Electronics
Analog and Digital Grounds

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Wilfrid Laurier University

May 31, 2017

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- digital noise; fast, lots of current
- analog noise; slow, low current

Connection resistance

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Consider a trace on a circuit board.

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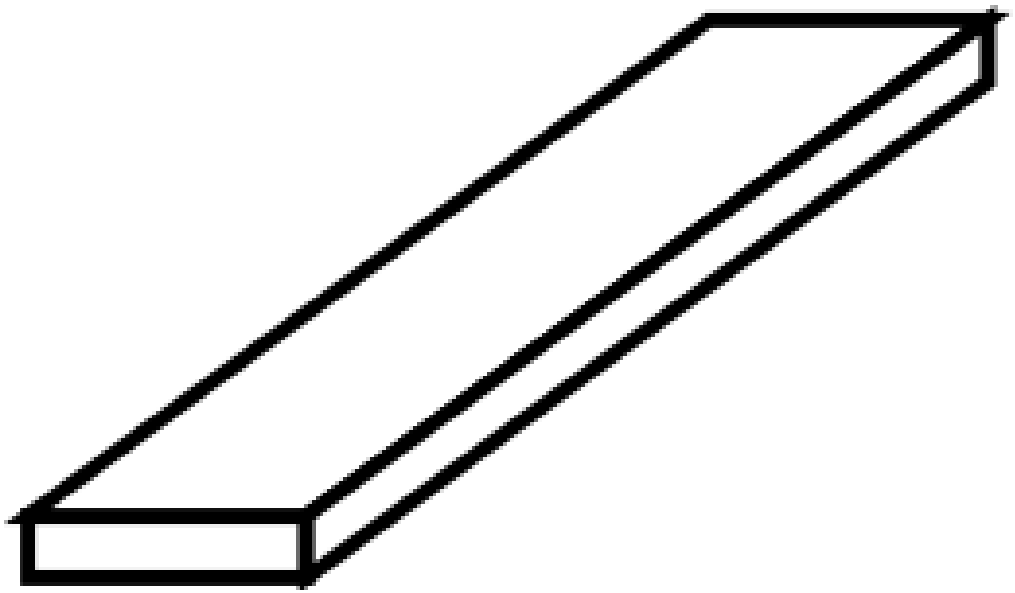

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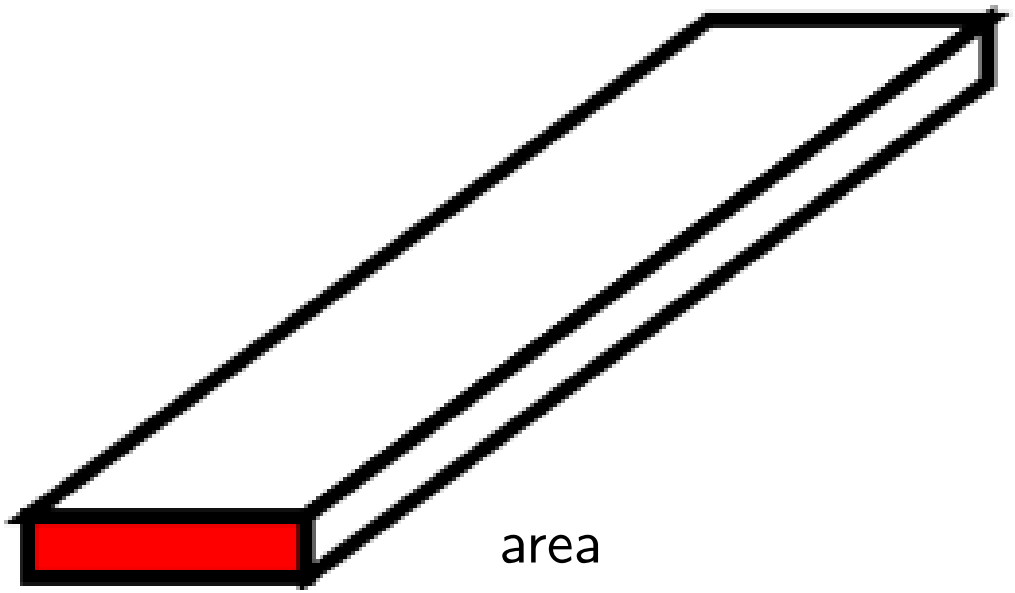

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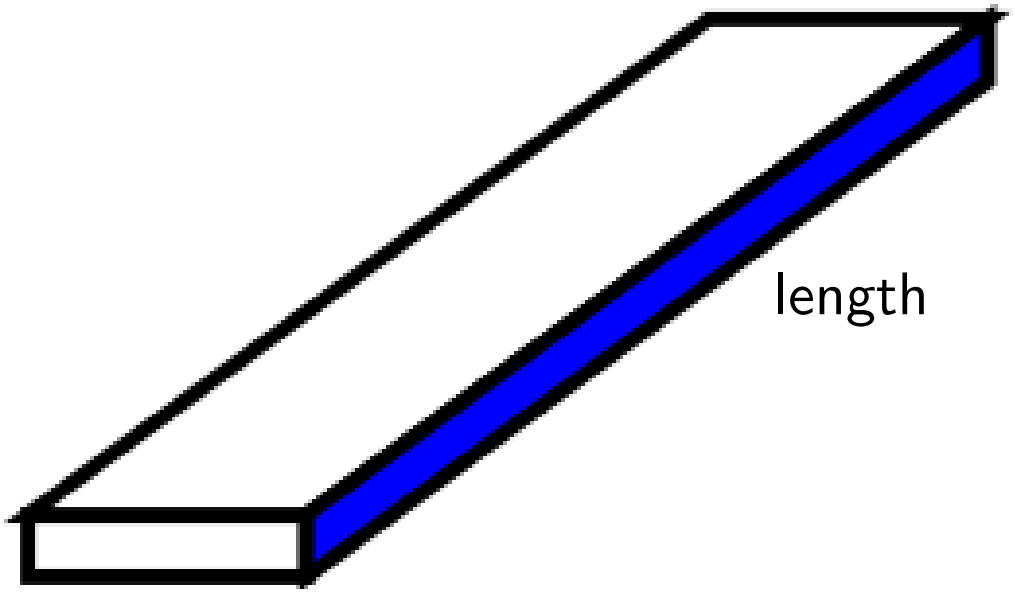

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- Voltage fluctuation on lines $\Delta V = (\Delta I)\, R$;

Thus mA fluctuation$\rightarrow$mV/m fluctuation. *This includes fluctuations on power and ground lines.* The farther you get from power and ground connections, the more noise you get on power and ground lines.

