White Paper

AEIC-3700

Advanced Voltage Monitoring for Reliable System Operation

Abstract

This white paper provides an in-depth analysis and overview of the Broadcom® AEIC-3700, an innovative Voltage Monitor IC designed to provide advanced voltage monitoring capabilities for electronic systems. The AEIC-3700 ensures precision monitoring, customizing options, and enhanced reliability, making it a key component in diverse applications. This document explores the features, applications, and benefits of the AEIC-3700.

Overview

It is essential to monitor the voltage rails to detect any potential faults in the power source. An irregularity in voltage levels, whether over or under voltage, can potentially disrupt the normal functioning of a microcontroller.

To facilitate this monitoring process, comparators are employed to assess the monitored voltage, VMON, against a predetermined threshold voltage. The output of the comparators varies based on which voltage value is higher. A window comparator, comprising two individual comparators and a precise, low-drift voltage reference, VREF, allows for the monitoring of voltage within a defined range, set by both lower and upper thresholds.

It is of utmost importance that the voltage, VMON, remains consistently within the specified voltage window. Any deviation from the defined thresholds triggers an alert, making the accurate functioning of the monitoring system vital in critical applications.

Features

- Supply voltage range from 2.8V to 6.5V
- Low quiescent current: 550 µA (Typical)
- Internal hysteresis: 5 mV (Typical)
- Wide operating temperature range: -40°C to 125°C
- Two main inputs and outputs (IN_A/IN_B,OUT_A/OUT_B)
- Package:
  - SOT-23-6 (3.0 mm x 1.5 mm Nominal)

Applications

- Control system especially for industrial automation
- FPGA applications
- ASIC applications
- Microcontroller applications system

NOTE: This product is not specifically designed or manufactured for use in any specific device. Customers are solely responsible for determining the suitability of this product for its intended application and solely liable for all loss, damage, expense, or liability in connection with such use.

AEIC-3700 Configurations

The AEIC-3700 has the capability to be used as a voltage detector that operates at the 2.8V to 6.5V supply voltage range. This device has two main input pins (INA and INB) that are used independently for voltage monitoring. INA and INB will take in external reference voltages in comparison with the IC internal reference signal (400 mV).

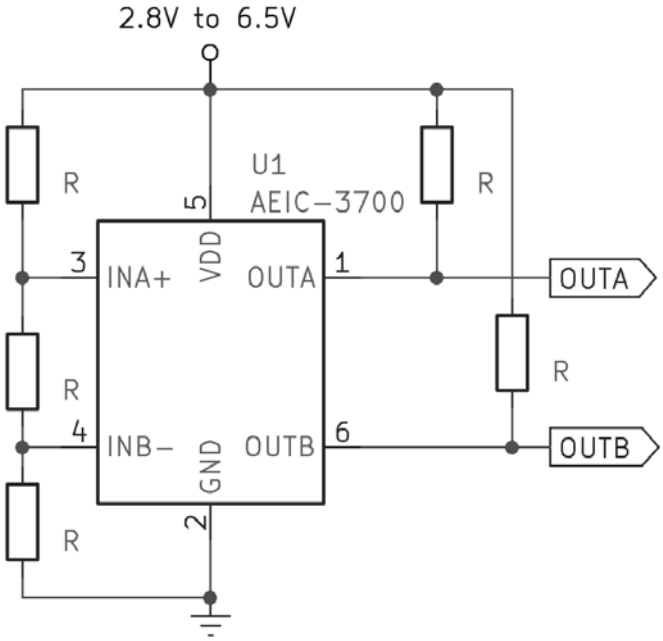
This device has high accuracy comparators which are suitable for overvoltage (OV) and undervoltage (UV) monitoring. These can be used either as a window voltage detector or as a two independent voltage monitors. The monitored voltages are set with the use of external resistors.

The device outputs are commonly connected to VDD using a resistor. However, certain applications might require pulling up the outputs to a voltage either higher or lower than VDD. This is essential for proper interfacing with the reset and enable terminals of other devices.

