35 Hampden Road
Mansfield, MA 02048-1807
Phone: (508)823-8080
Fax: (508)339-0375

Special Considerations for MicroVerter

General Description

Applying the MicroVerter® Triple output modules is nearly identical to applying the single output modules. There are, however, a few special aspects of applying the triples that must be considered. These aspects are discussed in this application note:

- power limitations
- minimum load
- output configurations
- common ground connections
- or'ing diodes for the auxiliaries
- paralleling

Implementation

Power Limitations

Because of thermal considerations, the triple output modules are limited to 185W of total output power. Any combination of loads on the three outputs may be used within the ratings of each output. However, all outputs can not be used at their maximum ratings simultaneously. Because there is no internal power limiting circuit it is up to the designer to ensure that the maximum output power rating is not exceeded.

Minimum Load

The triple output modules require a minimum load to maintain regulation of the auxiliary outputs. The minimum 5V load required is dependent on the amount of power drawn from the auxiliary outputs, and is shown as a graph on the data sheets. If the minimum load requirement is not met the auxiliary output voltages will be low and will probably not meet their ripple and noise, or transient response specifications. Operation under this condition will not damage the module.

Output Configurations

All of the outputs of the MicroVerter triple output modules are galvanically isolated from each other. They can therefore be connected in almost any series, parallel, or isolated configuration. For example, the module can be configured as a +5V, +12V, -12V supply, a +5V, +15V, +30V, or a +5V, +12V with a higher current capability. Care must be exercised, however, that the output isolation ratings of 500V (200V for the uv28 series) from output-to output and from output-to-case are not exceeded. For example, while one of the auxiliary supplies might make an excellent bias supply for a high side switch on a 48V supply it would not work for a similar application using a 500V supply.

Connecting the auxiliary outputs in parallel has to be done carefully as well. Since the auxiliaries are linear regulated, one of the outputs will take the entire load up to the point where it reaches its current limit. Then, as the first output begins to drop in current limit mode, the second auxiliary output will supply the remaining current. Current sharing between the auxiliaries can be improved by adding a small resistance in series with each output prior to the parallel connection. An example of this is shown in *Figure 14a*.

Common Ground Connections

In applications that require a common ground connection Astrodyne recommends that a common mode choke be placed on each auxiliary output as shown in *Figure 14b*. These chokes prevent common mode noise on the auxiliaries from being converted to differential mode noise on all the outputs.

35 Hampden Road
Mansfield, MA 02048-1807
Phone: (508)823-8080
Fax: (508)339-0375

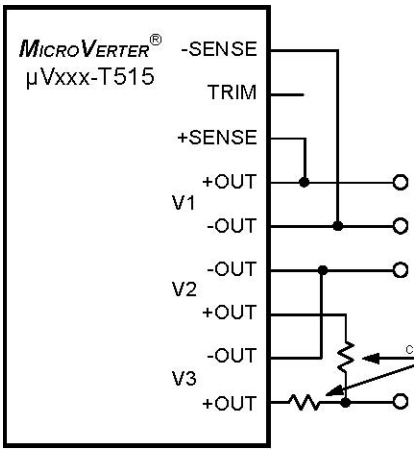


Figure 14a Add resistors to the auxiliary outputs to promote current sharing when combining the outputs for more current

Figure 14c shows the effects of adding the common mode chokes. Astrodyne recommends the 28F0248-6TO from Steward Manufacturing Company. This choke provides excellent noise reduction at a very low cost and was used to generate the graphs in *Figure 14c*. Also available for surface mount applications is the 2744051447 from Fair-Rite Products Corp.

The bypass capacitors shown in **Figure 14b** are necessary to achieve the desired noise reduction. Additional bypassing or bulk storage capacitors can also be used to further reduce the noise levels or improve transient response.

Applications where the load has a lot of very low ESR bypass capacitors may be able to forgo the common mode chokes. We have seen computer applications with acceptable noise levels where the motherboard was extremely well bypassed and cables were used connect the supply to the loads. This approach, however, is generally not recommended.

Applications using connections other than the common ground connection may also benefit from using common mode chokes on the auxiliary outputs.

OR-ING Diodes for the auxiliaries

When using or'ing on the auxiliary outputs the designer has to keep in mind that there is no remote sense available to compensate for the diode drop. The designer must therefore accept the diode drop as part of the output accuracy and regulation performance. *Table 14a* lists some candidate, low Vf or'ing diodes for the auxiliary outputs. All Vf data in the table is for Tj = 25°C. The voltage drop will be lower at higher temperatures; except for the 1N5820; which has almost no change in Vf at 3A over the 25°C to 100°C temperature range. This makes it a good choice for applications requiring excellent regulation vs. temperature.

