UT04VS33P / UT04VS50P Function Tables

Table 1: Cross Reference of Applicable Products

Product Name	Manufacturer Part Number	SMD #	Device Type	Internal PIC Number
3.3V Quad Channel Voltage Supervisor	UT04VS33P	5962-13206	Voltage Supervisor	YB11
5.0V Quad Channel Voltage Supervisor	UT04VS50P	5962-13206	Voltage Supervisor	YB10

1.0 Overview

The CAES radiation hardened Quad Voltage Supervisors can simultaneously monitor four separate voltage supplies. Both 3.3V (UT04VS33P) and 5.0V (UT04VS50P) versions are available. See Table 1: Cross Reference of Applicable Products. Each VIN voltage monitor drives a separate VOUT flag and contributes to a common RESET/RESETB. See Figure 1: UT04VS33P / UT04VS50P Block Diagram

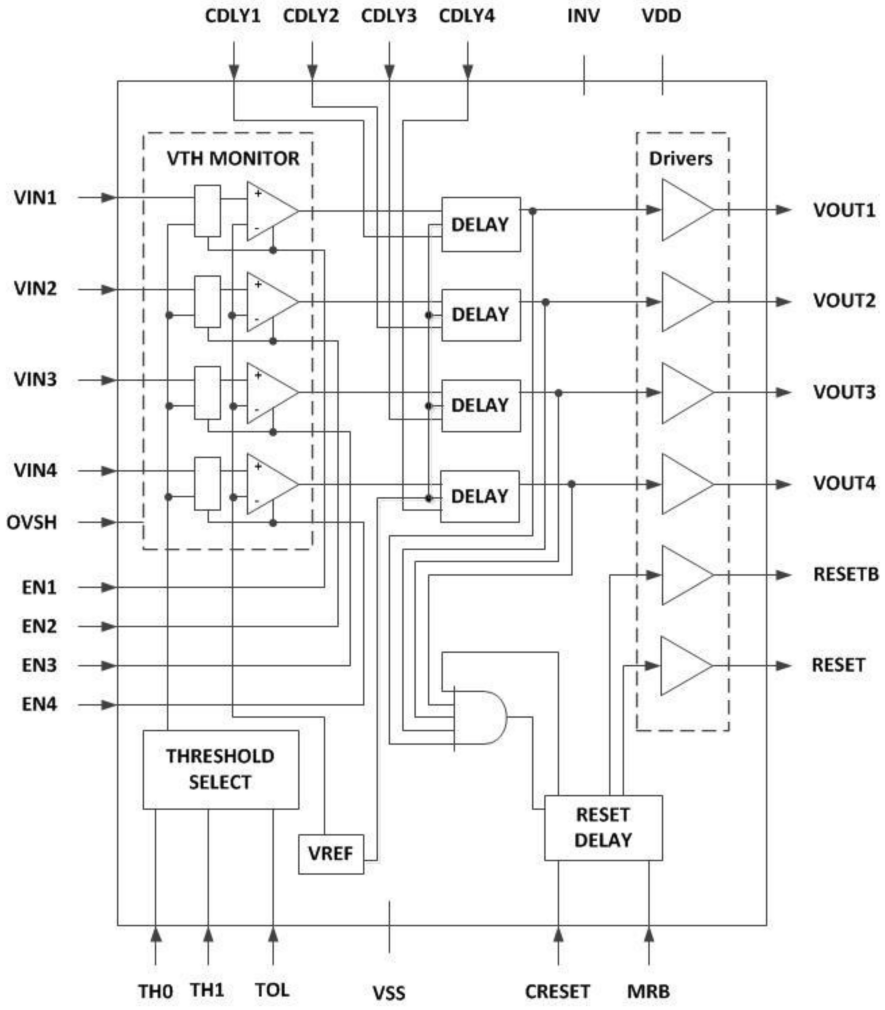

Figure 1: UT04VS33P / UT04VS50P Block Diagram

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VOUT and RESET/RESETB outputs are open drain. The threshold selects, TH1 and TH0, and the tolerance, TOL, define reference voltages for comparison. CDLY and CRESET are capacitive delay connects and add delay to the removal of the VOUTs and RESET/RESETB outputs when the VIN monitors return to threshold and remove all fault conditions. A master reset, MRB, forces the RESET/ RESETB active and an INV inverts the sense of the VOUT3 and VOUT4 outputs. Of particular interest to this paper are the enable signals, EN1–EN4, and the Over Voltage Select High (OVSH). The OVSH control signal determines if the Quad Supervisor is in under-voltage only mode, or in under-voltage / overvoltage mode. If OVSH=0, all four VIN voltage inputs monitor under-voltage conditions and the results are shown on the corresponding VOUT. If OVSH=1, VIN1 and VIN3 combine to monitor under-voltage and over-voltage respectively and control a common VOUT1 output. Similarly, with OVSH=1, VIN2 and VIN4 combine to monitor under-voltage and over-voltage and drive a common VOUT2 output. The enable signals, EN1-EN4, enable or remove voltage monitors and affect the RESET/RESETB outputs. Disabling a VIN voltage monitor forces the corresponding VOUT low and usually removes that monitor from affecting the RESET/RESETB. There is a slight difference in OVSH=1 mode which will be discussed. The paper highlights this and documents the functional behavior of all remaining critical input signals on the Quad Voltage Supervisors. Separate sections review Under-voltage Only mode and Under-voltage / Over-voltage mode. Function tables provide an easy reference to explain signal behavior. The user is also encouraged to visit the CAES website for data sheets and further information on the UT04VS33P and UT04VS50P Quad Voltage Supervisors.

