Simplify Telecom Power Supply Monitoring with the LTC1921 Integrated Dual –48V Supply and Fuse Monitor

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Introduction

The LTC1921 is the only fully integrated dual –48V supply and fuse monitor that meets common telecom specifications for supply range warning and that can withstand the high transient voltages required by telecom systems. This device improves system reliability by monitoring both supply inputs at the card edge and indicating the status of both supply fuses. The input pins are designed to withstand the large DC and transient voltages that may occur on the backplane supply. The outputs are designed to drive up to three LEDs or optoisolators, allowing warnings to be transmitted across an isolation barrier. The LTC1921 achieves high accuracy, high reliability and ease of use by combining an accurate internal reference, precision comparators and trimmed resistor networks in one package. Few external components are required, as shown in Figure 1, and none affect the threshold accuracy.

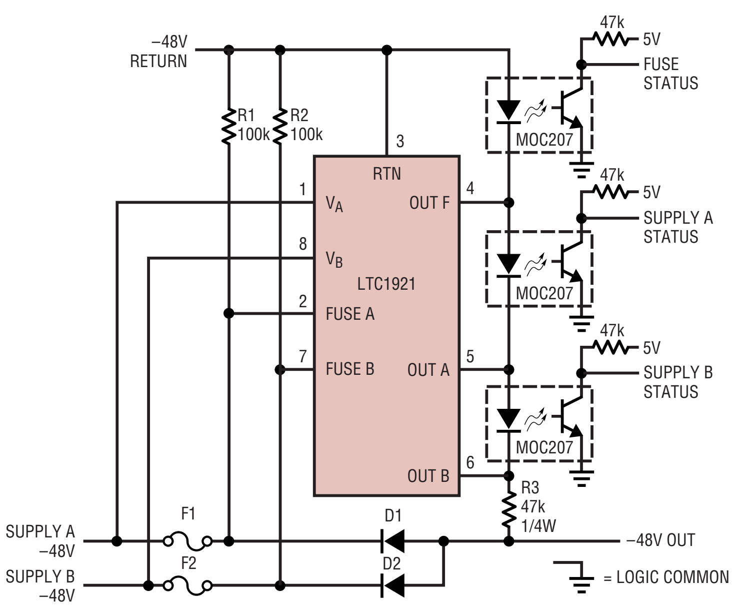
LTC1921 Features

- ❏ Independently monitors two –48V supplies for undervoltage (–38.5V ±1V_{MAX}) and overvoltage (–70V ±1.5V_{MAX}) faults
- ❏ Accurately detects undervoltage fault recovery: –43V±0.5V_{MAX}
- ❏ Monitors two external fuses
- ❏ Operates from –10V to –80V
- ❏ Tolerates DC faults to –100V
- ❏ Tolerates accidental supply reversal to 100V
- ❏ Withstands transient voltages up to 200V/–200V
- ❏ Small footprint: 8-lead MSOP and SO packages

How it Works

The LTC1921 monitors supply voltages by dividing the voltage internally and comparing the result to an internal precision reference. Since no precision external components are required, component cost, board space and engineering requirements are minimized, while accuracy is maximized. The LTC1921 comes with telecom industry accepted preset voltage thresholds, as illustrated by Figure 2, including undervoltage (–38.5V), undervoltage recovery (–43V) and overvoltage (–70V). The overvoltage threshold has a 1.3V hysteresis

...the LTC1921...can accurately provide warnings even if there is no power at all.



V_A	V_B	SUPPLY A STATUS	SUPPLY B STATUS
OK	OK	0	0
OK	UV OR OV	0	1
UV OR OV	OK	1	0
UV OR OV	UV OR OV	1	1

OK: WITHIN SPECIFICATION
OV: OVERVOLTAGE
UV: UNDERVOLTAGE

$V_{FUSE\ A}$	$V_{FUSE\ B}$	FUSE STATUS
$= V_A$	$= V_B$	0
$= V_A$	$\neq V_B$	1
$\neq V_A$	$= V_B$	1
$\neq V_A$	$\neq V_B$	1*

0: LED/PHOTODIODE ON
1: LED/PHOTODIODE OFF
*IF BOTH FUSES (F1 AND F2) ARE OPEN, ALL STATUS OUTPUTS WILL BE HIGH SINCE R3 WILL NOT BE POWERED

Figure 1: The LTC1921 requires few external components

that defines the overvoltage recovery threshold. These thresholds are trimmed to meet exacting requirements that are based on commonly used power supply specifications. This eliminates the need, as in the case of discretes, to calculate the aggregate error of a separate reference, multiple comparator offsets, and resistors. Internal resistors eliminate error due to board leakage, allowing the use of large internal resistor values that reduce power dissipation.

