Ultralow Power Voltage Detector

Data Sheet **ADM8641/ADM8642**

FEATURES

Ultralow power consumption with I_{CC} = 92 nA (typical)
Precision, low voltage monitoring
Pretrimmed voltage monitoring threshold options
- **10 options from 2 V to 4.63 V for the ADM8641**
- **20 options from 0.5 V to 1.9 V for the ADM8642**

±1.3% threshold accuracy over full temperature range
Output disable input
23 µs to 26 µs typical propagation delay
Open-drain type output
Power supply glitch immunity
Available in a 1.46 mm × 0.96 mm WLCSP
Operational temperature range: −40°C to +85°C

APPLICATIONS

Portable/battery-operated equipment
Microprocessor systems
Energy metering
Energy harvesting

FUNCTIONAL BLOCK DIAGRAMS

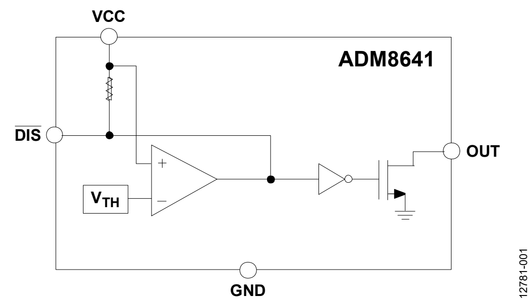

Figure 1. ADM8641 Functional Block Diagram

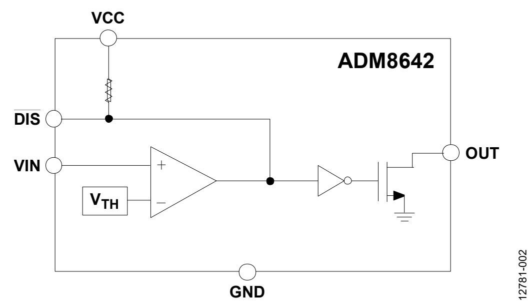

Figure 2. ADM8642 Functional Block Diagram

GENERAL DESCRIPTION

The ADM8641 and ADM8642 are simple voltage detectors suitable for use in general-purpose applications. The ultralow power consumption of these devices makes them suitable for power efficiency sensitive systems, such as battery-powered portable devices and energy meters.

The factory preset detection thresholds from 0.5 V to 4.63 V with ±1.2% accuracy over the full temperature range enable the devices to monitor the node of interest accurately with direct contact. The $\overline{\text{DIS}}$ input lets the user hold the output low regardless of the state of the input. Not all device options are released for sale as standard models. See the Ordering Guide section for full information.

The ADM8641 monitors the voltage using the VCC pin. The separate supply pin on the ADM8642 allows it to have a lower detection threshold down to 0.5 V.

The ADM8641 and ADM8642 are available in a 6-ball, 1.46 mm × 0.96 mm WLCSP. These devices are specified over the −40°C to +85°C temperature range.

Rev. D **Document Feedback**

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REVISION HISTORY

5/2021—Rev. C to Rev. D

Added VCC Slew Rate Consideration Section ... 9

1/2018—Rev. B to Rev. C

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Added Note 1 to Table 1 ... 3
Changed Out Output Parameter, Table 1 to Out Pin Output Parameter, Table 1, $\overline{\text{DIS}}$ Input Parameter, Table 1 to $\overline{\text{DIS}}$ Pin Input Parameter, Table 1 ... 4
Changed Device Options Section to Device Model Options Section ... 10
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1/2016—Rev. A to Rev. B

Changes to Ordering Guide ... 11

4/2015—Rev. 0 to Rev. A

Changes to Threshold Hysteresis Parameter, Table 1 ... 3

1/2015—Revision 0: Initial Version

SPECIFICATIONS

V_{CC} = 2 V to 5.5 V, V_{IN} < V_{CC} + 0.3 V, T_A = −40°C to +85°C, unless otherwise noted. Typical values are at T_A = 25°C.

