Xicor®

Terminal Voltage ±5V, 32 Taps, Log Taper

X9514

PushPot™ Potentiometer (Push Button Controlled)

FEATURES

- **Push Button Controlled**
- **Low Power CMOS**
  - **—Active Current, 3mA Max**
  - **—Standby Current, 200μA Max**
- **31 Resistive Elements**
  - **—Temperature Compensated**
  - **—±20% End to End Resistance Range**
  - **— –5V to +5V Range**
- **32 Wiper Tap Points**
  - **—Logarithmic Taper**
  - **—Wiper Positioned via Two Push Button Inputs**
  - **—Slow & Fast Scan Modes**
  - **—AUTOSTORE® Option**
  - **—Manual Store Option**
  - **—Wiper Position Stored in Nonvolatile Memory and Recalled on Power-Up**
- **100 Year Wiper Position Data Retention**
- **X9514W = 10KΩ**
- **Packages**
  - **—8-Lead PDIP**
 - **—8-Lead SOIC**
  - **—14-Lead TSSOP**

DESCRIPTION

The Xicor X9514 is a push button controlled, logarithmic taper potentiometer and is ideal for push button controlled resistance trimming.

The X9514 is a resistor array composed of 31 resistive elements. Between each element and at either end are tap points accessible to the wiper element. The position of the wiper element is controlled by the $\overline{PU}$ and $\overline{PD}$ inputs. The position of the wiper can be automatically stored in E^2 memory and then be recalled upon a subsequent power-on operation.

All Xicor nonvolatile products are designed and tested for applications requiring extended endurance and data retention.

FUNCTIONAL DIAGRAM
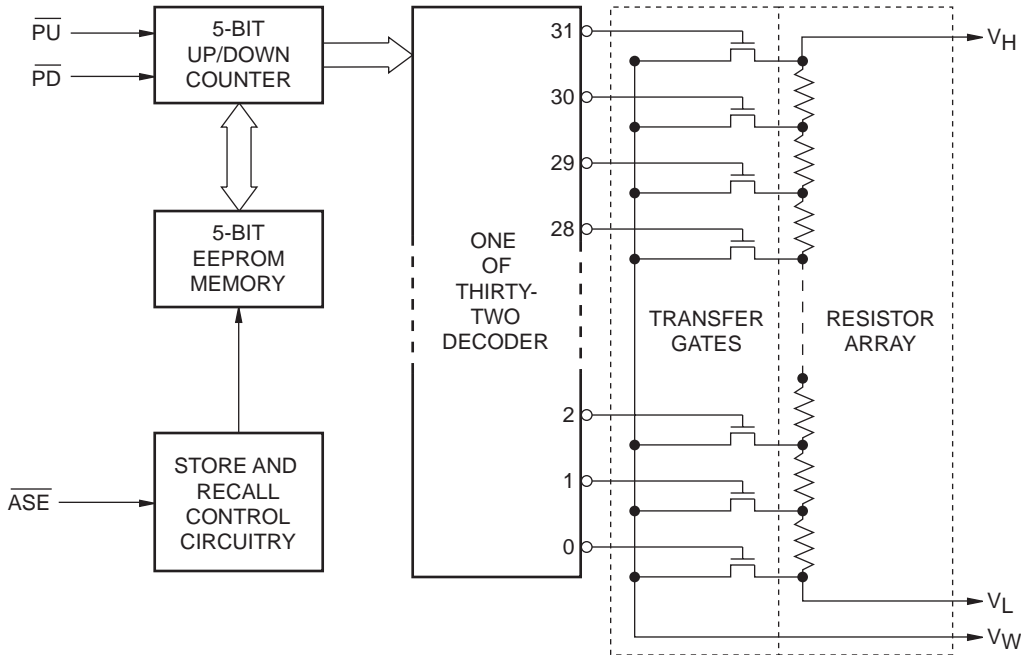
6487 ILL F01.1

Characteristics subject to change without notice

X9514

PIN DESCRIPTIONS

V_H and V_L

The high (V_H) and low (V_L) terminals of the X9514 are equivalent to the fixed terminals of a mechanical potentiometer. The minimum voltage is –5V and the maximum is +5V. It should be noted that the terminology of V_L and V_H references the relative position of the terminal in relation to wiper movement direction selected by the $\overline{PU}$ and $\overline{PD}$ inputs and not the voltage potential on the terminal.

$\overline{PU}$

The debounced $\overline{PU}$ input is for incrementing the wiper position. An on-chip pull-up holds the $\overline{PU}$ input HIGH. A switch closure to ground or a LOW logic level will, after a debounce time, move the wiper to the next adjacent higher tap position.

$\overline{PD}$

The debounced $\overline{PD}$ input is for decrementing the wiper position. An on-chip pull-up holds the $\overline{PD}$ input HIGH. A switch closure to ground or a LOW logic level will, after a debounce time, move the wiper to the next adjacent lower tap position.

$\overline{ASE}$

The debounced $\overline{ASE}$ (AUTOSTORE enable) pin can be in one of two states:

V_{IL} – AUTOSTORE is enabled. When V_{CC} powers-down an automatic store cycle takes place.