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2.0 UT04VSxxP Under-voltage Only Mode

When OVSH=0, the Quad Voltage Supervisors monitor all four separate VIN channels for undervoltage faults. Please reference Table 2: UT04VSxxP Under-voltage Functional Analysis. The threshold selects, TH1 and TH0, are set to "00" for this analysis to define the threshold voltages for comparison. The analysis could use any threshold selects, so long as the VINx voltages are properly set for AU and BU values. The master reset, MRB, forces the RESET/RESETB active regardless of the VINx, ENx and VOUTx values. Each VINx to VOUTx channel represents an individual voltage monitor. The result of comparing the VINx value with its' appropriate threshold voltage appears at the respective VOUTx. An under-voltage failure causes the VOUTx to go active low (open drain output) and the RESET/RESETB outputs to activate. When in under-voltage only mode, disabling a VINx – VOUTx voltage monitor with the ENx signal forces the VOUTx output active low and removes that voltage monitor channel from RESET/RESETB analysis.

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Table 2: UT04VSxxP Under-voltage Functional Analysis

MRB	OVSH	TH1	TH0	INV	VIN1	VIN2	VIN3	VIN4	EN1	EN2	EN3	EN4	VOUT1	VOUT2	VOUT3	VOUT4	RESET	RESETB
Under-voltage Analysis																		
0	0	0	0	0	AU	AU	AU	AU	1	1	1	1	1	1	1	1	0	1
1	0	0	0	0	AU	AU	AU	AU	1	1	1	1	1	1	1	1	1	0
0	0	0	0	0	AU	AU	AU	AU	0	1	1	1	1	0	1	1	0	1
0	0	0	0	0	AU	AU	AU	AU	0	0	0	0	0	0	0	0	0	1
1	0	0	0	0	AU	AU	AU	AU	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	BU	AU	AU	AU	1	1	1	1	0	1	1	1	1	0
0	0	0	0	0	BU	AU	AU	AU	0	1	1	1	0	1	1	1	0	1
0	0	0	0	0	BU	BU	BU	BU	1	1	1	1	0	0	0	0	1	0
0	0	0	0	0	BU	BU	BU	BU	0	0	1	1	0	0	0	0	1	0
0	0	0	0	0	BU	BU	BU	BU	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	BU	AU	BU	AU	1	1	1	1	0	1	0	1	1	0
0	0	0	0	0	BU	AU	BU	AU	0	1	0	1	0	1	0	1	0	1
0	0	0	0	1	AU	AU	AU	AU	1	1	1	1	1	1	0	0	0	1
0	0	0	0	1	AU	AU	AU	AU	0	0	1	1	0	0	0	0	0	1
0	0	0	0	1	BU	BU	BU	BU	1	1	1	1	0	0	1	1	1	0
0	0	0	0	1	BU	BU	BU	BU	0	0	1	1	0	0	1	1	1	0
0	0	0	0	1	BU	BU	BU	BU	1	1	0	0	0	0	1	1	1	0
0	0	0	0	1	BU	BU	BU	BU	0	0	0	0	0	0	1	1	0	1

1 = HIGH
0 = LOW
AU = value above undervoltage
BU = value below undervoltage

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3.0 UT04VSxxP Under-voltage / Over-voltage Mode