Table 1.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions/Comments
OPERATING VOLTAGE RANGE	V_{CC}					
ADM8641		0.9		5.5	V	Guarantees valid OUT output
ADM8642		2		5.5	V	Guarantees valid OUT output
		0.9			V	Guarantees OUT low
UNDERVOLTAGE LOCKOUT						ADM8642 only
Input Voltage Rising	$UVLO_{RISE}$			1.95	V	
Input Voltage Falling	$UVLO_{FALL}$	1.6			V	
Hysteresis	$UVLO_{HYS}$		90		mV	
INPUT CURRENT						
VCC Quiescent Current	I_{CC}		92	190	nA	V_{CC} = 2 V to 5.5 V, OUT pulled high
				110	nA	T_A = 25°C, OUT pulled high
VIN Average Input Current	I_{VIN}		4	32	nA	V_{IN} = 2 V, V_{CC} = 2 V
			4	8.5	nA	V_{IN} = 2 V, V_{CC} = 5.5 V
THRESHOLD VOLTAGE[1]	V_{TH}					Input falling
ADM8641		V_{TH} − 1.3%	V_{TH}	V_{TH} + 1.3%	V	See Table 6
ADM8642		V_{TH} − 1.3%	V_{TH}	V_{TH} + 1.3%	V	See Table 7, V_{TH} ≥ 1.2 V
		V_{TH} − 1.4%	1.1	V_{TH} + 1.4%	V	1.1 V threshold option
		V_{TH} − 1.6%	1	V_{TH} + 1.6%	V	1 V threshold option
		V_{TH} − 1.6%	0.95	V_{TH} + 1.6%	V	0.95 V threshold option
		V_{TH} − 1.7%	0.9	V_{TH} + 1.7%	V	0.9 V threshold option
		V_{TH} − 1.8%	0.85	V_{TH} + 1.8%	V	0.85 V threshold option
		V_{TH} − 1.8%	0.8	V_{TH} + 1.8%	V	0.8 V threshold option
		V_{TH} − 1.9%	0.75	V_{TH} + 1.9%	V	0.75 V threshold option
		V_{TH} − 1.9%	0.7	V_{TH} + 1.9%	V	0.7 V threshold option
		V_{TH} − 2.0%	0.65	V_{TH} + 2.0%	V	0.65 V threshold option
		V_{TH} − 2.1%	0.6	V_{TH} + 2.1%	V	0.6 V threshold option
		V_{TH} − 2.1%	0.55	V_{TH} + 2.1%	V	0.55 V threshold option
		V_{TH} − 2.2%	0.5	V_{TH} + 2.2%	V	0.5 V threshold option
THRESHOLD HYSTERESIS	V_{HYST}					
ADM8641			0.9% × V_{TH}		V	
ADM8642			0.9% × V_{TH}		V	V_{TH} > 1 V
			10.3		mV	V_{TH} ≤ 1 V
PROPAGATION DELAY						
ADM8641 VCC to OUT	t_{PD_VCC}	18	26	37	µs	V_{CC} falling with V_{TH} × 10% overdrive
		20.5	36	57	µs	V_{CC} rising with V_{TH} × 10% overdrive
ADM8642 VIN to OUT	t_{PD_VIN}	13.5	23	35	µs	V_{IN} falling with V_{TH} × 10% overdrive
		22	39.5	61	µs	V_{IN} rising with V_{TH} × 10% overdrive
INPUT GLITCH REJECTION						
ADM8641 VCC Glitch Rejection	t_{GR_VCC}		23		µs	V_{CC} falling with V_{TH} × 10% overdrive
			35		µs	V_{CC} rising with V_{TH} × 10% overdrive
ADM8642 VIN Glitch Rejection	t_{GR_VIN}		21		µs	V_{IN} falling with V_{TH} × 10% overdrive
			38		µs	V_{IN} rising with V_{TH} × 10% overdrive

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions/Comments
OUT PIN OUTPUT						
Output Voltage Low	V_{OUT_OL}			0.4	V	V_{CC} > 4.25 V, I_{SINK} = 6.5 mA
				0.4	V	V_{CC} > 2.5 V, I_{SINK} = 6 mA
				0.4	V	V_{CC} > 1.2 V, I_{SINK} = 4.6 mA
				0.4	V	V_{CC} > 0.9 V, I_{SINK} = 0.9 mA
Leakage Current				5	nA	V_{OUT} = V_{CC} = 5.5 V
$\overline{DIS}$ PIN INPUT						
V_{IL}				0.4	V	
V_{IH}		0.9			V	
$\overline{DIS}$ Glitch Rejection			0.4		µs	
$\overline{DIS}$ to OUT Delay	t_{D_DIS1}		0.65		µs	$\overline{DIS}$ falling
$\overline{DIS}$ Pull-Up Resistance		0.5	0.6	0.82	MΩ	

