminations with two minimum vias to the board plane is crucial for optimum performance. Further details for grounding and attachment are at this link: [www.x2y.com/cube/x2y.nsf/\(files\)/WebGrounding.pdf/\\$FILE/WebGrounding.pdf](http://www.x2y.com/cube/x2y.nsf/(files)/WebGrounding.pdf/$FILE/WebGrounding.pdf)

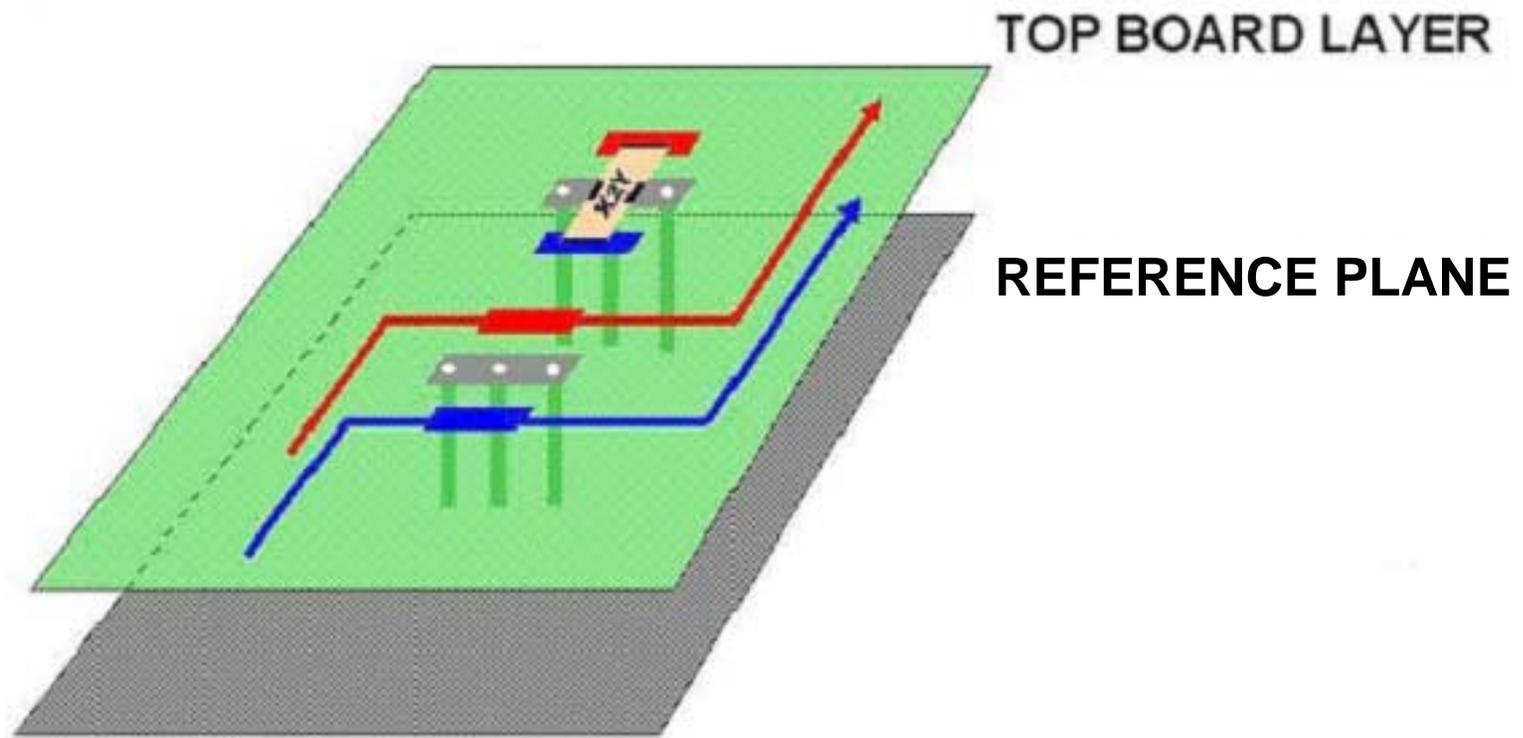
Land Pattern



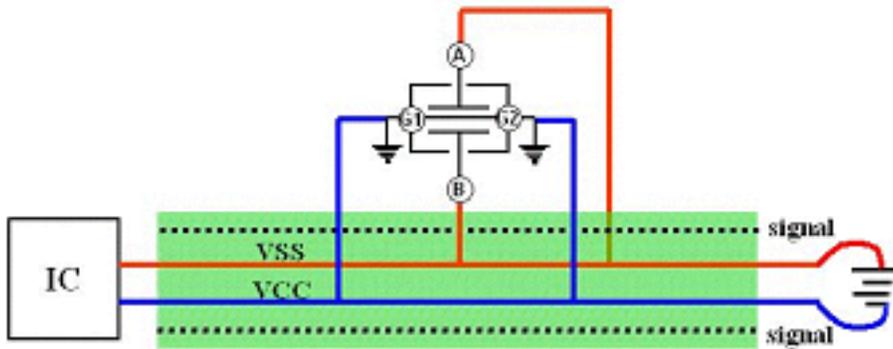
Board View



X2Y Attachment Examples

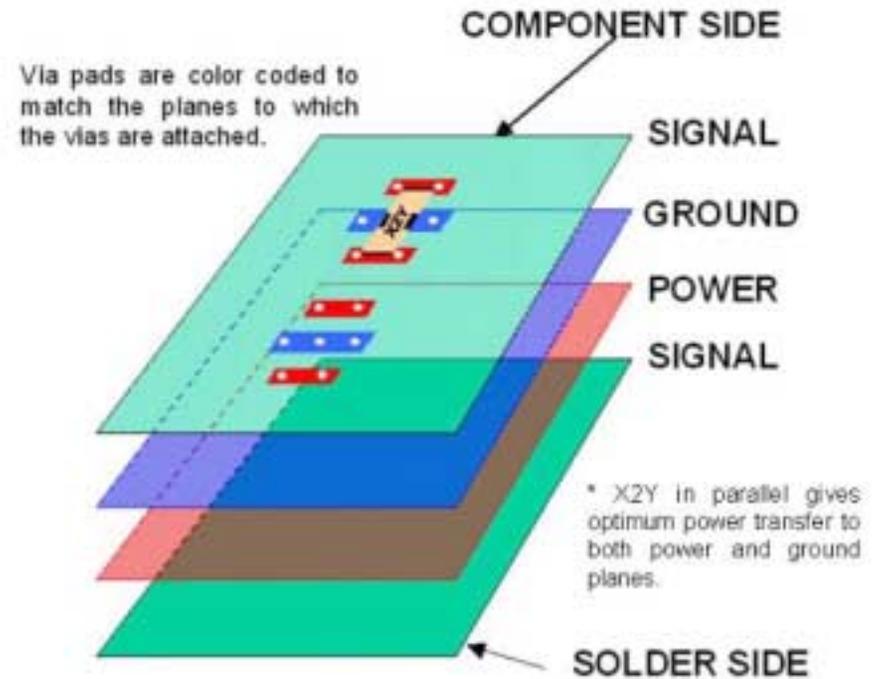
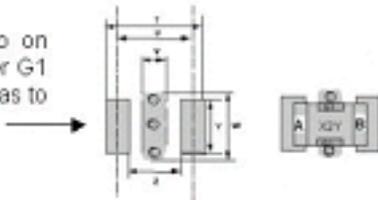


X2Y Attachment Examples

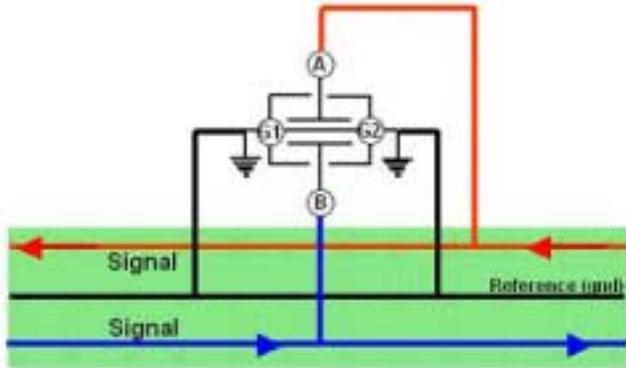


Land Patterns

Use continuous strip on the top of PCB under G1 and G2 with three vias to plane.

