

Use (Almost) Any Input Voltage Range with an AD7671, AD7665, or AD7663 PuLSAR 16-Bit ADC

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SUMMARY

The AD7671, AD7665, and AD7663 are specified for six analog input voltage ranges: ± 10 V, ± 5 V, ± 2.5 V, 0 V to 10 V, 0 V to 5 V, and 0 V to 2.5 V. These ADCs, however, can handle other input voltage ranges not described in the data sheet. For instance, 0 V to 4 V, 0 V to 3.3 V, ± 3.3 V, or 0 V to 24 V ranges are available; and these ranges, as well others, may be more suitable for some specific applications.

This application note assists the user in determining the configuration of the AD7671, AD7665, or AD7663 to use the analog input range of preference.

Also, a software tool called “PuLSAR input range” helps the user optimize the input voltage range choice and provides all the necessary information to use it. This software can be downloaded from the application note link from the AD7671, AD7665, and AD7663 product web pages.

DISCUSSION

As described in Table I of the data sheet, the different input voltage ranges are selected by connecting the four separate input pins called IND, INC, INB, and INA to three different signals comprising the analog signal itself (V_{IN}), the signal ground (GND), and the reference voltage (REF). Obviously, these four inputs offer more combinations than the six input ranges mentioned in the data sheet. These four inputs connect to an internal resistive divider, as shown in Figure 1. This resistive divider scales down and shifts the external signals. The output of this resistive divider is tied through the switch to the internal ADC which always has a range from 0 V to REF (C_S).

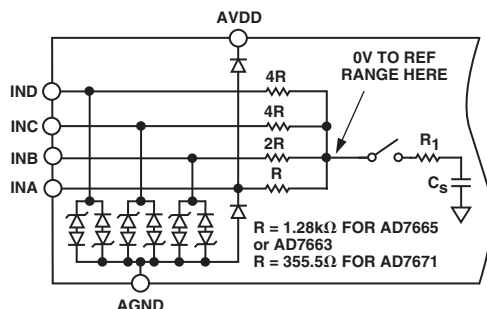


Figure 1. Simplified Analog Input

Table I gives the range the user can obtain as a function of the connection of the four inputs. Negative full-scale and positive full-scale columns are the ratio between the full-scale ends and the reference voltage. For instance, by connecting the V_{IN} signal to both INA and IND, and grounding INB and INC, the input voltage range is 0 V to 4 V with a 2.5 V reference. This table also provides the input impedance of the ADC.

The input voltage range of the AD7671, AD7665, and AD7663 can also be scaled by changing the reference voltage itself. These ADCs work well with a reference voltage as low as 2 V and up to $AVDD - 1.85$ V. Different considerations can drive the reference value choice. For a given input voltage range, the LSB value can be lowered, which provides an improved analog resolution. Also, an increase in the reference voltage reduces the weight of the internal ADC noise sources.

Although reference voltage and pin configuration allow many possible input voltage ranges, some are limited because of the absolute ratings of the ADC. Also, a high reference voltage such as 3V reduces the operating $AVDD$ power supply range to maintain a headroom of 1.85 V.

SOFTWARE

The best tool to calculate the optimum input voltage range is the PuLSAR input range software provided with this application note. This software calculates the list of input ranges that match the user criteria. The user criteria are the desired reference voltage and the voltage range. The results are sorted in the order of recommendation, as shown in Figure 2.

This software runs under Windows® 9x, Windows NT®, and Windows 2000. To install it, run setup.exe and follow the instructions.

Figure 2 gives a quick view of how to operate this software.

