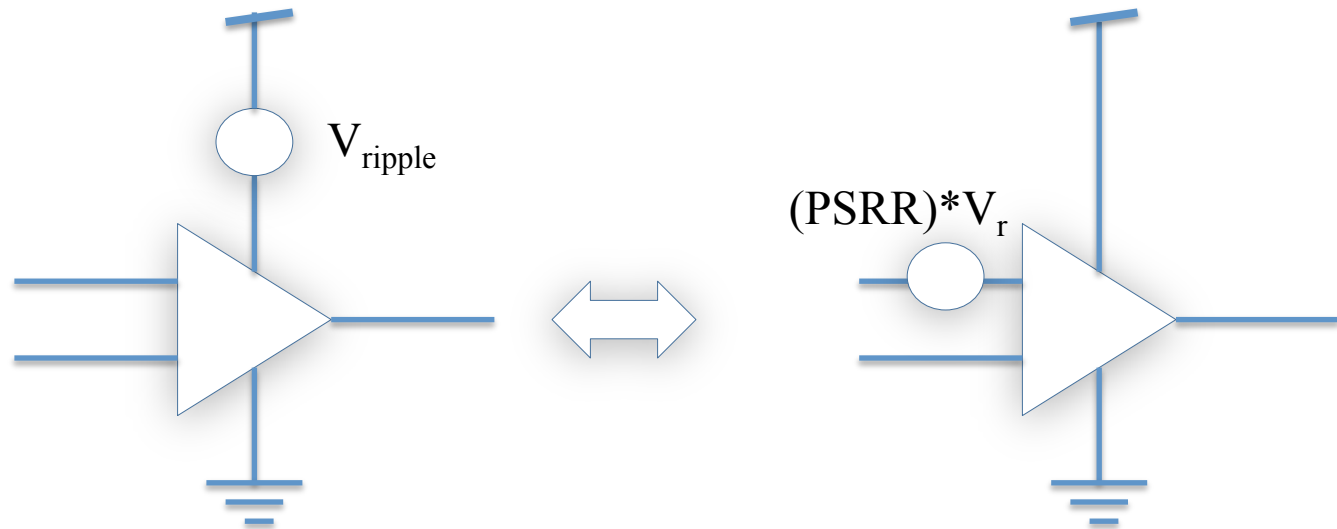




Power Supply Rejection Ratio (PSRR) VMM/MMFE8

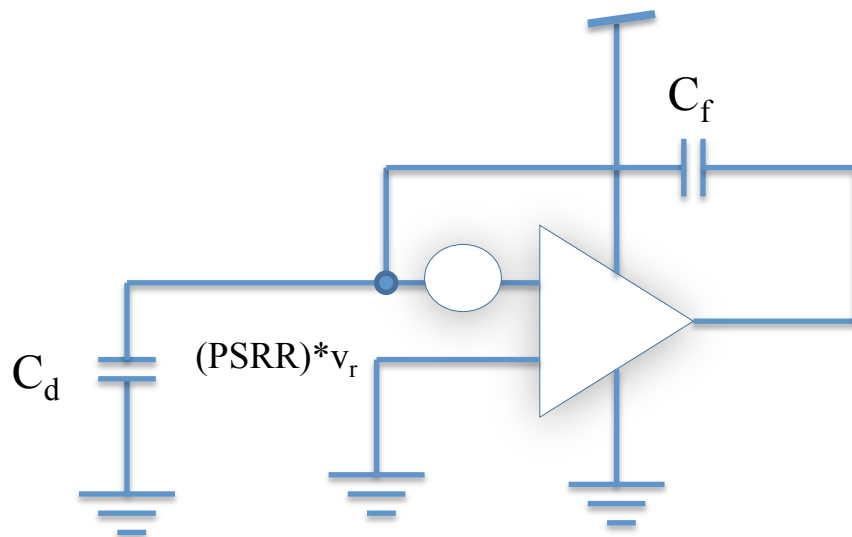


For ANY amplifier, power supply ripple will find it's way into the signal chain suppressed by PSRR

- Opamp \rightarrow PSRR very high $\sim 10^{-5}$ (- 100db or better)
- Nfet based charge amplifier \rightarrow Modest $\sim 10^{-3}$ (-60 db, my estimate)
- Pfet based charge amplifier \rightarrow Not suppressed \rightarrow PSRR ~ 1 (0 db)



Amplifier configured as a charge integrator (VMM)



- $V_{\text{out}} = (\text{PSRR}) * V_r * (1 + C_d / C_f) * \text{Gain}$

or stated in terms of equivalent input charge (enc) for VMM (PSRR ~ 1)

- $\text{Enc} \sim V_r * C_d$
- Example: for $V_r = 1 \mu\text{V}$, $C_d = 200 \text{ pf}$ (Micromegas strip)
 - $\text{enc} \sim 1,200$ electrons (0.2 fc)
 - For $\text{Gain} = 10 \text{ mV/fc} \rightarrow V_{\text{mo}} \sim 2 \text{ mV}$

[For more complete analysis, see “*Impact of Power Supply Ripple on Front End Resolution*” Gianluigi DG, 17-Jan-17 <https://indico.cern.ch/event/598168/>]



Takeaway

- Acceptable ripple on $V_{MO} \sim 1\text{mV} - 2\text{mV}$ (From George Iakovidis)
- For Micromegas, this requires $V_{\text{ripple}} < 1\text{uV}$
- Is it possible for V_{MO} to be worse than this, even if $V_{\text{ripple}} < 1\text{uV}$?
 - Yes, of course if other mechanisms present, but it can't be better.

Tests at BNL, Jan 2017

- Two day workshop with MMFE8 & small MM chamber
- Myself, Gianluigi, George, Lorne, Vinnie, & Tech from U. A.
- V_{ddp} measured directly with soldered in cable (no scope probe)
- $V_{\text{ripple}} \sim 130\text{ uV}$ (not visible without signal averaging)
- $V_{\text{ripple}} > 100\text{x}$ too high
 - $V_{MO} > \text{several } 100\text{ mV @ DC/DC converter frequency } (\sim 1.2\text{ MHz})$

Conclusions

- V_{ripple} must be reduced by more than 100x to $\sim 1\text{uV}$
- Can this be done with DC/DC converters on board?
 - IMHO, probably not but no harm in trying
 - We should certainly look at possibility of removing DC/DC converters from FEBS