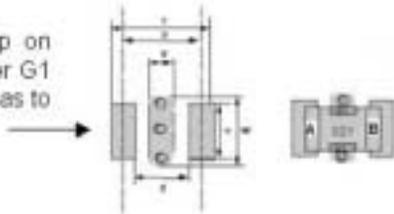


X2Y Attachment Examples

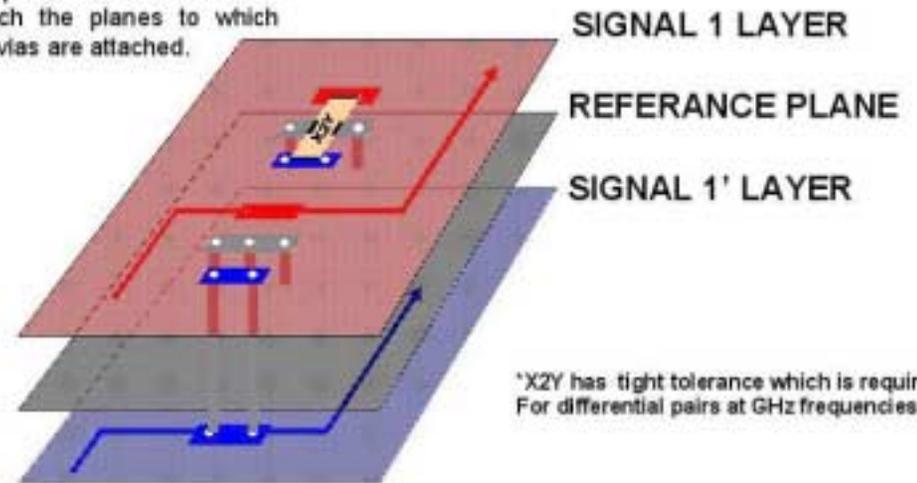


Land Patterns

Use continuous strip on the top of PCB under G1 and G2 with three vias to plane.



Via pads are color coded to match the planes to which the vias are attached.



*X2Y has tight tolerance which is required For differential pairs at GHz frequencies.

Applications

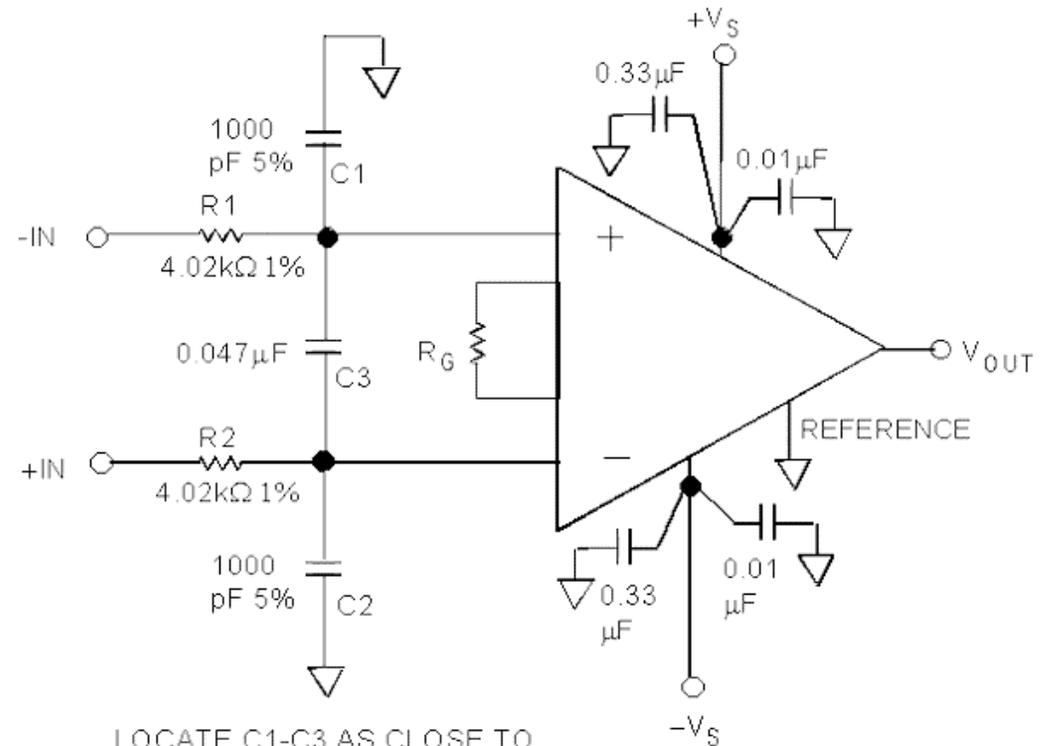
Standard Filter Suggestion

Standard Components:

- 7 regular capacitors are required for filtering, which consumes board space and raises placement costs.
- Expensive tight tolerance capacitors are required for good circuit function.
- Capacitors C1 and C2 need to be $\pm 5\%$ tolerance devices to avoid degrading the circuit's common mode rejection.

Application Requirements:

- The circuit should be built using a PC board with a ground plane on both sides.
- All component leads should be as short as possible.
- Resistors R1 and R2 can be common 1% metal film units.
- Capacitors C1 and C2 need to be $\pm 5\%$ tolerance devices to avoid degrading the circuit's common mode rejection.
- Either the traditional **5% Silver mica units** or **Panasonic $\pm 2\%$ PPS film capacitors** are recommended.



LOCATE C1-C3 AS CLOSE TO THE INPUT PINS AS POSSIBLE

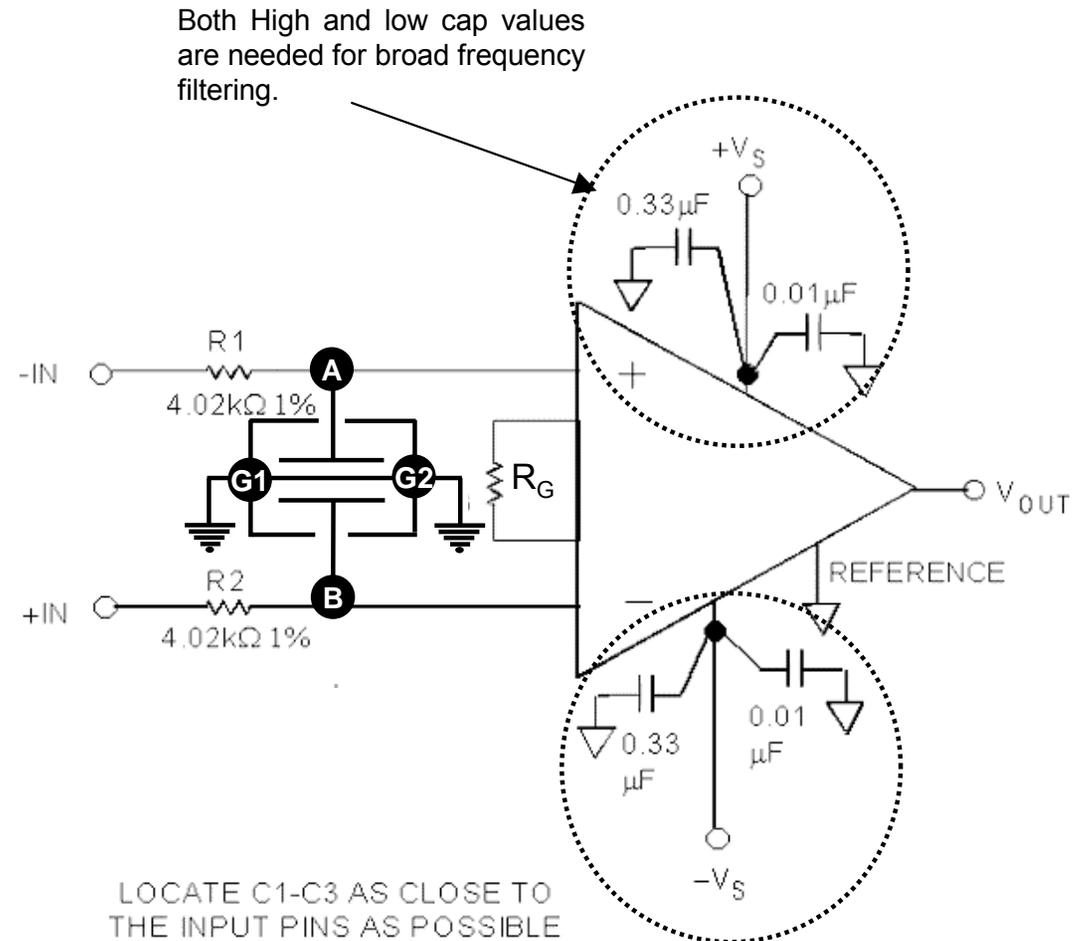
X2Y Filter Suggestion, Option 1

X2Y Benefits:

- 3 regular capacitors are replaced with a single X2Y, which saves board space and lowers placement costs.
- A single X2Y replaces the expensive Mica or Film tight tolerance capacitors.