Monitoring Voltage the Same Rail Supplying VDD

In this application, the monitoring voltage comes from the same rail that supplies the VDD. Figure 1 shows the requirement for connecting the resistor divider to the VDD rail.

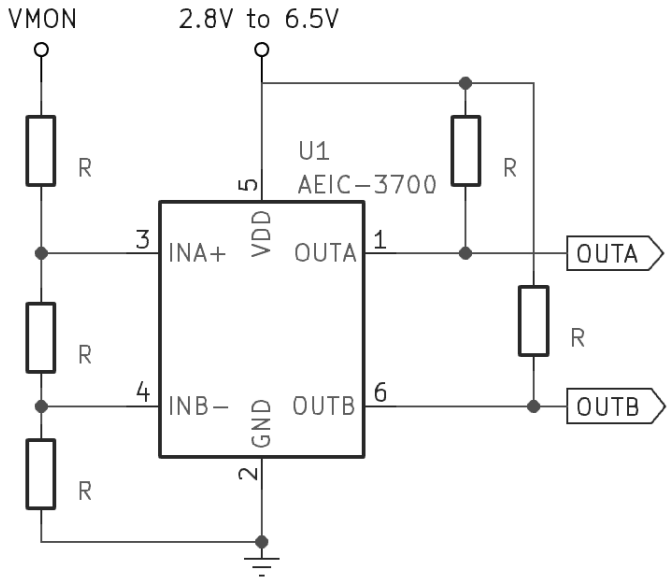
Figure 1: Monitoring Voltage from the Same Rail Supplying V_{DD}



Monitoring Voltage Rails Other Than the One Supplying VDD

This application illustrates monitoring a voltage different from VDD. Figure 2 shows the resistor divider connected to the monitored rail. This resistor divider serves to set the desired threshold for the monitoring voltage. Note that the inputs (INA+ and INB–) can monitor a voltage higher than the maximum value of VDD by connecting them to an external resistor divider.

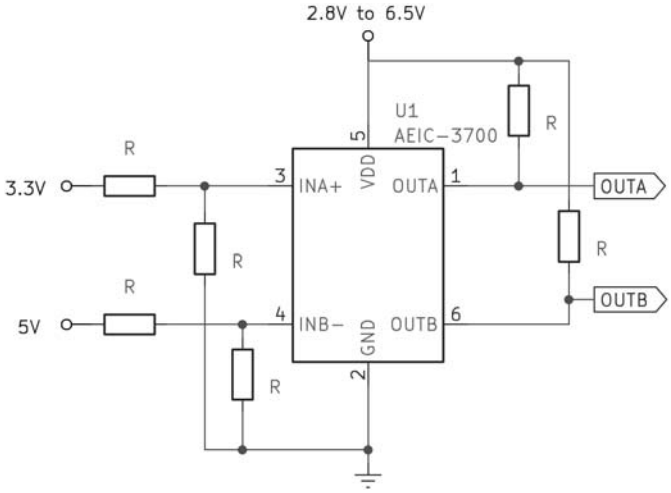
Figure 2: Monitoring a Voltage Other Than V_{DD}



Monitoring Overvoltage and Undervoltage on Two Separate Rails

In this application, overvoltage is monitored on one rail, while undervoltage is monitored on a different rail. Two independent resistor dividers must be used for this application.

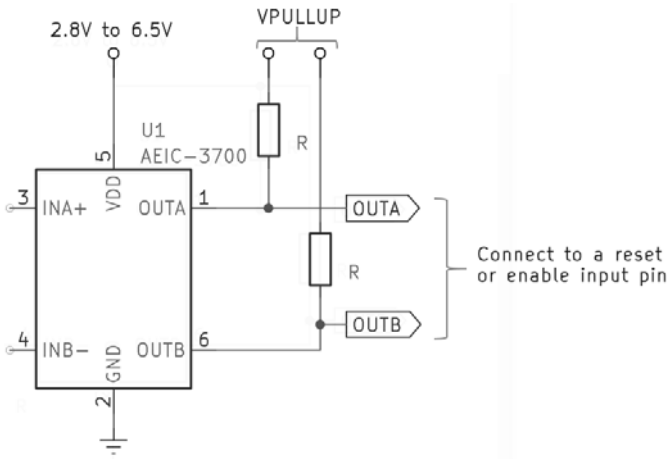
Figure 3: Monitoring Overvoltage and Undervoltage on Two Separate Rails



V_{PULLUP} to a Voltage Other Than VDD

The connections of the outputs typically involve a linkage to VDD using a resistor. However, certain applications may require the outputs to be elevated or reduced to a voltage level different from VDD. This adjustment ensures proper interfacing with the reset and enable terminals of other devices.

