1.5% Accurate Single-Supply Supervisors Simplify Part Selection and Operate to 125°C

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Introduction

A new line of full-featured single-input supervisors are easy to place, easy to bias and easy to configure. They are also highly accurate, an important feature for keeping systems running reliably.

The LTC2915, LTC2916, LTC2917 and LTC2918 provide as many as twenty-seven integrated, user-selectable thresholds that are compatible with many standard power supply voltages. A user-adjustable input also allows for customizable thresholds. The reset timeout period is fixed at 200ms, or add a capacitor to generate a custom timeout. The even-numbered parts include an option to generate a reset-on-demand using the manual reset input, which is compatible with mechanical or electrical switching. The LTC2917 and LTC2918 have watchdog circuits that monitor processor signal activity within a user-adjustable window or non-windowed time period.

Electrical specifications are guaranteed to 125°C, so these supervisors are perfect for high temperature environments, such as automotive applications. Operating voltage range begins at a low 1.5V, and extends to any

Table 1. LTC2915, LTC2916, LTC2917 and LTC2918 feature summary

Feature	LTC2915	LTC2916	LTC2917	LTC2918
9 Selectable Thresholds	✓	✓	✓	✓
Wide Temperature Range –40°C to +125°C	✓	✓	✓	✓
Threshold Accuracy	±1.5%	±1.5%	±1.5%	±1.5%
Shunt Regulator for High Voltage Operation	✓	✓	✓	✓
Quiescent Current	30µA	30µA	30µA	30µA
Low Voltage Reset	0.8V	0.8V	0.8V	0.8V
Reset Timeout: 200ms Fixed or Externally Adjustable	✓	✓	✓	✓
Power Supply Glitch Immunity	✓	✓	✓	✓
Selectable Supply Tolerance –5%, –10%, –15%	✓		✓	
Manual Reset		✓		✓
Watchdog Timeout: 1.6s Fixed or Externally Adjustable			✓	✓
Non–Windowed Watchdog			-A	-A
Windowed Watchdog			-B	-B

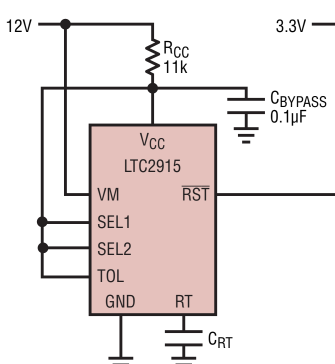


Figure 1. A 12V supply monitored from 12V, utilizing internal shunt regulator with 3.3V logic out

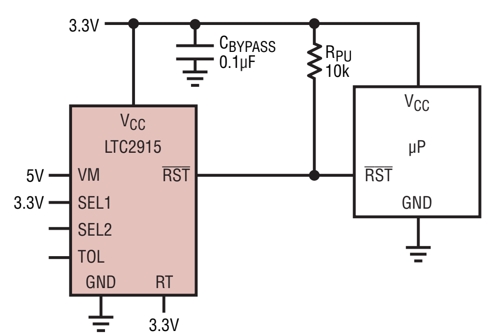


Figure 2. A 5V, –10% tolerance supply monitor with 200ms internal reset timeout

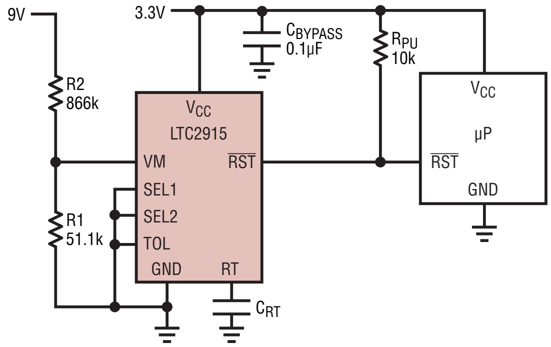


Figure 3. A 9V, –15% tolerance supply monitor with 3.3V logic out

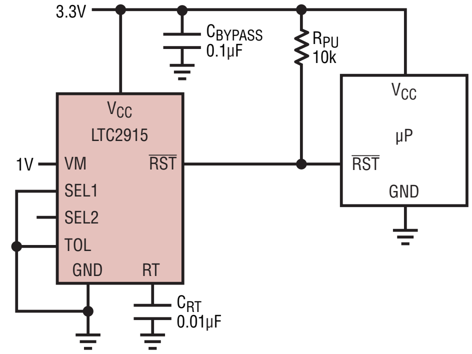


Figure 4. A 1V, –15% tolerance supply monitor with 90ms timeout

positive high voltage when biasing the integrated 6.2V shunt regulator. With all these features (and more discussed below), users can qualify one product to meet almost any supervisory need. Table 1 summarizes the features for all four products.

