

Configuring the AD7656/AD7657/AD7658 for Serial and Daisy-Chain Interface Modes of Operation

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INTRODUCTION

The AD7656/AD7657/AD7658 can be configured to operate in three interface modes: parallel interface mode, serial interface mode, or daisy-chain interface mode. The parallel mode of operation is covered extensively in the [AD7656/AD7657/AD7658](#) data sheet. In addition to the information provided in the data sheet, this application note further describes how to configure the AD7656 for the serial and daisy-chain interface modes.

FUNCTIONAL BLOCK DIAGRAM

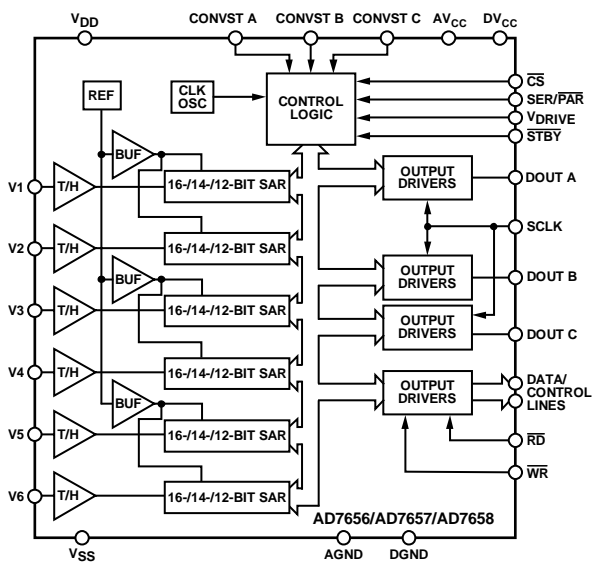


Figure 1.

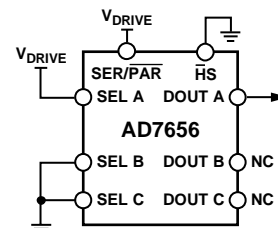
CONFIGURING THE AD7656, AD7657, AND AD7658 FOR SERIAL INTERFACE MODE

The SER/ $\overline{\text{PAR}}$ /SEL pin on the AD7656 is used to select between the parallel interface mode and the serial interface mode. To select the serial interface mode, this pin must be tied to logic high. When in serial interface mode, the AD7656 should be configured for the hardware select mode of operation and $\overline{\text{H/S}}$ SEL should be tied to a logic low. In serial interface mode, the AD7656 cannot be configured for the software mode of operation.

When operating in serial interface mode, the AD7656 must be configured to select the number of serial DOUT lines required by the application. SEL A, SEL B, and SEL C are used to enable data output lines DOUT A, DOUT B, and DOUT C, respectively. If only one DOUT line is required for the serial

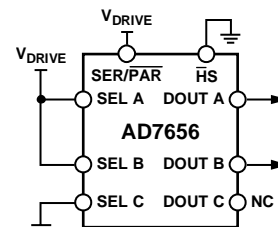
interface, DOUT A should be used. To enable DOUT A, the SEL A pin should be tied to logic high, and the SEL B and SEL C pins should be tied to logic low. To configure the serial interface to have two data output lines, DOUT A and DOUT B should be used. To enable DOUT A and DOUT B, the SEL A and SEL B pins should be tied to logic high, and SEL C should be tied to a logic low. To configure the serial interface to operate with all three data output lines, DOUT A, DOUT B, and DOUT C should be enabled. To enable all three DOUT lines, the SEL A, SEL B, and SEL C lines should be tied to logic high (see Figure 2, Figure 3, and Figure 4).

If only one or two DOUT lines are used for the serial interface, the unused DOUT lines should be left unconnected. These unused DOUT lines should have their respective SEL pin tied to logic low.