Application Requirements:

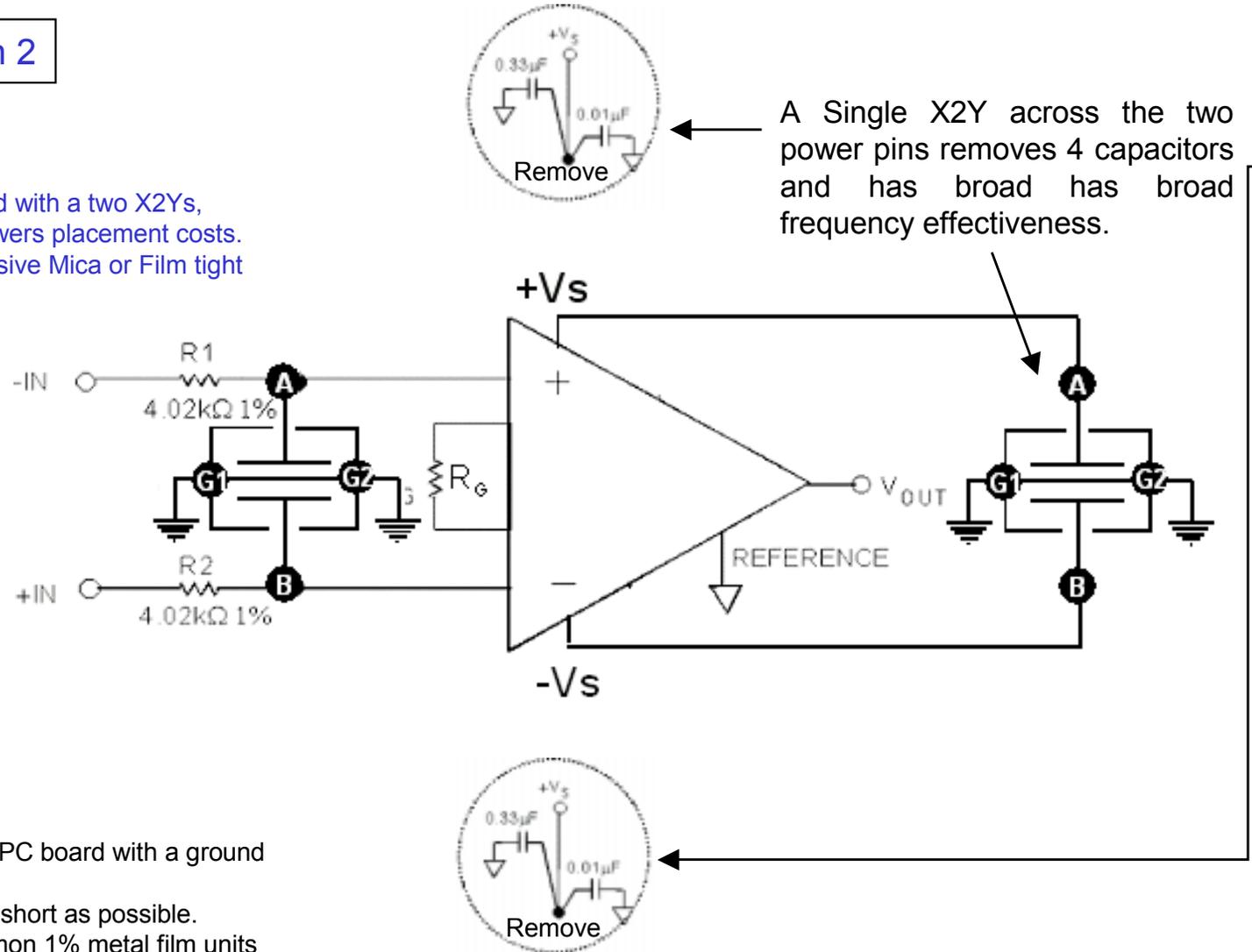
- The circuit should be built using a PC board with a ground plane on both sides.
- All component leads should be as short as possible.
- Resistors R1 and R2 can be common 1% metal film units.
- Capacitors C1 and C2 need to be $\pm 5\%$ tolerance devices to avoid degrading the circuit's common mode rejection.
- Either the traditional **5% Silver mica units** or **Panasonic $\pm 2\%$ PPS film capacitors** are recommended.



X2Y Filter Suggestion, Option 2

X2Y Benefits:

- 7 regular capacitors are replaced with a two X2Ys, which saves board space and lowers placement costs.
- A single X2Y replaces the expensive Mica or Film tight tolerance capacitors.



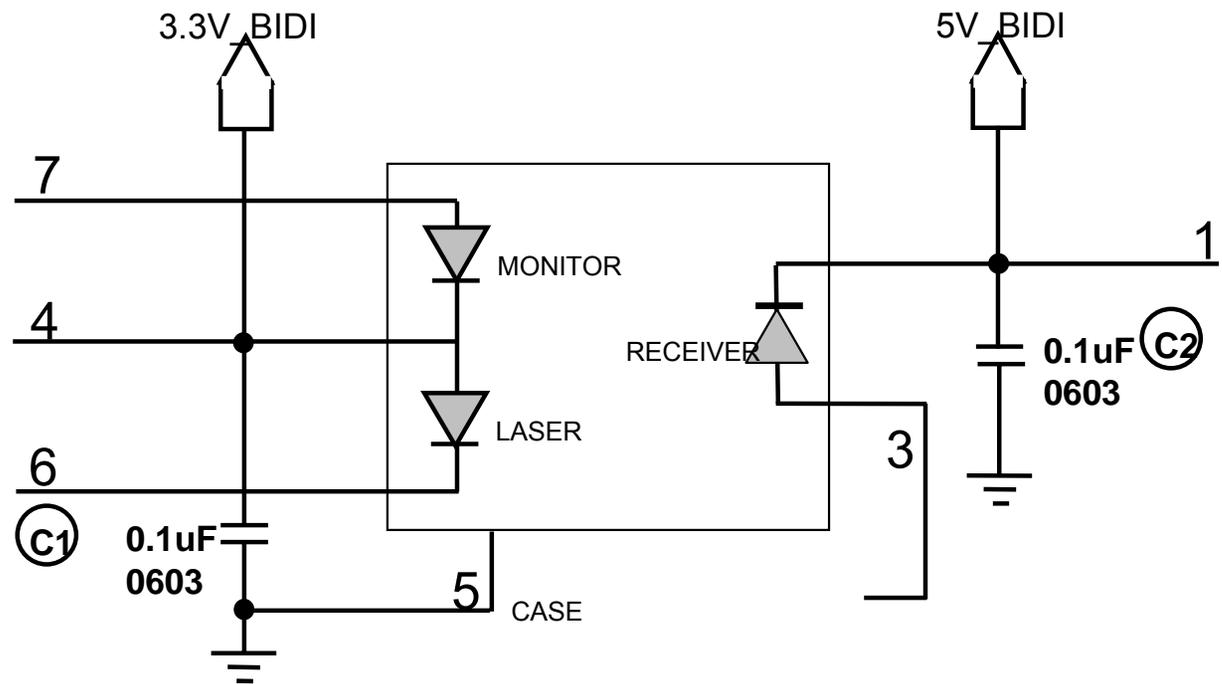
Application Requirements:

- The circuit should be built using a PC board with a ground plane one both sides.
- All component leads should be as short as possible.
- Resistors R1 and R2 can be common 1% metal film units
- Capacitors C1 and C2 need to be $\pm 5\%$ tolerance devices to avoid degrading the circuit's common mode rejection.
- Either the traditional **5% Silver mica units** or **Panasonic $\pm 2\%$ PPS film capacitors** are recommended.