Effect of noise on power and ground lines

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Analog

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Digital

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Digital

May produce glitches.

Solution to noise problems - analog

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Digital and analog grounds should be separated to minimize problems with analog signals due to digital noise on power and ground lines.

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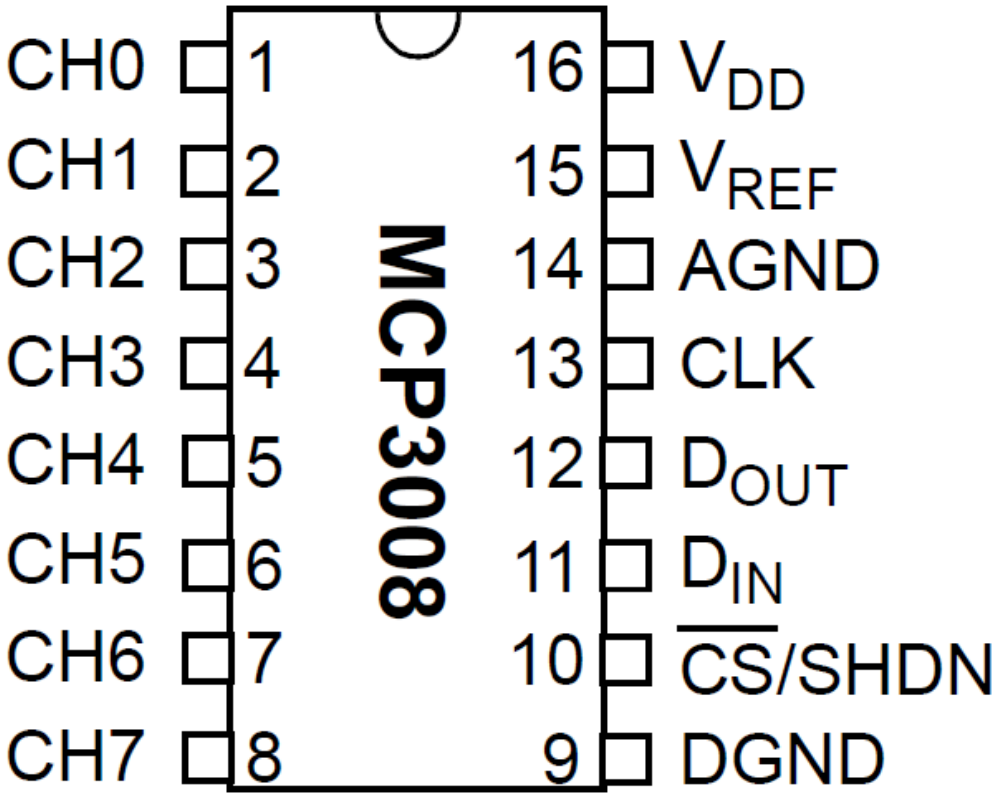
Digital and analog grounds should be separated to minimize problems with analog signals due to digital noise on power and ground lines.
Keep separate power and grounds (so digital noise absent); only join once near supply.

Separate grounds; MCP3008 (Microchip)



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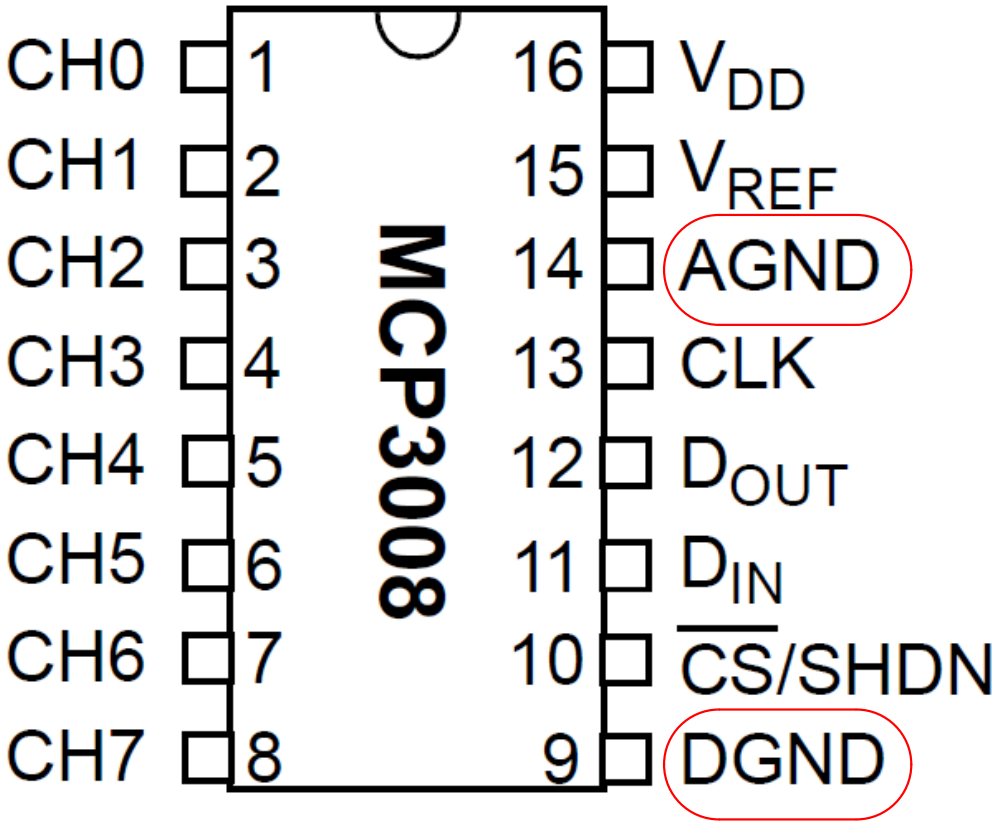