Easy Placement

Despite a general trend to integrate devices as much as possible, single-input supervisors have certain advantages over multi-voltage devices. The single-input supervisor is not taxed with the requirement to be engaged with multiple supply voltages so that it is much easier to place. Lead pitches on modern device packages dictate that multi-supply supervisors have their monitor inputs physically close to each other. Such covenants naturally lead to signal routing and congestion problems. Furthermore, due to the close proximity of multiple supply lines, undesirable noise coupling can be a problem.

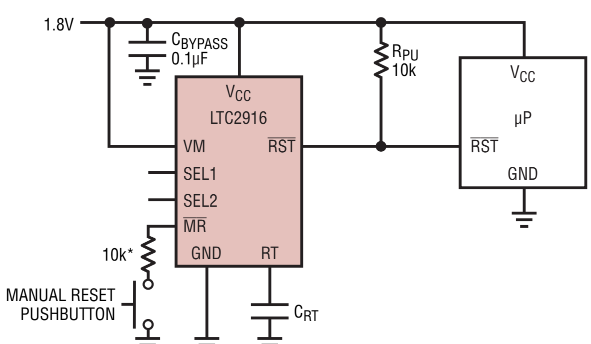
Specifying a physical system location for a multi-supply supervisor involves tradeoffs since an optimal distance between supplies, supervisor and microprocessor may be difficult to achieve. Systems using a single supervisor do not suffer from these problems; the supervisor may be located as near to the monitored supply or processor as desired. The LTC2915 and LTC2916 are available in low profile (1mm) TSOT-23 and DFN (3mm × 2mm) packaging. The LTC2917 and LTC2918 are available in 10-lead MSOP and DFN (3mm × 2mm) packaging.

Correct and Stable Operation

In concept, the job of a good supply monitoring supervisor is simple: when a power supply voltage drops below a specified value, generate a reset. In reality, the job of a supervisor is much more complicated. Start-up and shutdown conditions, noise, and transients all contribute to the complexity of a real supervisor's job. If the supervisor generates a reset while the monitored supply is actually within specification, the result is annoying and consumes operating margin. Spurious resets generated by typical supply noise are equally vexing. Worse yet, not eliciting a microprocessor reset at voltages too low for proper system behavior can be catastrophic.

Supervisor threshold accuracy is a critical specification and must be reckoned with during the system design phase. Most power supplies are specified to operate within a tolerance band. Consider the example of monitoring a 5V supply with a ±10% tolerance. The lowest specified output voltage is therefore 4.5V. An ideal voltage monitor (perfect accuracy) would generate a reset at precisely 4.5V and below, regardless of operating conditions, indicating an out-of-tolerance supply voltage. The problem is that ideal, perfectly accurate voltage monitors do not exist. A randomly selected real-world voltage monitor has a threshold that resides within a distributed band of values. All 27 of the LTC2915, LTC2916, LTC2917 and LTC2918 selectable thresholds have the same relative threshold band of ±1.5% of the selected nominal input voltage, over the full temperature range (–40°C to 125°C). The 5V monitor threshold band is therefore 150mV wide.

The upper limit of the threshold band should be coincident with the



*OPTIONAL RESISTOR RECOMMENDED TO EXTEND ESD TOLERANCE

Figure 5. 1.8V, –5% supply monitor with manual reset

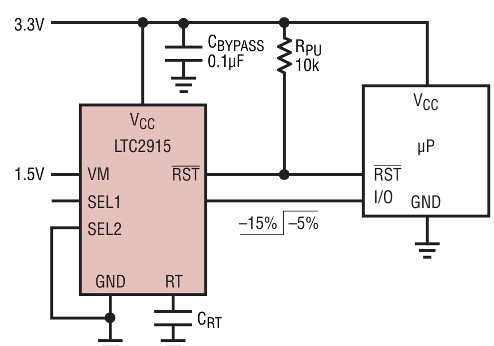


Figure 6. 1.5V supply monitor with tolerance control for margining, –5% operation with –15% margining

lowest specified power supply output voltage (4.5V in our example). Otherwise, operating range is potentially consumed if the monitor threshold reaches above 4.5V. Using the monitor voltage select (SEL1, SEL2) and tolerance (TOL) inputs on the LTC2915 and LTC2917 (for 5V supply, 10% reset threshold), we can configure the upper threshold limit to 4.5V. The lower threshold limit is 150mV below, or 4.35V. Statistically, most devices will have an actual threshold closer to 4.425V, which is the center of threshold band. Because of the threshold spread, the powered system must work reliably down to the *lower* threshold limit, over temperature. It is easy to see why less accurate monitors (larger threshold spreads) can contribute to system problems.