Paralleling Triples

Paralleling MicroVerter triple output modules is nearly identical to paralleling MicroVerter single output modules (See AP-13.) There is, however, one significant difference between the two. One of the main goals in paralleling modules, whether for improved reliability or for increased power capability, is to have the modules share the stress of powering the load equally. The most common method of ensuring this is to require output current sharing. With the MicroVerter triple output modules a slightly different philosophy has to be used.

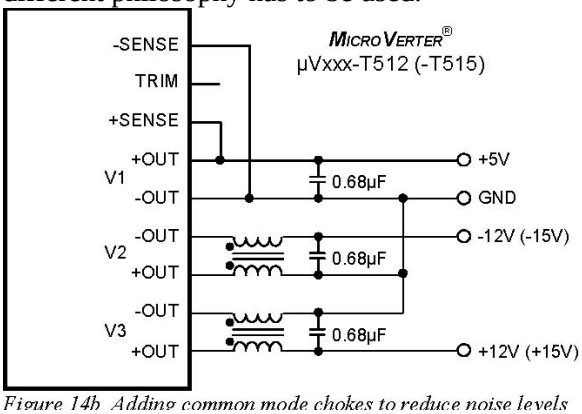


Figure 14b Adding common mode chokes to reduce noise levels

The control circuits that provide the current sharing properties of the MicroVerter modules are located on the primary side of the transformer. As such, the MicroVerter modules essentially share input power. With single output modules there is only one path for the power to

35 Hampden Road
Mansfield, MA 02048-1807
Phone: (508)823-8080
Fax: (508)339-0375

take - through the main output. Since all of the paralleled outputs are constrained to have nearly the same output voltage the modules are forced to have the nearly same output current and current sharing is achieved. With triple output modules the power can take three different paths. Because the control circuits are on the primary side they can't determine or control how much power each output of the triple is providing; they can only control how much input power the module consumes.

It is therefore possible that one triple module in a paralleled system will provide more power from an auxiliary output while another one will providing more power from the main output. All the time, however, the modules will draw the same input power and therefore will have roughly the same amount of internal heating and stress.

Triple modules can be paralleled like the single output modules. However, the designer must keep in mind that the goal is not to achieve current sharing, but to achieve stress sharing. And, that with the triple output modules; the overall system will have improved reliability because the stress of powering the load is evenly distributed among all of the modules.

Table 14a Some Or'ing diode candidates for the auxiliary outputs

DEVICE Vr Vf @ 3A MAX Package	Features
IR95SQ015 15V 0.27V DO204 MOT 1N5820 20V 0.48V DO204	Lowest Vf in axial package Very low drift of Vf vs. Tj in 2-3A range
IR32CTQ030 30V 0.40V T0220AB IR30CPQ035 35V 0.38V T0247	30V, dual 35V, dual
MOT MBR3035PT 35V 0.38V TO247, TO248	35V, dual

Possible Applications

Paralleling for Increased Power - The MicroVerter triple output modules can be paralleled to increase the system power beyond the 185W limit of an individual module.

Configuring Output Power -The outputs of the triple modules can be configured in many ways to get the output power, voltage, and current capability required. They can also be combined with other RO modules for complete system design flexibility.

Providing n+m Redundancy -The triple output modules can be paralleled using or'ing diodes, PDMs, and other components to provide n+m redundancy for improved system reliability.

Hot plug-in Applications -The triple output modules can be paralleled using or'ing diodes, PDMs, and other components to provide hot plug-in assemblies for replacement and repair with zero down time.

Voltage sensitivity of PARALLEL pin - If the PARALLEL-ON/OFF pin voltage, applied or induced, exceeds 6V, the module can fail. RO recommends connecting a 6.2V -1W Zener diode from PARALLELON/OFF to –IN. The Zener should be located as close to the module as possible.
For proper converter operation, the pin should be left floating, not forced high. Always use a mechanical switch or open collector to control the pin. Never apply an external voltage to this pin.

Noise sensitivity - The PARALLEL-ON/OFF pin is noise sensitive. If the traces or cables connecting to this pin are more than an inch long, or if the environment is electrically noisy, connect a capacitor from PARALLEL-ON/OFF to – IN. A 0.022µF NPO ceramic capacitor is normally recommended. If wire cables are used for the disable function, use a twisted pair, or better, use coax cable.