Figure 4: V_{PULLUP} Configuration



Importance of AEIC-3700 as a Voltage Monitoring Component

Brownout Protection

The system voltages are sometimes lowered due to heavy demand, resulting in brownouts characterized by a partial and temporary reduction in power supply voltage. In these instances, power is not lost but rather reduced. Reducing the supply voltage below the threshold may cause problems to the system. In this case, the AEIC-3700 serves as a protective component capable of detecting instances where the supply voltage falls below a specified level. It then initiates a reset state in the microcontroller, ensuring a proper start up when the supply voltage subsequently rises to a safe level.

Critical Voltage Rail Monitoring

Monitoring voltage rails is important for identifying power source faults. In industrial automation applications, an undervoltage or overvoltage error has the potential to trigger undefined behavior in a microcontroller that may cause problems to the internal and external system, as well as causing harm to the worker and environment. Using the AEIC-3700 to monitor a specific voltage rail will ensure that the voltage remains within the specification for optimal circuit functionality. In addition, monitoring the critical voltage rails helps prevent deviations that could otherwise result in performance issues or system failures, thereby maintaining stability and reliability.

Reliable System Start-Up (Power-On Reset)

Throughout the power-up phase, the voltage monitor monitors the voltage levels to protect against the potential fluctuations or instability. By continuously monitoring these conditions, the IC ensures that the system begins its operation only when the voltage has stabilized within predefined levels. This not only prevents unpredictable behavior during start up, but also protects sensitive electronic components from potential damage that may arise due to unstable power conditions.

Examples of AEIC-3700 Applications

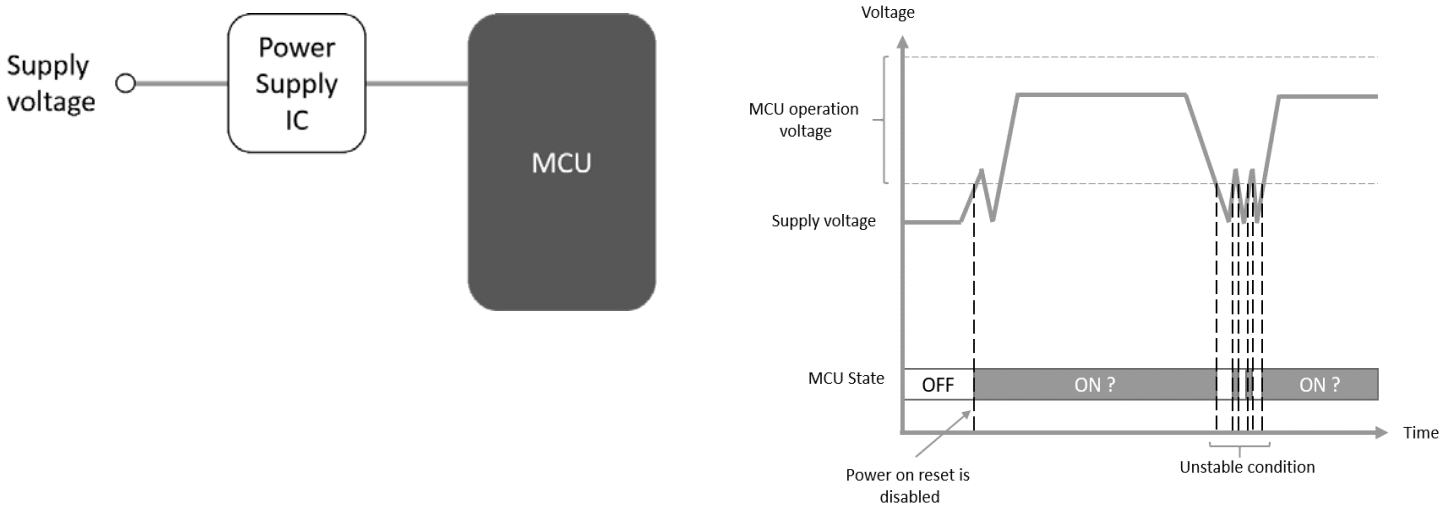
Ensuring the Safe Start Up of a Microcontroller

