

Amplification for a PMT

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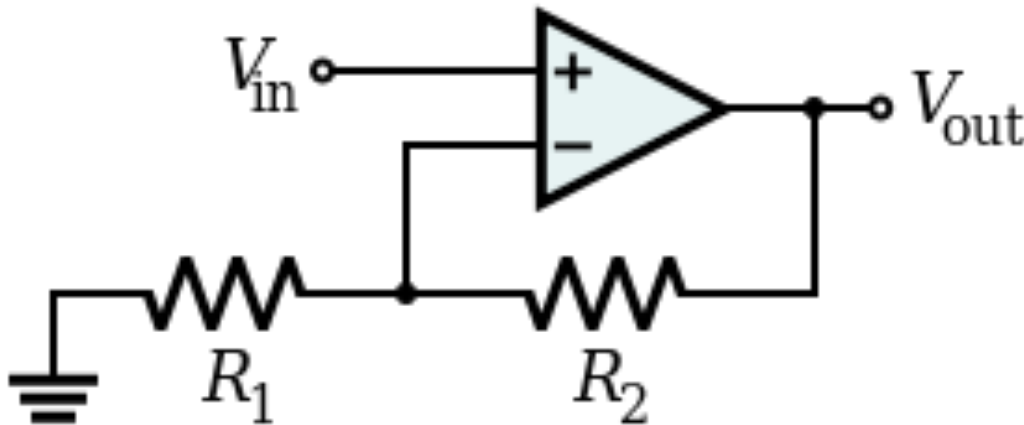
Sergio Ribeiro

Purpose

- Amplify the signal coming from a photomultiplier tube
- The background noise may swamp out the signal

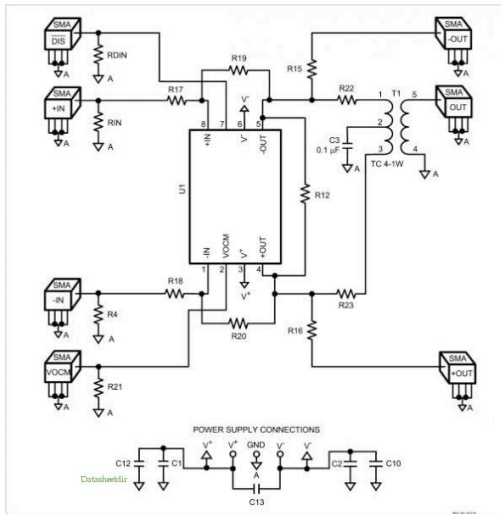
Simple Non-Inverting Amplifier

- Purpose is to amplify incoming signals using a solid-state amplifier
- Amplifiers must have high slew rate

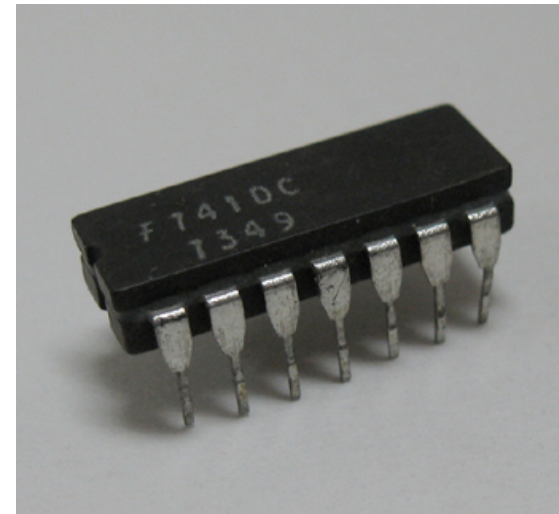


Possible amplifiers

1. LMH 730154: High speed differential amplifier
2. LM 741C: An operational amplifier that is much cheaper



LMH 730154 high speed differential amplifier



LM 741 C 14 Pin Operational Amplifier

Slew Rate

- The slew rate of an amplifier is a measure of how fast an amplifier can respond
- The slew rate of an amplifier determines what frequencies can be amplified and calculated by the formula,

$$S = 2\pi f V_p$$

- The slew rate is specified in volts/second or more commonly volts/microsecond

LM 741 C Operation Amplifier

- Pros
 - Cheaper
 - The price of a LM 741 C operational amplifier is between \$0.25 and \$0.50
 - Robust
 - This operational amplifier is fairly robust, and will handle input voltages of +30 volts and -30 volts
 - Power supply voltages of +18 volts to -18 volts
 - Operating temperature range from 0 to 70 Celsius
 - Power dissipation of 500 mW
- Cons
 - Low slew rate
 - Amplification bandwidth only extends to about 1 MHz

LMH 730154 Differential Amp

- Benefits
 - High slew rate
 - Amplification bandwidth of approximately 2 GHz
- Cons
 - Very Expensive
 - Range from \$10.00 to \$11.00
 - Small and easy to lose
 - Electronics are easily blown out by static electricity accumulated on body

Comparison of Amplifiers

- What is required
 - A high slew rate
 - An amplification within the GHz range
 - Nanosecond response time
- The clear choice is to use the more expensive LMH 730154 Differential Amplifier

Is an Amplifier Necessary?

- The gain of a photomultiplier tube (PMT) is approximately 10^6 to 10^8
- With a gain this large, an amplifier may not even be necessary
- Signals produced by many PMT's are about 10 mV to 50 mV
 - This signal *may* be drowned by background noise, but uncertain
 - This needs to be tested

Test the PMT First

- We should test the PMT first to see if we can get a discernable signal
- This would be done by giving a low light signal to the PMT and testing how large of a signal is obtained
- If the PMT signal is not easily detectable, we will move on to amplifying the signal with the LMH 730154 differential amplifier.