V_{IH} – AUTOSTORE is disabled. A LOW to HIGH will initiate a manual store operation. This is for a user who wishes to connect a push button switch to this pin. For every valid push, the X9514 will store the current wiper position to the E2PROM.
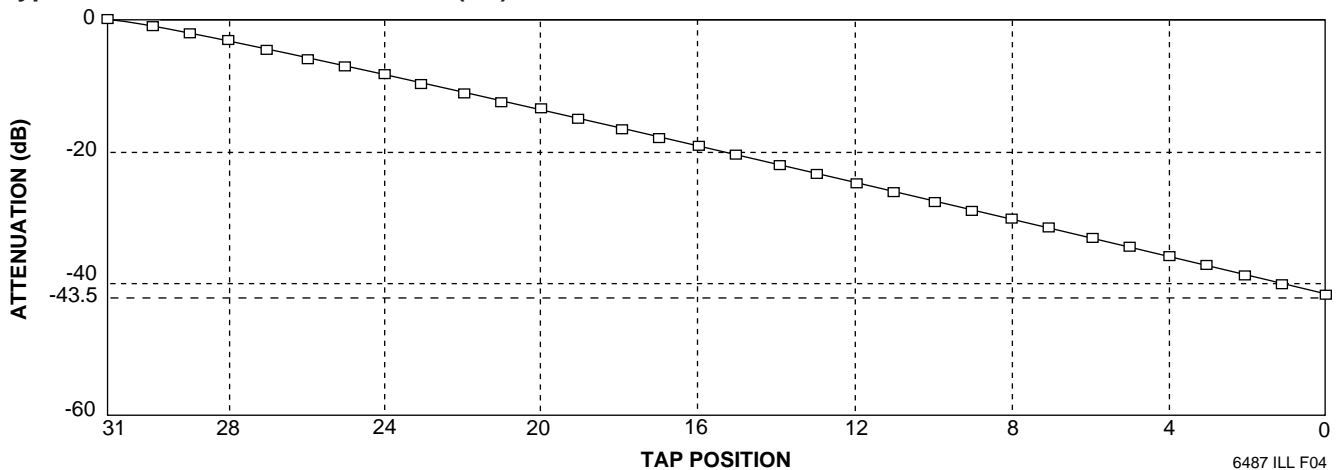
PIN CONFIGURATION

6487 ILL F02.2
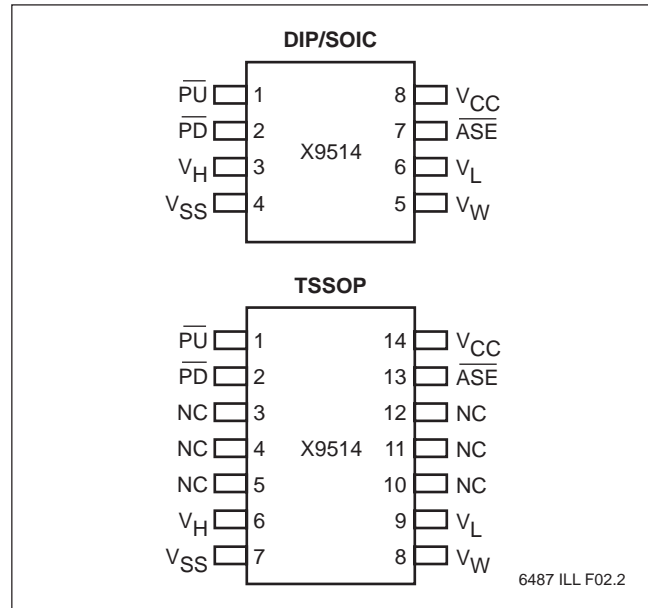
PIN NAMES

Symbol	Description
V_H	High Terminal
V_W	Wiper Terminal
V_L	Low Terminal
V_{SS}	Ground
V_{CC}	Supply Voltage
$\overline{PU}$	Push Up Input
$\overline{PD}$	Push Down Input
$\overline{ASE}$	AUTOSTORE Enable Input
NC	No Connect

6487 PGM T01.2

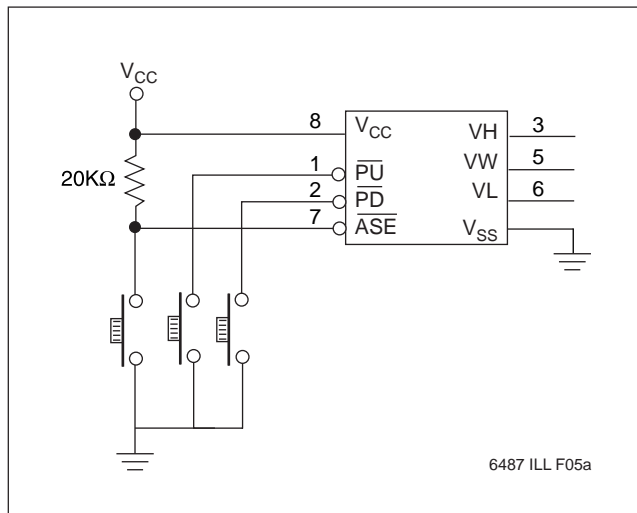## Typical Attenuation Characteristics (dB)

6487 ILL F04

DEVICE OPERATION

There are three sections of the X9514: the input control, counter and decode section; the E^{2}PROM memory; and the resistor array. The input control section operates just like an up/down counter. The output of this counter is decoded to turn on a single electronic switch connecting a point on the resistor array to the wiper output. Under the proper conditions the contents of the counter can be stored in E^{2}PROM memory and retained for future use. The resistor array is comprised of 31 individual resistors connected in series. At either end of the array and between each resistor is an electronic switch that transfers the potential at that point to the wiper.

