Dual Wide Range I^2C Power Monitor

DESCRIPTION

Demonstration Circuit 2561A features the LTC®2992, a rail-to-rail system monitor that measures current, voltage, and power of two supplies. It features an operating range of 2.7V to 100V and includes a shunt regulator for supplies above 100V. The voltage measurement range of 0V to 100V is independent of the input supply. Two ADCs simultaneously measure each supply's current. A third ADC monitors the input voltages and four auxiliary external voltages. Each supply's current and power is added for total system consumption. Minimum and maximum values are stored and an over range alert with programmable thresholds minimizes the need for software polling.

Data is reported via a standard I^2C interface. Shutdown mode reduces power consumption to 25µA typically.

The demo board features nested pads for a range of sense resistor package sizes to support a wide range of power applications. It is populated for a 5A application. This can be changed by replacing RSNS1 and RSNS2 with appropriate resistors.

Design files for this circuit board are available at http://www.linear.com/demo/DC2561A

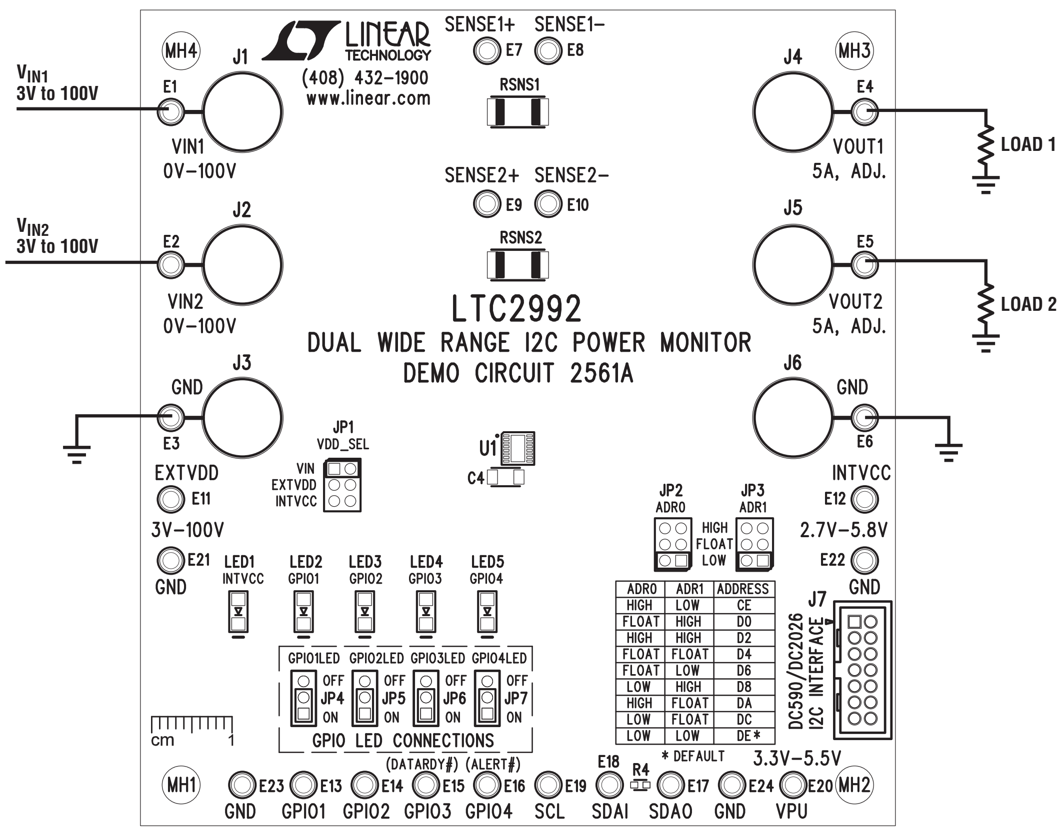


Figure 1. Typical Setup

OPERATING PRINCIPLES

The DC2561A was designed to be connected to the DC590/DC2026 and controlled through the QuikEval™ suite of software. All thresholds can be set and ADC registers read back through the QuikEval interface, which provides a convenient way to evaluate the LTC2992.

QUICK START PROCEDURE

Jumper Settings

VDD_SEL: Selects the VDD source. It can be set to VIN, INTVCC or EXTVDD (which requires a voltage to be present at the EXTVDD turret). Please see the Hardware Configuration section for examples of how these different settings are used. Note: If measurement across the whole 0V to 100V range is desired on both input rails then the device must be powered through a secondary source. Set VDD_SEL to EXTVDD and power with a 5V rail.

ADR0, ADR1: Selects the I^2C slave address of the LTC2992. Any changes here should also be made inside of QuikEval for communications to persist. By default both jumpers are set to LOW, which corresponds to an address of 0xDE.

GPIO1LED, GPIO2LED, GPIO3LED, GPIO4LED: Connects the GPIO pins to the onboard LEDs. If measurements are to be made using the GPIO pins then it is recommended that the jumpers are set to the OFF position to prevent measurement errors.