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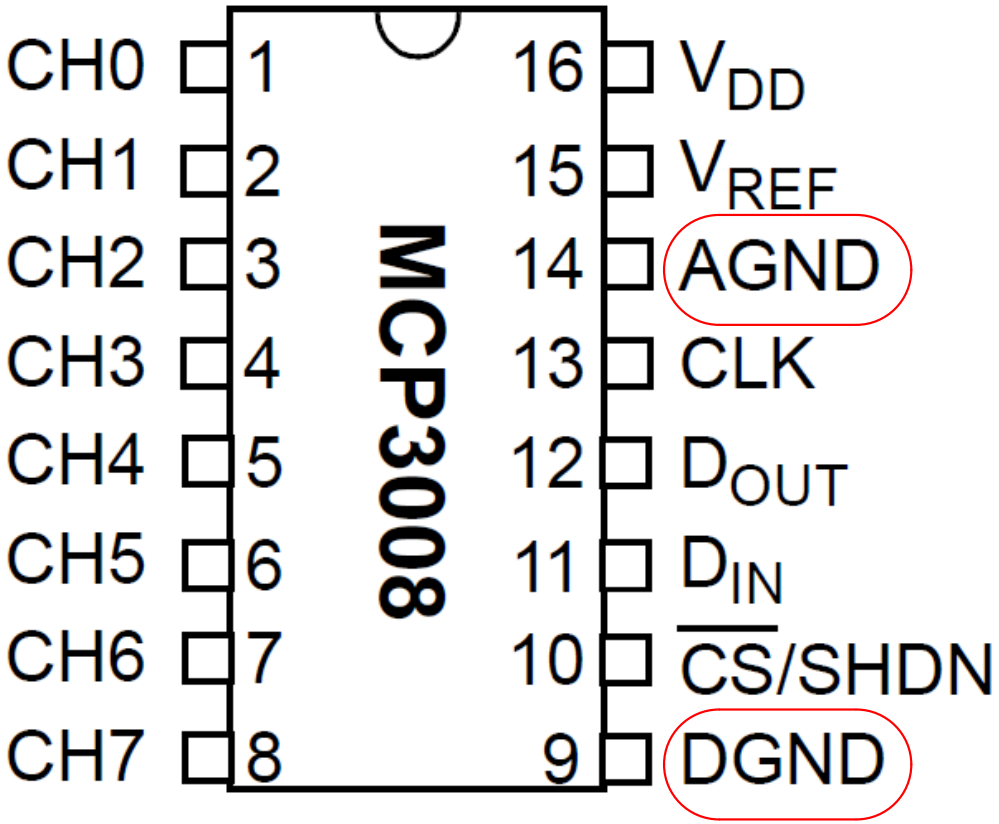

"If no ground plane is utilized, both grounds must be connected to V_{SS} on the board."

From MCP3008 datasheet (Microchip)