The X9514 is designed to interface directly to two push button switches for effectively moving the wiper up or down. The $\overline{PU}$ and $\overline{PD}$ inputs increment or decrement a 5-bit counter respectively. The output of this counter is decoded to select one of the thirty-two wiper positions along the resistive array. The wiper increment input, $\overline{PU}$ and the wiper decrement input, $\overline{PD}$ are both connected to an internal pull-up so that they normally remain HIGH. When pulled LOW by an external push button switch or a logic LOW level input, the wiper will be switched to the next adjacent tap position.

Internal debounce circuitry prevents inadvertent switching of the wiper position if $\overline{PU}$ or $\overline{PD}$ remain LOW for less than 40ms, typical. Each of the buttons can be pushed either once for a single increment/decrement or continuously for a multiple increments/decrements. The number of increments/decrements of the wiper position depend on how long the button is being pushed. When making a continuous push, after the first second, the increment/decrement speed increases. For the first second the device will be in the slow scan mode. Then if the button is held for longer than 1 second the device will be in the fast scan mode. As soon as the button is released the X9514 will return to a standby condition.

The wiper, when at either fixed terminal, acts like its mechanical equivalent and does not move beyond the last position. That is, the counter does not wrap around when clocked to either extreme.

AUTOSTORE

The value of the counter is stored in E^{2}PROM memory whenever the chip senses a powers-down of V_{CC} while $\overline{ASE}$ is enabled (held LOW). When power is restored, the content of the memory is recalled and the counter reset to the last value stored.

If AUTOSTORE is to be implemented, $\overline{ASE}$ is typically hard wired to V_{SS}. If $\overline{ASE}$ is held HIGH during power up and then taken LOW, the wiper will not respond to the $\overline{PU}$ or $\overline{PD}$ inputs until $\overline{ASE}$ is brought HIGH and held HIGH.

Manual (Push Button) Store

When $\overline{ASE}$ is not enabled (held HIGH) a push button switch may be used to pull $\overline{ASE}$ LOW and released to perform a manual store of the wiper position.

R$_{TOTAL}$ with V$_{CC}$ Removed

The end to end resistance of the array will fluctuate once V_{CC} is removed.

Typical circuit with $\overline{ASE}$ store pin controlled by push button switch

6487 ILL F05a

Typical circuit with $\overline{ASE}$ store pin used in AUTOSTORE mode

6487 ILL F05.2
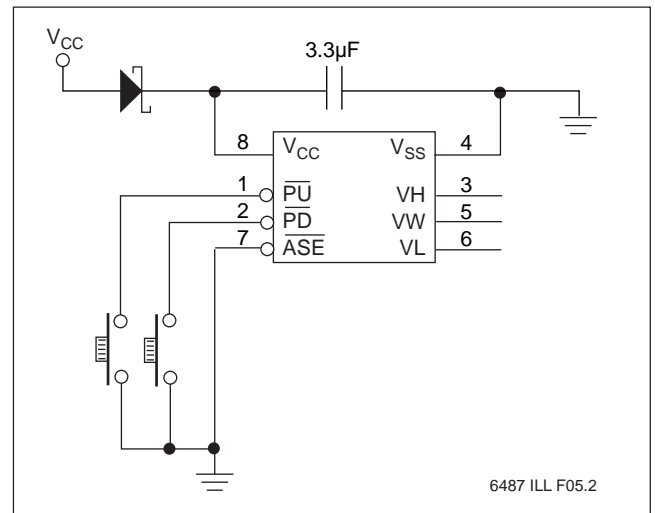
X9514

ABSOLUTE MAXIMUM RATINGS*

Temperature under Bias .... –65°C to +135°C
Storage Temperature .... –65°C to +150°C
Voltage on $\overline{PU}$, $\overline{PD}$, $\overline{ASE}$ and V_{CC}
    with Respect to V_{SS} .... –1V to +7V
Voltage on V_H and V_L Referenced to V_{SS}
$\Delta V = |V_H–V_L|$ 10V
Lead Temperature (Soldering 10 seconds) .... 300°C
Wiper Current .... ±1mA

*COMMENT

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and the functional operation of the device at these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ANALOG CHARACTERISTICS

Electrical Characteristics

End-to-End Resistance Tolerance .... ±20%
Power Rating at 25°C
    X9514W 10mW
Wiper Current .... ±1mA Max.
Typical Wiper Resistance .... 40Ω at 1mA
Typical Noise .... < –120dB/√ Hz Ref: 1V

Relative Variation

Relative variation is a measure of the error in step size between taps = $\log(V_{w(n)}) - \log(V_{w(n-1)}) = 0.08±0.05$ for tap n = 2 – 31

Temperature Coefficient

(–40°C to +85°C)
X9514W .... +600 ppm/°C Typical
Ratiometric Temperature Coefficient .... ±20 ppm

