Remote Sensing

(+ SENSE, - SENSE)

General Description

The remote sense feature provides excellent regulation at the load rather than at the HDM module output terminals. It does this by sensing the voltage at the load. This allows the module to compensate for load current IR drops across the output connectors, printed wiring board traces and distribution cables, as well as applicable oring diode forward voltage drops. Although available on all models, remote sense is most useful for high current (low voltage) modules where IR drops can be significant.

The amount of remote sense compensation on Rantec's standard modules varies depending upon the specific model. The data sheet should be consulted for each specific model. If the voltage drop between the output terminals of the module and the load exceeds the amount shown in the module's data sheet, other design changes, such as increasing conductor size or decreasing connector resistance may need to be considered. If this is not possible or not practical, and remote sense compensation greater than the amount shown in the module's data sheet is needed, please consult the factory, as it may be possible for Rantec to accommodate your unique system needs.

Voltage drops across external series resistance (IR drops) vary with output current. If the load current remains relatively constant, or if the changes in the voltage at the load due to system IR drops can be tolerated, it is recommended that the trim function of the module be used rather than remote sense (See HDMA-104 Output Voltage Trimming).

Output voltage trim increases the output voltage by a fixed amount to compensate for static IR drops between the power module and the load. Remote sense adjusts the output voltage dynamically to compensate for variable IR drops due to load current changes.

Implementation

The remote sense terminals of the HDM module must always be connected, either to the output terminals or to the respective load. To achieve remote sensing, connect the +Sense lead to the + load termination and the –Sense lead to the – load termination as shown in Figure 1. The sense lines should be connected at the point at which regulation is desired, as the module will regulate the voltage at the point at which the sense lines are connected.

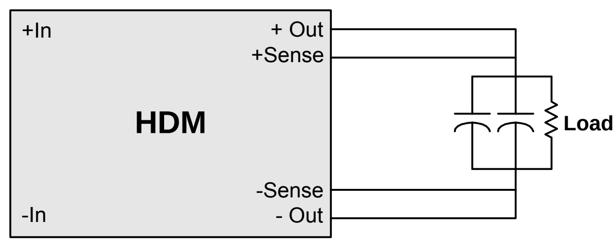

Figure 1. Remote sense implementation showing the remote sense leads and filter capacitors connected at the point of load.

To reduce noise susceptibility, parallel a tantalum capacitor and ceramic capacitor across the remote sense terminals where they are connected to the load as shown in Figure 1. A typical value for a 5V module might be a 330uF tantalum capacitor in parallel with a 1uF ceramic capacitor. Noise filter capacitors are especially helpful when the remote sensing leads exceed 1 foot in length.

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Precautions

Improper use of the remote sense feature can introduce noise into the module's feedback loop, potentially resulting in noise or oscillations at the module's output. There are several ways to minimize remote sense system noise pickup.

1. If using wires for remote sense lines, use shielded and/or twisted leads. In addition, use shielded and/or twisted leads for the load lines.

2. If using a printed wiring board for remote sense lines, route the lines in close proximity to each other and use a ground shield layer to shield the lines. In addition, route the load lines in parallel planes in opposite layers. For example, the +Vout load trace might be routed on layer 1 with the –Vout load trace routed on layer 2, directly below the +Vout trace. Also, consider using a ground shield layer within the printed wiring board to shield the load lines from potential system noise pickup.

3. If the system needs can tolerate it, consider avoiding using the remote sense feature by using the trim feature of the module by trimming the module to the desired output voltage.

Open Sense

If the sense lines fail open circuit, the output voltage of the module will rise to the over voltage protection set point. If there is any possibility of this occurring in the system and the system cannot tolerate the over voltage protection level of the module applied to the system load, consider connecting resistors from +Vout to +Sense and –Vout to –Sense (see figure 2). If the remote sense lines fail open with these resistors connected, the output voltage will rise only a few percent. The resistor value should be about 10 times the output voltage. For example, for a 5V module, 50 Ω resistors should be used. For a 12V module, 120 Ω resistors should be used. These resistors dissipate very little power during normal operation. It is only during the unique situation of "shorted sense" that the resistors will dissipate any significant power (see "Shorted Sense").

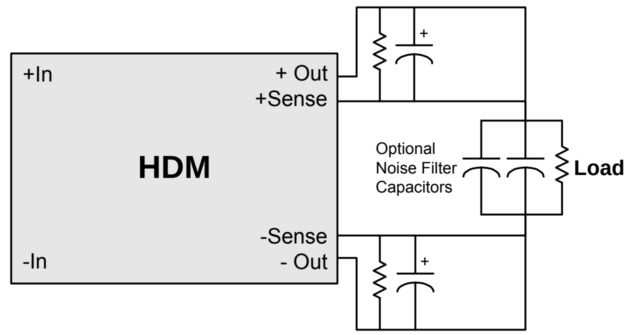

Figure 2. When there is a possibility of remote sense leads failing open, connect a resistor from each SENSE terminal to its respective OUT terminal at the converter. If there is high parasitic inductance, connect capacitors in parallel with the resistors (observer polarity).

Shorted Sense

If the sense lines are shorted while they are not connected to their respective output power terminals, then the module's output voltage will rise to the over voltage protection set point level. If the resistors are connected between the output power terminals and the sense lines as shown in Figure 2, the resistors will dissipate a significant amount of power during a shorted sense condition. For example, if a 5V module using 50 Ω resistors were to have its sense lines shorted (while not connected to their respective output power terminals), the output voltage of the module would rise to its over voltage protection set point. The power dissipated in the resistors under this condition would be calculated as follows:

$$P_{Diss} = (Vovp)^2 / (2R) = (6)^2 / (2 * 50) = 0.36W$$

Each resistor would dissipate half of that or 0.18W. Proper selection of wattage rating of the resistors needs to be considered. Resistors rated for 1/2 watt each would be a good choice.

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Reverse Sense

Reversing the sense lines, that is, connecting the +Vout power terminal to the –Sense terminal and the –Vout power terminal to the +Sense terminal must be avoided, as it would likely cause damage to the module.

High Parasitic Inductance

As previously discussed, all precautions should be taken to minimize the parasitic inductance of both the load lines and the sense lines in a power system. If these precautions were not taken during the design phase of the power system or if it is not possible to keep the parasitic inductance to a minimum, capacitors can be added between to the +Vout and +Sense terminals and between the –Vout and –Sense terminals (See Figure 2). Generally, if the sense lines in a power system exceed one foot in length, utilizing these capacitors should be considered. These capacitors can help stabilize the module. The capacitors should be physically located near the pins of the module, as opposed to at the power system load. The minimum necessary value for these capacitors is dependant upon the amount of parasitic inductance in the load lines and sense lines in the power system. The value of this inductance can be difficult to determine. Using large value capacitors is therefore recommended for power systems that have large parasitic inductance. A 150uF/10V tantalum capacitor would be a good choice for a 5V module. Take note of the polarity of these capacitors shown in Figure 2.

During normal operating conditions, these capacitors have very little voltage across them. The capacitors essentially have about half of the remote sense compensation voltage across each of them. For example, a power system utilizing a 5V module might normally have about 0.1 to 0.2V across each of the capacitors. However, if a “shorted sense” condition could possibly occur (see “Shorted Sense”), the voltage rating of these capacitors needs to be taken into account, as the capacitors can see up to the entire output over voltage protection level of the module during a shorted sense condition.

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