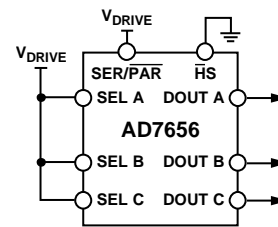
NC = NO CONNECT

Figure 2. AD7656 with One DOUT Line



NC = NO CONNECT

Figure 3. AD7656 with Two DOUT Lines



NC = NO CONNECT

Figure 4. AD7656 with Three DOUT Lines

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REVISION HISTORY

3/07—Revision 0: Initial Version

CONFIGURING THE HARDWARE PROGRAMMABLE PINS

When operating the AD7656 in serial mode and hardware select mode, several pins must be configured depending on the required mode of operation for the AD7656. These pins include, $\overline{\text{REF}}_{\text{EN}/\text{DIS}}$, DCIN C, DCIN B, DCIN A, DCEN, DB11, DB12, DB13, DB15, $\overline{\text{REF}}_{\text{BUF}}_{\text{EN}/\text{DIS}}$, RESET, RANGE, $\overline{\text{STBY}}$, and $\overline{\text{W/B}}$.

For serial interface mode, the $\overline{\text{W/B}}$, $\overline{\text{RD}}$, DB11, DB12, DB13, and DB15 pins should be tied to logic low.

Similar to operating the AD7656 in parallel interface mode, the $\overline{\text{REF}}_{\text{EN}/\text{DIS}}$, $\overline{\text{REF}}_{\text{BUF}}_{\text{EN}/\text{DIS}}$, RESET, RANGE, and $\overline{\text{STBY}}$ pins should be configured as required by the application.

When operating the AD7656 in serial interface mode but not in daisy-chain mode, the DCEN, DCIN A, DCIN B, and DCIN C pins should be tied to DGND.

READING DATA FROM THE AD7656

When operating the AD7656 in serial interface mode, the conversion control is the same as that outlined in the AD7656 data sheet for parallel interface mode. The CONVST pins are used to initiate conversions on the AD7656 channel pairs. When the BUSY pin returns low to indicate that the conversion is complete, the user can read the data from the AD7656.

In serial interface mode, the $\overline{\text{CS}}$, SCLK, and DOUT signals are used to access the conversion data from the AD7656. Figure 5 shows the typical read sequence using all three data output DOUT lines.

When using three DOUT lines to read the conversion data of the six channels, the AD7656 channel data is presented on the DOUT lines as described in Table 1.

Table 1.

| DOUT LINE | DOUT A | DOUT B | DOUT C |
|--------------|--------|--------|--------|
| Channel Data | V1, V2 | V3, V4 | V5, V6 |

When using two DOUT lines to read the conversion data of the six channels, the conversion data is presented on the DOUT lines as described in Table 2.

Table 2.

| DOUT LINE | DOUT A | DOUT B |
|--------------|------------|------------|
| Channel Data | V1, V2, V5 | V3, V4, V6 |

When using one DOUT line to read the conversion data of the six channels, the conversion data is presented on DOUT A in ascending order.

When converting on four channels (V1, V2, V3, and V4) of the AD7656, the conversion data can be read using one or two DOUT lines. In the case of one DOUT line (DOUT A), the data is output in ascending order. In the case of using two DOUT lines (DOUT A and DOUT B), the data is output as described in Table 3.

Table 3.

| DOUT LINE | DOUT A | DOUT B |
|--------------|--------|--------|
| Channel Data | V1, V2 | V3, V4 |

The timing for the CONVST and BUSY signals in serial interface mode is the same as outlined in AD7656 data sheet for the parallel interface mode. As mentioned previously, the $\overline{\text{RD}}$ signal should be tied to logic low for serial interface mode.

When the BUSY signal returns low to indicate the end of the conversion, the $\overline{\text{CS}}$ signal can be brought low immediately, as indicated by t_2 in the timing specifications of the AD7656 data sheet. The falling edge of $\overline{\text{CS}}$ is used to clock out the MSB of the first conversion result and to take the bus out of three-state (see Figure 5). The access time t_{17} indicates how long after the $\overline{\text{CS}}$ edge the MSB will become valid. Subsequent data bits are clocked out of the AD7656 on the SCLK rising edge. Again, t_{17} is the time required after the SCLK rising edge for the data to become valid. Data should be clocked into the processor on the SCLK falling edge. If data must be clocked into the processor on the SCLK rising edge, ensure that the MSB is clocked in after the $\overline{\text{CS}}$ signal is brought low. Sixteen SCLKs are required to read the complete conversion result from each channel on the AD7656.

If all six channels are performing conversions, the minimum SCLK pulses required to read the six channels depends on the number of DOUT lines used: 32 SCLKs are required for three DOUT lines, 48 SCLKs for two DOUT lines, and 96 SCLKs for one DOUT line.