Wiper Adjustability
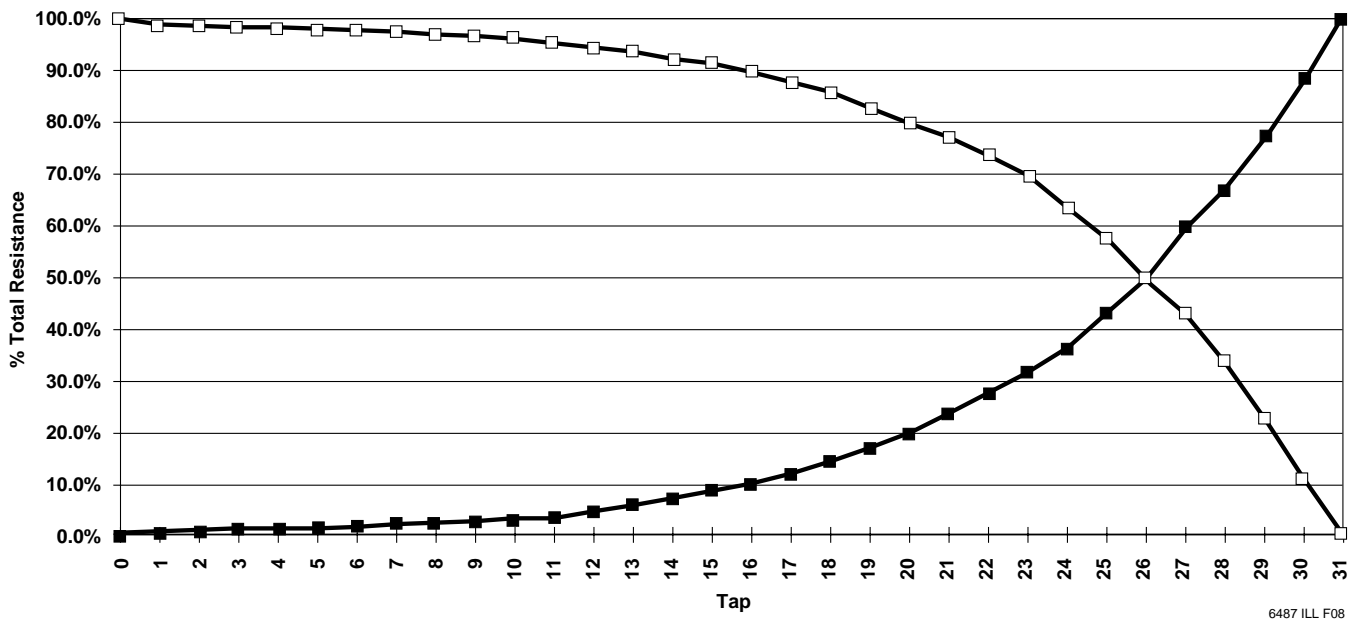
    Unlimited Wiper Adjustment (Non-Store operation)
    Wiper Position Store Operations 100,000
                                              Data Changes

Physical Characteristics

Marking Includes
    Manufacturer's Trademark
    Resistance Value or Code
    Date Code

Typical Electrical Taper

6487 ILL F08

X9514

RECOMMENDED OPERATING CONDITIONS

Temperature	Min.	Max.
Commercial	0°C	+70°C
Industrial	−40°C	+85°C
Military	−55°C	+125°C

6487 PGM T03.1

Supply Voltage	Limits
X9514	5V ±10%

6487 PGM T04.1

D.C. OPERATING CHARACTERISTICS (Over recommended operating conditions unless otherwise specified.)

| Symbol	Parameter	Limits			Units	Test Conditions
		Min.	Typ.[4]	Max.		
I_{CC}	V_{CC} Active Current		1	3	mA	$\overline{PU}$ or $\overline{PD}$ held at V_{IL} the others at V_{IH}
I_{SB}	Standby Supply Current			200	µA	$\overline{PU} = \overline{PD} = V_H$
I_{LI}	$\overline{ASE}$, $\overline{PU}$, $\overline{PD}$ Input Leakage Current			10	µA	$V_{IN} = V_{SS}$ to V_{CC}
V_{IH}	$\overline{ASE}$, $\overline{PU}$, $\overline{PD}$ Input HIGH Voltage	2		$V_{CC} + 1$	V	
V_{IL}	$\overline{ASE}$, $\overline{PU}$, $\overline{PD}$ Input LOW Voltage	−1		0.8	V	
R_W	Wiper Resistance		40	100	Ω	Max. Wiper Current ±1mA
V_{VH}	VH Terminal Voltage	−5		+5	V	
V_{VL}	VL Terminal Voltage	−5		+5	V	
C_{IN}[5]	$\overline{ASE}$, $\overline{PU}$, $\overline{PD}$ Input Capacitance			10	pF	$V_{CC} = 5V$, $V_{IN} = 0V$, $T_A = 25°C$, f = 1MHz

6487 PGM T05.4

STANDARD PARTS
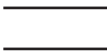
Part Number	Maximum Resistance	Wiper Increments	Minimum Resistance
X9514W	10KΩ	Log Taper	40Ω

6487 PGM T08.1

Notes: (4) Typical values are for $T_A = 25°C$ and nominal supply voltage.
(5) This parameter is periodically sampled and not 100% tested.