[1] Not all device options are released for sale as standard models. See the Ordering Guide section for full information.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
VCC	−0.3 V to +6 V
OUT	−0.3 V to +6 V
VIN	−0.3 V to +6 V
$\overline{\text{DIS}}$	−0.3 V to V_{CC} + 0.3 V
Input/Output Current	10 mA
Storage Temperature Range	−40°C to +150°C
Operating Temperature Range	−40°C to +85°C

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

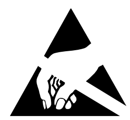
THERMAL RESISTANCE

θ_{JA} is specified for a device soldered on an FR4 board with a minimum footprint.

Table 3.

Package Type	θ_{JA}	Unit
6-Ball WLCSP	105.6	°C/W

ESD CAUTION



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

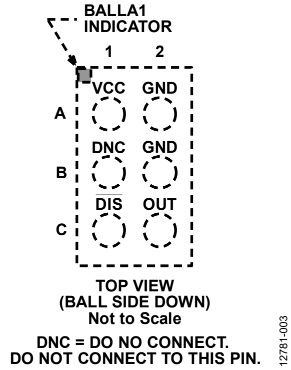


Figure 3. ADM8641 Pin Configuration

Table 4. ADM8641 Pin Function Descriptions

Pin No.	Mnemonic	Description
A1	VCC	Power Supply Input. The voltage on the VCC pin is monitored on the ADM8641. It is recommended to place a 0.1 µF decoupling capacitor between the VCC pin and the GND pin.
A2	GND	Ground. Both GND pins on the ADM8641 must be grounded.
B1	DNC	Do Not Connect. Do not connect to this pin.
B2	GND	Ground. Both GND pins on the ADM8641 must be grounded.
C1	$\overline{\text{DIS}}$	Active Low Output Disable Input.
C2	OUT	Open-Drain Detector Output.

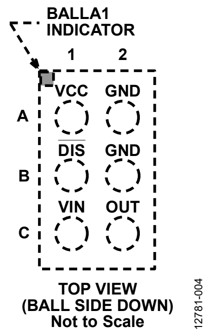


Figure 4. ADM8642 Pin Configuration

Table 5. ADM8642 Pin Function Descriptions

Pin No.	Mnemonic	Description
A1	VCC	Power Supply Input. The voltage on the VCC pin is not monitored on the ADM8642. It is recommended to place a 0.1 µF decoupling capacitor between the VCC pin and the GND pin.
A2	GND	Ground. Both GND pins on the ADM8642 must be grounded.
B1	$\overline{\text{DIS}}$	Active Low Output Disable Input.
B2	GND	Ground. Both GND pins on the ADM8642 must be grounded.
C1	VIN	Low Voltage Monitoring Input. This separate supply input allows the ADM8642 to monitor low voltages of 0.8 V on the VIN pin.
C2	OUT	Open-Drain Detector Output.