External Connections

Signal connections are made via the row of turret posts along the edges of the board.

GND: (6 Turrets, 2 Banana Jacks) These turrets are connected directly to the ground planes.

VIN1/VIN2: Used as supply and current sense input for the internal current sense amplifier.

INTVCC: Internal Low Voltage Supply Input/Output. This turret is used to power internal circuitry and can be configured as a direct input, as a linear regulator from a higher voltage connected to V_{DD} or as a shunt regulator. Please see LTC2992 data sheet for more details.

EXTVDD: External Voltage Supply. This turret can be used to power the LTC2992 independently of the VIN power path. Connect to 2.7V to 100V external supply if this option is selected through JP1.

VPU: Pull-Up Voltage for the LEDs. Connected on this board to a 5V isolated supply on the DC590/DC2026. If a DC590/DC2026 is not used and the DC2561 is operated independently, a 5V supply must be provided here, in order for the LEDs to work.

SENSE1+/SENSE2+: Supply Voltage and Current Sense Input. Used as a supply and current sense input for internal current sense amplifiers. The voltages at these pins are monitored by the onboard ADC with a full-scale input range of 102.4V.

SENSE1–/SENSE2–: Current Sense Input. An external sense resistor is connected between $SENSE^+$ and $SENSE^-$ to measure current. See Hardware configuration section for details.

QUICK START PROCEDURE

Digital Connections

SCL: I^2C Clock Input.

SDA/SDAI: I^2C Data Input. Connected to SDAO through 0Ω resistor R4. Remove R4 if opto-isolated I^2C functionality is desired.

SDAO: I^2C Data Output. Connected to SDAI through 0Ω resistor R4. Remove R4 if opto-isolated I^2C functionality is desired.

GPIO1, GPIO2: General Purpose Input/Output (Open Drain). Configurable to general purpose output, logic input, and data converter input. On the DC2561A, a resistive divider of 147k and 3k is present on the pins to allow the user to measure voltages up to 100V. Ensure that JP4 and JP5 are in the OFF configuration to minimize measurement errors, due to the onboard indicator LED, if configured as an input.

GPIO3: General Purpose Input/Output (Open Drain). Configurable to general purpose output, logic input, data converter input and data ready signal ($\overline{\text{DATAREADY}}$).

GPIO4: General Purpose Input/Output (Open Drain). Configurable to general purpose output, logic input, data converter input and SMBUS alert ($\overline{\text{ALERT}}$). As $\overline{\text{ALERT}}$, it is pulled to ground when a fault occurs to alert the host controller.

LEDs

INTVCC: Lights up green when VPU and LTC2992 are powered.

GPIO1: General Purpose Output. Lights up green when pulled low. Default state is low.

GPIO2: General Purpose Output. Lights up green when pulled low. Default state is low.

GPIO3 ($\overline{\textbf{DATAREADY}}$): General Purpose Output. Lights up yellow when pulled low. Can be configured to be a $\overline{\text{DATAREADY}}$ indicator. Can also be monitored on the DATARDY# turret.

GPIO4 ($\overline{\textbf{ALERT}}$): General Purpose Output. Lights up red when pulled low. Can be configured to be an $\overline{\text{ALERT}}$ indicator. Can also be monitored on the ALERT# turret.