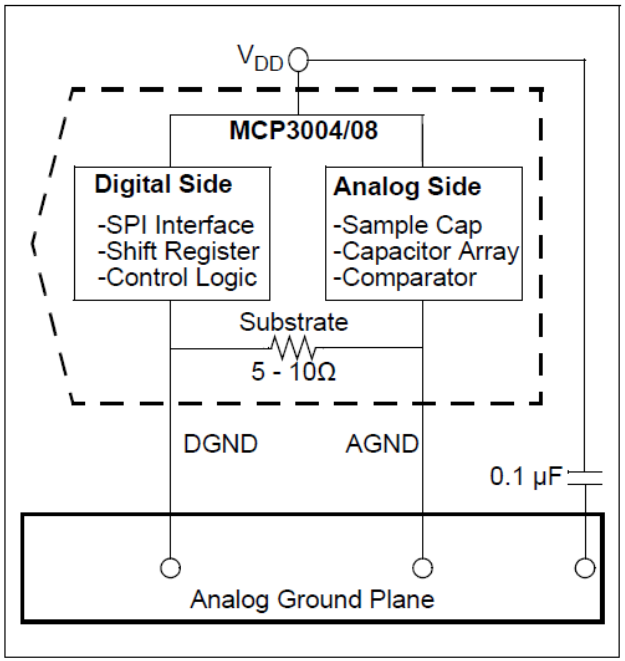

FIGURE 6-5: *Separation of Analog and Digital Ground Pins.*

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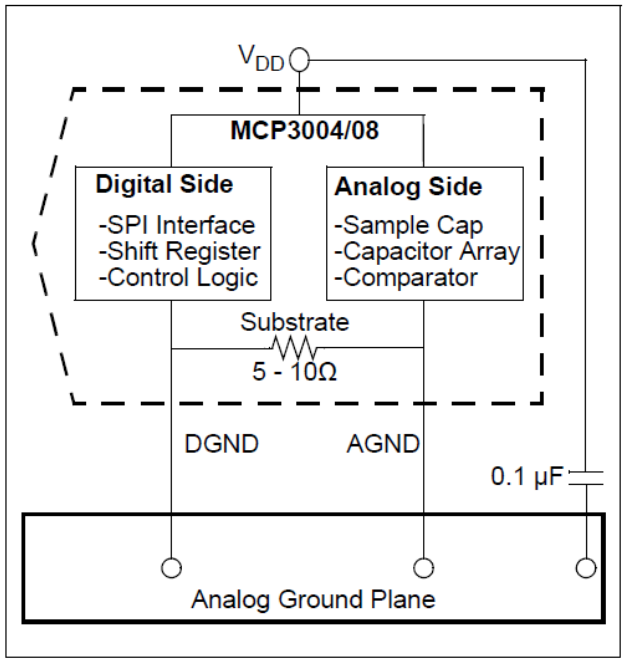
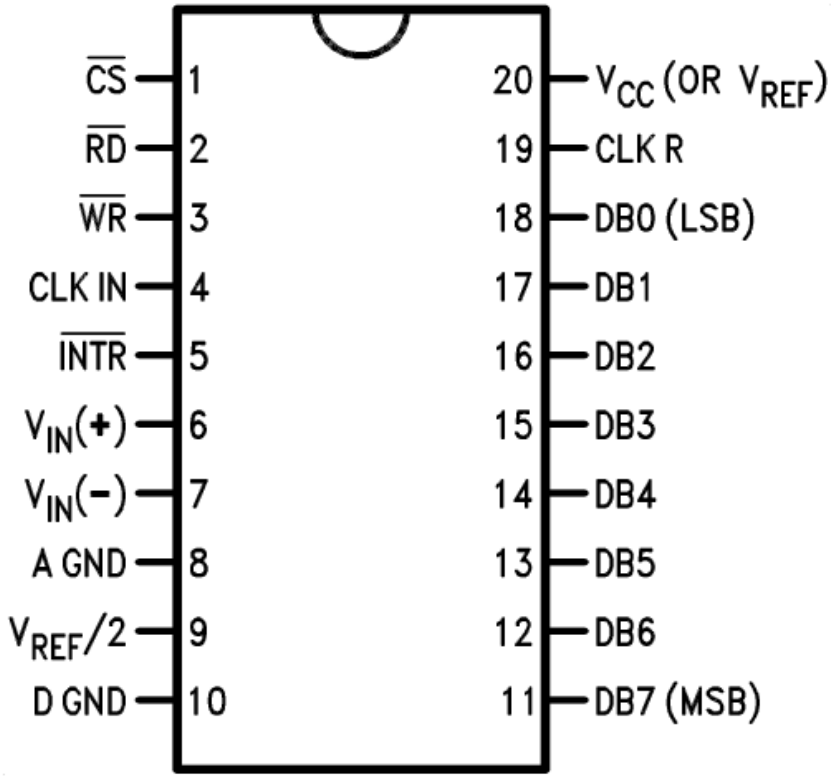


FIGURE 6-5: *Separation of Analog and Digital Ground Pins.*

"If a ground plane is available, both digital and analog ground pins should be connected to the analog ground plane."

Separate grounds; ADC0804 (National Semiconductor)



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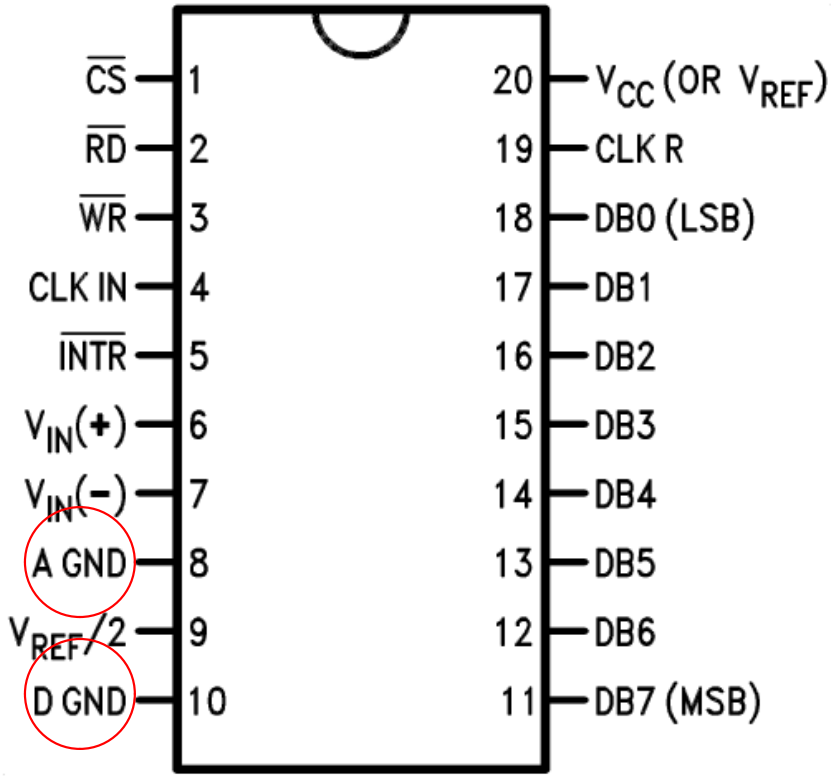

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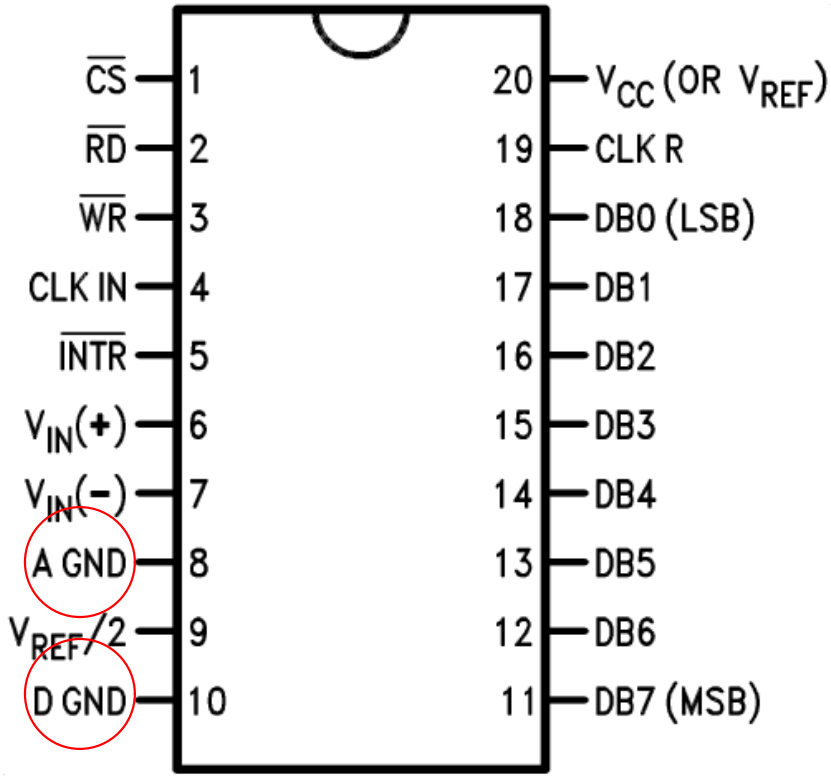

"Note:The separate A Gnd point should always be wired to the D Gnd."