Standard Filter Suggestion

Standard Components:

- Regular capacitors are in series and have narrow operating bandwidth.
- Series feed thru type components with DC resistance can introduce voltage drop.



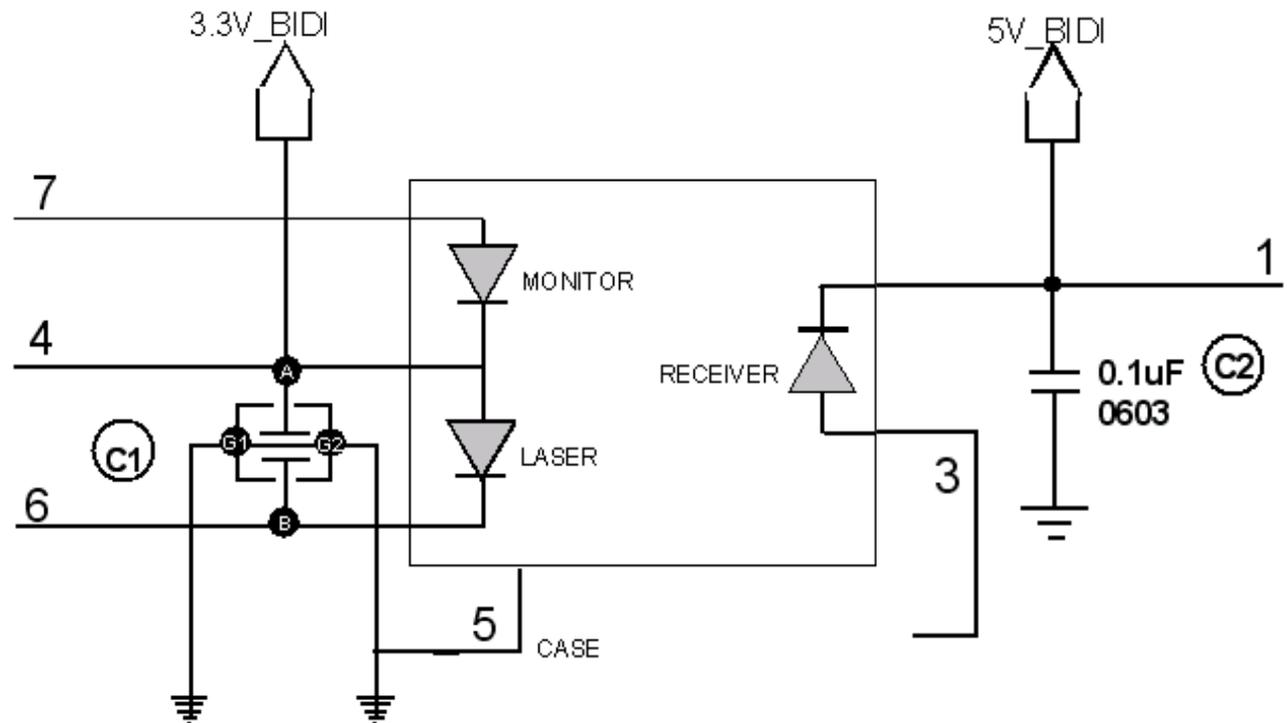
Application Requirements:

1. Filtering across the diodes to reduce noise emissions.
2. Place filter components close to pins.
3. Low capacitance to prevent signal distortion

X2Y Filter Suggestion

X2Y Benefits:

1. X2Y is as close to the pins as possible.
2. A & B go across the diode.
3. Both G1 and G2 go to case/board ground.
4. Continuous trace under G1 & G2.
5. Connection to case ground should be short (low inductance).



Application Requirements:

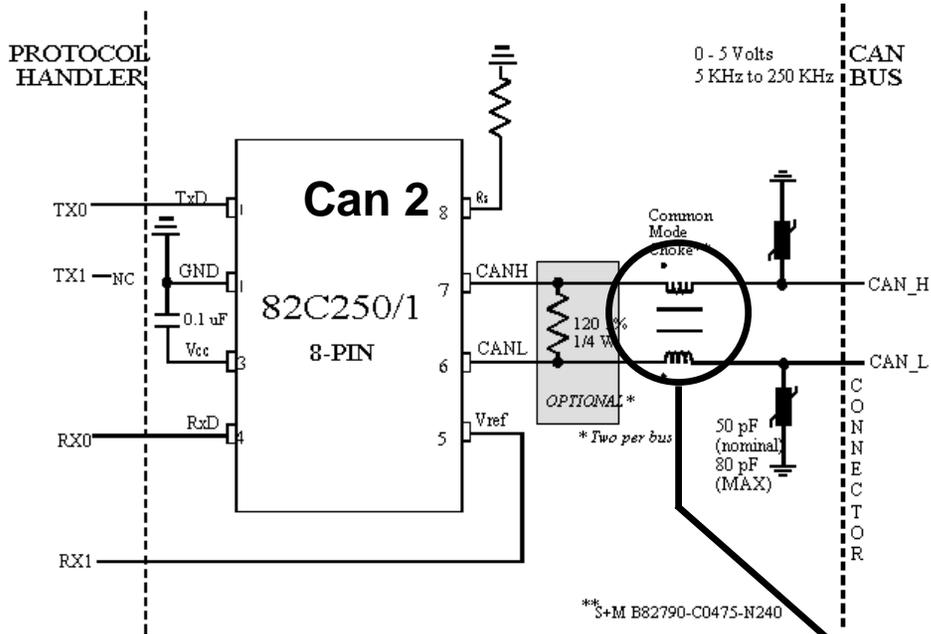
1. Filtering across the laser and receiver diode to reduce noise emissions.
2. Place filter components close to pins.
3. Low capacitance to prevent signal distortion

Note: Low capacitance value should be used so Signal is not affected.

Standard Filter Suggestion

Standard Components:

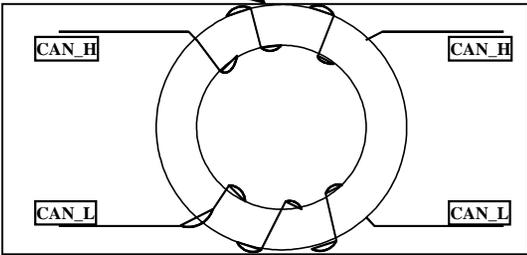
1. Three expensive components required (1 common mode choke and two cap varistors).
2. Uses more board space than a single cap solution



Application Requirements:

CAN ISSUES

1. EMC: Radiated emissions
2. Most existing CAN applications do not allow much capacitance
3. Problems in AM and/or FM band
4. Use "common mode choke"