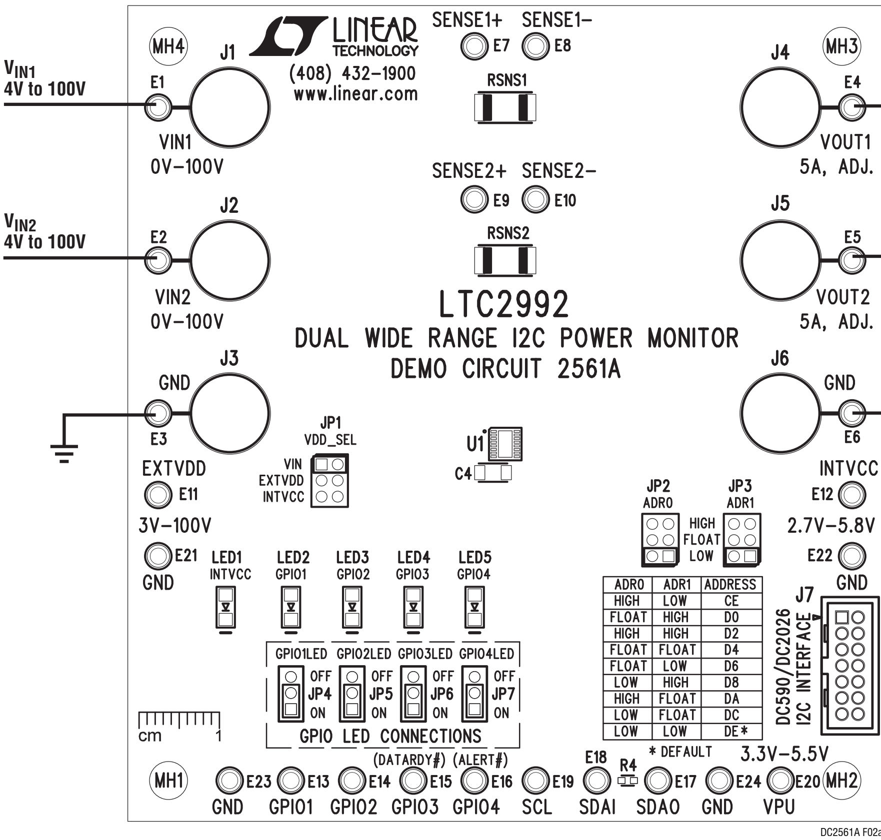
Hardware Configuration

Like the LTC2945, the LTC2992 offers great flexibility in terms of supply options due to separate V_{DD} and SENSE pins, along with the added feature of dual channels.

The VDD_SEL jumper allows easy configuration of the various supply options.

QUICK START PROCEDURE

If the VDD_SEL jumper is set to VIN, then V_{DD} (pin) and VIN are connected (Figure 2a and Figure 2b). In this configuration sensing is done on the same rail which is supplying power to the LTC2992. Provide 4V to 100V at VIN in this configuration to power the LTC2992. The rails are OR'ed to provide power to the V_{DD} pin so only one channel is required to be above the 3V minimum required input range.



ADR0	ADR1	ADDRESS
HIGH	LOW	CE
FLOAT	HIGH	D0
HIGH	HIGH	D2
FLOAT	FLOAT	D4
FLOAT	LOW	D6
LOW	HIGH	D8
HIGH	FLOAT	DA
LOW	FLOAT	DC
LOW	LOW	DE*

Figure 2a. LTC2992 Powered by V_{IN}

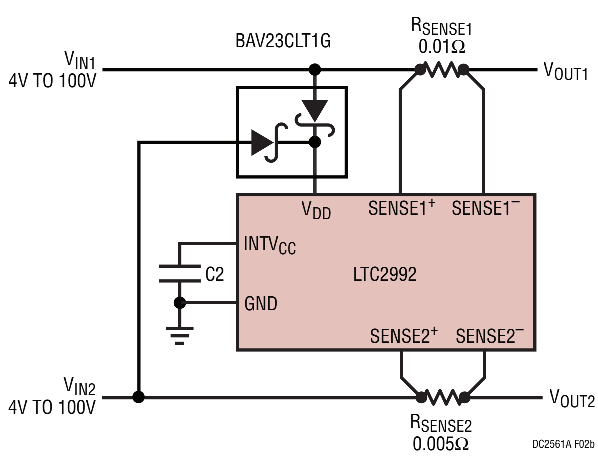


Figure 2b. LTC2992 V_{DD} Powered from Measurement Rails

QUICK START PROCEDURE

If the VDD_SEL jumper is set to EXTVDD then the sense and power lines are separated (Figure 3a and Figure 3b). Sensing is achieved on the VIN line while power is supplied from EXTVDD. Provide a separate 3V to 100V at the EXTVDD turret in this configuration.