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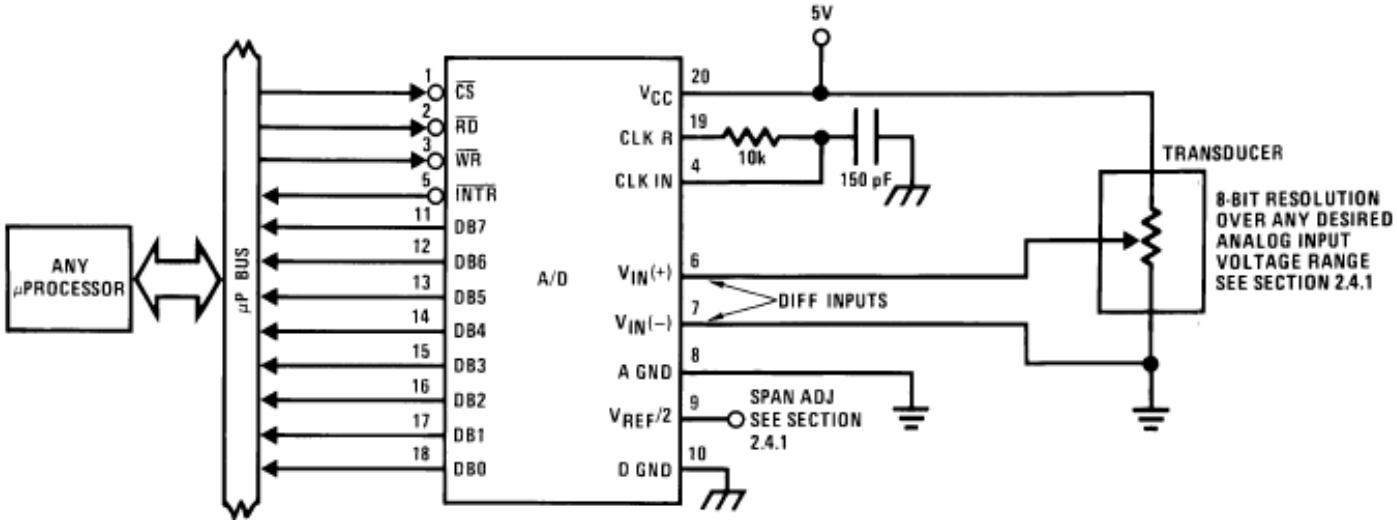

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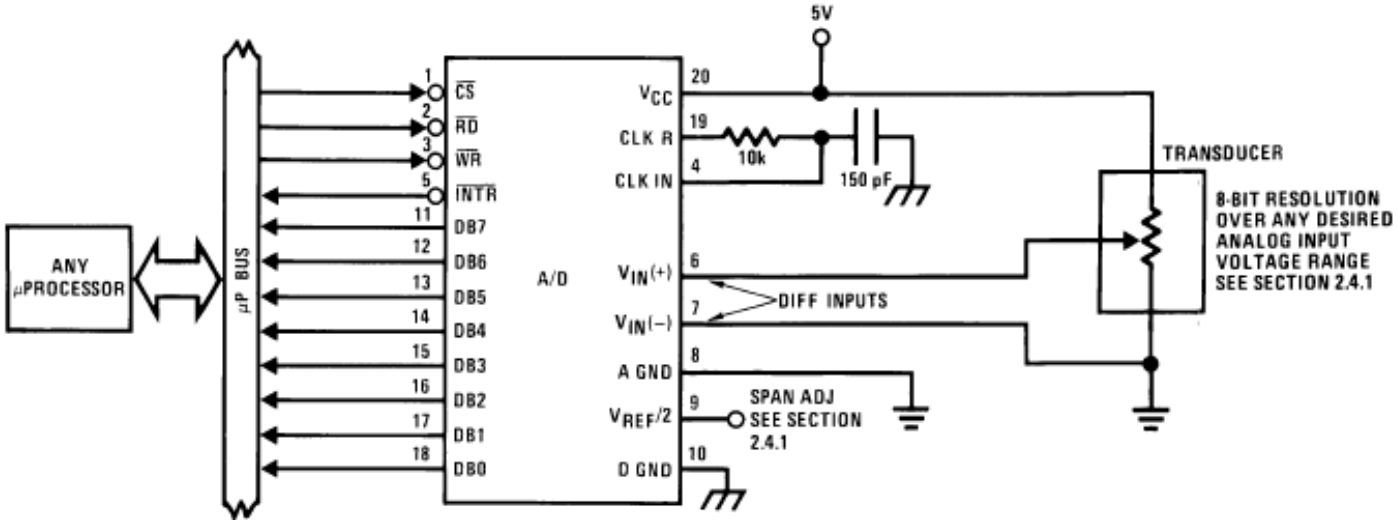

Can you identify which symbol is for each type of ground?