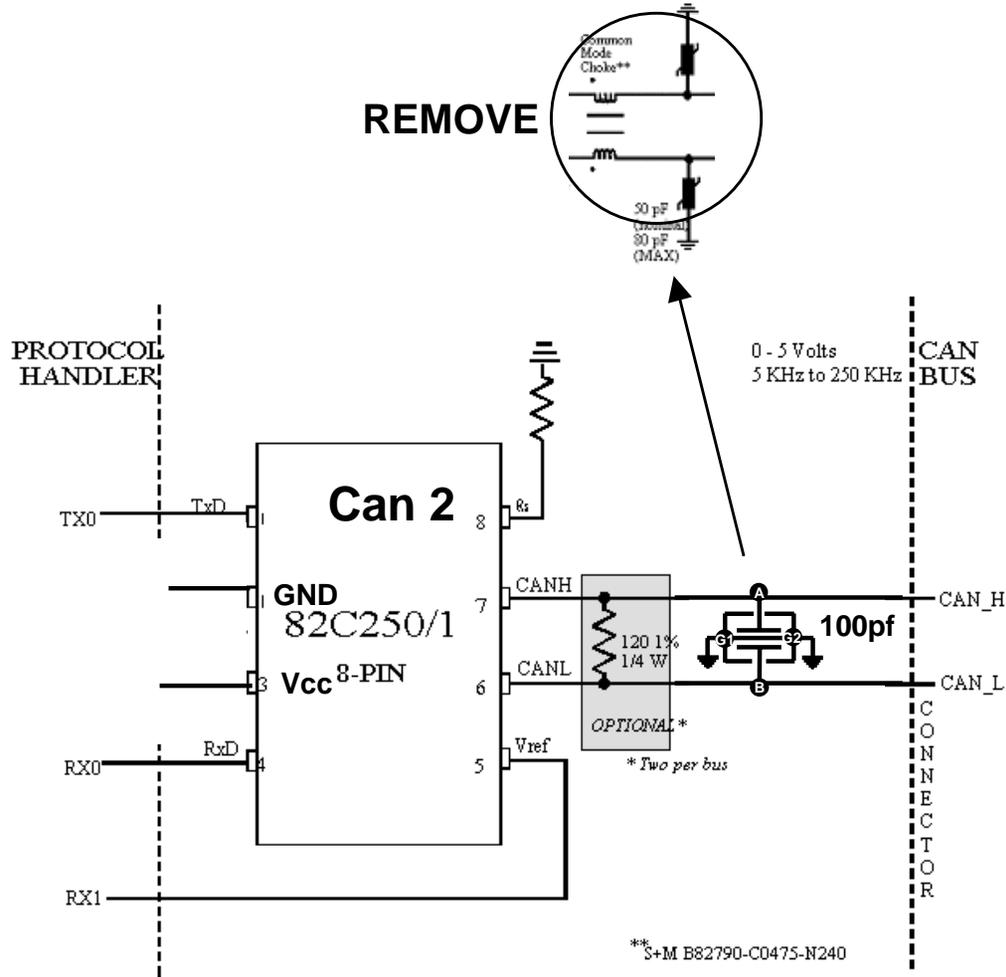


* Common Mode Choke: 51 uH rated inductance; 2 uH stray inductance; 0.3 ohm DC; 0.5 amp

X2Y Filter Suggestion

X2Y Advantages:

1. One capacitor required
2. Uses less board space
3. X2Y functions over a much broader frequency spectrum



Application Requirements:

CAN ISSUES

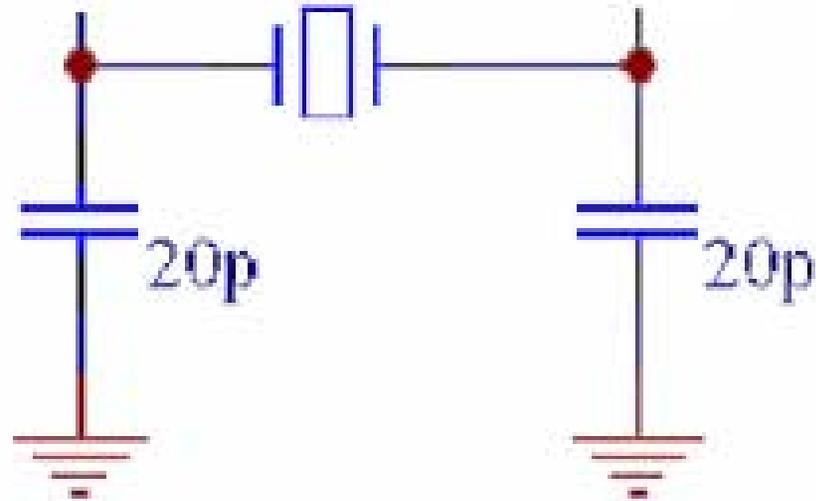
1. EMC: Radiated emissions
2. Most existing CAN applications do not allow much capacitance
3. Problems in AM and/or FM band
4. Use "common mode choke"

* Common Mode Choke: 51 uH rated inductance; 2 uH stray inductance; 0.3 ohm DC; 0.5 amp

Standard Filter Suggestion

Standard Components:

1. Two closely matched capacitance tolerance components are needed for best balancing of the crystal circuit.
2. Two caps Uses more board space than a single cap solution



CRYSTAL OSCILATOR

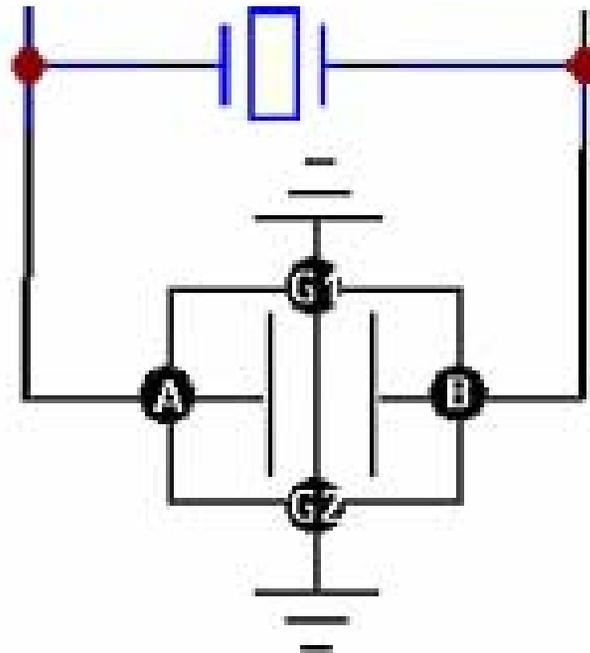
Application Requirements:

1. Place component close to Crystal
2. Use surface mount components leads or traces should be as short as possible
3. Balanced capacitance for best function

X2Y Filter Suggestion

X2Y Advantages:

1. One capacitor required
2. Uses less board space
3. One closely balanced X2Y can provide better balance the Crystal Circuit
4. X2Y functions over a much broader frequency spectrum



X2Y 1206 18pF
0805
0603

Application Requirements:

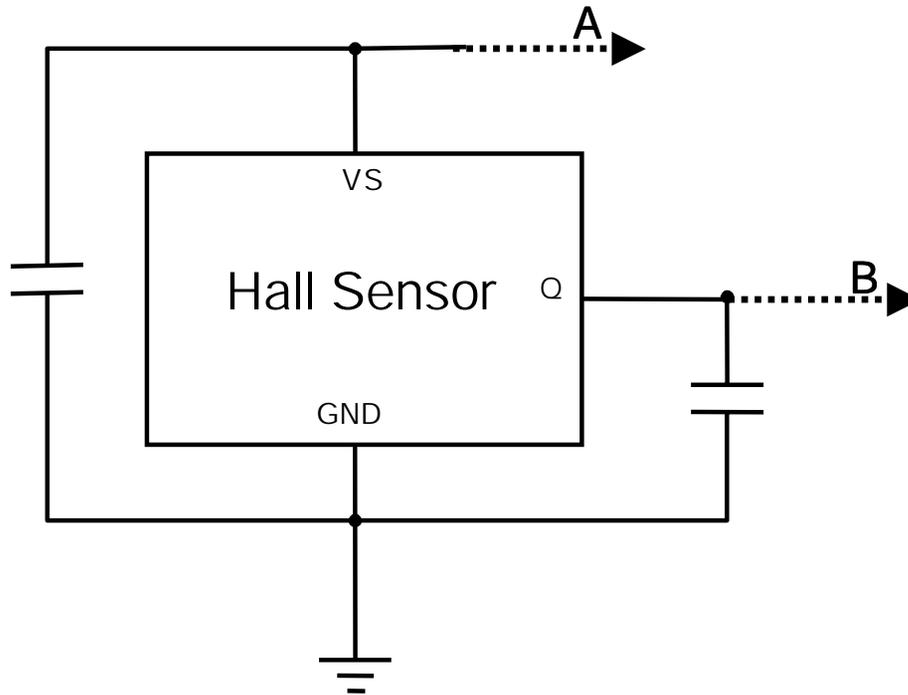
1. Place component close to Crystal
2. Use surface mount components leads or traces should be as short as possible
3. Balanced capacitance for best function

CRYSTAL OSCILATOR

Standard Filter Suggestion

Standard Components:

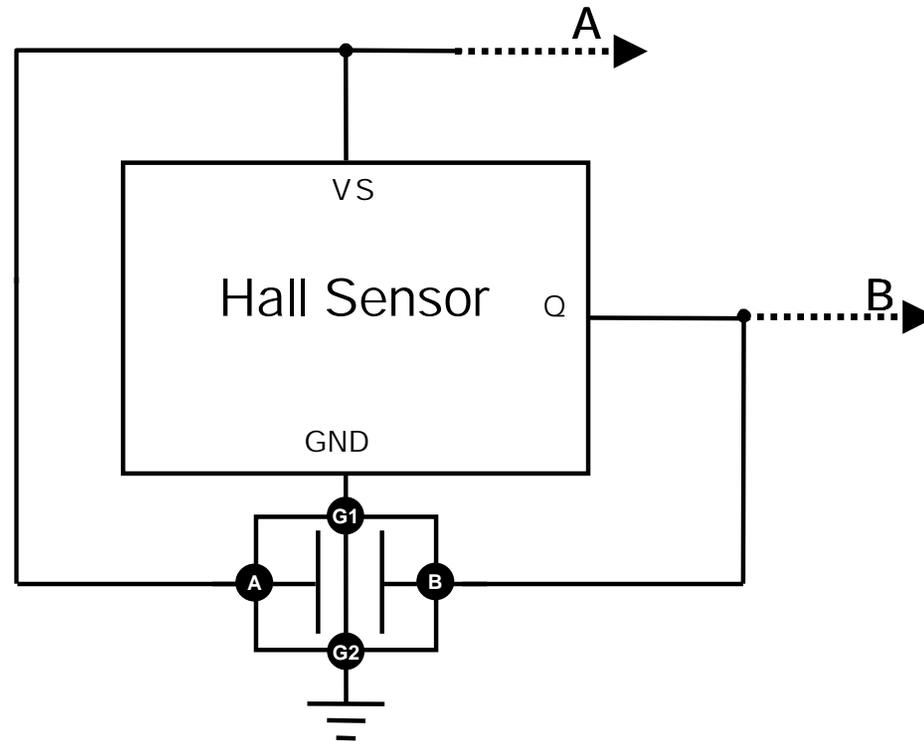
1. Some circuits require two standard caps.
2. Two standard caps give poor common mode filtering.



X2Y Filter Suggestion

X2Y Advantages:

- 1. Single X2Y cap.
- 2. Balanced and improved common mode filtering
- 3. Differential mode filtering also provided
- 4. X2Y has <ns response time to ESD



Fast switching LED's can introduce common mode noise into a circuit and raise overall radiated and conducted emissions.



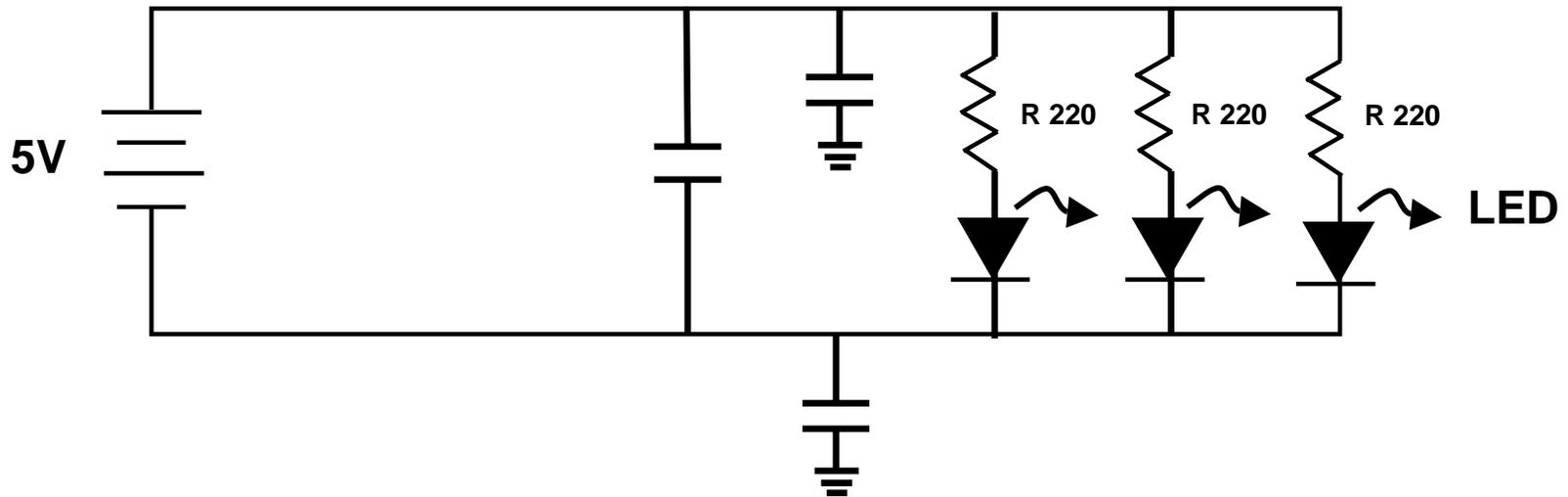
Typical LED circuit with a series limiting resistor ¹

¹ Sirius microSystems, www.siriusmicro.com/B2.pdf

Standard Filter Suggestion

Standard Components:

1. Requires two standard caps.
2. Two standard caps give poor common mode filtering
3. Single standard X capacitor is a narrow band filter element.



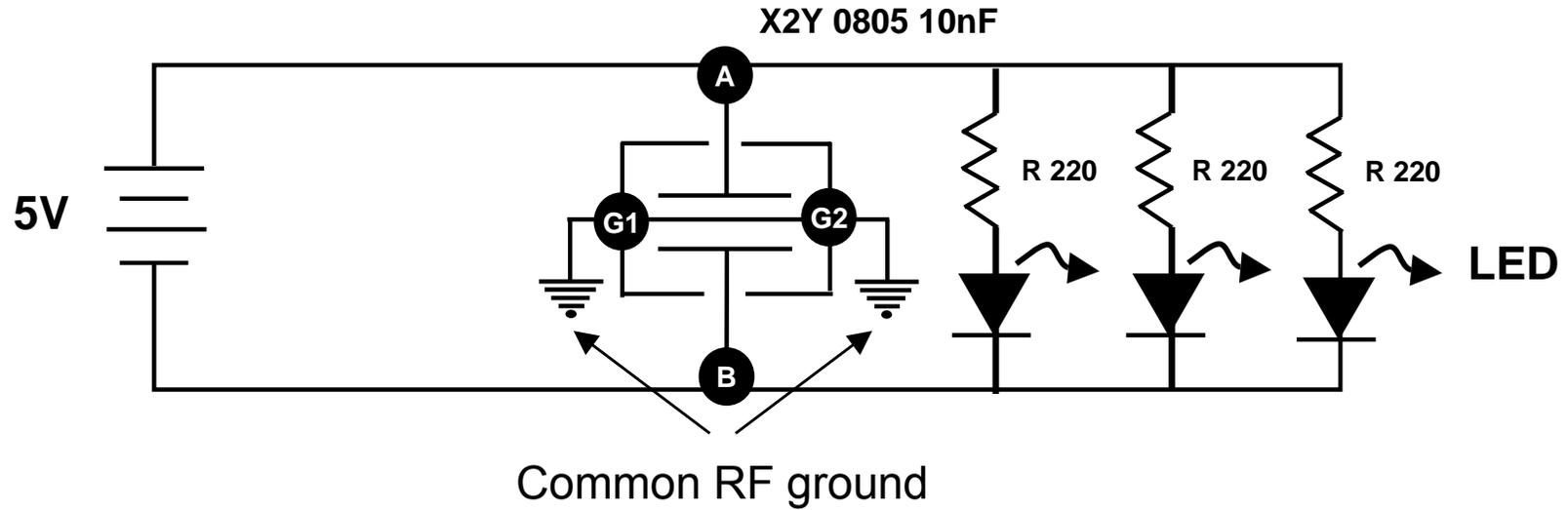
Typical LED circuit with a series limiting resistor ¹

¹ Sirius microSystems, www.siriusmicro.com/B2.pdf

X2Y Filter Suggestion

X2Y Advantages:

- 1. Single X2Y can replace three devices.
- 2. Balanced and improved filtering.



Typical LED circuit with X2Y added.