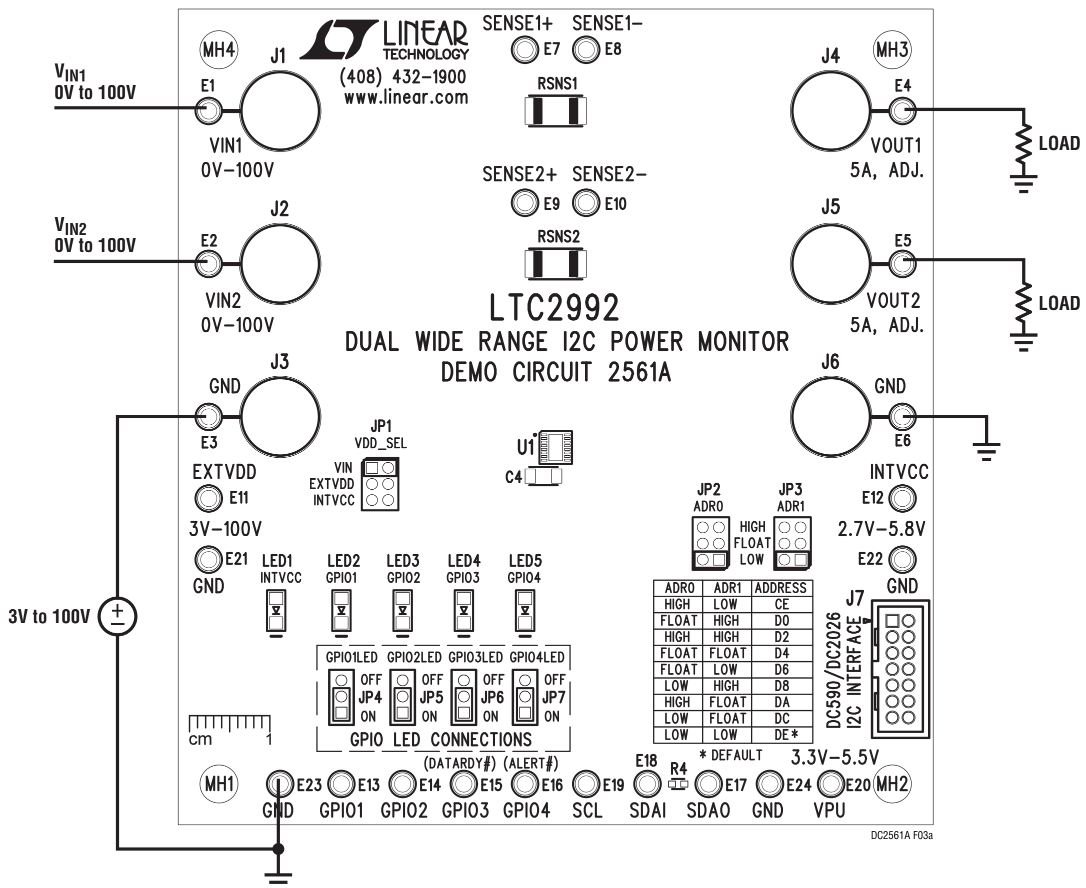


Figure 3a. DC2561 Powered by EXTVDD

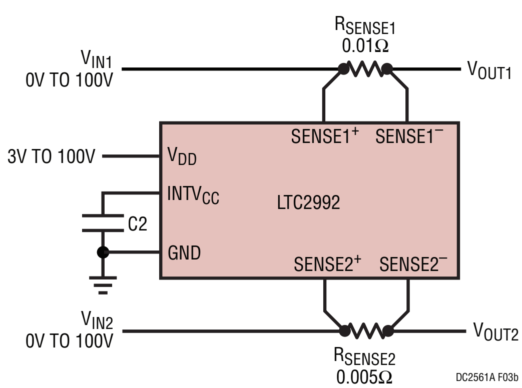


Figure 3b. LTC2992 Powered by EXTVDD

QUICK START PROCEDURE

If the VDD_SEL jumper is set to INTVCC, then the LTC2992 internal circuitry is powered from $INTV_{CC}$. A low voltage supply (2.7V to 5.8V) connected to INTVCC helps minimize on-chip power dissipation (Figure 4a and Figure 4b). The device can also be used as a shunt regulator in this configuration to monitor rails higher than 100V.