TYPICAL PERFORMANCE CHARACTERISTICS

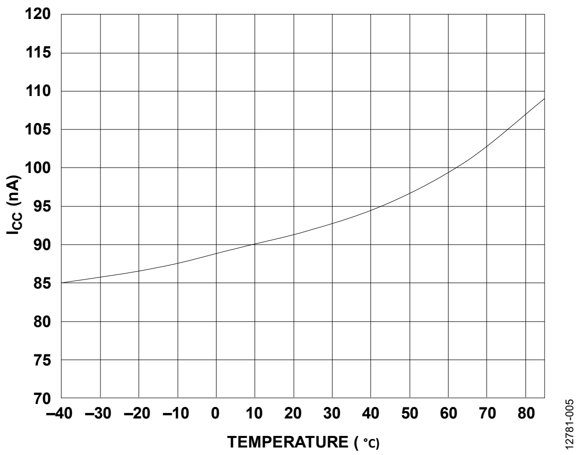


Figure 5. Supply Current (I_{CC}) vs. Temperature

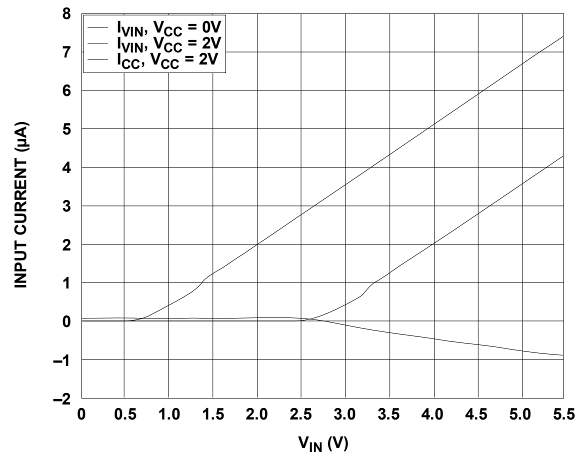


Figure 8. VIN Pin and VCC Pin Input Current vs. V_{IN}

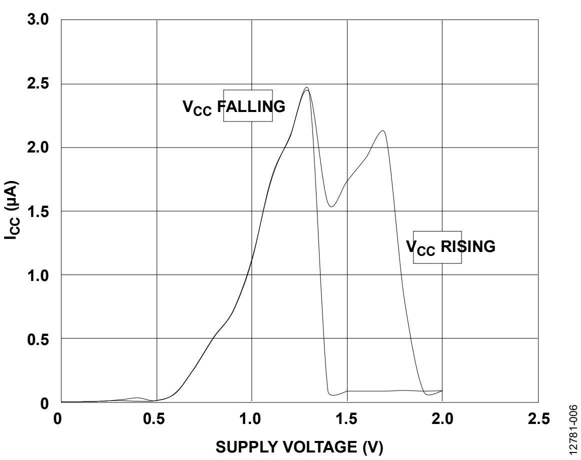


Figure 6. Supply Current (I_{CC}) vs. Supply Voltage, $V_{CC} < 2$ V

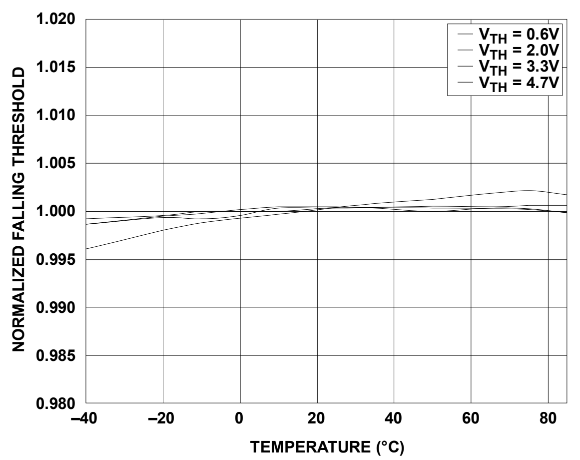


Figure 9. Normalized Falling Threshold vs. Temperature

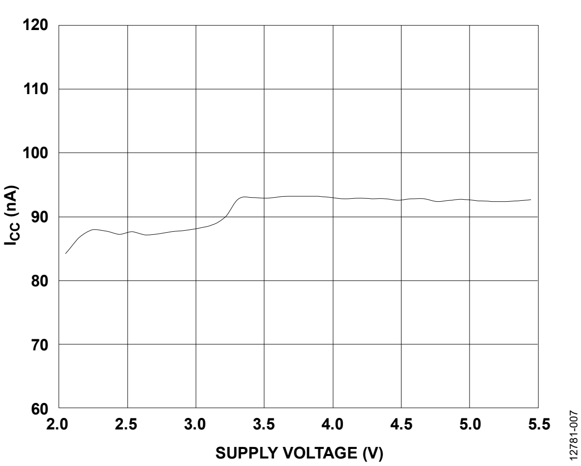


Figure 7. Supply Current (I_{CC}) vs. Supply Voltage

