Vtrim & Paralleling.

Abstract: *This application note describes the process for paralleling the Xgen powerMod outputs in order to increase output current when using the onboard potentiometers or a dynamic Vtrim signal to set the output voltage. Please note that only powerMods of the same type should be paralleled.*

Definitions

- Front end of chassis: This is defined as the same side that the AC mains power is applied to connector J1.
- Back end of chassis: This is defined as the opposite side to that of the front end of the chassis.
- Underside of chassis: This is defined as the base of the chassis where the output module mounting screws are located.

Equipment

- Screwdriver: Philips Size 1 or equivalent.
- Pot Trimmer Screwdriver.
- Multimeter
- XP1 Parallel Link Connection Bars.

Figure 1 Equipment Needed

Current share by droop:

The Xgen power supply utilises the droop current share method for load sharing. It does this by using an error signal (set by the output current) which is added into the control loop of the converter. This results in the output voltage to operate as a function of load current. As current increases, output voltage decreases. If one *powerMod* is delivering more current than another *powerMod* that it is paralleled with, its output voltage will be forced down a little so both paralleled *powerMods* will be delivering equal current.

The Circuit:

On board each PowerMod we have a current sense resistor (R sense) from which we feed the voltage drop into a differential amplifier This allows us to get a voltage representation of the current that each module is supplying.
When the switch is closed then we feed a proportion of this data into the main feedback loop.

This has two effects

1. If the voltage is proportionally high then it will reduce the voltage on the unit. This is as a result of a higher voltage level been added by the current sense amplifier back to the feedback on the main error amplifier.
2. It will decrease the DC gain of the control loop which will increase the load regulation of the individual PowerMod.

This ensures that we see the load current being shared between the adjacent modules. It is important to note that the Current Sharing will be proportional to the dV on set up (difference between the initial voltage settings of the *powerMods*).

Section 1 below describes the process for setting the voltages on the module , where the voltages will reamin static throughout the operation of the power supply. The Xgen has the added feature set in that paralleled units can have their voltages adjusted on the fly, by means of the Vtrim pin. Section 2 will provide details on how to setup the units for this mode of operation.

Section 1: Procedure for Paralleing , set & forget.

When connecting *powerMODs* in parallel, the following steps should be followed to maximise the effectiveness of current sharing:

1. Ensure that the *powerMod* DIP switches on each *powerMod* is switched to I-Share ON.

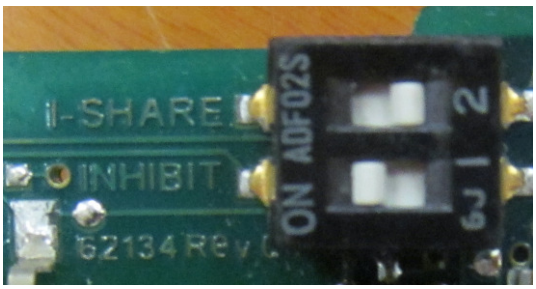

Figure 2 I-Share OFF

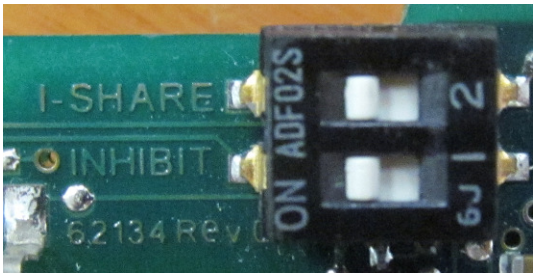

Figure 3 I-Share On

2. Insert *powerMods* in the back end of the chassis.

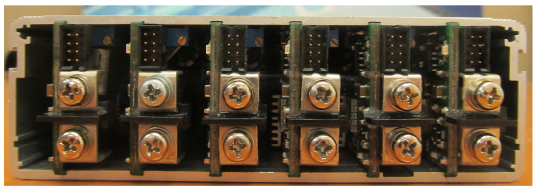

Figure 4 Xgen Modules

3. Attach the negative Parallel Links (XP1) to all modules being paralleled.

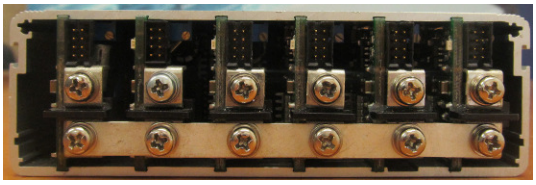

Figure 5 Xgen with Negative Links

4. Set the voltage of *powerMod* 1 to the output voltage required using the onboard potentiometer.

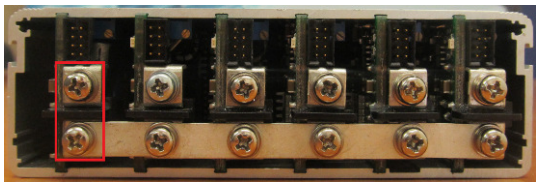

Figure 6 Set powerMod 1 Voltage

5. One by one, measure the voltage difference (dV) between the positive terminals of the *powerMod* 1 and the remaining *powerMods* and adjust them to minimise dV using their onboard potentiometers (typically to within 5 mV).

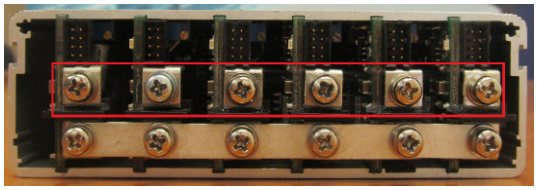

Figure 7 Minimise dV for powerMods

6. Attach the positive parallel links.

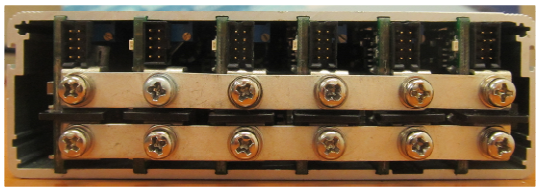

Figure 8 Xgen with Positive and Negative Links

The percentage of current sharing can be calculated as follows:

I-Share error % = 10000dV / 1.5 V_{max}

Remote Sense can be implemented as with a single *powerMod*. Simply connect the sense pins of the paralleled *powerMods*. Bring the sense connections from one of the *powermod* to the load.

Section 2: Paralleling while utilising a Dynamic Vtrim

When the same Vtrim signal is applied to two different modules, their output voltages will be slightly different due to the tolerances of the components used in the Vtrim circuitry. These components are outlined in Fig 9 below.

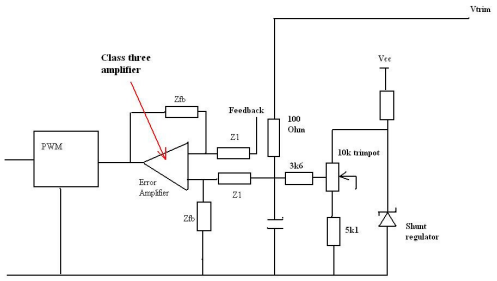

Figure 9 Xgen Modules

As we have seen previously, this difference (dV) will result in a poor current share.

However, if we use the following configuration procedure we can compensate for these component tolerances (even when using a dynamic Vtrim signal).

1. Determine the dynamic trim range of the Vtrim signal that will be used in the application. We will then optimise for the midpoint, i.e. for a 12 V to 24 V output, we will optimise for 18 V.
2. Ensure that the *powerMod* DIP switches on each *powerMod* is switched to I-Share ON.