The LTC1921 is designed to indicate proper supply status over a wide range of conditions. In order to accomplish this, the internal architecture is symmetrical. The LTC1921 is powered via the supply monitor input pins, V_A and V_B, as shown in Figure 1. Supply current can be drawn from either or both pins, so the device can operate properly as long as at least one supply is within the operating range. Since power is not drawn from a combined supply (such as would be available with a diode OR), the LTC1921 will function properly even if the fuses or diodes are not functional.

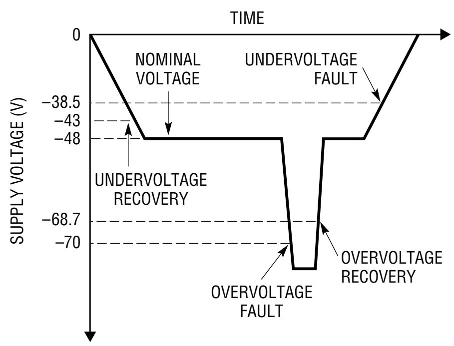
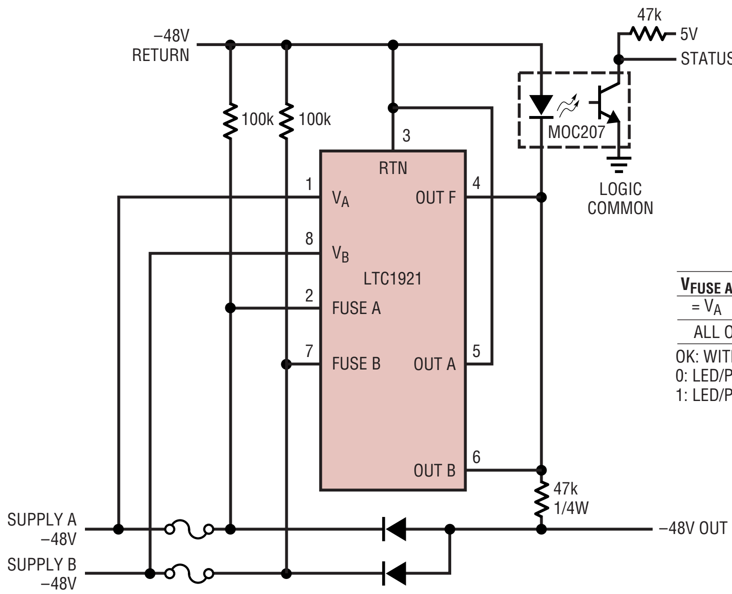