When the $\overline{\text{CS}}$ signal is brought low to clock out the MSB of the first conversion, it can remain low for the remainder of the read sequence. However, if the user wishes, the $\overline{\text{CS}}$ signal can be pulsed between the individual channel reads (see Figure 6).

At the end of the serial read, the $\overline{\text{CS}}$ signal should return high, and the user should ensure that the t_{QUIET} time elapses before initiating the next conversion.

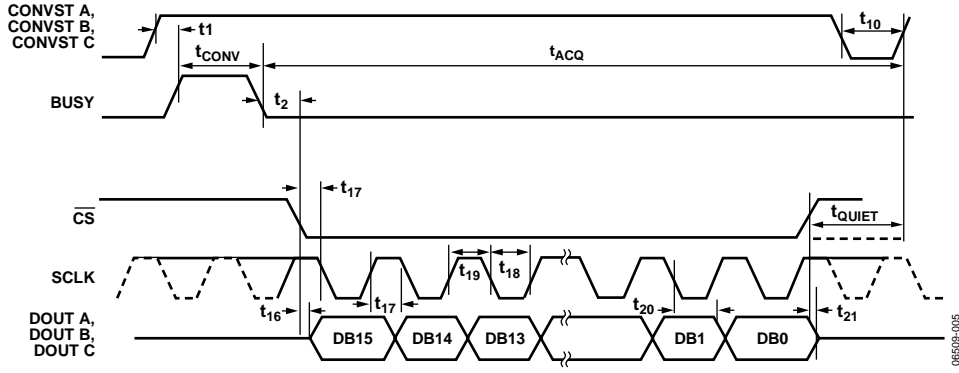


Figure 5. Typical Serial Read Timing Using Three DOUT Lines

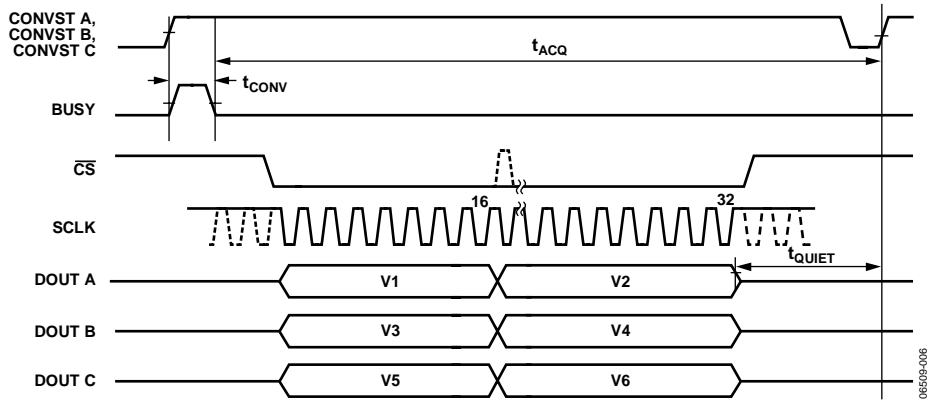


Figure 6. AD7656 Serial Read Timing Diagram

DAISY-CHAIN MODE

With serial interface mode, the user has the option of using the DCEN pin to configure the devices in daisy-chain mode and cascade multiple devices in a daisy-chain configuration. Daisy-chain mode has the advantage of using a single serial interface to control multiple devices. As with the serial interface mode, the daisy-chain mode allows the user to select the number of DOUT lines used.

When the devices are configured to operate in daisy-chain mode (DCEN is logic high), the user can select the number of DOUT lines by using the SEL A, SEL B, and SEL C pins. These SEL pins also determine the number of DCIN pins for each AD7656 device.

The DCIN pins should be connected to the corresponding DOUT pins of the AD7656 device upstream in the daisy chain. Figure 7 to Figure 9 show the various daisy-chain configurations. The device labeled Device 2, or the device furthest up-stream in the chain, should not be configured for daisy-chain operation (DCEN should be set to logic low). Device 1 should be configured for daisy-chain operation (DCEN should be set to logic high). When the device is configured for daisy-chain mode, Pins 12, 13, and 14 are configured as DCIN pins. As with the serial interface mode, SEL A, SEL B, and SEL C must be configured to select the number of DOUT interface lines required.

