Integrator and VCCS

The Operational Ammplifier Integrator Circuit

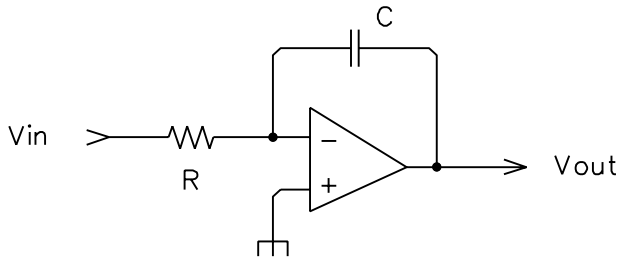

Figure 16

To understand the Integrator in Figure 16 just recall what an OpAmp does. It says, "my inputs draw no current and my output does whatever it needs to do to keep my inputs at the same voltage, independent of their voltage with respect to ground".

So if Vin above were +1 Volt then the output would need to linearly ramp in the negative direction just fast enough to force +1 Volt / R of current through capacitor C. At any instant, Vout ramps at − Vin / RC Volts per second. This is just saying that the current in the resistor and capacitor must be equal because no current flows into the OpAmp input. Whenever Vin goes to zero then Vout just sits still at whatever voltage it happens to have reached.

If we connect an Integrator to the ouput of the Phase Sensitive Amplifier in Figure 12 then we have exactly what we need to generate a Feedback signal, that is a signal that is proportional to the amount of flux from the Input Coil that we need to balance or cancle out.

Whenever the PSA output is not zero, then the integrator will ramp the Feedback signal until it drives the PSA output to zero, i.e. it will ramp until it balances or cancles out any flux from the User's Input Current and then it will automatically hold at that point. The polarity of the output from the PSA tells the integrator which direction it needs to ramp in to cancle the flux in the SQUID.

In the normal RUN operating Mode it is the voltage ouput from this Integrator that is displayed with LEDs on the QD 2010 Analog Control Unit (ACU) and presented on its front panel "OUTPUT" BNC connector.

But there is a technical problem - the output from the Integrator is a voltage but flux is proportional to current. We can not just send the Integrator output voltage to the RF Coil because the resulting flux would depend on the resistance of the RF Coil, its cables, and the various connectors. Rather we first need to make a current that is proportional to the Integrator's output voltage, i.e. use a Voltage Controlled Current Source.