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Power Supply "Remote Sense" Mistakes and Remedies

Most medium to high power AC-DC power supplies and some DC-DC converters include "Remote Sense" connection points (+ and - Sense) that are used to tightly regulate the supply's output voltage at the load. Since the output cables that connect a power supply's output to its load have some resistance, as current flow increases, so will the voltage drop across the cables (I x R = Voltage Drop). Moreover, since it's best to regulate the voltage directly at the load, the use of the two Remote Sense wires connected from the supply to the load will compensate for these unwanted voltage drops. Refer to Fig. 1 which shows the typical connections when the Remote Sense function is used.
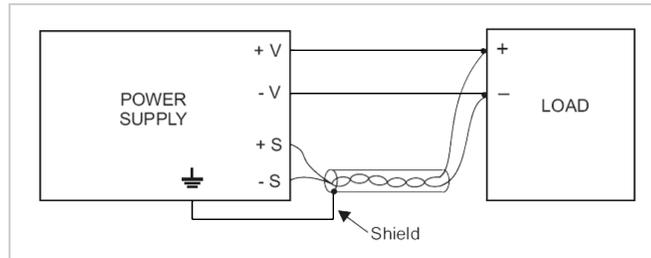

Fig. 1: Power Supply with Twisted "Remote Sense" Wires Connected to the Load

Typical "Remote Sense" Problems & Remedies

1. Most remote sensing circuits are capable of compensating for from 0.25V to 0.75V of voltage-drops across the output cables. However, to be sure, always check your power supply's instruction manual to determine its maximum remote sense compensating range. If the voltage drop across the output cables exceeds the compensating range of the remote sense circuits, the voltage at the load will no longer be regulated. This problem can be remedied by either reducing the length of the output cables or increasing the size (heavier wire gauge) of the output cable's to reduce the excessive voltage drop. Voltage drops across the output cables should be minimized since this is a source of wasted power. For example, with just a 0.5V cable drop with a 100A load, the lost power amounts to 50W in each cable or 100W total.
2. The remote sense function automatically increases the output voltage at the output terminals of the supply to compensate for any unwanted voltage drop in the output cables with heavy load currents. Likewise, the remote sense function decreases the output voltage of the supply when the required load current is reduced. In some applications, the power supply's output needs to be adjusted by the user to voltage higher than its nominal (e.g. 5V nominal, adjusted to 5.5V). Always adjust the power supply's output while measuring the voltage at the load. In addition, care should be taken to assure that under full load that the remote sense function does not push the Vout to a higher voltage that could possibly trip the OVP set-point and shutdown the supply. Therefore, always read the power supply's instruction manual to be aware of the supply's adjustment range and OVP set-point.
3. The remote sense leads carry very little current so light gauge wires can be used. However, steps should be taken to ensure that the remote sense wires do not pick up radiated noise by either twisting the + and - Sense wires together and/or by shielding the wires from the noise (refer to Fig 1). It is best to use different colored sense wires (e.g., black and red) so that after they are twisted it is easy to determine which wire is the + and – Sense.
4. Refer to **Fig. 2** below for a simplified schematic of a power supply's remote sense circuits. It is important to observe the correct polarities, i.e., the +Sense wire should connect at the load near the +Vload connection and the –Sense wire should connect at the load near to the – Vload connection. If by mistake the remote sense wires are crossed-connected (+Sense to –Vload and – Sense to +Vload) current will flow in the Sense lines and burn out the internal Rsense resistors, causing a malfunction of the supply. Typically, these internal Rsense resistors are around 10 to 100 Ohms with a maximum rating of 0.5W.
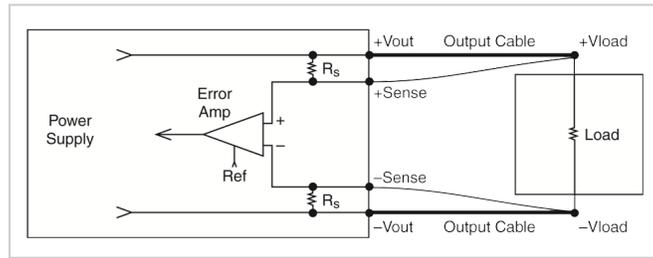
Fig. 2: Simplified Schematic of Remote Sense Circuit with External Output & Sense Wires

5. We have seen applications where the user has installed a switch or fuse in series with one or both output wires. This can cause a serious problem if the remote sense lines remain connected to the load, because if the output cable switch or fuse opens, current will flow in the sense lines and cause the internal Rsense resistors to burn up. System debugging can cause similar problems, for example, where the power and sense cables are located on separate connectors and if by error, only the power cable connector is disconnected.

6. There are applications where the user may not want to use the remote sense feature. In these cases, the remote sense lines should not be left open for optimum load regulation; instead, a local sense configuration must be used. Referring to Fig. 3, to use a local sense set up the + and -Sense lines should be connected to either their corresponding local sense (LS) terminals, which are provided on many power supplies, or connected to the corresponding +Vout and −Vout terminals. Most power supplies are shipped from the factory with these "Local Sense" jumpers installed on the power supply (see photos below).
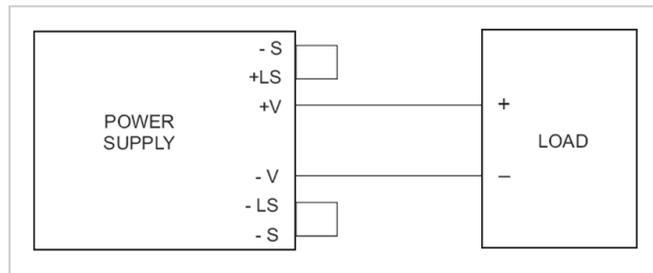

Fig. 3: Schematic of Power Supply with "Local Sense" Jumpers Installed

Photo of Power Supply with Local Sense Wires Connected (see Red & Black jumper wires)

Photo of PSU with Sense Screw Terminals Connected to Output Screw Terminals with Metal Jumpers

In summary, the "Remote Sense" feature automatically compensates for unwanted output cable drops, which vary as the output current increases and decreases. This feature is advantageous to the user, but is subject to mistakes that should be avoided to insure the proper operation of the power supply and the end-product.

Posted by [Power Guy](#)