SYMBOL TABLE

WAVEFORM	INPUTS	OUTPUTS
	Must be steady	Will be steady
	May change from LOW to HIGH	Will change from LOW to HIGH
	May change from HIGH to LOW	Will change from HIGH to LOW
	Don't Care: Changes Allowed	Changing: State Not Known
	N/A	Center Line is High Impedance

A.C. OPERATING CHARACTERISTICS (Over recommended operating conditions unless otherwise specified)

Symbol	Parameter	Min.	Typ.[6]	Max.	Units
		Limits			
t_{GAP}	Time Between Two Separate Push Button Events	0			μs
t_{DB}	Debounce Time			60	ms
$t_{S\ SLOW}$	After Debounce to Wiper Change on a Slow Mode	100	250	375	ms
$t_{S\ FAST}$[7]	Wiper Change on a Scan Mode	25	50	75	ms
t_{PU}[7]	Power Up to Wiper Stable			500	μs
$t_R\ V_{CC}$[7]	V_{CC} Power-up Rate	0.2		50	mV/μs
t_{ASTO}[7]	AUTOSTORE Cycle Time	2			ms
V_{ASTH}[7]	AUTOSTORE Threshold Voltage		4		V
V_{ASEND}[7]	AUTOSTORE Cycle End Voltage		3.5		V

6487 PGM T07.3

AUTOSTORE Cycle Timing Diagram

6487 ILL F03.2
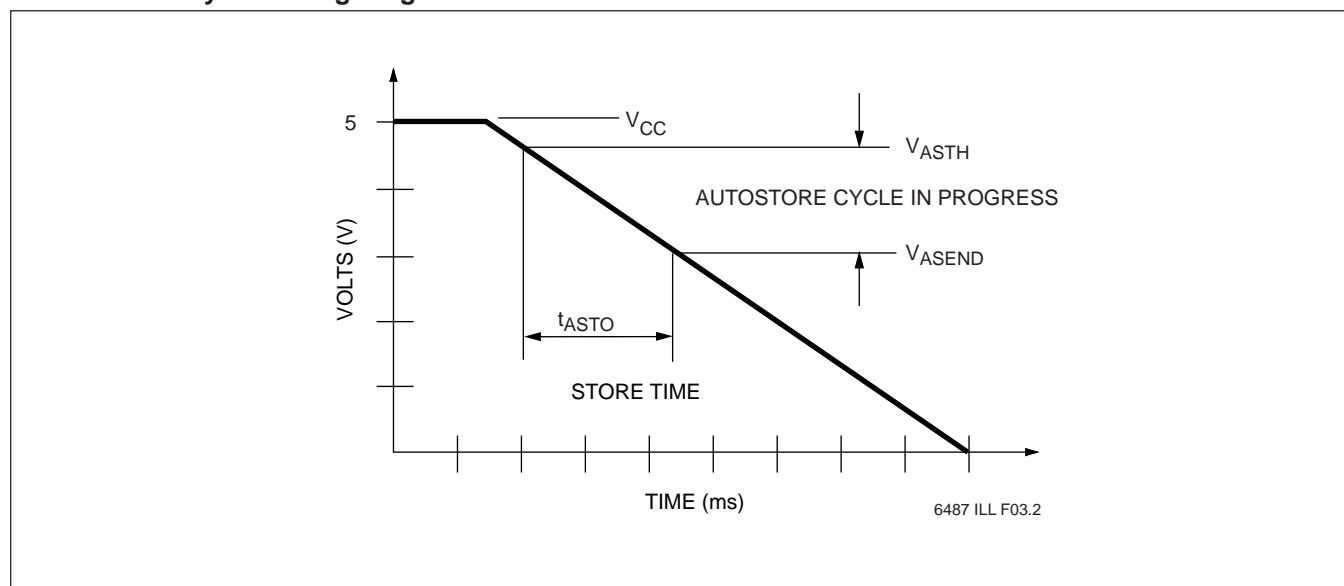
Notes: V_{ASTH} – AUTOSTORE threshold voltage
V_{ASEND} – AUTOSTORE cycle end voltage
t_{ASTO} – AUTOSTORE cycle time
(6) Typical values are for $T_A = 25°C$ and nominal supply voltage.
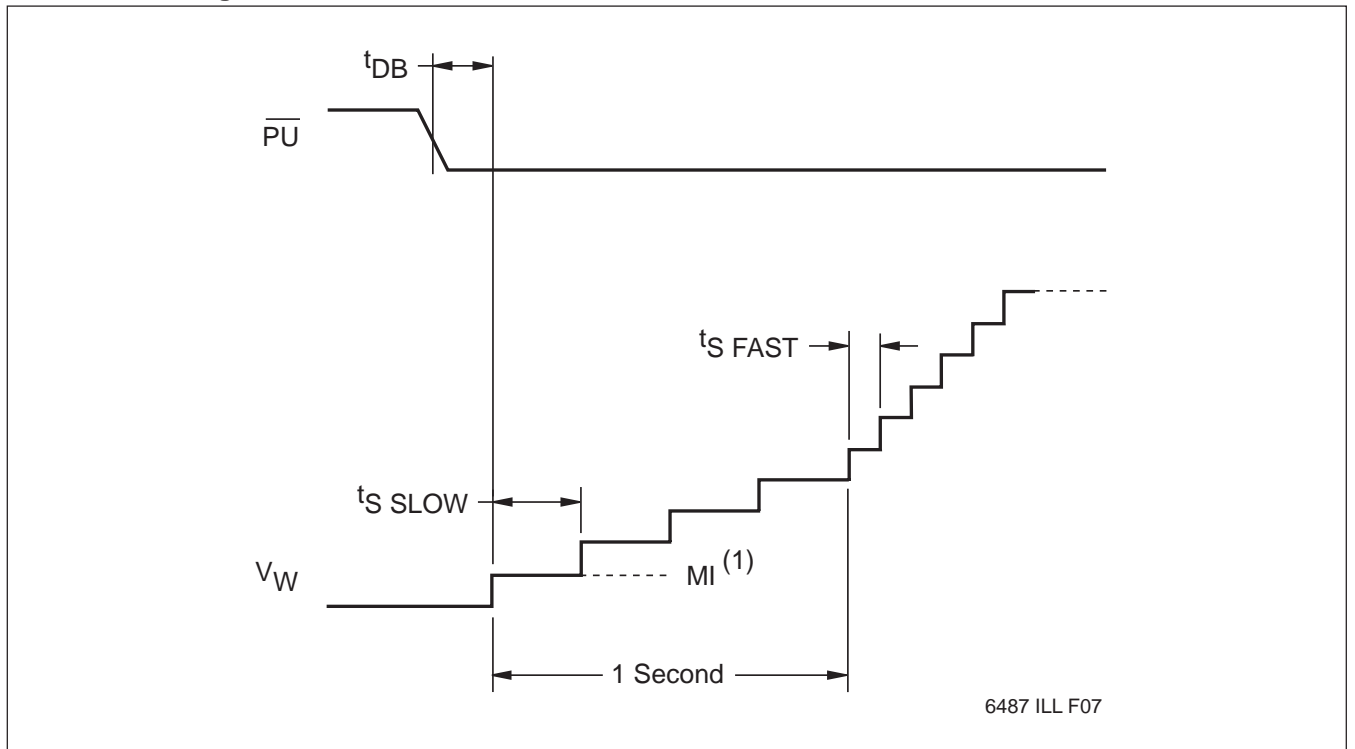(7) This parameter is periodically sampled and not 100% tested.

