

### Operating Speeds of Digital Potentiometers (DP)

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How fast we can move the wiper of the digital potentiometers and then transfer the wiper position to and from memory is governed by the type of serial interface and the AC electrical specifications of the potentiometer. This Design Note lists the dominant operating time and frequency characteristics of programming digital potentiometers.

#### **DP with 3-Wire Serial Interfaces (DP7112/7114)**

There are three key operations:

- (1) *digitally incrementing/decrementing the wiper*

$$t_{\text{CYC}} \geq 1\mu\text{s}$$
$$f \leq 1\text{MHz}$$

- (2) *programming the wiper to a specific voltage*

$$T = t_{\text{CYC}} + t_{1\text{W}} \geq (1\mu\text{s} + 5\mu\text{s})$$
$$f \leq 167\text{kHz}$$

The parameter  $t_{1\text{W}}$  is the time it takes the analog wiper voltage to respond. The wiper can be moved digitally at a 1MHz rate until its final position is reached, and then 5μsec must be allowed for the wiper's analog voltage to reach its final value.

- (3) *storing the digital wiper position in nonvolatile memory*

$$T = t_{\text{WR}} \leq 10\text{ms}$$
$$f \geq 100\text{ Hz}$$

Conditions:  $V_{\text{CC}}$  stable

#### **DP with Microwire-like Serial Interfaces (DP72X Series)**

There are two key operations:

- (1) *programming the wiper (digital and analog) or executing a volatile write*

$$T = \{11\text{ clks} \times 1\mu\text{s}/\text{clk}\} + t_{\text{DS}} (\text{settling time}) \geq (11\mu\text{s} + 10\mu\text{s}) \geq 21\mu\text{s}$$
$$f \leq 47.6\text{kHz}$$

- (2) *storing the wiper position in nonvolatile memory*

$$T \leq 5\text{ms (dominant)}$$
$$f \geq 200\text{Hz}$$

Conditions:  $V_{\text{CC}}$  stable

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