# How do I implement a Constant Current / Constant Voltage (CI/CV) characteristic?

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Figure 1: CI/CV characteristic (Left). Simplified application schematic for CI/CV operation (Right)

The usual way to accomplish this is to use two error amplifiers. The I\_out error amplifier compares a sample of the output current against the current regulation reference and the V\_out error amplifier compares a sample of the output voltage against the voltage regulation reference. The outputs from the two error amplifiers are diode ored into the controller EA+ pin. Under any given operating condition, one error amplifier will be saturated high, reverse biasing its diode and the other will forward bias its diode and have control of the output. The overall effect is that you get the output voltage/current characteristic in the figure above.

 If the output current is less than the current regulation set-point then the system will be in CV mode. The V\_out error amplifier will pull the EA+ pin down to whatever level is needed to regulate the output voltage at and the diode in its output will be forward biased. However the output of the I\_out amplifier will saturate high because the load current is less than the current regulation set-point. The diode in its output circuit will be reverse biased which means that in CV mode the I\_out error amplifier has no effect on the output.

If the load current increases to the current regulation point then, the I\_out error amplifier will come out of saturation and the system will enter CI mode. The diode in its output will be forward biased. The I\_out error amplifier regulates the output current by pulling the EA+ pin down in the same way as the V\_out error amplifier was able to regulate the output voltage in CV mode. The output voltage will drop to whatever level is needed to maintain current regulation and this will cause the output of the V\_out error amplifier to saturate high, reverse biasing the diode in its output so that it has no effect on the output.

Note that the on-chip error amplifier in the UCC2895X is configured as a voltage follower and other than this it plays no part in the control loop. The on-board reference of the UCC2895X may not be accurate enough for Li Ion battery charging in particular so an external LM4132 reference may be used – as shown here. There is a reference design using this approach at <http://www.ti.com/tool/PMP8740> <http://www.ti.com/tool/PMP9622> and more information in the design review at <https://www.ti.com/seclit/ml/slup348/slup348.pdf> .