When OVSH=1, the Quad Voltage Supervisors are in under-voltage / over-voltage mode. Please reference Table 3: UT04VSxxP Under-voltage / Over-voltage Functional Analysis. The threshold selects, TH1 and TH0, are set to "00" for this analysis. Again, this defines the threshold voltages for the under-voltage comparisons. In under-voltage / over-voltage mode, TH1 and TH0 define comparison voltages for the VIN1 and VIN2 under-voltage inputs only. The VIN3 and VIN4 inputs use the reference threshold voltage (V_{RFTH}) for an over-voltage comparison. The under-voltage analysis can use any threshold selects, so long as the VIN1 and VIN2 voltages are properly set for AU and BU values. The VIN3 and VIN4 inputs use voltage dividers to define AO and BO values for over-voltage comparison. In under-voltage / over-voltage analysis, VIN1 and VIN3 combine to monitor under-voltage and over-voltage respectively, with the combined result appearing at VOUT1. If VIN1 fails the under-voltage analysis, or VIN3 fails the over-voltage analysis, the VOUT1 output is active low (open drain outputs). Similarly, VIN2 and VIN4 combine to monitor under-voltage and over-voltage respectively, with the combined result appearing at VOUT2. Again, if VIN2 fails the under-voltage analysis or VIN4 fails the over-voltage analysis, VOUT2 is active low (open drain output). VOUT3 and VOUT4 are inactive in this mode, and their state depends on the value of the INV input. With INV=0, the VOUT3 and VOUT4 are open drain low. If INV=1, the VOUT3 and VOUT4 outputs are inverted and are pulled high. The monitor enables, ENx, have a slightly different effect in this mode. EN1 and EN2 for the under-voltage VIN1 and VIN2 inputs can disable a channel, force the VOUT1 or VOUT2 output low and remove the entire channel from RESET/RESETB analysis. In other words, if EN1 is low it forces VOUT1 low and removes both VIN1 and VIN3 from RESET/RESETB analysis. If EN1 and EN2 are both inactive low, then the RESET/RESETB is inactive regardless of the enables or input states for VIN3 and VIN4. If EN1 and EN2 are active high and VIN1 and VIN2 are valid, the analysis considers the effects of the enables and voltage conditions for the VIN3 and VIN4. If EN3 or EN4 is active high, the over-voltage conditions on VIN3 and VIN4 are considered. If an over-voltage condition occurs, that VOUT1 or VOUT2 is low, and the RESET/RESETB is active. If EN3 or EN4 is inactive low, the VOUT1 or VOUT2 is low, and the RESET/RESETB is active. In other words, when VIN1 and VIN2 are active and pass the under-voltage analysis, disabling the EN3 or EN4 forces the corresponding VOUT1 or VOUT2 low and activates the RESET/RESETB outputs. The master reset, MRB, forces the RESET/RESETB outputs active regardless of the VINx, ENx and VOUTx values.

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Table 3: UT04VSxxP Under-voltage / Over-voltage Functional Analysis

