



# CMOS 10- & 12-Bit Monolithic Multiplying D/A Converters

## AD7520/AD7521

### 1.1 Scope.

This specification covers the detail requirements for a 10- and a 12-bit monolithic CMOS multiplying digital-to-analog converters.

### 1.2 Part Number.

The complete part numbers per Tables 1 and 2 of this specification are as follows:

| Device | Part Number   |
|--------|---------------|
| -1     | AD7520SQ/883B |
|        | AD7521SQ/883B |
| -2     | AD7520TQ/883B |
|        | AD7521TQ/883B |
| -3     | AD7520UQ/883B |
|        | AD7521UQ/883B |

### 1.2.3 Case Outline.

See Appendix 1 of General Specification ADI-M-1000: package outline: Q-16 – AD7520  
Q-18 – AD7521

### 1.3 Absolute Maximum Ratings. ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

|                                   |   |
|-----------------------------------|---|
| $V_{DD}$ to GND                   | +17V  |
| $V_{REF}$ to GND                  | $\pm 25\text{V}$                            |
| Digital Input Voltage Range       | $V_{DD}$ to GND                             |
| Output Voltage (Pins 1 and 2)     | -100mV to $V_{DD}$                          |
| Power Dissipation                 |   |
| Up to $+75^\circ\text{C}$         | 450mW                                       |
| Derates above $+75^\circ\text{C}$ | 6mW/ $^\circ\text{C}$                       |
| Digital Input Voltage Range       | $V_{DD}$ to GND                             |
| Operating Temperature Range       | $-55^\circ\text{C}$ to $+125^\circ\text{C}$ |
| Storage Temperature Range         | $-65^\circ\text{C}$ to $+150^\circ\text{C}$ |

### 1.5 Thermal Characteristics.

Thermal Resistance  $\theta_{JC} = 35^\circ\text{C}/\text{W}$  for Q-16 or Q-18  
 $\theta_{JA} = 120^\circ\text{C}/\text{W}$  for Q-16 or Q-18

# AD7520/AD7521 SPECIFICATIONS

| AD7520<br>Test                            | Symbol            | Device   | Design<br>Limit<br>$T_{min}-T_{max}$ | Sub<br>Group<br>1 | Sub<br>Group<br>2, 3 | Sub<br>Group<br>4 | Test Condition <sup>1</sup><br>$V_{DD} = +15V$   | Units        |
|---|-------------------|----------|--------------------------------------|-------------------|----------------------|-------------------|--|--------------|
| Resolution                                | RES               | -1, 2, 3 | 10                                   |                   |                      |                   |  | Bits         |
| Relative Accuracy                         | RA                | -1       | 2                                    | 2                 | 2                    |                   |  | ± LSB max    |
|   |                   | -2       | 1                                    | 2                 | 1                    | 1                 |  |              |
|   |                   | -3       | 1/2                                  | 2                 | 1/2                  | 1/2               |  |              |
| Nonlinearity Tempco                       | TC <sub>NL</sub>  | -1, 2, 3 | 2                                    |                   |                      |                   |  | ± ppm/°C max |
| Gain Tempco                               | TC <sub>AE</sub>  | -1, 2, 3 | 20                                   |                   |                      |                   |  | ± ppm/°C max |
| Output Leakage Current<br>Pin 1           | I <sub>OUT1</sub> | -1, 2, 3 | 200                                  | 200               | 200                  |                   | Digital Inputs = V <sub>IL</sub> .   | ± nA max     |
| Pin 2                                     | I <sub>OUT2</sub> | -1, 2, 3 | 200                                  | 200               | 200                  |                   | Digital Inputs = V <sub>IH</sub> .   | ± nA max     |
| Output Current Settling Time <sup>2</sup> | t <sub>SL</sub>   | -1, 2, 3 | 500                                  |                   |                      |                   | To ± 1/2LSB. All Digital Inputs<br>V <sub>IL</sub> to V <sub>IH</sub> and V <sub>IH</sub> to V <sub>IL</sub> . | ns max       |
| Feedthrough Error <sup>2,3</sup>          | FT                | -1, 2, 3 | 30                                   |                   |                      |                   | V <sub>REF</sub> = 20V p-p, 100kHz, All<br>Digital Input = V <sub>IL</sub> .                                   | mV p-p max   |
| Reference Input Resistance                | R <sub>IN</sub>   | -1, 2, 3 | 5                                    | 5                 | 5                    |                   | Measured at Pin 15.  | kΩ min       |
|   |                   |          | 20                                   | 20                | 20                   |                   |  | kΩ max       |
| Digital Input High Voltage                | V <sub>IH</sub>   | -1, 2, 3 | 2.4                                  | 2.4               | 2.4                  |                   |  | V min        |
| Digital Input Low Voltage                 | V <sub>IL</sub>   | -1, 2, 3 | 0.8                                  | 0.8               | 0.8                  |                   |  | V max        |
| Digital Input Leakage Current             | I <sub>IN</sub>   | -1, 2, 3 | 1.0                                  |                   |                      |                   |  | ± μA max     |
| Output Capacitance                        | C <sub>OUT1</sub> | -1, 2, 3 | 120                                  |                   |                      |                   | All Digital Inputs V <sub>IH</sub> .   | pF max       |
|   |                   | -1, 2, 3 | 37                                   |                   |                      |                   | All Digital Inputs V <sub>IH</sub> .   | pF max       |
|   | C <sub>OUT2</sub> | -1, 2, 3 | 37                                   |                   |                      |                   | All Digital Inputs V <sub>IL</sub> .   | pF max       |
|   |                   | -1, 2, 3 | 120                                  |                   |                      |                   | All Digital Inputs V <sub>IL</sub> .   | pF max       |
| Supply Current from V <sub>DD</sub>       | I <sub>DD</sub>   | -1, 2, 3 | 2                                    | 2                 | 2                    |                   | All Digital Inputs V <sub>IL</sub> or V <sub>IH</sub> .  | mA max       |