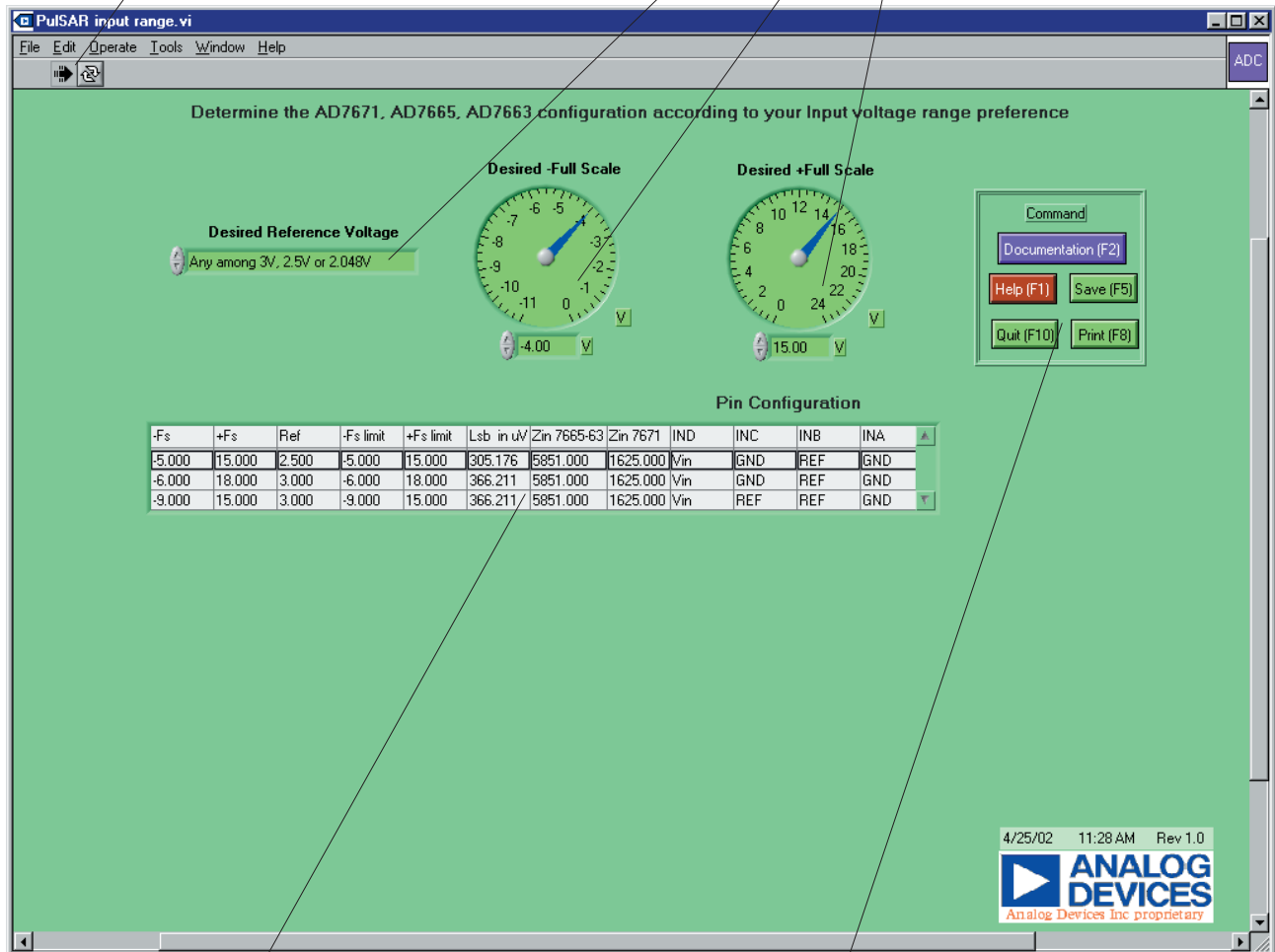
Table I. Analog Voltage Input

Negative Full Scale	Positive Full Scale	IND	INC	INB	INA	AD7663/AD7665 Z_{IN}	AD7671 Z_{IN}
0.000	1.000	V_{IN}	V_{IN}	V_{IN}	V_{IN}	0	0
0.000	1.143	GND	V_{IN}	V_{IN}	V_{IN}	5851	1625
-0.143	1.000	REF	V_{IN}	V_{IN}	V_{IN}	5851	1625
0.000	1.333	GND	GND	V_{IN}	V_{IN}	3413	948
-0.167	1.167	GND	REF	V_{IN}	V_{IN}	3413	948
-0.333	1.000	REF	REF	V_{IN}	V_{IN}	3413	948
0.000	1.600	V_{IN}	GND	GND	V_{IN}	2731	758
-0.200	1.400	REF	V_{IN}	GND	V_{IN}	2731	758
-0.400	1.200	GND	V_{IN}	REF	V_{IN}	2731	758
-0.600	1.000	V_{IN}	REF	REF	V_{IN}	2731	758
0.000	2.000	V_{IN}	V_{IN}	V_{IN}	GND	2560	711
-0.250	1.750	REF	GND	GND	V_{IN}	2560	711
-0.500	1.500	REF	REF	GND	V_{IN}	2560	711
-0.750	1.250	GND	REF	REF	V_{IN}	2560	711
-1.000	1.000	V_{IN}	V_{IN}	V_{IN}	REF	2560	711
0.000	2.667	GND	V_{IN}	V_{IN}	GND	2731	758
-0.333	2.333	REF	V_{IN}	V_{IN}	GND	2731	758
-1.333	1.333	GND	V_{IN}	V_{IN}	REF	2731	758
-1.667	1.000	REF	V_{IN}	V_{IN}	REF	2731	758
0.000	4.000	V_{IN}	V_{IN}	GND	GND	3413	948
-0.500	3.500	REF	GND	V_{IN}	GND	3413	948
-1.000	3.000	V_{IN}	V_{IN}	REF	GND	3413	948
-2.000	2.000	V_{IN}	V_{IN}	GND	REF	3413	948
-2.500	1.500	REF	GND	V_{IN}	REF	3413	948
-3.000	1.000	V_{IN}	V_{IN}	REF	REF	3413	948
0.000	8.000	V_{IN}	GND	GND	GND	5851	1625
-1.000	7.000	V_{IN}	REF	GND	GND	5851	1625
-2.000	6.000	V_{IN}	GND	REF	GND	5851	1625
-3.000	5.000	V_{IN}	REF	REF	GND	5851	1625
-4.000	4.000	V_{IN}	GND	GND	REF	5851	1625
-5.000	3.000	V_{IN}	REF	GND	REF	5851	1625
-6.000	2.000	V_{IN}	GND	REF	REF	5851	1625
-7.000	1.000	V_{IN}	REF	REF	REF	5851	1625

Multiply the values in the negative and positive full-scale column by the reference voltage to determine the actual analog voltage range.

Step 1. The Run button starts the software. This button is pressed first.

Step 2. Enter the reference voltage and the full scale range that you want to use.



Step 3. This table displays all the possible input ranges compatible with the necessary criteria. The results are sorted in the order of recommendation.

Step 4. Different commands may be chosen from this menu.

Save or F5 allows the user to save the table of results in an Excel spreadsheet.

Figure 2. PulSAR Input Range Software Front Panel