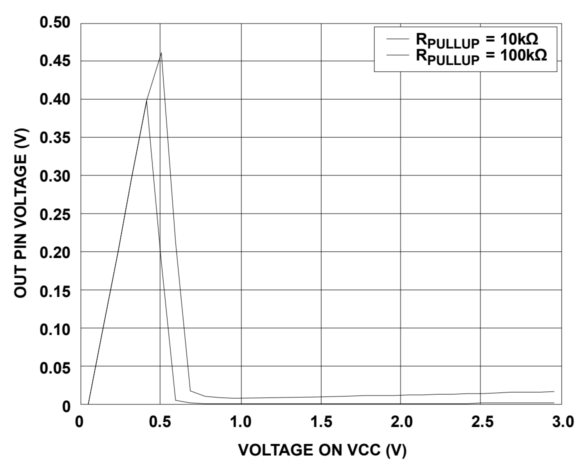


Figure 10. OUT Pin Voltage vs. Voltage on VCC
(with the OUT Pin Pulled up to the VCC Pin Through R_{PULLUP})

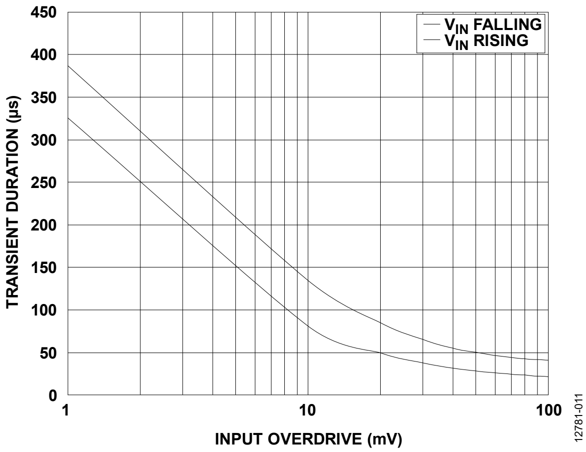


Figure 11. Maximum Transient Duration vs. Input Overdrive

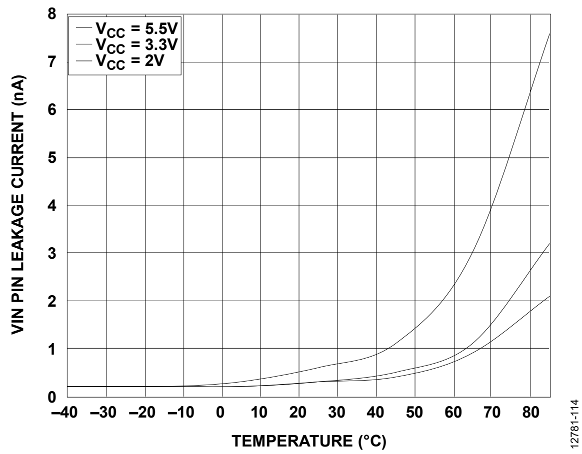


Figure 12. VIN Pin Leakage Current vs. Temperature

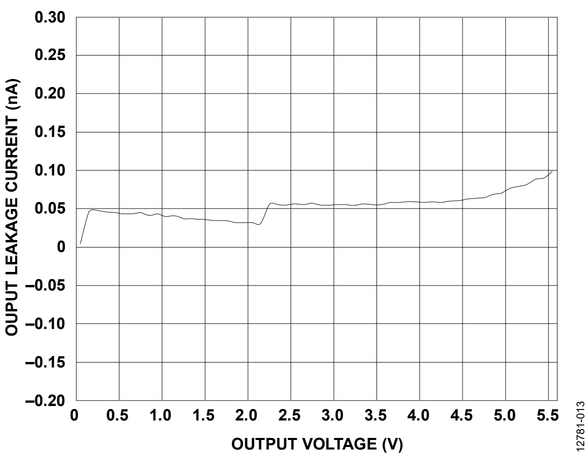


Figure 13. Output Leakage Current vs. Output Voltage

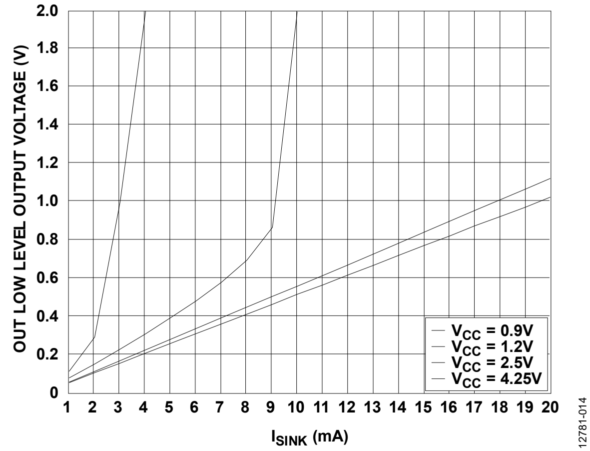


Figure 14. OUT Low Level Output Voltage vs. Sink Current (I_{SINK})