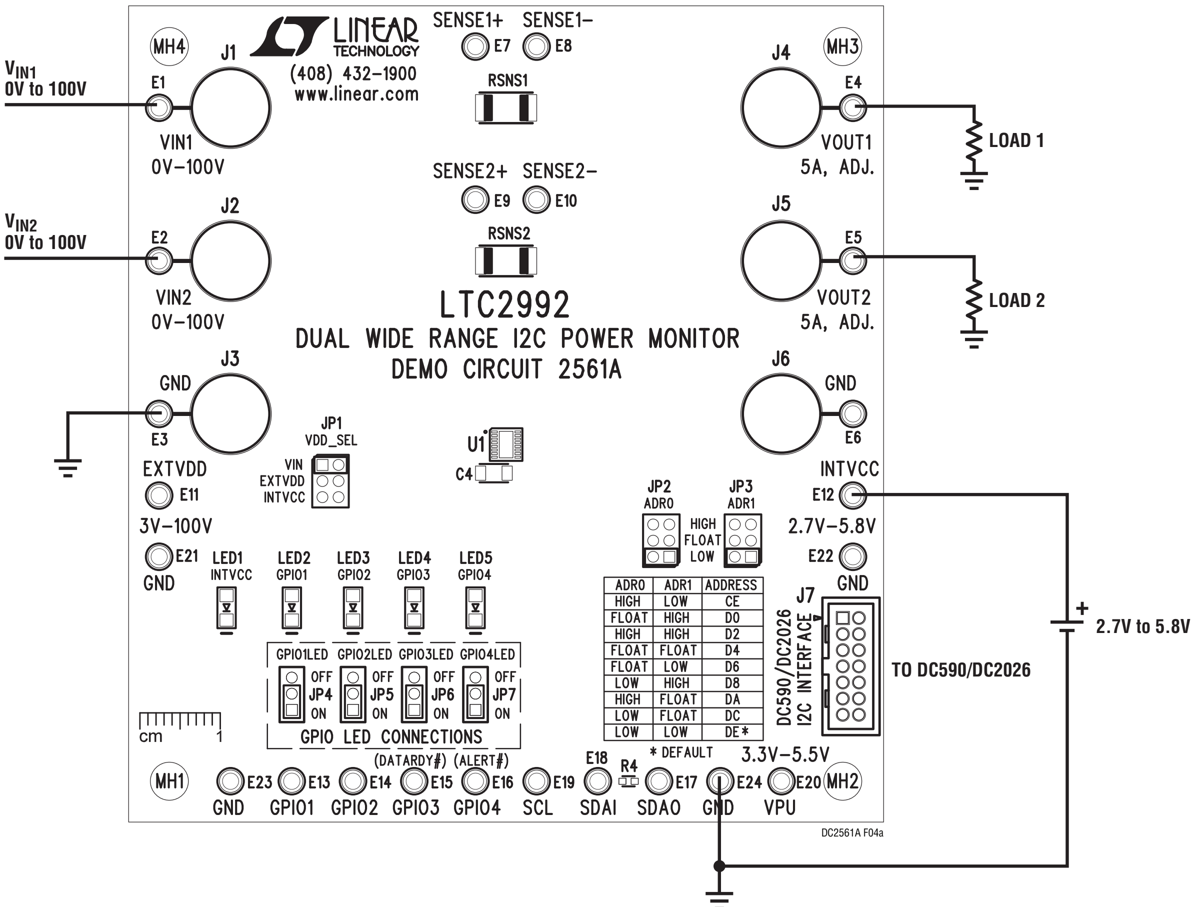


Figure 4a. DC2561 Powered by INTVCC

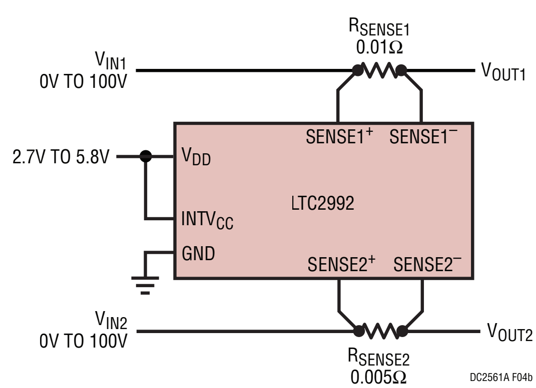


Figure 4b. LTC2992 Powered by INTVCC

QUICK START PROCEDURE

The LTC2992 can also be powered by voltages that are greater than 100V. Figure 5a shows a low side rail-to-rail power monitor which derives power from a greater than 100V secondary supply as it monitors two independent 100V rails. The voltage at $INTV_{CC}$ is clamped at 6.3V above ground in a low side shunt regulator configuration to power the part.

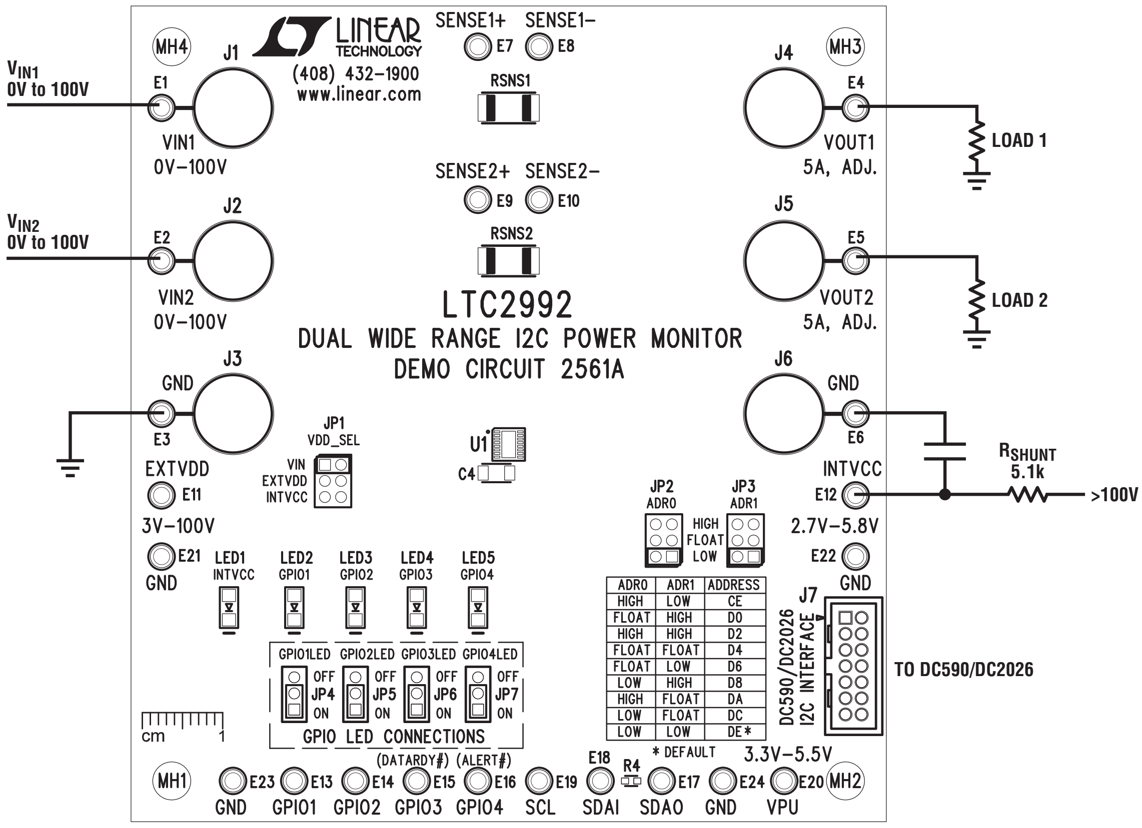


Figure 5a. DC2561 Derives Power Through a Low Side Shunt Regulator in a High Side Current Sense Topology