X9514

Slow Mode Timing
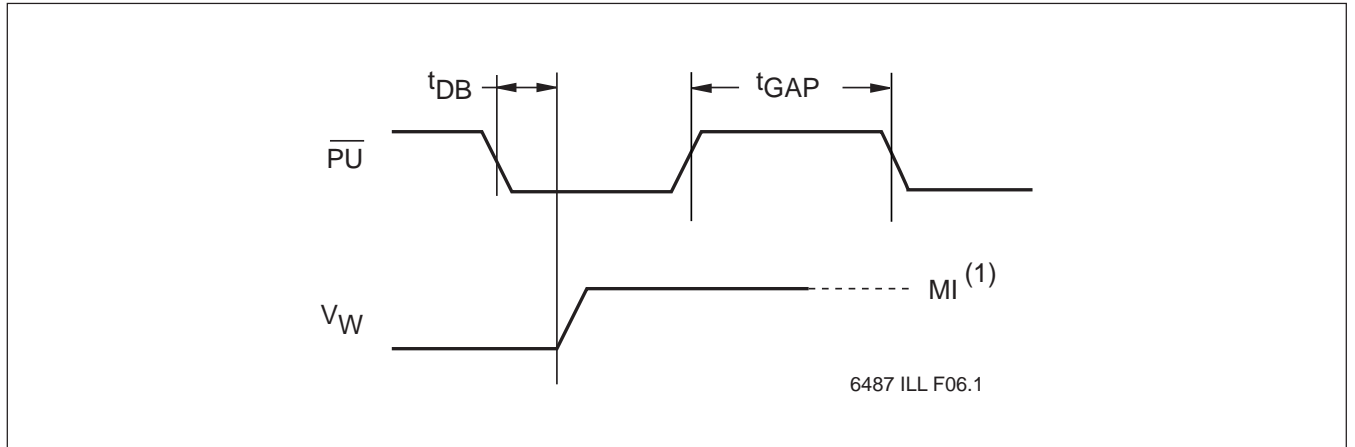
6487 ILL F06.1

Notes: (1) MI in the A.C. timing diagram refers to the minimum incremental change in the wiper voltage.

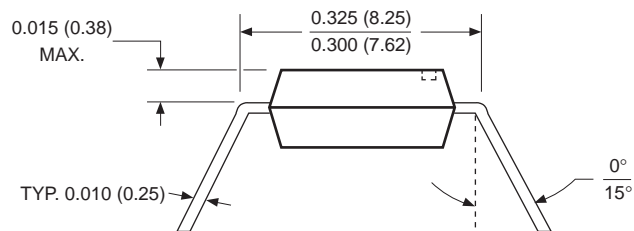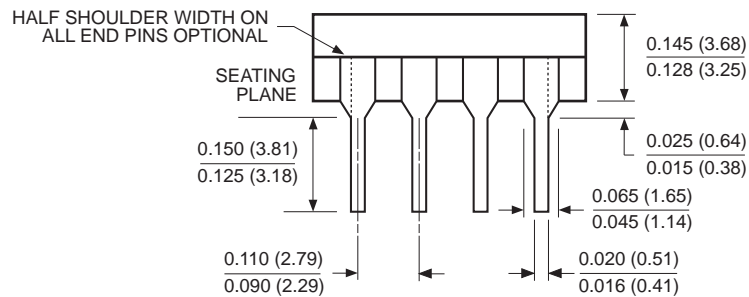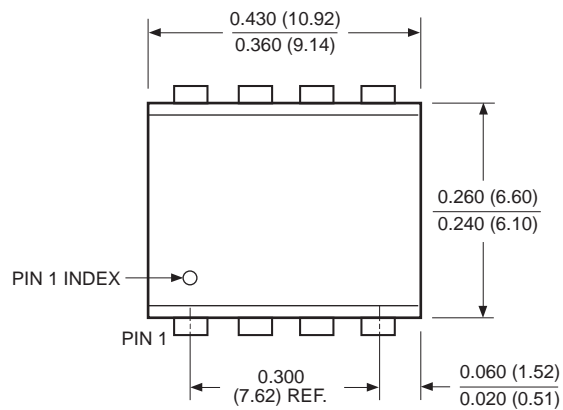**Fast Mode Timing**

6487 ILL F07

Notes: (1) MI in the A.C. timing diagram refers to the minimum incremental change in the wiper voltage.