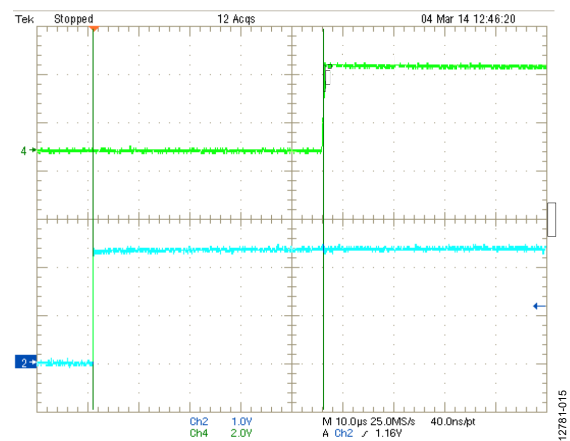


Figure 15. OUT Propagation Delay With VCC/VIN Rising

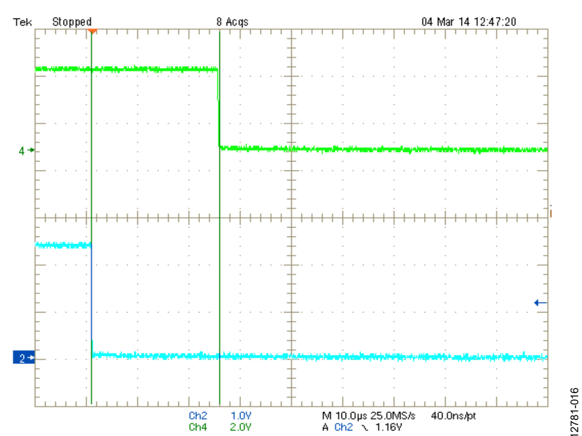


Figure 16. OUT Propagation Delay With VCC/VIN Falling

THEORY OF OPERATION

The ADM8641 and ADM8642 ultralow power voltage detectors are especially suited for battery-powered applications due to the 190 nA quiescent current (maximum). The internal precision reference allows the user to monitor specific voltage levels accurately from 0.5 V to 4.63 V. These devices feature internal input hysteresis and an open-drain output. The output remains logic high after the monitored input is above the preset threshold. The output changes to logic low after the input voltage falls below the threshold. The devices keep the output in a logic low state whenever the supply voltage on the VCC pin is below the UVLO threshold. The output disable input can also keep the output low regardless of the status on the input.

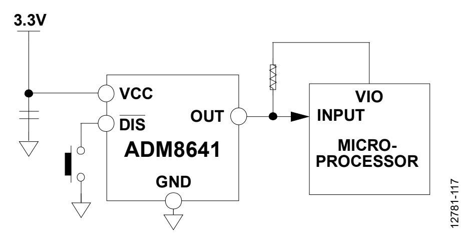


Figure 17. ADM8641 Typical Application Circuit

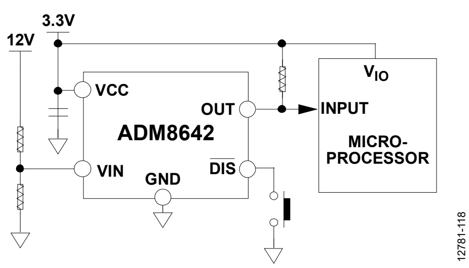


Figure 18. ADM8642 Typical Application Circuit

VOLTAGE MONITORING INPUT

The VCC pin on the ADM8641 acts as both a device power input node and a voltage monitoring input node. The ADM8642 uses separate pins for supply and voltage monitoring to achieve a low voltage monitoring threshold to 0.5 V. It is recommended to place a 0.1 µF decoupling capacitor between the VCC pin and the GND pin.