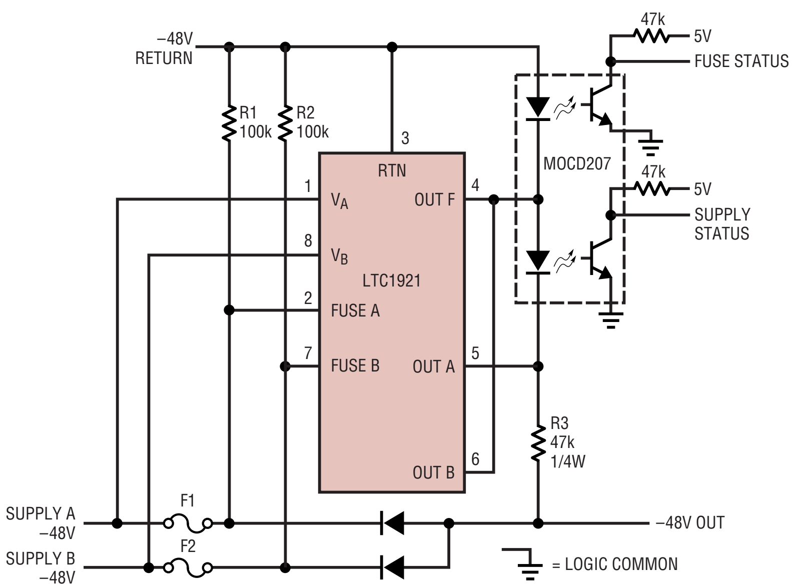
Figure 2: Voltage monitor thresholds

A useful feature of the LTC1921 architecture is that it can accurately



$V_{FUSE\ A}$	$V_{FUSE\ B}$	V_A	V_B	STATUS
$= V_A$	$= V_B$	OK	OK	0
ALL OTHER CONDITIONS				1

OK: WITHIN SPECIFICATION
0: LED/PHOTODIODE ON
1: LED/PHOTODIODE OFF



V_A	V_B	SUPPLY STATUS
OK	OK	0
OK	UV OR OV	1
UV OR OV	OK	1
UV OR OV	UV OR OV	1

OK: WITHIN SPECIFICATION
OV: OVERVOLTAGE
UV: UNDERVOLTAGE

$V_{FUSE\ A}$	$V_{FUSE\ B}$	FUSE STATUS
$= V_A$	$= V_B$	0
$= V_A$	$\neq V_B$	1
$\neq V_A$	$= V_B$	1
$\neq V_A$	$\neq V_B$	1*

0: LED/PHOTODIODE ON
1: LED/PHOTODIODE OFF
*IF BOTH FUSES (F1 AND F2) ARE OPEN, ALL STATUS OUTPUTS WILL BE HIGH SINCE R3 WILL NOT BE POWERED

Figure 3: Output OR allows for fewer components

provide warnings even if there is no power at all. This is accomplished with a low voltage lockout circuit. If both supply voltages are very low, all three outputs of the LTC1921 lock into a fault indication state, thus communicating to supervisory systems that there is a power supply problem, even though the LTC1921 does not have enough power to maintain accuracy. As an example, if both supplies are active and fall below a magnitude of 13V, all outputs shunt until the supplies either recover or fall so low that the LTC1921 cannot keep its outputs shorted. At this point, the supply voltages are so low that the output diodes do not receive enough current through R3 (Figure 1) to turn on, so they continue to indicate a warning. The low supply lockout ensures that the LTC1921 provides proper warning if there is insufficient supply voltage to power its internal circuitry, and it occurs well below the undervoltage threshold of –38.5V, so supply warning accuracy is not compromised.

Finally, the LTC1921 is designed to monitor the supply voltages at the edge-connector, upstream of the series-connected supply diodes and fuses, which allows the LTC1921 to provide the most accurate assessment of supply condition possible.

LTC1921 monitors supply fuses F1 and F2, in Figure 1, by comparing the voltage potentials on each side of each fuse. This is accomplished by comparing the voltage at V_A (pin 1) to the voltage at Fuse A (pin 2) and the voltage at V_B (pin 8) to the voltage at Fuse B (pin 7). If a significant difference (about 2V) arises, the LTC1921 signals that a fuse has opened. The voltage difference across the damaged fuse may be reduced by diode reverse leakage, making it difficult to detect a damaged fuse. Weak pull-up resistors (R1 and R2, Figure 1) ensure that the voltage across a damaged fuse is sufficient for the LTC1921 to detect an open-circuit fuse. The size of these resistors is determined by the reverse leakage of the ORing diodes used in the application. The higher reverse leakage current exhibited by Schottky diodes may require lower-valued resistors to be used (as with R9 and R10, Figure 4).

The LTC1921 replaces complicated monitoring circuitry with a simple integrated precision monitoring system contained entirely in an MSOP-8 or SO-8 package.

The LTC1921 can communicate supply and fuse status by controlling external optoisolators or LEDs. This allows for intelligent system monitoring despite high isolation voltage requirements. Control of the LEDs or optoisolators is accomplished by connecting the LTC1921 outputs in parallel with the LEDs or photodiodes. During normal supply and fuse conditions, the LTC1921 outputs are high impedance: current flows through the external diodes continuously. If a fuse opens, or a supply voltage falls outside of the allowed window, then the proper LTC1921 output shunts the current around the diode, thus indicating a fault. The outputs have been designed to accommodate series connection of the output status diodes. This allows the use of one resistor (R3, Figure 1) instead of three, and cuts the total output current by the same factor. The outputs may be ORed to reduce the number of required optoisolators as shown in Figure 3. The supply outputs may be combined, or all outputs may be combined. The required warnings will be provided in all cases. The only difference in function is that the exact source of the warnings cannot be distinguished when the outputs are combined.