X9514

PACKAGING INFORMATION

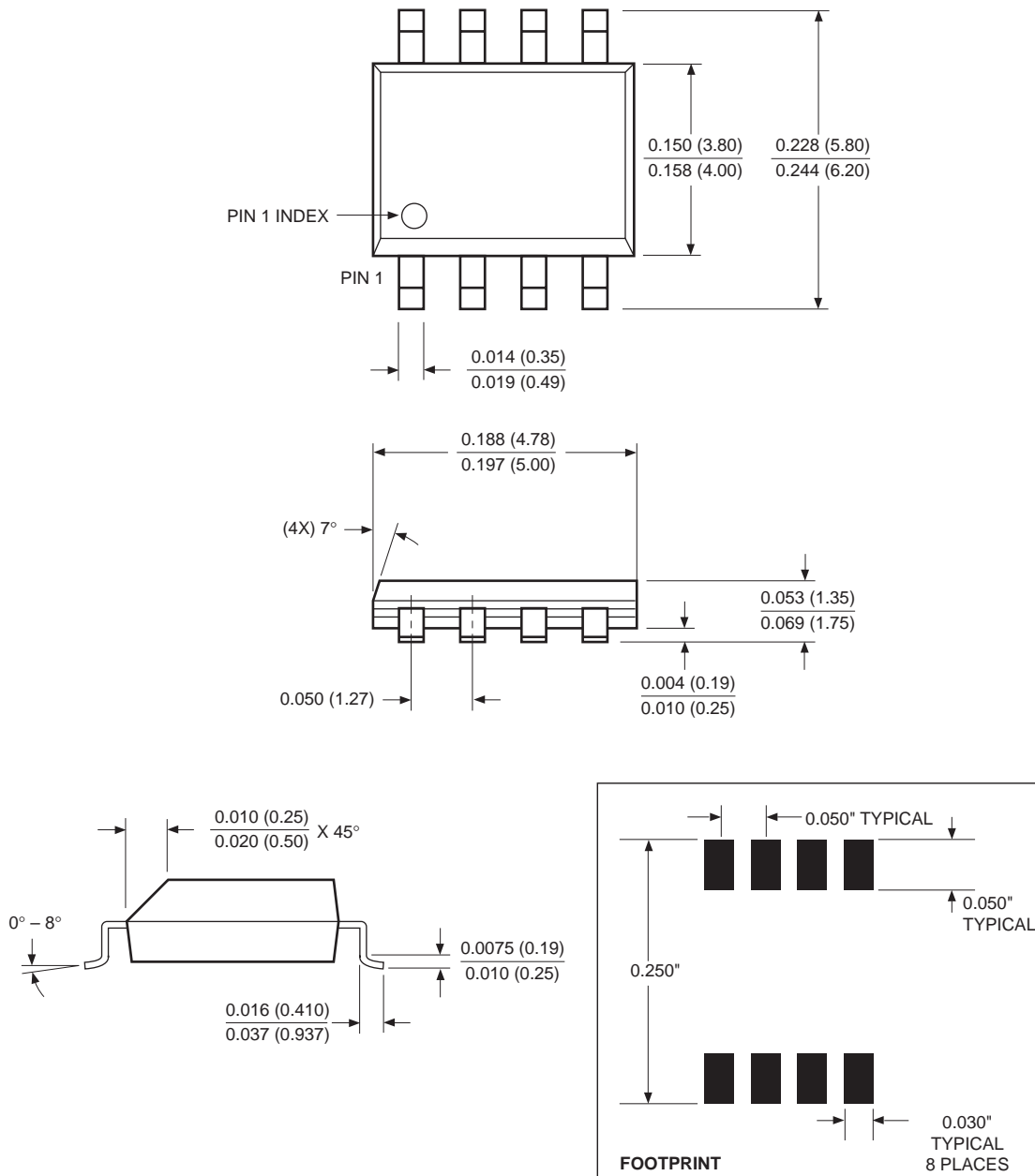### 8-LEAD PLASTIC DUAL IN-LINE PACKAGE TYPE P

0.430 (10.92)
0.360 (9.14)

0.260 (6.60)
0.240 (6.10)

PIN 1 INDEX →

PIN 1

0.300
(7.62) REF.

0.060 (1.52)
0.020 (0.51)

HALF SHOULDER WIDTH ON
ALL END PINS OPTIONAL

SEATING
PLANE

0.145 (3.68)
0.128 (3.25)

0.025 (0.64)
0.015 (0.38)

0.150 (3.81)
0.125 (3.18)

0.065 (1.65)
0.045 (1.14)

0.110 (2.79)
0.090 (2.29)

0.020 (0.51)
0.016 (0.41)

0.015 (0.38)
MAX.