The monitor threshold discussion, so far, deals only with the DC value of the monitored supply. Real supplies also have AC components or noise from sources such as load transients and switching artifacts. These AC components should be ignored by the monitor, since they can cause undesirable spurious reset events. One way to avoid noise-induced sporadic resets is to add hysteresis to the monitor comparators—many monitors on the market use this method. There is a problem with this approach, in that the added hysteresis degrades the accuracy of the monitor and ushers in the design problems discussed earlier. The LTC2915, LTC2916, LTC2917 and LTC2918 single supervisors do not apply hysteresis. Instead, the

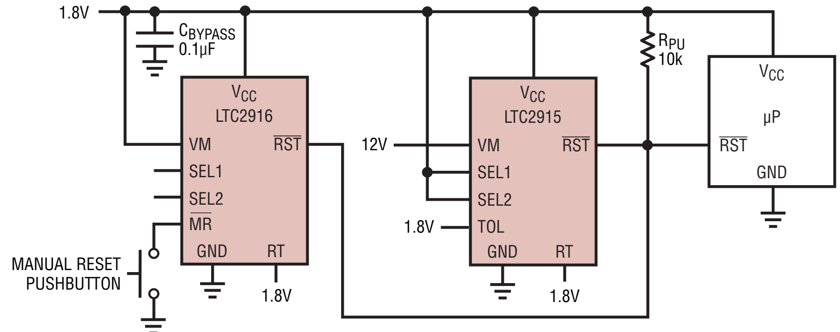


Figure 7. Dual supply monitor (1.8V and 12V) with manual reset and 200ms Reset timeout

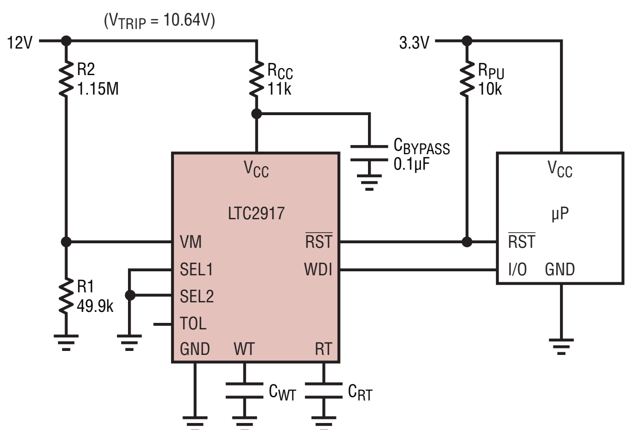


Figure 8. A 12V supply monitor powered from 12V, utilizing the internal shunt regulator with 3.3V logic out

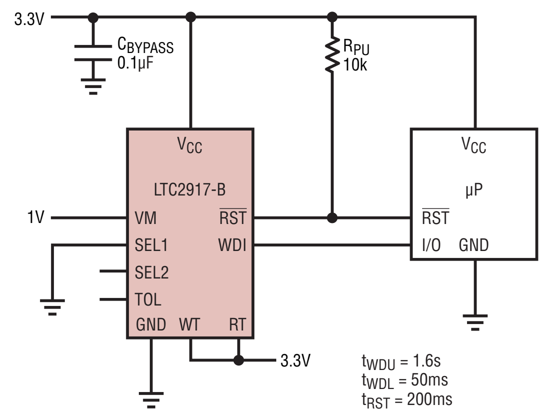


Figure 9. A 1V supply monitor with windowed watchdog timeout and internal timers selected

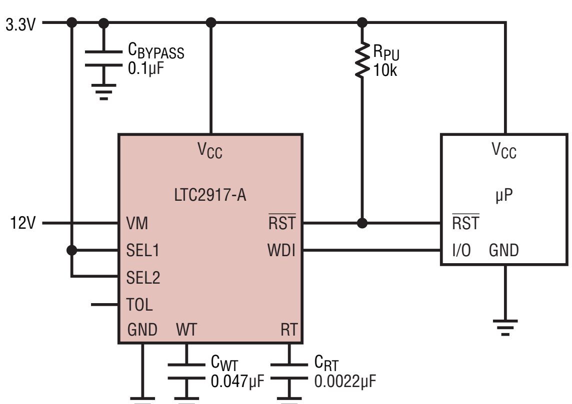


Figure 10. A 12V supply monitor with 20ms reset timeout and 3.4s watchdog timeout, with 3.3V logic out

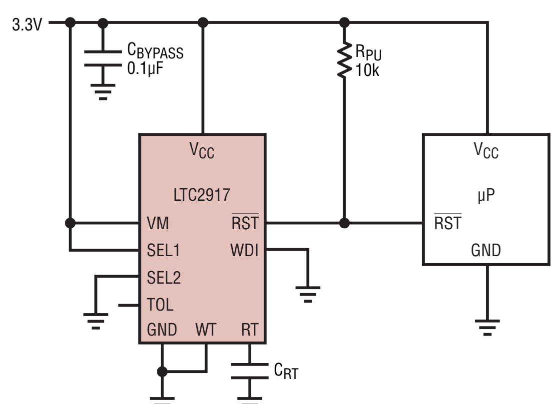


Figure 11. A 3.3V, –10% tolerance supply monitor with disabled watchdog

comparators incorporate anti-glitch circuitry. Any transient at the input of the monitor comparator must be of sufficient magnitude and duration (energy) to switch the comparator. Designs utilizing these single supervisors promote correct and glitch-free resets, which leads to stable and ultimately more reliable systems.