Standard Filter Suggestion

Standard Components:

1. Capacitors are in series to ground and are effective over a narrow frequency range.
2. Requires ferrite block
3. Requires additional filtering on the board

Before: Standard Solution



Application Requirements:

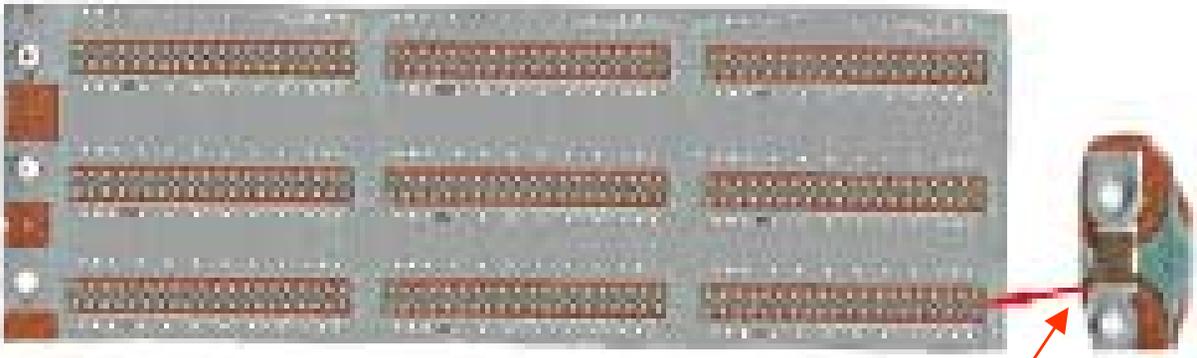
1. Connector pins require high frequency filtering.
2. Cross talk should be minimized
3. Filter size must meet demands for miniaturization.

X2Y Filter Suggestion

X2Y Advantages:

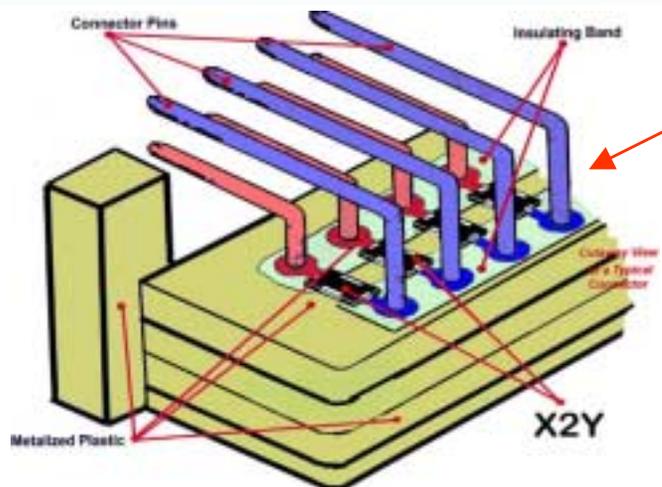
- 1. Requires half the capacitors
- 2. Increased reliability
- 3. Broader frequency effectiveness
- 4. **No need for ferrite block**
- 5. X2Y gives improved cross talk reduction
- 6. Increased production throughput

After: X2Y Solution



Application Requirements:

- 1. Connector pins require high frequency filtering.
- 2. Cross talk should be minimized
- 3. Filter size must meet demands for miniaturization.

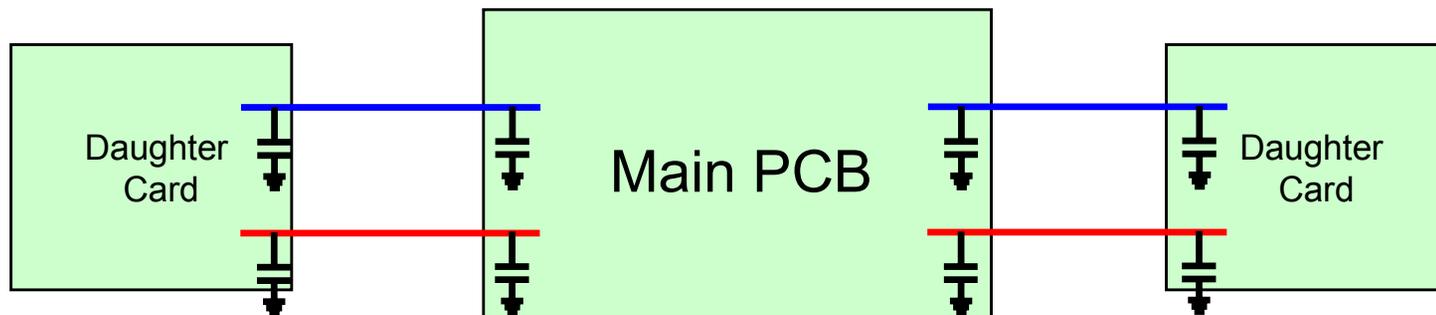


X2Y uses just 1 Cap every 2 Pins

Standard Filter Suggestion

Standard Components:

1. Capacitors are only effective over a narrow frequency range.
2. Need two capacitors (one per line)
3. Sometimes requires additional filtering



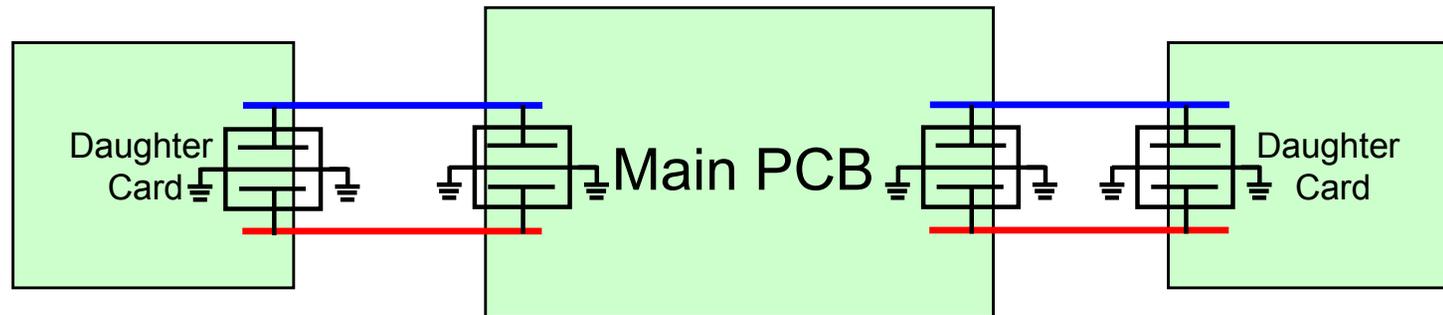
Application Requirements:

- Bypass capacitors at all I/O lines
- Surface mount capacitors with minimal lead length are best.
- Low cap values for the signal lines, higher cap values for power lines

X2Y Filter Suggestion

X2Y Advantages:

1. Requires one capacitors for both lines
2. Broader frequency effectiveness
3. Decoupling and filtering with one device



Application Requirements:

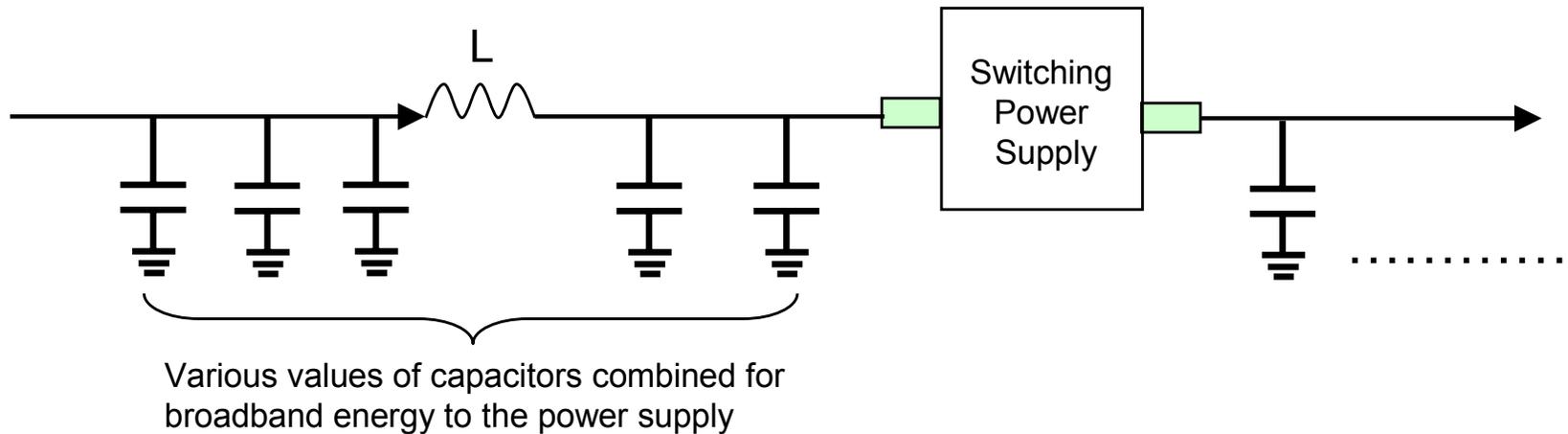
- Bypass capacitors at all I/O lines
- Surface mount capacitors with minimal lead length is best.
- Low cap values for the signal lines higher cap values for power lines