0.325 (8.25)
0.300 (7.62)

TYP. 0.010 (0.25) →

0°
15°

NOTE:
1. ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)
2. PACKAGE DIMENSIONS EXCLUDE MOLDING FLASH

3926 FHD F01

X9514

PACKAGING INFORMATION

8-LEAD PLASTIC SMALL OUTLINE GULL WING PACKAGE TYPE S

PIN 1 INDEX

PIN 1

$\frac{0.150\ (3.80)}{0.158\ (4.00)}$ $\frac{0.228\ (5.80)}{0.244\ (6.20)}$

$\frac{0.014\ (0.35)}{0.019\ (0.49)}$

$\frac{0.188\ (4.78)}{0.197\ (5.00)}$

(4X) 7°

$\frac{0.053\ (1.35)}{0.069\ (1.75)}$

0.050 (1.27)

$\frac{0.004\ (0.19)}{0.010\ (0.25)}$

$\frac{0.010\ (0.25)}{0.020\ (0.50)}$ X 45°

0° − 8°

$\frac{0.0075\ (0.19)}{0.010\ (0.25)}$

$\frac{0.016\ (0.410)}{0.037\ (0.937)}$

0.050" TYPICAL

0.050" TYPICAL

0.250"

0.030" TYPICAL 8 PLACES

FOOTPRINT

NOTE: ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)

3926 FHD F22.1

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PACKAGING INFORMATION

14-LEAD PLASTIC, TSSOP PACKAGE TYPE V

.025 (.65) BSC

$\frac{.169 (4.3)}{.177 (4.5)}$

.252 (6.4) BSC

$\frac{.193 (4.9)}{.200 (5.1)}$

.047 (1.20)

$\frac{.0075 (.19)}{.0118 (.30)}$

$\frac{.002 (.05)}{.006 (.15)}$

.010 (.25)

Gage Plane

0° – 8°

Seating Plane

$\frac{.019 (.50)}{.029 (.75)}$

Detail A (20X)

$\frac{.031 (.80)}{.041 (1.05)}$

See Detail "A"
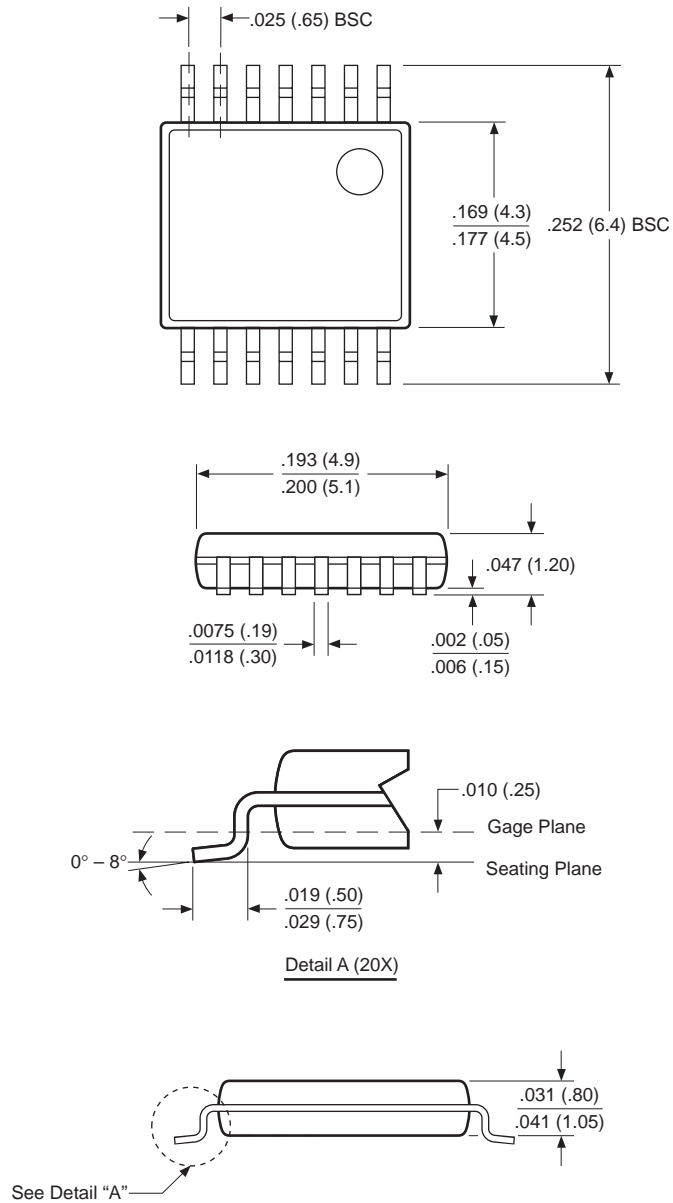
NOTE: ALL DIMENSIONS IN INCHES (IN PARENTHESES IN MILLIMETERS)

3926 FHD F32

X9514

ORDERING INFORMATION

X9514X   X   X

Temperature Range
Blank = Commercial = 0°C to +70°C
I = Industrial = –40°C to +85°C
M = Military = –55°C to +125°C

Package
P = 8-Lead Plastic DIP
S = 8-Lead SOIC
V = 14-Lead TSSOP

End to End Resistance
W = 10KΩ