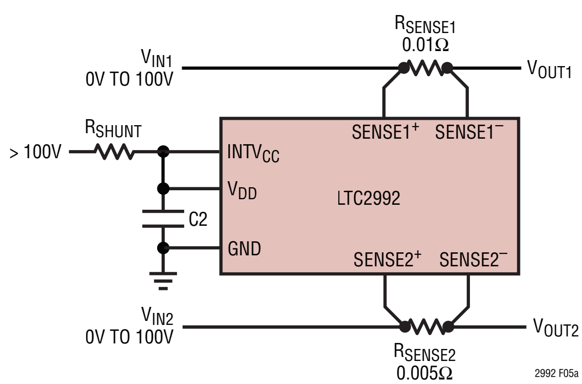


Figure 5b. LTC2992 Derives Power Through a Low Side Shunt Regulator in a High Side Current Sense Topology

QUICK START PROCEDURE

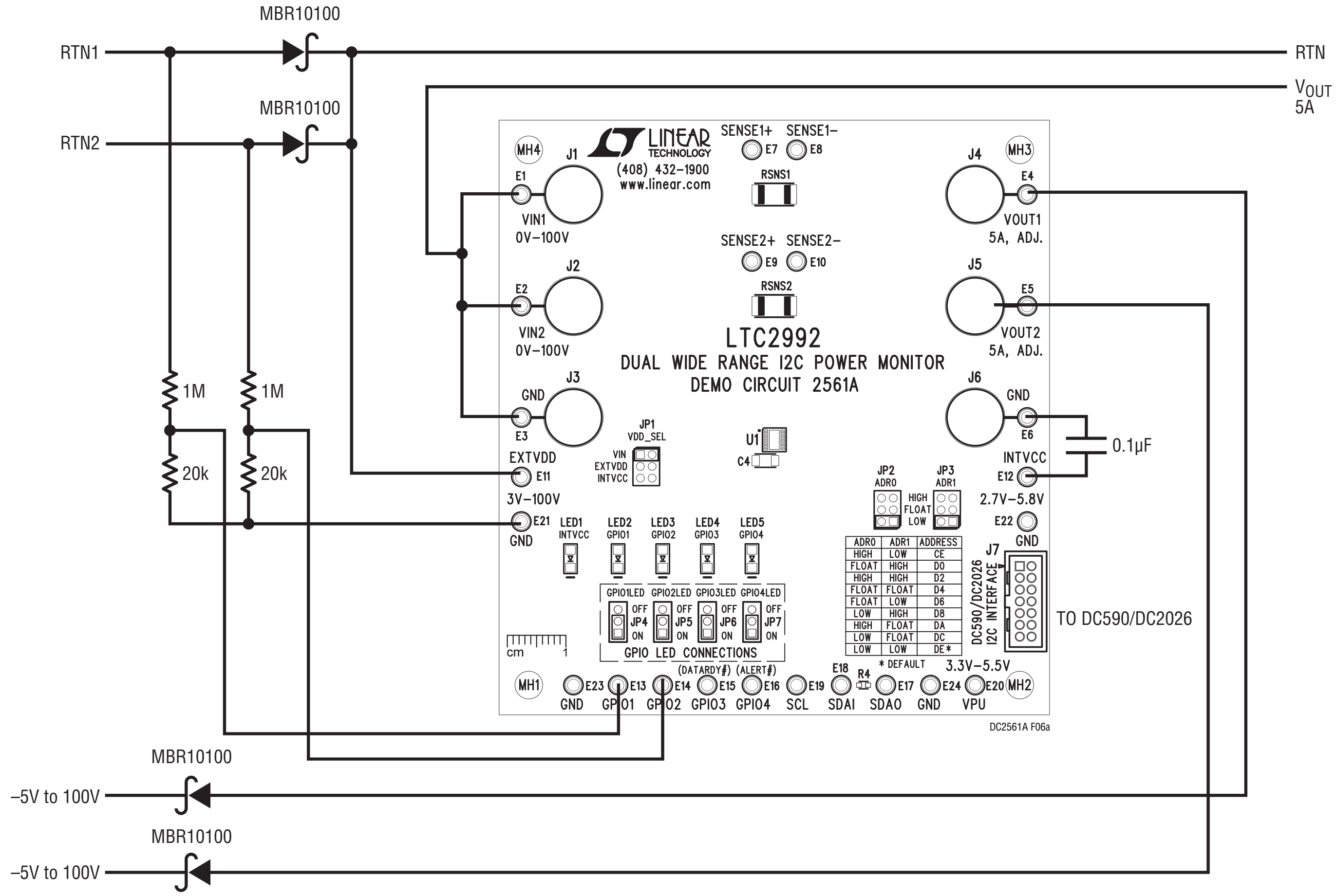


Figure 6a. DC2561 Derives Power from the Supply Monitored in a Low Side Current Sense Topology to Monitor Two Independent –48V Rails