VCC Slew Rate Consideration

A fast VCC ramp (µs range) on power-up can cause the device to behave in an irregular manner. In applications where a high slew rate on VCC is possible, for example, powering up using a battery pack, it is recommended that an RC filter is used to reduce the slew rate. RC combinations of 3.3 kΩ + 2.2 µF and 1 kΩ + 10 µF have been tested and identified as safe options.

VIN AS AN ADJUSTABLE INPUT

Due to the low leakage nature of the VIN pin, the ADM8642 can be used as a device with an adjustable threshold. Use an external resistor divider circuit to program the desired voltage monitoring threshold based on the VIN threshold, as shown in Figure 19.

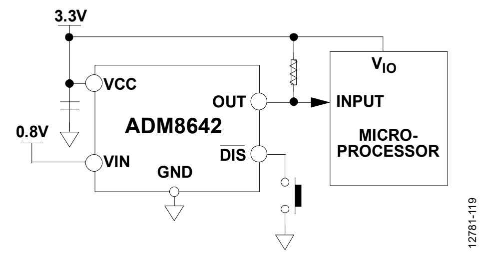


Figure 19. ADM8642 as an Adjustable Threshold Device

TRANSIENT IMMUNITY

To avoid unnecessary output state changes caused by fast power supply transients, an input glitch filter is added to the VCC pin of the ADM8641 and the VIN pin of the ADM8642 to filter out the transient glitches on these pins.

Figure 11 shows the comparator overdrive (that is, the maximum magnitude of positive and negative going pulses with respect to the typical threshold) vs. the pulse duration without changing the state of the output.

OUTPUT

Both the ADM8641 and ADM8642 voltage detectors have an open-drain output. For the ADM8641, the state of the output is guaranteed to be valid as soon as V_{CC} rises above 0.9 V. For the ADM8642, the output is guaranteed to be logic low from when V_{CC} = 0.9 V to when the device exits ULVO.

When the monitored voltage falls below its associated threshold, the OUT pin asserts low after 23 µs to 26 µs (typical). When the monitored voltage rises above the threshold plus hysteresis, the OUT pin asserts high after 36 µs to 39.5 µs (typical).

DISABLE INPUT

The ADM8641/ADM8642 feature a disable input ($\overline{\text{DIS}}$). Drive the $\overline{\text{DIS}}$ pin low to assert the output low. The $\overline{\text{DIS}}$ input has a 0.6 MΩ internal pull-up resistor so that the input is always high when unconnected. To drive the $\overline{\text{DIS}}$ input, use an external signal or a push-button switch to ground; debounce circuitry is integrated on-chip for this purpose. Noise immunity is provided on the $\overline{\text{DIS}}$ input, and fast, negative going transients of up to 0.4 µs (typical) are ignored. If required, a 0.1 µF capacitor between the $\overline{\text{DIS}}$ pin and ground provides additional noise immunity.

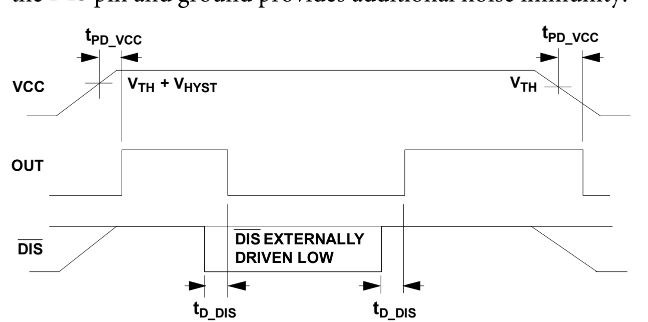


Figure 20. $\overline{\text{DIS}}$ Input Timing

DEVICE MODEL OPTIONS

The ADM8641/ADM8642 include many device options, however, not all options are released for sale. Released options are called standard models and are listed in the Ordering Guide section. The Simple Reset Supervisory IC page also offers a list of standard models. Contact a sales representative for information on nonstandard models and be aware that samples and production units have long lead times.