Processor Communication

Two of the monitors (LTC2917 and LTC2918) communicate with host processors through their watchdog circuits. The basic requirement for the processor is to "pet" the watchdog periodically to avoid being "bitten" by the dog. Processor resets are invoked by the built-in watchdog hardware when the watchdog petting frequency has become too slow or too fast. Precise knowledge of the system's timing characteristics is required to set the watchdog timeout period. Adjust the watchdog timeout period by connecting a capacitor between the watchdog timing input (WT) and ground. Connect WT to V_{CC} to achieve a default 1.6s timeout, without the need for external capacitance.

Simple and Compliant Bias

A unique feature common to all four of these devices is the ability to provide operating bias from almost any positive voltage. It does not matter whether it is a 1.8V LDO, 5V switcher, 12V car battery, 24V wall-wart or 48V telecom supply; the integrated 6.2V shunt regulator can work with any system. For input voltages above 5.7V the only requirement is to size the bias resistor (R_{CC}) to the range of the input voltage. Connect R_{CC} between the high voltage supply and the V_{CC} input. Below 5.7V, simply connect the supply directly to the V_{CC} input. Deriving resistor sizing for worst-case operation requires knowledge of the minimum ($V_{S(MIN)}$) and maximum ($V_{S(MAX)}$) input supply:

$$\frac{V_{S(MAX)} - 5.7V}{5mA} \le R_{CC} \le \frac{V_{S(MIN)} - 7V}{250\mu A}$$

Be sure to decouple the V_{CC} input using a 0.1µF (or greater) capacitor to ground.

Qualify Once, Specify Forever

During product development cycles, power supply requirements often change. While supply requirements are changing, your choice of supervisor doesn't have to. The LTC2915, LTC2916, LTC2917 and LTC2918 can relieve the burden of having to find the right supervisor for the job. Qualify any one of these parts and you can monitor any one of eight different supply voltages, each with three different internally fixed thresholds. You can also monitor any custom voltage down to 0.5V using an external resistor divider. Multi-supply monitoring is easily achieved by using two or more devices and connecting their $\overline{RST}$ outputs together.

Meet Your Match

The LTC2915, LTC2916, LTC2917 and LTC2918 single supervisors are the perfect match for a variety of applications. Browse the applications shown in the figures and quickly find the right application for your system.

Conclusion

The LTC2915, LTC2916, LTC2917 and LTC2918 are feature-laden single supervisors that can be comfortably placed near your monitored supply and/or microprocessor, leading to easy printed circuit board layout and reliable system operation.

Unprecedented configurability makes it possible to qualify and stock just one product that can meet all of your supervisory needs. Integration provides twenty-seven user-selectable monitor thresholds with ±1.5% accuracy. Any non-standard threshold can be user-configured with the adjustable setting.

Other features include high voltage operation, configurable reset and watchdog timers, manual reset, and low quiescent current. External components are seldom required to realize fully functional designs. Electrical specifications are guaranteed from –40°C to 125°C.

LTC4311, continued from page 9

Auto Detect Standby Mode and Disable Mode

To conserve power, when both bus voltages are within 400mV of the bus pull-up supply, the LTC4311 enters standby mode, consuming only 26µA of supply current. When ENABLE is forced low, as shown in Figure 4, the LTC4311 enters a disable mode and consumes less than 5µA of supply current. Both bus pins are high impedance when in disable mode or when the LTC4311 is powered down, regardless of the bus voltage.

Conclusion

The LTC4311 efficiently and effectively addresses slow rise times, decreased noise margins at low bus supplies, and increased DC bus power consumption found in 2-wire bus systems. Strong slew rate controlled pull-up currents quickly and smoothly slew the I^2C or SMBus bus lines, decreasing rise times to allow up to 400kHz operation for bus capacitances in excess of 1nF. The advantages of the strong slew rate controlled currents extend to reducing the low state bus voltage, DC bus power consumption, and fall times, since larger value bus pull-up resistors can be used.

With a small 2mm × 2mm × 0.75mm DFN or SC70 footprint, high ±8kV HBM ESD performance and low power consumption in standby or disable mode, the LTC4311 Low Voltage I^2C or SMBus accelerator is also ideally suited for all I^2C or SMBus systems. Examples of such systems include notebooks, palmtop computers, portable instruments, RAIDs, and servers where I/O cards are hot-swapped.