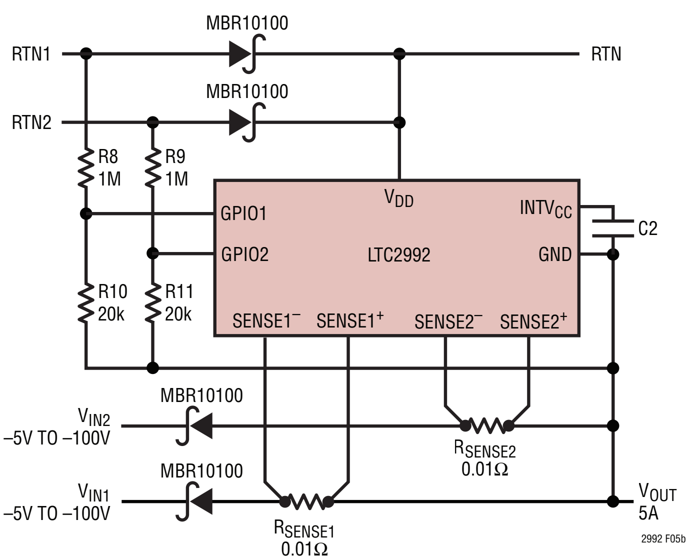


Figure 6b. LTC2992 Derives Power from the Supply Monitored in a Low Side Current Sense Topology to Monitor Two Independent –48V Rails

QUICK START PROCEDURE

Regardless of which configuration is selected, if the system is connected properly, the green INTVCC LED should be lit and the $\overline{\text{ALERT}}$ red LED should be off.

In order to support a wide range of applications, the LTC2992 demo board also features multiple nested sense pads to support high current monitoring. These pads are kelvin sensed. By default the board supports current monitoring of up to 5A. An appropriate sense resistor can be used to support monitoring of desired current levels of up to 20A using the onboard sense resistor. The $SENSE^+$ and $SENSE^-$ turrets may be used to connect an external sense resistor and power path for any current level. Remove RSNS1 and RSNS2 in this case.

–48V System Monitoring

The DC2561A can also be configured to provide power monitoring in –48V Telecom applications by setting JP1 to EXTVDD, with the –48V input tied to VOUT and GND and the –48V return tied to EXTVDD. With the LTC2992 two independent –48V rails can be measured. The DC590 as well as the DC2026 provide isolation and level shifting, as the I^2C interface is operating at –48V with respect to –48V RTN, which is normally near earth ground potential.

Software Configuration

The DC2561A software user interface was designed to allow the user to quickly evaluate the LTC2992. The user has the ability to set fault thresholds, enable/disable and clear alerts, change the source for the VIN measurement as well as monitor voltage, current and power for both channels. RSNS1 and RSNS2 are set to 20mΩ by default on the DC2561A, should any changes be made on the board, the corresponding value should be entered into the software control panel. By pressing Start, the software interface will begin using the DC590 for data collection. The LTC2992 software UI is split up into two main components. The Data Acquisition Terminal and a Tabbed Interface. A screen shot of the GUI is shown in Figure 7.

The data acquisition terminal display is always in view of the user, providing convenient controls to quickly perform common functions and display real time voltage, current power, total current and total power. The acquisition terminal consists of a Performance Graph chart which is user configurable to display any channel in any combination the user desires.

The tabbed interface allows the user to cycle between the various control and threshold registers of the LTC2992 without losing view of the data.

Due to the sheer number of registers present in the part, the fault register is displayed in its own window by clicking the Open Fault Panel. The panel will show faults from FAULT1, FAULT2, FAULT3 and FAULT4 registers as shown in Figure 8. Each individual fault will light up a red LED. The fault can be cleared by clicking on the respective fault's LED or by clicking the Clear Faults button.