## NOTES

<sup>1</sup>V<sub>REF</sub> = +10V, unless otherwise stated.

<sup>2</sup>These design limits are +25°C only.

<sup>3</sup>Feedthrough error can be further minimized by connecting the metal lid to ground.

Table 1.

# AD7520/AD7521

| AD7521<br>Test                            | Symbol            | Device   | Design Limit<br>$T_{min}-T_{max}$ | Sub Group<br>1 | Sub Group<br>2, 3 | Sub Group<br>4 | Test Condition <sup>1</sup><br>$V_{DD} = +15V$   | Units        |
|---|-------------------|----------|-----------------------------------|----------------|-------------------|----------------|--|--------------|
| Resolution                                | RES               | -1, 2, 3 | 12                                |                |                   |                |  | Bits         |
| Relative Accuracy                         | RA                | -1       | 8                                 | 8              | 8                 |                |  | ± LSB max    |
|   |                   | -2       | 4                                 | 8              | 4                 | 4              |  |              |
|   |                   | -3       | 2                                 | 8              | 2                 | 2              |  |              |
| Nonlinearity Tempco                       | TC <sub>NL</sub>  | -1, 2, 3 | 2                                 |                |                   |                |  | ± ppm/°C max |
| Gain Tempco                               | TC <sub>AE</sub>  | -1, 2, 3 | 20                                |                |                   |                |  | ± ppm/°C max |
| Output Leakage Current<br>Pin 1           | I <sub>OUT1</sub> | -1, 2, 3 | 200                               | 200            | 200               |                | Digital Inputs = V <sub>IL</sub> .   | ± nA max     |
| Pin 2                                     | I <sub>OUT2</sub> | -1, 2, 3 | 200                               | 200            | 200               |                | Digital Inputs = V <sub>IH</sub> .   | ± nA max     |
| Output Current Settling Time <sup>2</sup> | t <sub>SL</sub>   | -1, 2, 3 | 500                               |                |                   |                | To ± 1/2LSB. All Digital Inputs<br>V <sub>IL</sub> to V <sub>IH</sub> and V <sub>IH</sub> to V <sub>IL</sub> . | ns max       |
| Feedthrough Error <sup>2,3</sup>          | FT                | -1, 2, 3 | 30                                |                |                   |                | V <sub>REF</sub> = 20V p-p, 100kHz, All<br>Digital Input = V <sub>IL</sub> .                                   | mV p-p max   |
| Reference Input Resistance                | R <sub>IN</sub>   | -1, 2, 3 | 5                                 | 5              | 5                 |                | Measured at Pin 17.  | kΩ min       |
|   |                   |          | 20                                | 20             | 20                |                |  | kΩ max       |
| Digital Input High Voltage                | V <sub>IH</sub>   | -1, 2, 3 | 2.4                               | 2.4            | 2.4               |                |  | V min        |
| Digital Input Low Voltage                 | V <sub>IL</sub>   | -1, 2, 3 | 0.8                               | 0.8            | 0.8               |                |  | V max        |
| Digital Input Leakage Current             | I <sub>IN</sub>   | -1, 2, 3 | 1.0                               |                |                   |                |  | ± μA max     |
| Output Capacitance                        | C <sub>OUT1</sub> | -1, 2, 3 | 120                               |                |                   |                | All Digital Inputs V <sub>IH</sub> .   | pF max       |
|   |                   |          | 37                                |                |                   |                | All Digital Inputs V <sub>IH</sub> .   | pF max       |
|   | C <sub>OUT2</sub> | -1, 2, 3 | 37                                |                |                   |                | All Digital Inputs V <sub>IL</sub> .   | pF max       |
|   |                   |          | 120                               |                |                   |                | All Digital Inputs V <sub>IL</sub> .   | pF max       |
| Supply Current from V <sub>DD</sub>       | I <sub>DD</sub>   | -1, 2, 3 | 2                                 | 2              | 2                 |                | All Digital Inputs V <sub>IL</sub> or V <sub>IH</sub> .  | mA max       |

