

## Overview

This Application Note was written to provide an insight into issues surrounding the connection of the common pin (COM Pin) for all output module control applications.

## Background

Vox Power single output modules provide an advanced voltage and current control system using three signal pins;  $V_{CONTROL}$ ,  $I_{CONTROL}$  and COM. However, to attain the best performance careful attention must be given to the connection of these signals to minimise control errors and prevent damage to the output modules.

## Details

Figure 1 below shows three typical output module application setups.

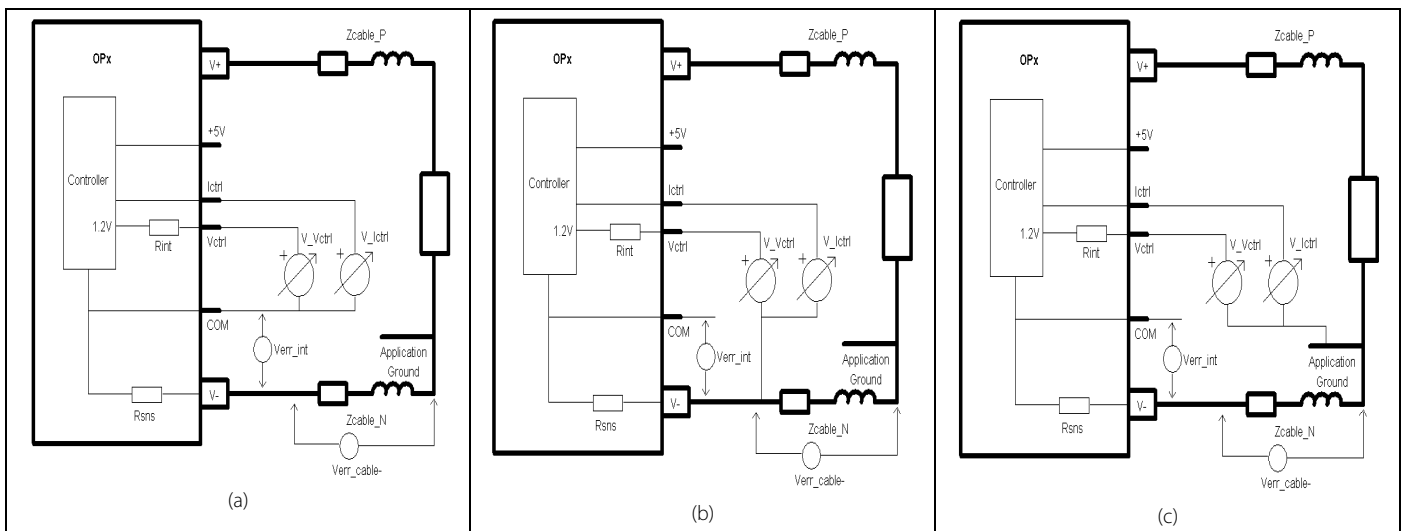


Figure 1 – Typical output module application setup's. (a) Preferred setup, (b) less accurate setup, (c) least accurate setup

The diagrams show the internal connection of the COM signal and the cable paracitic components which can give rise to error components in the control signals. We can see that the connection point of the COM signal in the application can have a significant affect on the error components in the control signals. Figure (1a) shows the preferred setup which has no error components in the control voltages. Figure (1b) has slightly more error components due to the internal sensing resistor (R<sub>sns</sub>). R<sub>sns</sub> is reasonably well defined and will generate approximately 30mV of error voltage when the module is fully loaded and the effect of this can be calculated using the equations in the user manuals. Figure (1c) has the most error components due to internal and external (cabling impedance) sources. This error source is not very well defined and may change with environmental conditions and/or over time. Dynamic loads reacting with cable inductance can generate large voltage errors which, although temporary, may produce partuculary poor outcomes.