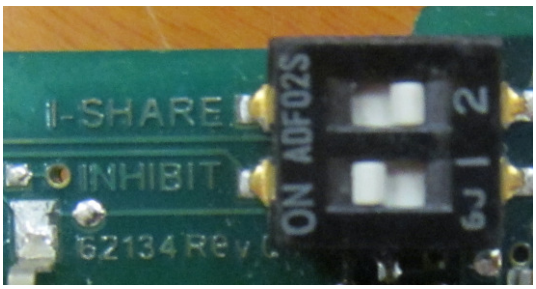

Figure 10 I-Share OFF

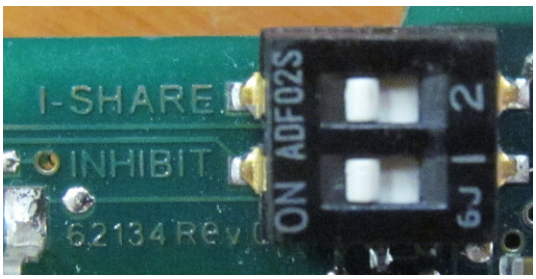

Figure 11 I-Share On

3. Insert *powerMods* in the back end of the chassis. Trim all modules to their nominal voltage outputs using the onboard potentiometers.

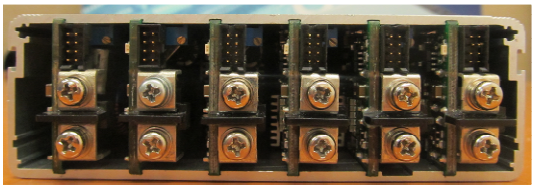

Figure 12 Xgen Modules

4. Attach the negative Parallel Links (XP1) to all modules being paralleled.

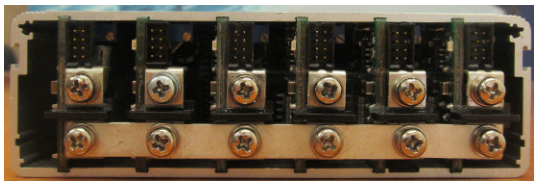

Figure 13 Xgen with Negative Links

5. Apply a Vtrim signal to all *powerMods* being paralleled. This should be from a single source (i.e. all Vtrim pins of paralleled *powerMods* are connected together, all –Sense pins of paralleled *powerMods* are connected together). See the designers' manual if more information on the Vtrim process is required.

6. Trim the applied Vtrim signal until the output of *powerMod 1* is the midpoint voltage determined in step 1.

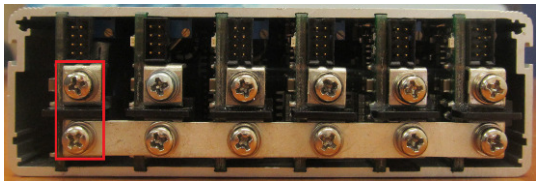

Figure 14 Set powerMod 1 Voltage

7. One by one, measure the voltage difference (dV) between the positive terminals of the *powerMod* 1 and the remaining *powerMods* and adjust them using their onboard potentiometers to minimise dV. (typically to within 5 mV).

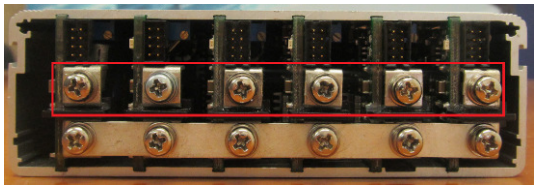

Figure 15 Minimise dV for powerMods

8. Attach the positive parallel links. Once the positive links have been attached, **Do Not** remove the Vtrim connections. Without the Vtrim connection the modules may be trimmed to very different voltages, and so should not be paralleled.

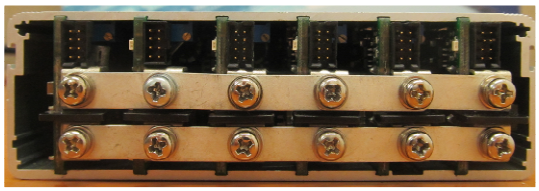

Figure 16 Xgen with Positive and Negative Links

If the above process is used, the Xgen will have a good current share at the midpoint of operation, and very good optimisation across the range of dynamic trim operation.

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