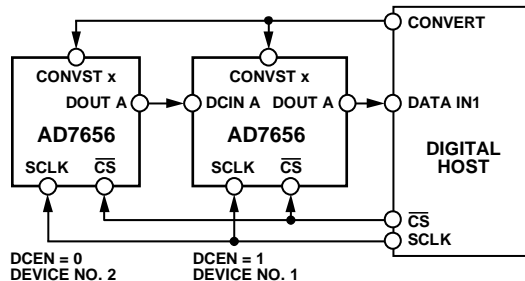


Figure 7. AD7656 Daisy-Chain mode with One DOUT Line

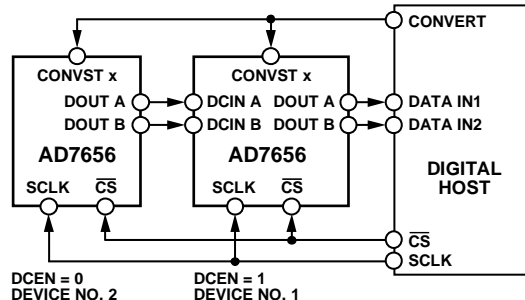


Figure 8. AD7656 Daisy-Chain Mode with Two DOUT Lines

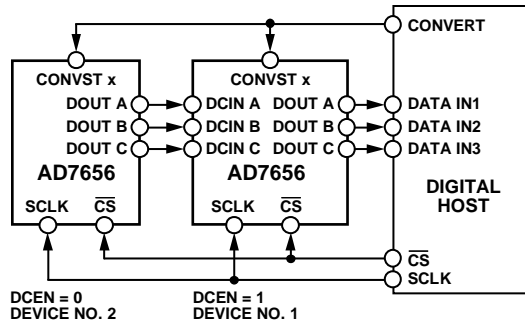


Figure 9. AD7656 Daisy-Chain Mode with Three DOUT Lines

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Figure 10 shows the serial read operation with the devices configured as shown in Figure 8. A single CONVST signal is sent to both AD7656 devices in the chain. When the BUSY signal returns low to indicate that the conversion is complete, the \overline{CS} signal can be brought low to start the serial transfer. The \overline{CS} signal can remain low for the full serial transfer, or it can be pulsed after each channel read (every 16 SCLKs). During the first 48 SCLKs, Device 1 transfers its conversion data to the digital host through DOUT A (Channels 1, 2, and 5) and DOUT B (Channels 3, 4, and 6), and Device 2 clocks its conversion data out on DOUT A (Channels 1, 2, and 5) and DOUT B

(Channels 3, 4, and 6) into Device 1. This data is clocked into DCIN A and DCIN B, respectively, of Device 1. During the second 48 SCLKs of the serial transfer, Device 1 clocks the data that was previously clocked in by Device 2 into the digital host, and Device 2 clocks out 0s into Device 1.

Similar principles apply when configuring the AD7656 in daisy-chain mode using three or one DOUT lines.

The number of SCLK pulses required for a serial transfer in daisy-chain mode depends on the number of devices in the chain and the number of DOUT lines used in the interface.

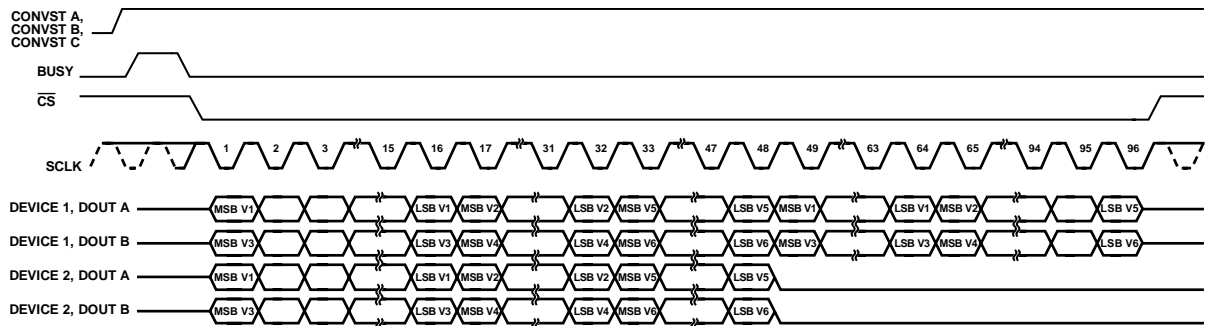


Figure 10. Daisy-Chain Serial Read Operation

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