The AEIC-3700 has the capability to become a reset IC, whenever the voltage drops below a threshold or exceeds a certain level. Although some components (such as microcontroller) can perform certain reset IC functions, there are specific functions and safety considerations that are more effectively managed by a dedicated reset IC.

For proper microcontroller (MCU) functioning, it needs a specific minimum operating voltage. If the MCU starts at a voltage below this threshold or experiences an unstable power supply, it may lead to malfunctions or failures in the controlled devices. To ensure reliable MCU operation, it is crucial to perform a Power-On Reset operation. In cases of unstable power supply during start up, the MCU's power-on reset generator may not operate effectively, resulting in instability post-start up.

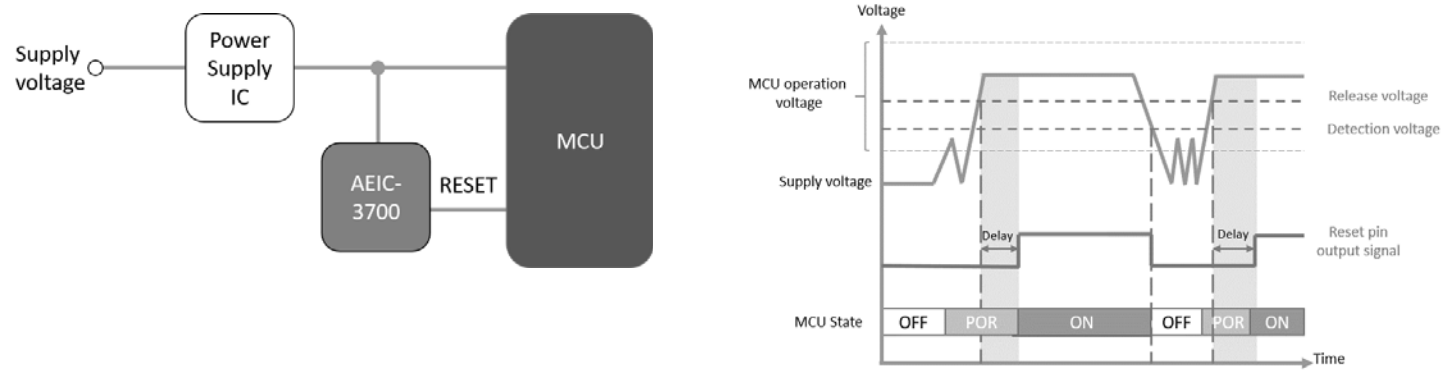
Figure 5 illustrates the MCU starting up without a power-on reset, leading to unstable operation.

Figure 5: MCU Start Up without using a Reset IC



To avoid this, the AEIC-3700 functions to monitor the level of the supply voltage so that it is under the allowable voltage level. When the voltage drops below a threshold or exceeds a certain level, the AEIC-3700 clears the reset signal to allow the MCU to start up. By introducing a delay time, the MCU reset status can be kept, ensuring sufficient time for the MCU power-on reset.