Application Example

Figure 4 shows an LTC1921 and an LT4250 Hot Swap controller comprising a complete telecommunications power system solution. The LTC1921 monitors both –48V supply inputs from the power bus, as well as the supply fuses. Because the LTC1921 measures both supplies at the card edge, it can provide warnings for conditions that other solutions cannot

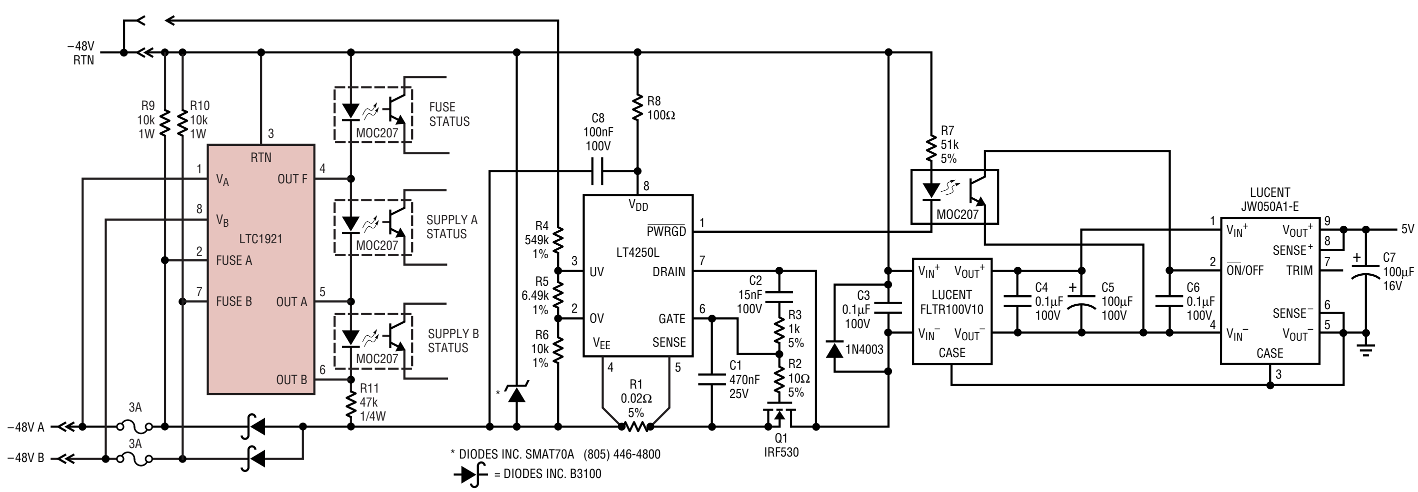


Figure 4: Network switch card application with Hot Swap control

measure, such as one supply failing or one fuse damaged. The supply measurement is also more accurate, since the voltage drop across the fuses or diodes does not affect it. Resistors R9 and R10 pull up the fuse pins so that damaged fuses can be detected. The status signals may be wired off the card, with optoisolators, to an isolated microprocessor or microcontroller that controls system performance and warning functions. This allows an automated system supervisor to issue a warning or record the event, despite operating from an isolated supply. The LT4250L switches the –48V supply via Q1 during hot swapping and low supply conditions, and monitors the supply voltage provided to the load. The PWRGD output of the LT4250 drives an optoisolator, providing a supply status signal to the DC/DC converter. This signal may also be used to monitor the condition of the ORing diodes by comparing it to the supply status signals from the LTC1921.

Conclusion

Reliability is top priority for the designers of modern telephone and communication equipment. Designers take extra care to protect circuitry from failure-causing temperature and voltage changes, employing redundancy whenever possible, especially for power supplies. They monitor supplies for early warnings of impending failure, often using complicated circuitry that can include a voltage reference, comparators, an LDO and several precision resistor dividers. Designers may also use discrete components to indicate the state of power supply fuses. The resulting circuits can be expensive in terms of component cost, board space and engineering time. The LTC1921 replaces this complicated monitoring circuitry with a simple integrated precision monitoring system contained entirely in an MSOP-8 or SO-8 package.