Table 6. ADM8641 V_{CC} Threshold (V_{TH}) Options (T_A = −40°C to +85°C)

Threshold Number	Min	Typ	Max	Unit
200	1.974	2	2.026	V
220	2.171	2.2	2.229	V
232	2.290	2.32	2.350	V
263	2.596	2.63	2.664	V
280	2.764	2.8	2.836	V
293	2.892	2.93	2.968	V
300	2.961	3	3.039	V
308	3.040	3.08	3.120	V
440	4.343	4.4	4.457	V
463	4.570	4.63	4.690	V

Table 7. ADM8642 V_{IN} Threshold (V_{TH}) Options (T_A = −40°C to +85°C)

Threshold Number	Min	Typ	Max	Unit
050	0.489	0.5	0.511	V
055	0.538	0.55	0.562	V
060	0.588	0.6	0.612	V
065	0.637	0.65	0.663	V
070	0.686	0.7	0.714	V
075	0.736	0.75	0.764	V
080	0.785	0.8	0.815	V
085	0.835	0.85	0.865	V
090	0.885	0.9	0.915	V
095	0.935	0.95	0.965	V
100	0.984	1	1.016	V
110	1.084	1.1	1.116	V
120	1.184	1.2	1.216	V
130	1.283	1.3	1.317	V
140	1.382	1.4	1.418	V
150	1.481	1.5	1.520	V
160	1.579	1.6	1.621	V
170	1.678	1.7	1.722	V
180	1.777	1.8	1.823	V
190	1.875	1.9	1.925	V

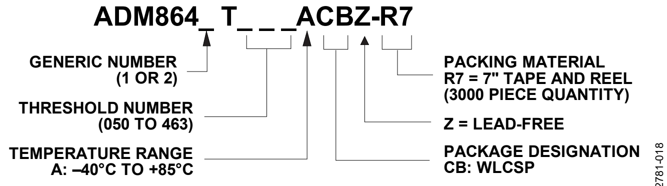


Figure 21. Ordering Code Structure

OUTLINE DIMENSIONS

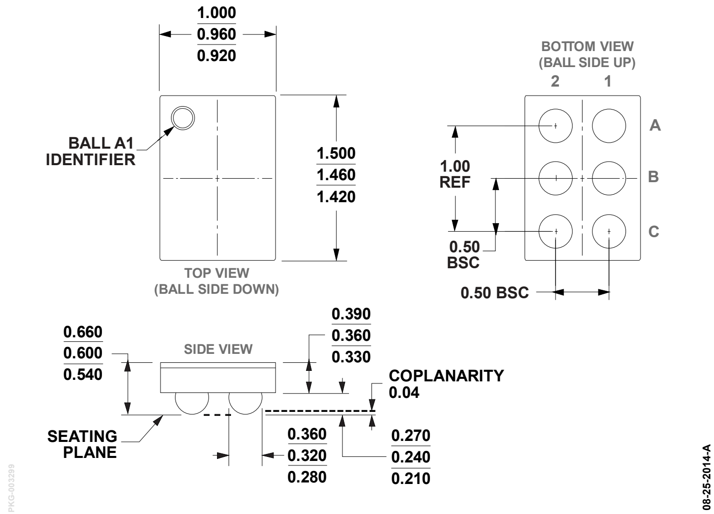


Figure 22. 6-Ball Wafer Level Chip Scale Package [WLCSP]
(CB-6-17)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1, 2, 3]	Temperature Range	Threshold Voltage (V)	Package Description	Package Option	Marking Code
ADM8641T263ACBZ-R7	−40°C to +85°C	2.63	6-Ball WLCSP	CB-6-17	DT
ADM8642T100ACBZ-R7	−40°C to +85°C	1.0	6-Ball WLCSP	CB-6-17	DU
ADM8641-EVALZ			Evaluation Board		
ADM8642-EVALZ			Evaluation Board		

[1] Z = RoHS Compliant Part.
[2] ADM8641/ADM8642 include many device options, however, not all options are released for sale. Released options are called standard models and are listed in the Ordering Guide. The Simple Reset Supervisory IC page also offers a list of standard models. Contact a sales representative for information on nonstandard models and be aware that samples and production units have long lead times.
[3] If ordering nonstandard models, complete the ordering code shown in Figure 21 by inserting the model number and threshold number.