35 Hampden Road
Mansfield, MA 02048-1807
Phone: (508)823-8080
Fax: (508)339-0375

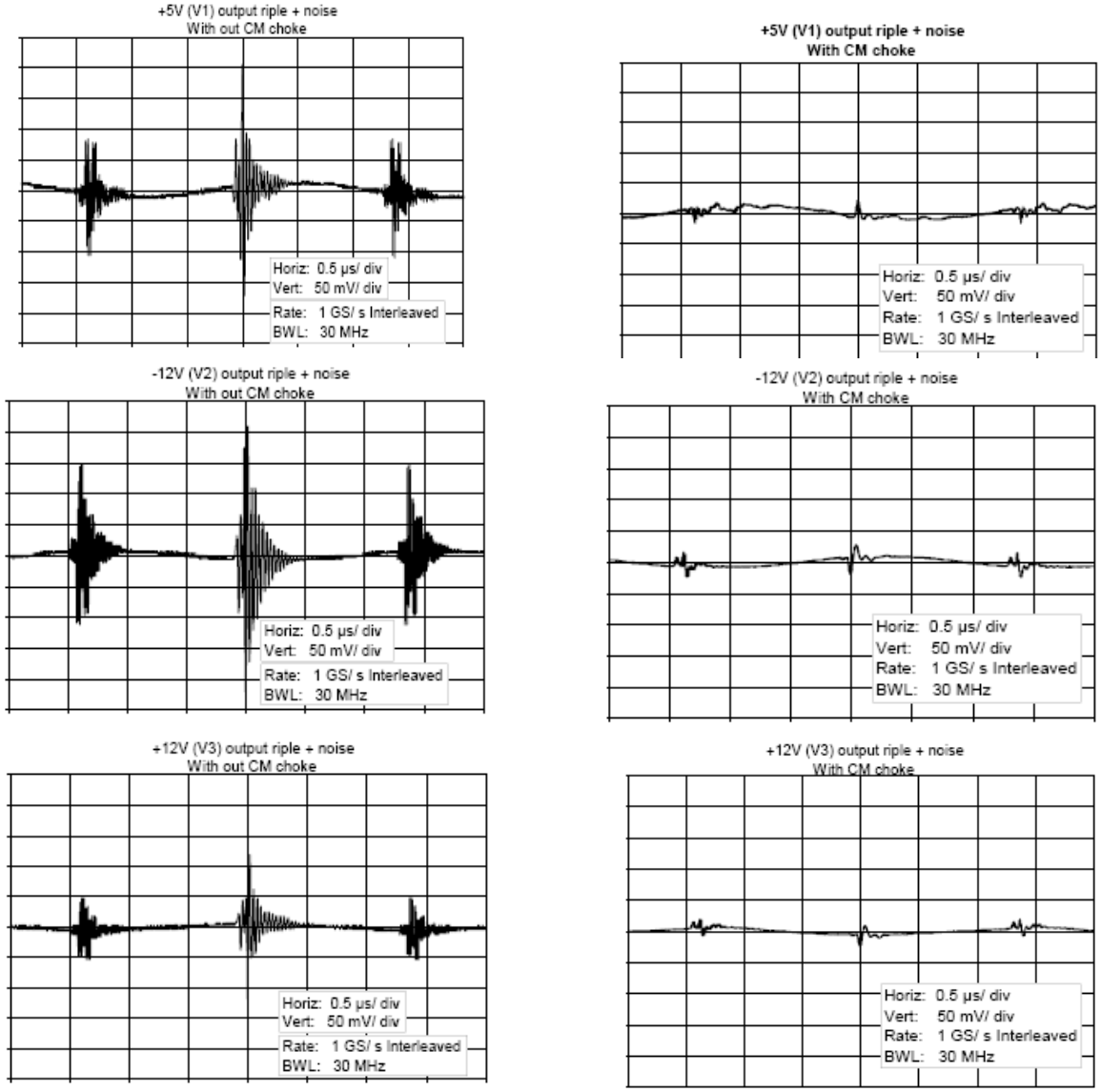
Related Topics

AP-3 Input Ripple Measurement and Filtering
AP-5 Output Voltage Trimming
AP-9 Trimming Paralleled Modules
AP-13 Paralleling with Current Sharing and n+m Redundancy
AP-18 Board Layout Considerations and Recommendations
AP-19 Hole Dimensions and Socket Information

Precautions

Do not exceed power rating -Exceeding the 185W power rating of the triple modules can cause overheating and may result in damage to the module.

Figure 14c Oscillographs showing the effect of adding a CM choke to each auxiliary output



08172010revA