**NOTES**

<sup>1</sup>V<sub>REF</sub> = +10V, unless otherwise stated.

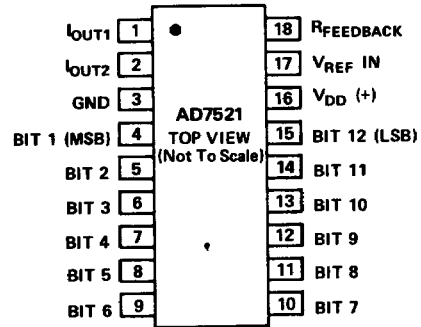
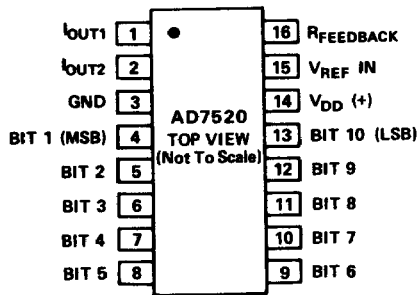
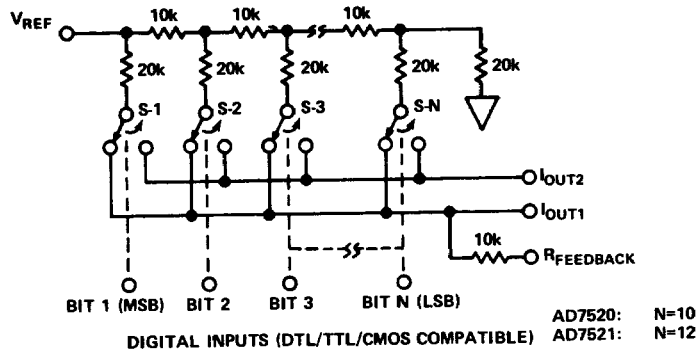
<sup>2</sup>These design limits are +25°C only.

<sup>3</sup>Feedthrough error can be further minimized by connecting the metal lid to ground.

Table 2.

# AD7520/AD7521

## 3.2.1 Functional Block Diagram and Terminal Assignments.



## 3.2.4 Microcircuit Technology Group.

This microcircuit is covered by technology group (80).

## 4.2.1 Life Test/Burn-In Circuit.

Steady state life test is per MIL-STD-883 Method 1005. Burn-in is per MIL-STD-883 Method 1015 test condition (B).