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Use filter capacitors from V_{cc} to ground near IC to smooth the fluctuations as close to the device as possible;

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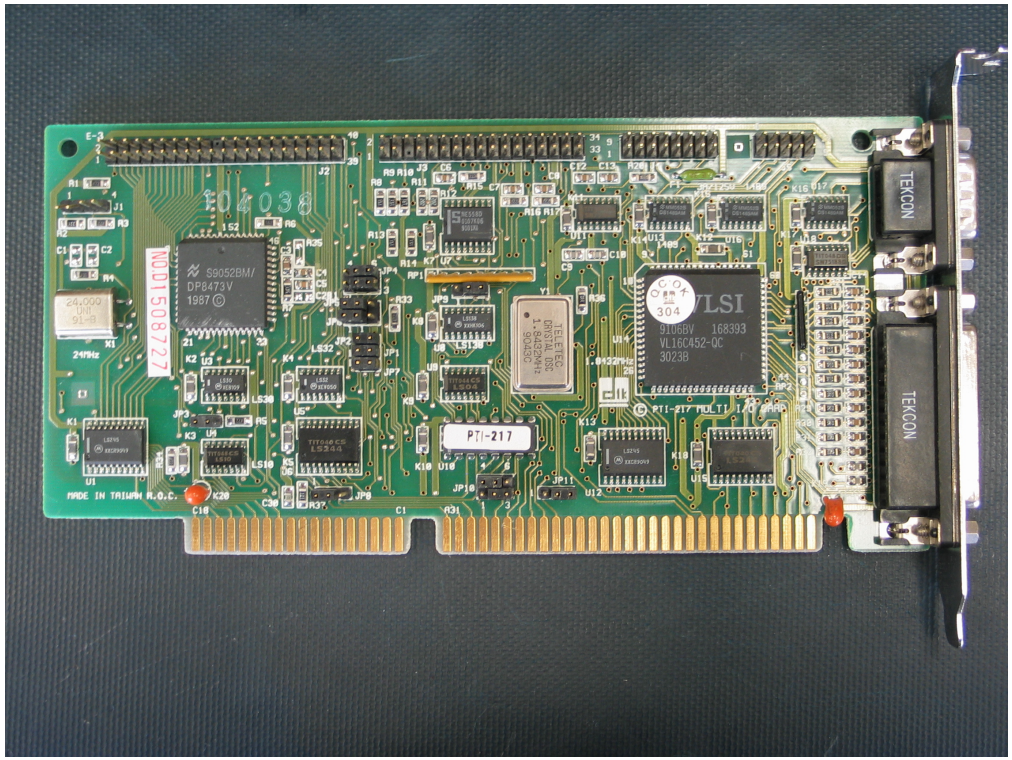
Filter capacitors



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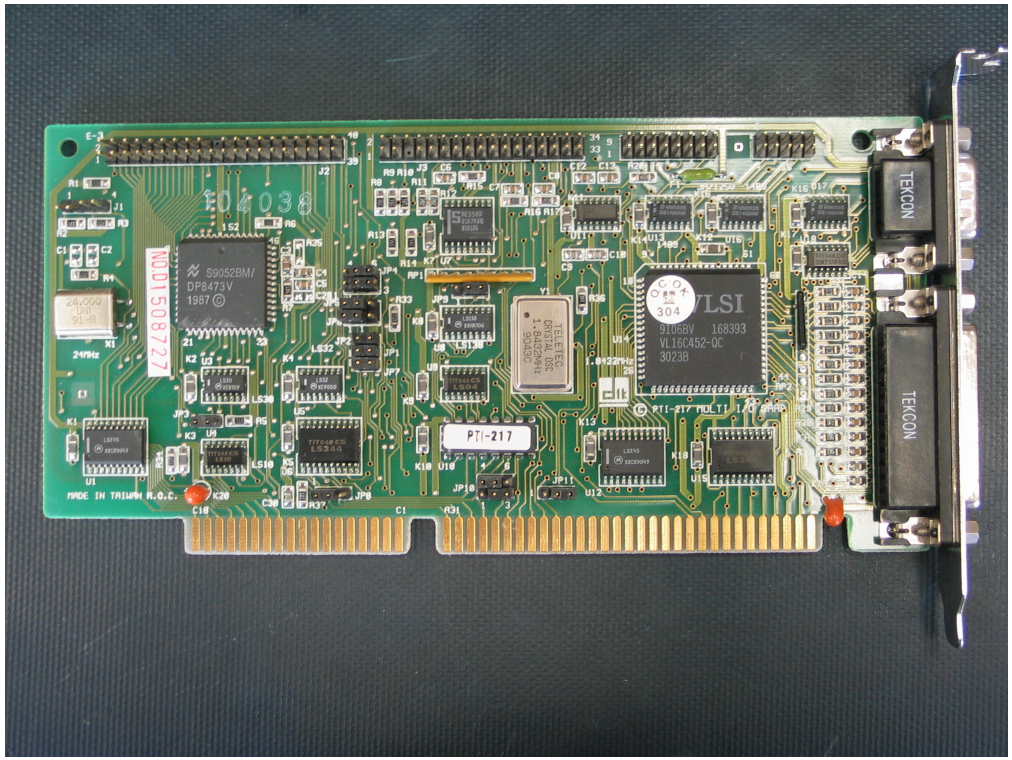

Here's an ordinary circuit board.

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Notice the filter capacitors.

