Add On-Board Power Measurement Capability To Telecom Equipment

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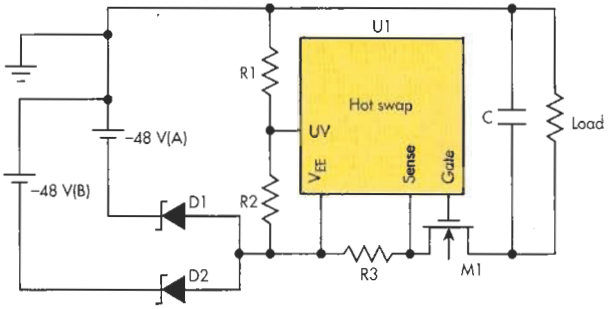
This idea shows how to monitor input voltage and current consumption for telecommunications equipment powered by two independent feeds: –48 V (A) and –48 V (B). Each feed supplies at least –42.5 V to –56.5 V, and for redundancy the feeds are ORed on the module. For maintenance and support purposes, it's important to monitor input voltage, the feeds' presence, and the module's power consumption.

Figure 1 shows a simplified front end of a commonly used power section for telecom equipment. The feeds are ORed through D1 and D2. The hot-swap circuit (U1) gradually powers up a load (data-processing side) as soon as the ORed voltage exceeds an undervoltage threshold defined by R1 and R2. R3 is a sense resistor that provides U1 information about the incoming current. The addition of several components allows users to measure the incoming current (through R3) and the ORed voltage at UV on U1.



1. A simplified front end of a commonly used power supply for telecom equipment includes a pair of ORing diodes for the two independent –48-V feeds.

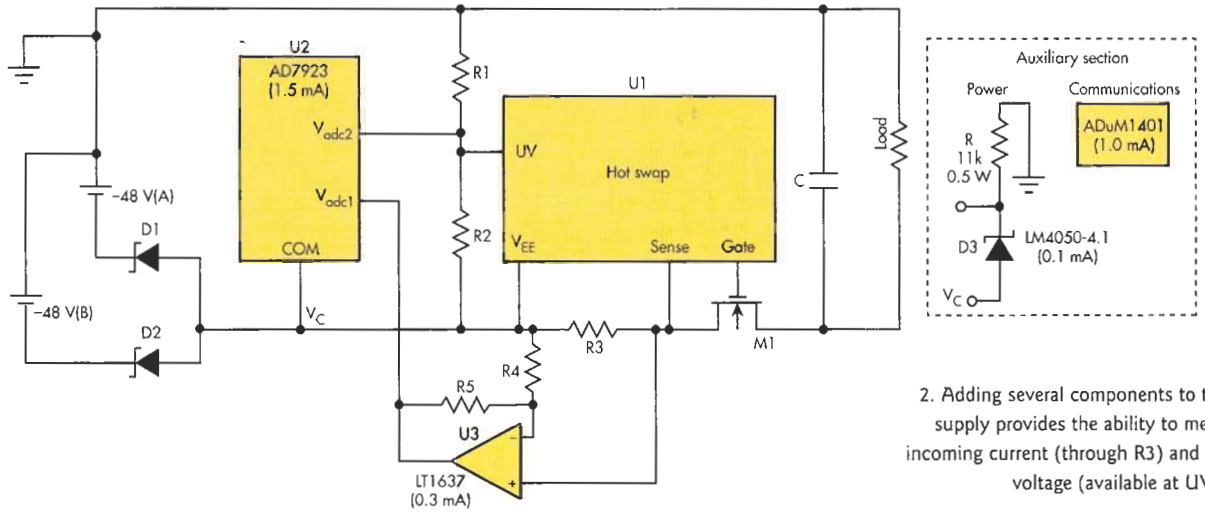
These measurements require an analog-to-digital converter (ADC) on the entry (primary) side and most likely an isolation barrier on the secondary (data processing) side to transfer the data *(Fig. 2)*. Analog Devices' AD7923 was used as the analog-to-digital converter (ADC) and an ADuM1401 can provide the isolation and all data communication paths (auxiliary section in Figure 2). A local power source for this activity is required.

Resistor R in the auxiliary power section is calculated to provide the required amount of power if either feed is over about 37 V. The precision op-amp U3 will improve the measurement accuracy when a very low value sense resistor (R3) is used.

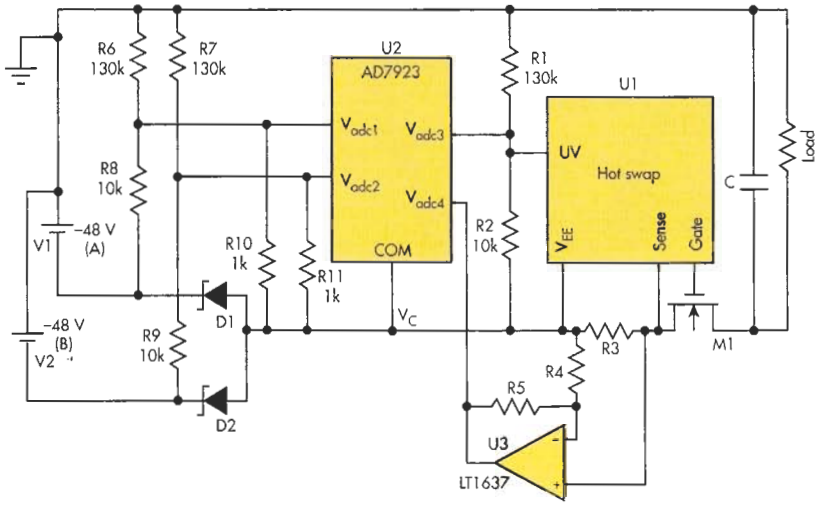
Keep in mind that each milliamp consumed on this side may equate to 56 mW of power wasted. Thus, special attention must be paid to make the design as power frugal as possible. The maximum operating current for each part is shown in parentheses in Figure 2.

If two more ADC inputs are available, the design can be extended to measure the value of each feed independently *(Fig. 3)*. The auxiliary section (omitted) is the same as for Figure 2.

Note that the voltages are coming from two independent sources, making the ADC's common point (COM) a floating one. It will be equal to the larger voltage minus the diode drop. Since a direct conversion of the signal measured at V_{adc1} and V_{adc2} to the corresponding voltage is impossible, the following algorithm has to be used:



2. Adding several components to the power supply provides the ability to measure the incoming current (through R3) and the ORed voltage (available at UV on U1).



3. Employing the additional inputs available on the ADC allows each feed's value to be measured independently.

1. The ADC acquires the signal from all four inputs.

2. The current is calculated as: $I = (V_{adc4} * R4)/[R3 * (R5 + R4)]$

3. $V_{OR} = 14 * V_{adc3}$.

4. Determine which of the other two ADC readings (V_{adc1} and V_{adc2}) are smaller. That reading belongs to the feed with the highest (absolute value) voltage and will define (minus the diode drop) the common point for the ADC.

5. Calculate the voltage drop across the ORing diode using:

$$V_D = (14 * V_{adc3} - 144 * V_{adc2})/13$$

Calculating the voltage drop across the ORing diodes instead of using an approximation of 0.6 V will greatly increase the measurement accuracy as it will account for the diode drop variation due to current.

6. Determine the values for −48 V (B) and −48 V (A) using:

$V48(B) = (144 * V_{adc2}) + (14 * V_D)$ and
$V48(A) = [14 * V48(B) - 144 * V_{adc1} - 14 * V_{D1}]/13$.

SAMUEL KEREM holds a master's degree in biomedical electronics from Saint Petersburg Electrotechnical University (LETI), Russia.

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