Bulk Capacitance to Switching Power Supplies

Standard Filter Suggestion

Standard Components:

1. Capacitors are only effective over a narrow frequency range.
2. Requires many different caps and values



Application Requirements:

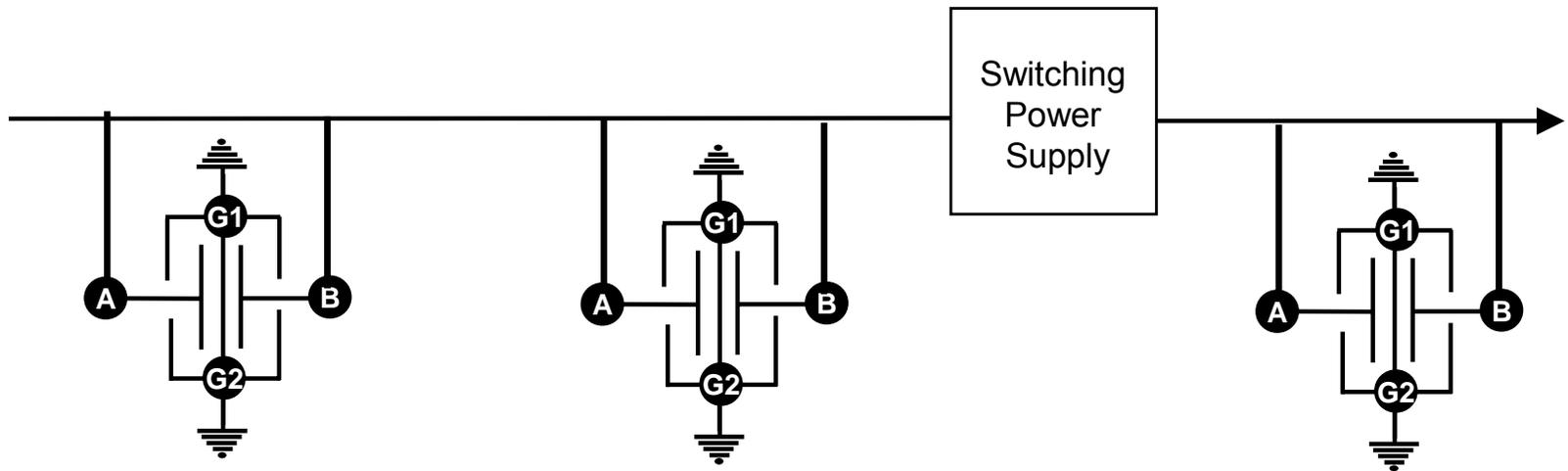
- Low ESR Capacitors
- Use pads to planes without traces or lead length to minimize inductance

Bulk Capacitance to Switching Power Supplies

X2Y Filter Suggestion

X2Y Advantages:

1. X2Y has lower ESR
2. Using X2Y requires fewer capacitors
3. Saves board space
4. Increased Reliability
5. Broader Frequency Effectiveness



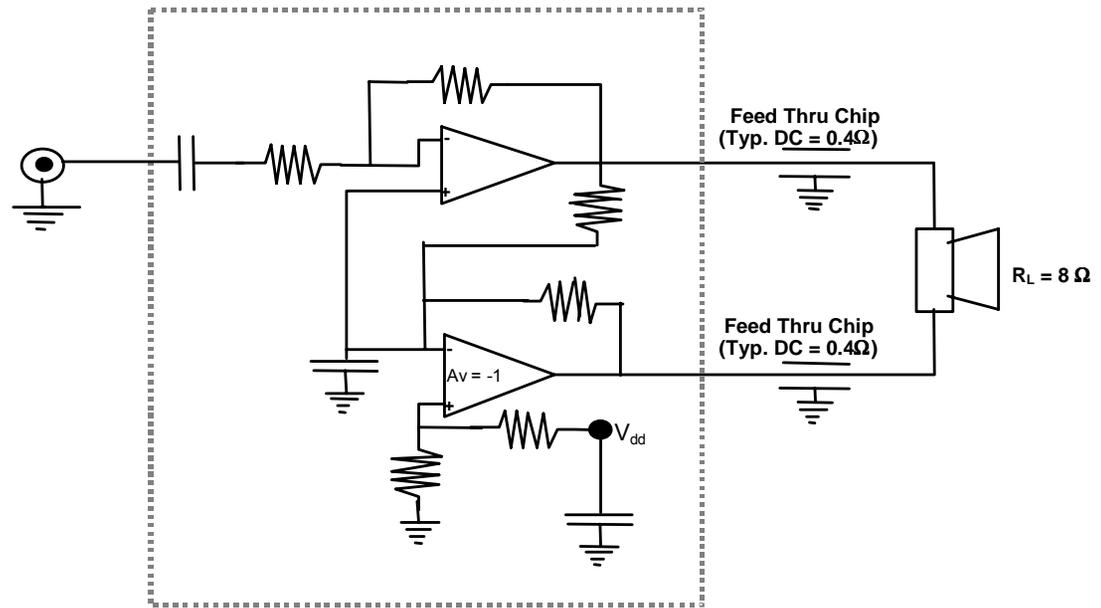
Application Requirements:

- Low ESR Capacitors
- Use pads to planes without traces or lead length to minimize inductance

Standard Filter Suggestion

Standard Components:

1. Requires two capacitors.
2. Adds DC resistance to the circuit
3. Reduces circuit power
4. Unbalanced filtering



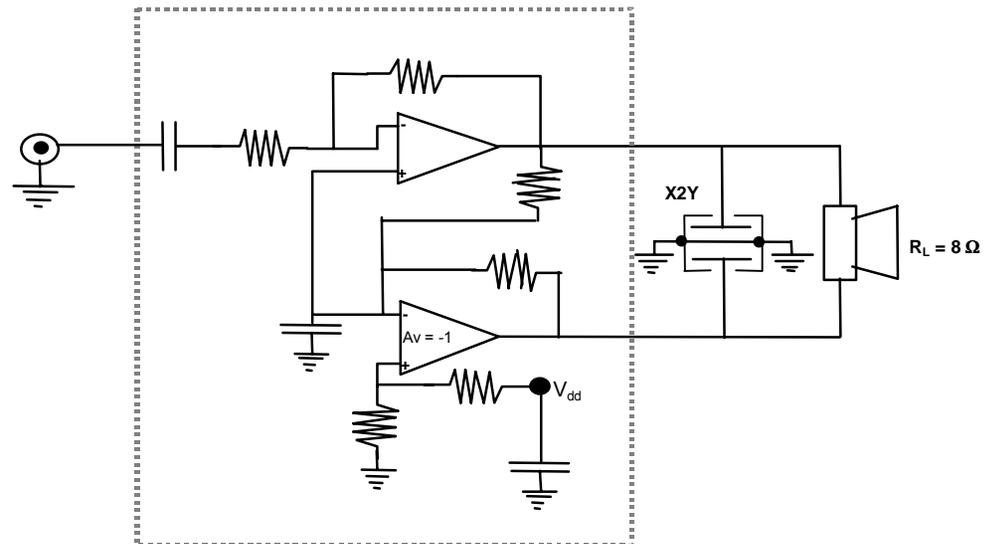
Application Requirements:

- Filter audio amp to meet EMC requirements
- Keep costs low
- Use surface mount components
- Place component close to amplifier output to keep loops small

X2Y Filter Suggestion

X2Y Advantages:

1. One X2Y is needed versus two or more resistive devices, depending on the application
2. Better balance, $\leq 3\%$ capacitance tolerance between each internal line to ground Y
3. Equal aging and temperature tracking because of the single component package.
4. Broader Insertion Loss Characteristics with X2Y



Application Requirements:

- Filter audio amp to meet EMC requirements
- Keep costs low
- Use surface mount components
- Place component close to amplifier output to keep loops small

For comments or questions, please email: x2y@x2y.com
Subject Line: **Applications**

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