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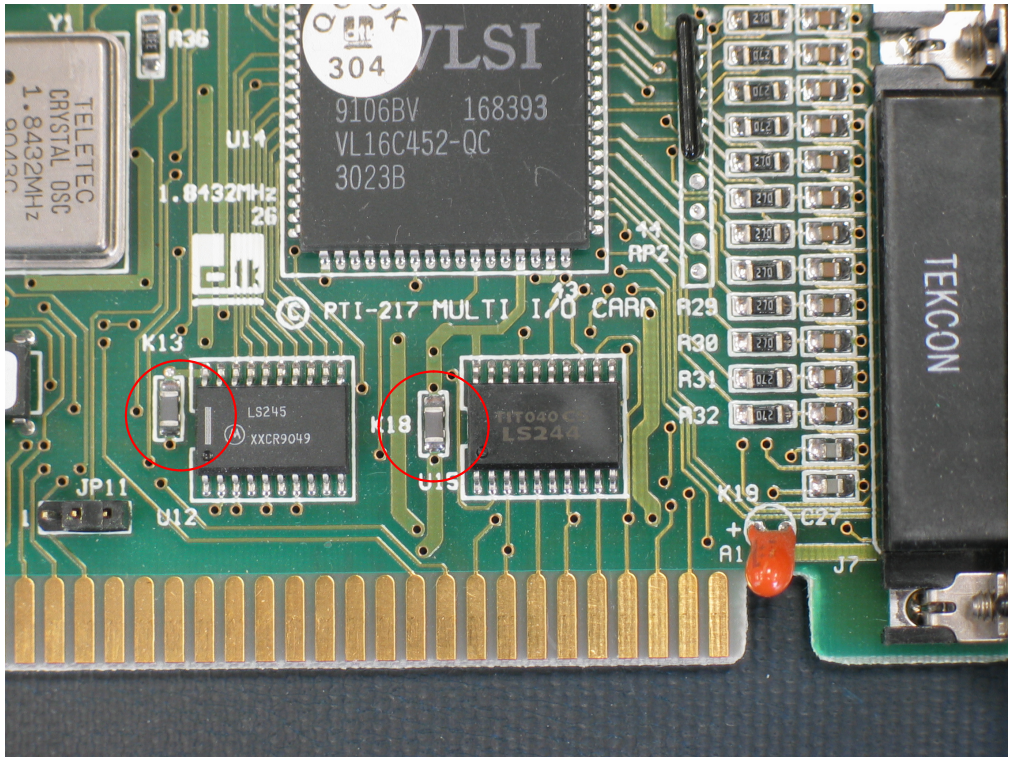

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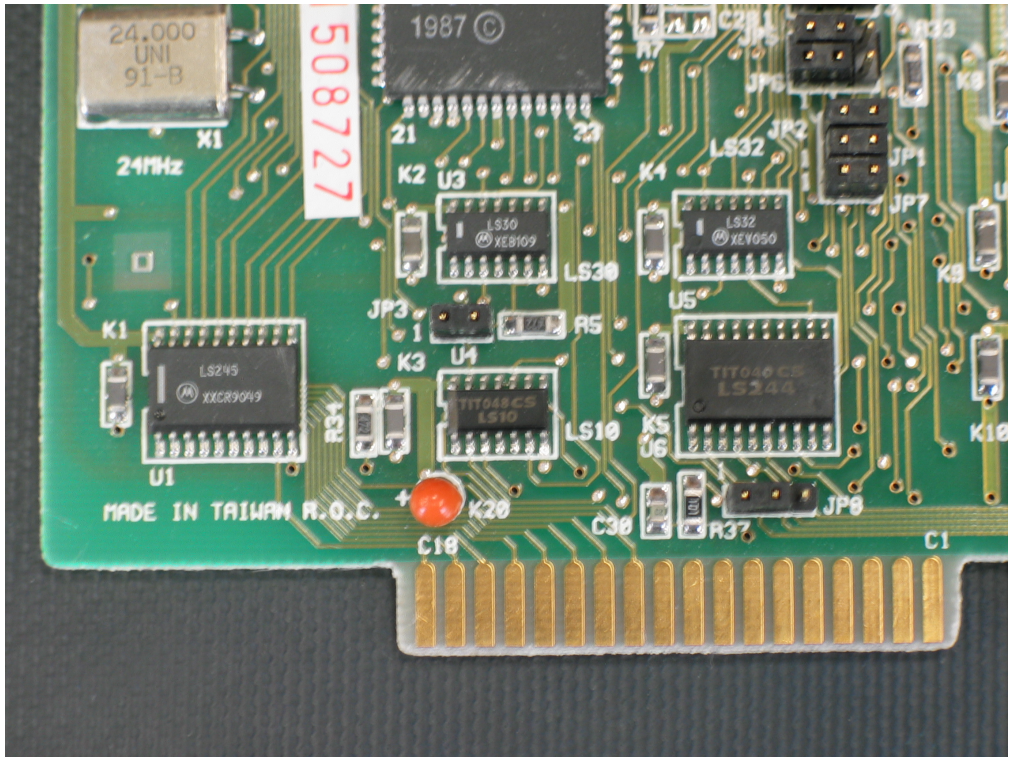

Here are more.

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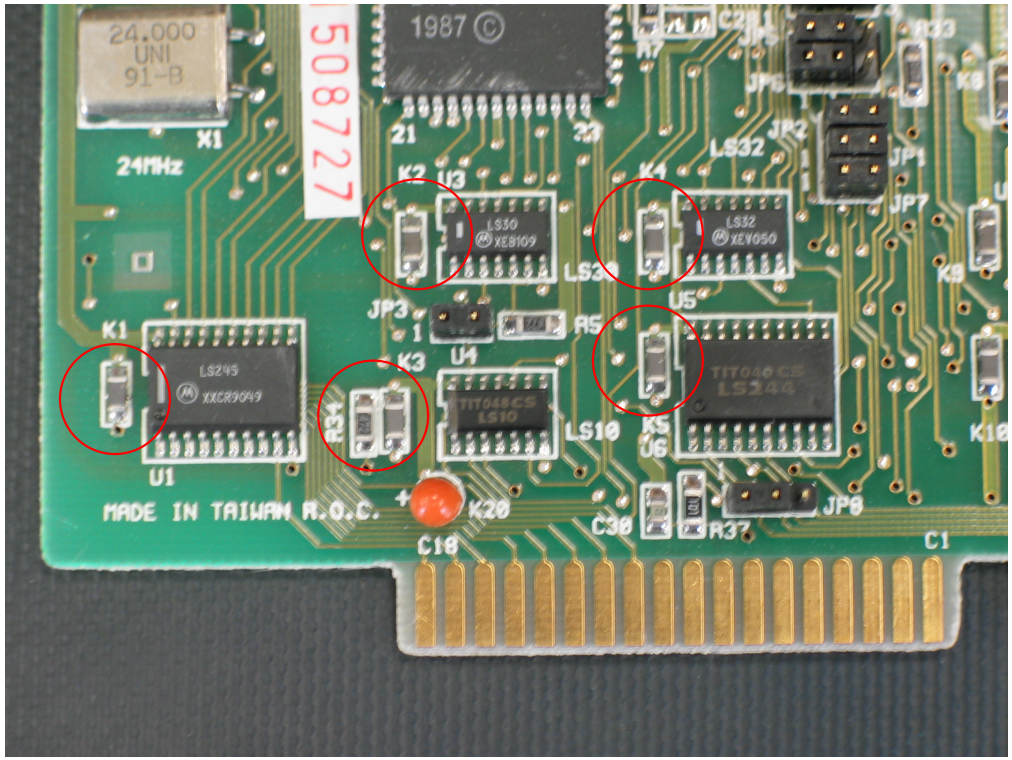