QUICK START PROCEDURE

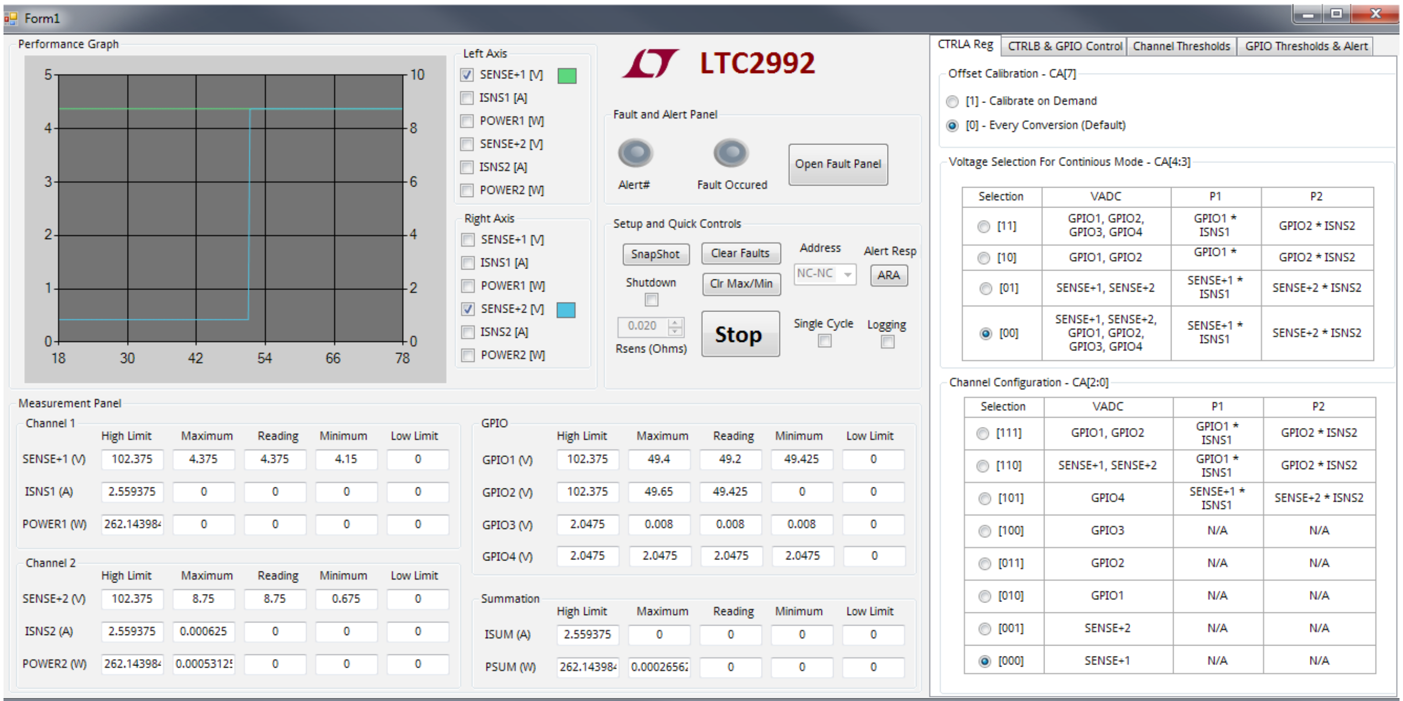


Figure 7. LTC2992 GUI

QUICK START PROCEDURE

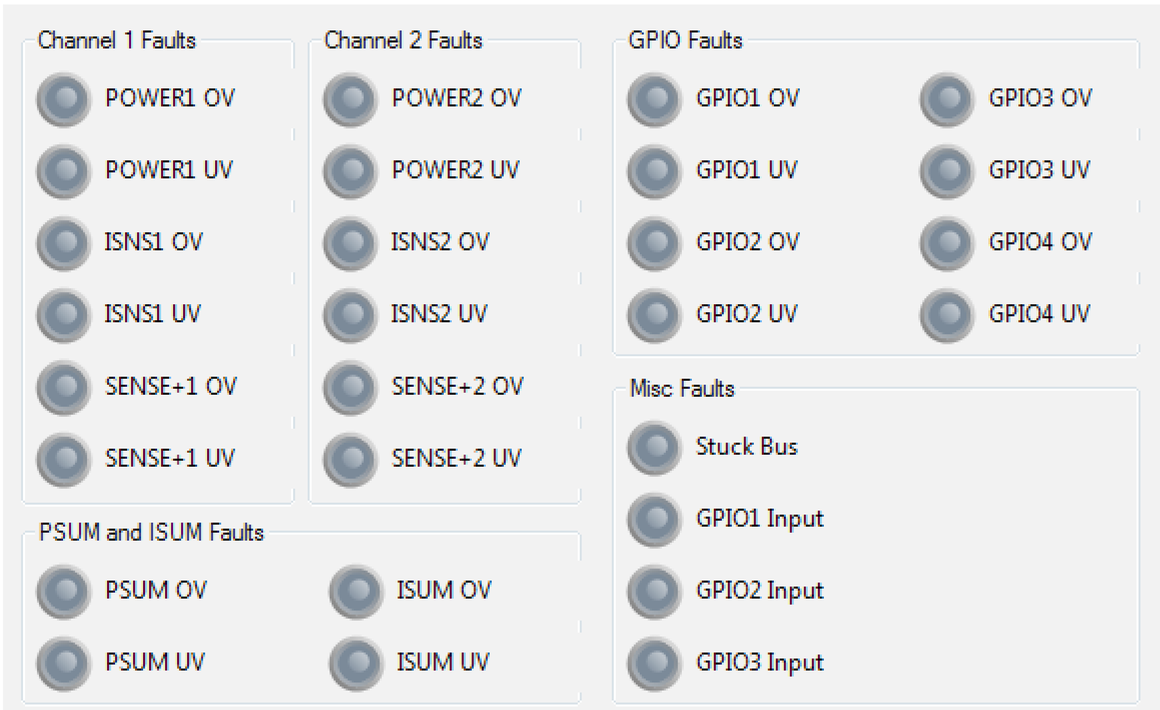


Figure 8. Fault Panel

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