MRB	OVSH	TH1	TH0	INV	VIN1	VIN2	VIN3	VIN4	EN1	EN2	EN3	EN4	VOUT1	VOUT2	VOUT3	VOUT4	RESET	RESETB
Under-voltage / Over-voltage Analysis																		
0	1	0	0	0	AU	AU	BO	BO	1	1	1	1	1	1	0	0	0	1
1	1	0	0	0	AU	AU	BO	BO	1	1	1	1	1	1	0	0	1	0
0	1	0	0	0	AU	AU	BO	BO	1	1	0	0	0	0	0	0	1	0
0	1	0	0	0	AU	AU	BO	BO	0	0	1	1	0	0	0	0	0	1
0	1	0	0	0	AU	AU	BO	BO	1	1	0	1	0	1	0	0	1	0
0	1	0	0	0	AU	AU	BO	BO	1	1	1	0	1	0	0	0	1	0
0	1	0	0	0	AU	AU	BO	BO	0	0	0	0	0	0	0	0	0	1
1	1	0	0	0	AU	AU	BO	BO	0	0	0	0	0	0	0	0	1	0
0	1	0	0	0	AU	AU	BO	BO	1	0	0	0	0	0	0	0	1	0
0	1	0	0	0	AU	AU	BO	BO	1	0	1	0	1	0	0	0	0	1
0	1	0	0	0	AU	AU	BO	BO	0	1	0	1	0	1	0	0	0	1
0	1	0	0	0	BU	BU	BO	BO	1	1	1	1	0	0	0	0	1	0
0	1	0	0	0	BU	BU	BO	BO	0	0	1	1	0	0	0	0	0	1
0	1	0	0	0	BU	BU	BO	BO	1	1	0	0	0	0	0	0	1	0
0	1	0	0	0	BU	BU	BO	BO	0	0	0	0	0	0	0	0	0	1
0	1	0	0	0	AU	AU	AO	AO	1	1	1	1	0	0	0	0	1	0
0	1	0	0	0	AU	AU	AO	AO	0	0	1	1	0	0	0	0	0	1
0	1	0	0	0	AU	AU	AO	AO	1	1	0	0	0	0	0	0	1	0
0	1	0	0	0	AU	AU	AO	AO	0	0	0	0	0	0	0	0	0	1
0	1	0	0	0	BU	BU	AO	AO	1	1	1	1	0	0	0	0	1	0
0	1	0	0	0	BU	BU	AO	AO	0	0	1	1	0	0	0	0	0	1
0	1	0	0	0	BU	BU	AO	AO	1	1	0	0	0	0	0	0	1	0
0	1	0	0	0	BU	BU	AO	AO	0	0	0	0	0	0	0	0	0	1
1	1	0	0	0	BU	BU	AO	AO	0	0	0	0	0	0	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	0	1	1	1	0	1	0	0	0	1
0	1	0	0	0	AU	BU	BO	AO	1	0	1	1	1	0	0	0	0	1
0	1	0	0	0	BU	AU	AO	BO	0	1	0	1	0	1	0	0	0	1
0	1	0	0	0	AU	BU	BO	AO	1	0	1	0	1	0	0	0	0	1
0	1	0	0	0	AU	BU	BO	AO	1	0	0	0	0	0	0	0	1	0
0	1	0	0	0	AU	BU	BO	AO	1	0	0	1	0	0	0	0	1	0
0	1	0	0	0	AU	BU	BO	AO	0	1	0	0	0	0	0	0	1	0
0	1	0	0	0	AU	BU	BO	AO	0	1	0	1	0	0	0	0	1	0
0	1	0	0	0	AU	BU	BO	AO	0	1	1	0	0	0	0	0	1	0
0	1	0	0	0	AU	BU	BO	AO	0	1	1	1	0	0	0	0	1	0
0	1	0	0	0	AU	BU	BO	AO	1	1	1	0	1	0	0	0	1	0

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0	1	0	0	0	AU	BU	BO	AO	1	1	0	1	0	0	0	0	1	0
0	1	0	0	0	AU	BU	BO	AO	1	1	1	1	1	0	0	0	1	0
0	1	0	0	0	AU	BU	BO	AO	1	1	0	0	0	0	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	1	0	1	1	0	0	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	1	0	1	0	0	0	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	1	0	0	1	0	0	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	1	0	0	0	0	0	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	0	1	1	0	0	0	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	0	1	0	0	0	0	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	1	1	1	1	0	1	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	1	1	1	0	0	0	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	1	1	0	1	0	1	0	0	1	0
0	1	0	0	0	BU	AU	AO	BO	1	1	0	0	0	0	0	0	1	0
0	1	0	0	1	AU	AU	BO	BO	1	1	1	1	1	1	1	1	0	1
0	1	0	0	1	AU	AU	BO	BO	1	1	0	0	0	0	1	1	1	0
0	1	0	0	1	AU	AU	BO	BO	0	0	1	1	0	0	1	1	0	1
0	1	0	0	1	AU	BU	BO	AO	1	0	1	1	1	0	1	1	0	1
0	1	0	0	1	BU	AU	AO	BO	0	1	0	1	0	1	1	1	0	1

1 = HIGH
0 = LOW
AU = value above undervoltage
BU = value below undervoltage
AO= value above overvoltage
BO= value below overvoltage

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UT04VS33P / UT04VS50P Function Tables

4.0 Summary and Conclusion

The CAES radiation hardened Quad Voltage Supervisors can simultaneously monitor up to four separate voltage supplies. These Voltage Supervisors find many system uses in voltage monitoring, voltage sequencing and Fault Detection, Isolation and Recovery (FDIR) schemes. To use the Voltage Supervisors in these systems, the designer must have a detailed understanding of all critical control signals and their effect on performance. The Quad Supervisors have two functional modes defined by the OVSH control: under-voltage only and under-voltage / over-voltage. The VIN to VOUT channel response and the use of the ENx enables have different results in each mode. The effects of these signals and the rest of the control inputs are the focus of this paper and its' functional tables. In particular, the function tables serve as a quick reference for the designer using the Quad Voltage Supervisors.

Revision History

Date	Rev. #	Author	Change Description
12/06/2016	1.0.0	rbl	Initial Release

The following United States (U.S.) Department of Commerce statement shall be applicable if these commodities, technology, or software are exported from the U.S.: These commodities, technology, or software were exported from the United States in accordance with the Export Administration Regulations. Diversion contrary to U.S. law is prohibited.