At first glance the solution to these issues seems to be to connect the COM signal to the application ground. This however is wrong and can actually damage the module. By connecting the COM signal to the application ground we would be interfering with the signal coming from  $R_{sns}$  and this can have damaging consequences. **The COM signal should never be connected to V- or any of the associated cabling.**

In cases where it is necessary to reference the control signals to the application ground we can use other methods to minimise the error components within the control signals. Figure 2 below shows one such method.

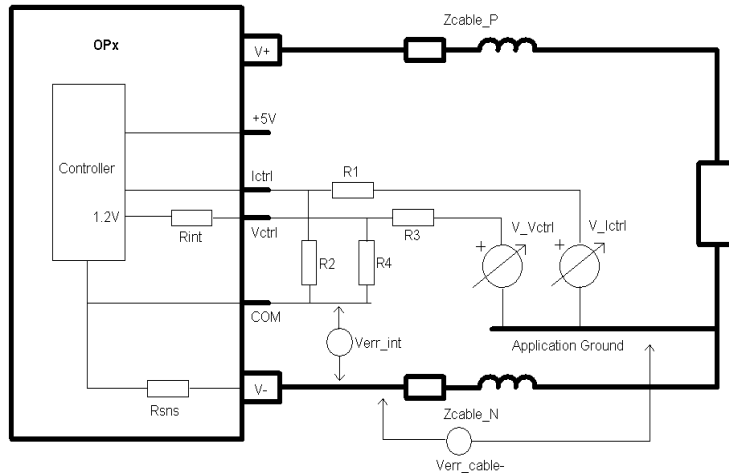


Figure 2 – Minimising control error using resistor divider

In this setup, the control voltages are referenced to the application ground and the COM signal is left floating. Two resistor divider chains R1, R2 & R3, R4 are used to divide down the control signals but also the error signals. If a large divider ratio is used then the error components will be minimised at the expense of using higher control voltages.

Another method that can be used is shown in figure 3 below.

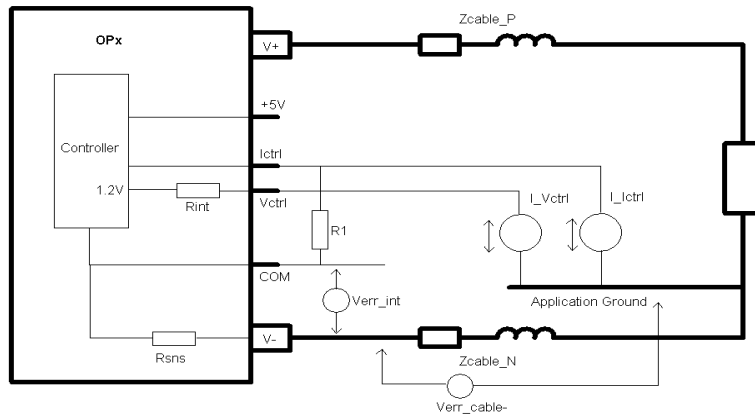


Figure 3 - Minimising control error using current sources

In this method the control voltage sources are replaced with current sources that are capable of sourcing and sinking current. This completely eliminates all control errors as the  $V_{CONTROL}$  current source works with  $R_{INT}$  and the  $I_{CONTROL}$  current source works with R1 to generate the required control voltages referenced to the COM signal.

For the methods outlined in figures 2 and 3 it may be necessary to add local capacitance from  $V_{CONTROL}$  &  $I_{CONTROL}$  to COM in order to control noise and filter some of the larger dynamic effects of the cable inductance.

# Conclusion

Vox Power single type output modules can be very versatile and flexible when their advanced controls are implemented correctly. However, carefull attention must be paid to COM signal connection in order to minimise errors and prevent damage. In applications where it is impractical to reference control signals directly to the COM signal, there are a number of methods that can be used to overcome any potential issues.

If there is ever any doubt about the correct wiring or application setup, you can always contact Vox Power Technical Support who will be happy to help!