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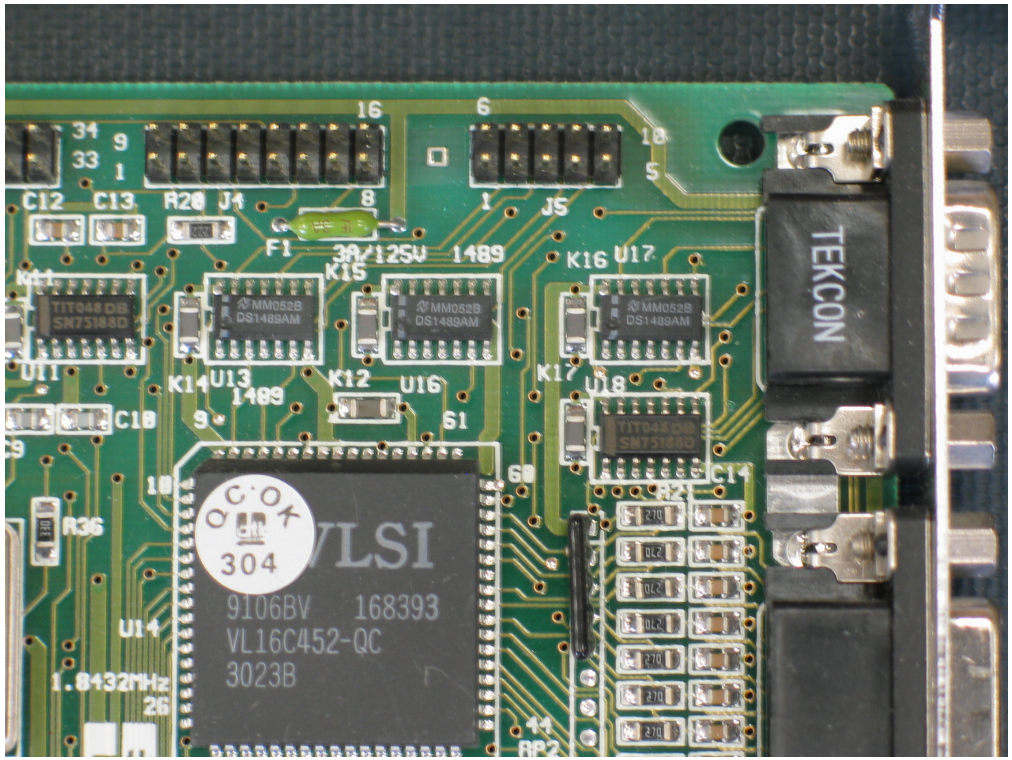

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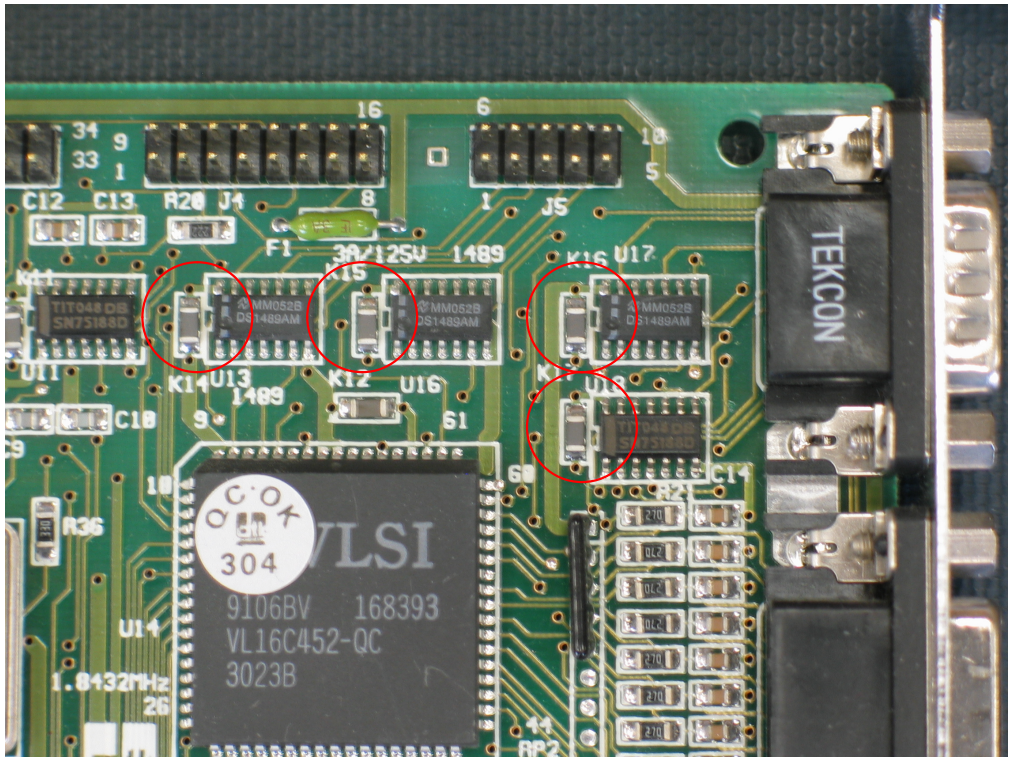

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