Figure 6: Using AEIC-3700 as a Reset IC to Monitor Power Supply Voltage

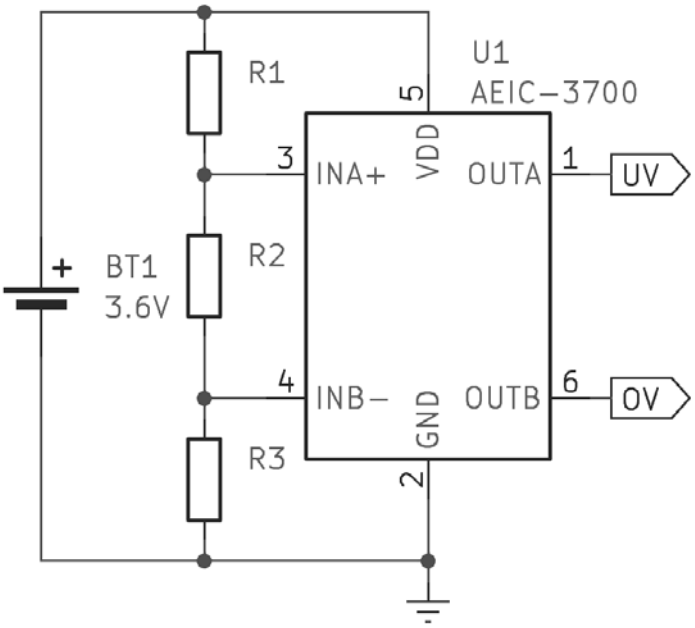


Monitoring the Voltage Level of the Battery

Lithium-ion (Li-ion) batteries are widely used in various applications. Undercharging and overcharging can potentially cause issues in electronic systems. Ensuring the safe operation of Li-ion batteries is crucial to protect them from these situations.

The following example (Figure 7) illustrates using the AEIC-3700 to monitor voltage for a 3.6V Li-ion battery.

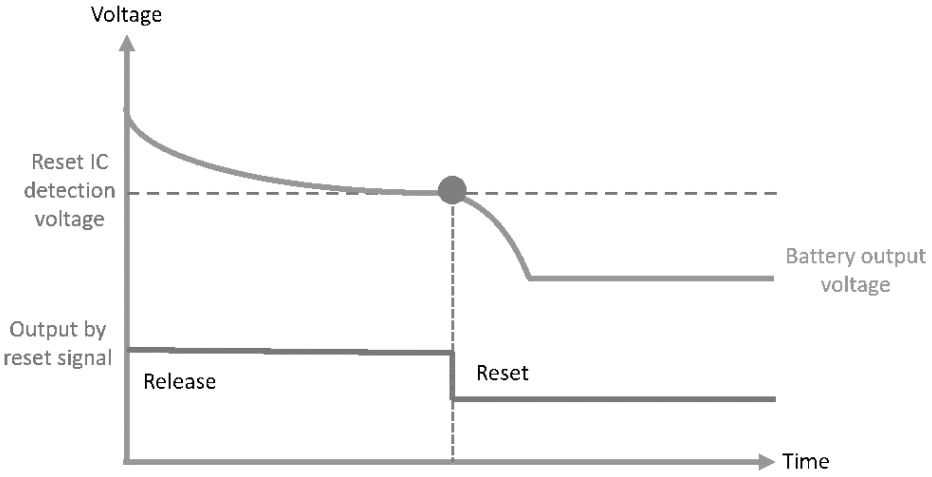
Figure 7: Overvoltage and Undervoltage Level Monitoring of a 3.6V Li-ion Battery using AEIC-3700



As the battery gets closer to empty, the decrease in output voltage speeds up. It is crucial to manage the operation of battery-powered devices before the output voltage drop accelerates to avoid malfunctions and failures.

By employing a reset IC to oversee the battery's output voltage, a reset signal is generated to regulate device operation prior to the acceleration of battery voltage depletion (as shown in Figure 8). Furthermore, the use of a reset IC with high-accuracy detection voltage contributes to further extending battery life.

Figure 8: Reset Signal Generated Prior to a Rapid Decline in Battery Voltage



Conclusion

The Broadcom AEIC-3700 sets a new standard for voltage monitoring with its precision, configurability, and digital interface. As electronic systems continue to evolve, the AEIC-3700 stands out as a reliable and versatile solution for ensuring stable and efficient operation.

For detailed information on device configuration, application circuits and further technical details, refer to the AEIC-3700 datasheet and application notes provided by Broadcom.