

N57L5125

Product Preview

32-tap Digital Potentiometers (POTs) with 2-wire Interface

Description

N57L5125 linear-taper digital POTs perform the same function as a mechanical potentiometer or a variable resistor. This device consists of a fixed resistor and a wiper contact with 32-tap points that are digitally controlled through a 2-wire up/down serial interface.

The N57L5125 is configured as a potentiometer. Three resistance values are available: 10 k Ω , 50 k Ω and 100 k Ω . All devices are available in a space-saving 6-pin SOT-23 package.

Features

- 0.3 μ A Ultra-low Standby Current
- Single-supply Operation: 2.7 V to 5.5 V
- Glitchless Switching between Resistor Taps
- Power-on Reset to Midscale
- 2-wire Up/Down Serial Interface
- Resistance Values: 10 k Ω , 50 k Ω and 100 k Ω
- Low Wiper Resistance: 80 Ω
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

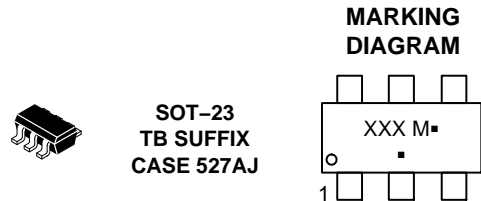
Applications

- LCD Screen Adjustment
- Volume Control
- Mechanical Potentiometer Replacement
- Gain Adjustment
- Line Impedance Matching



ON Semiconductor®

www.onsemi.com



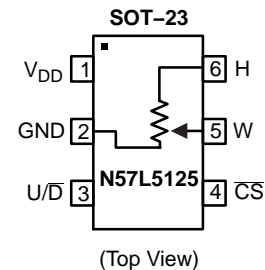
XXX = Specific Device Code

M = Date Code

▪ = Pb-Free Package

(Note: Microdot may be in either location)

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

N57L5125

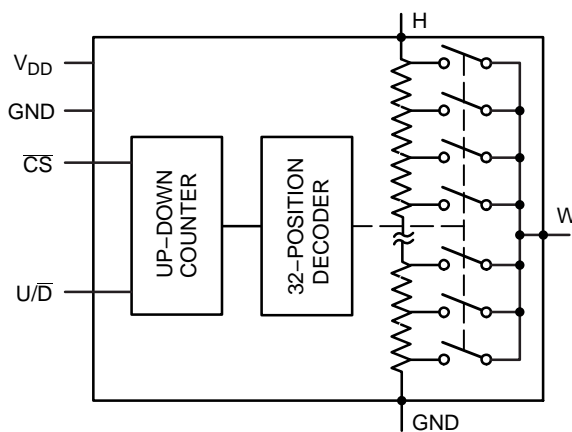


Figure 1. Functional Diagram

Table 1. PIN DESCRIPTIONS

Pin Number	Pin Name	Description
1	V _{DD}	Power Supply
2	GND	Ground
3	U/ \bar{D}	Up/Down Control Input. With \bar{CS} low, a low-to-high transition increments or decrements the wiper position.
4	\bar{CS}	Chip Select Input. A high-to-low \bar{CS} transition determines the mode: increment if U/ \bar{D} is high, or decrement if U/ \bar{D} is low.
5	W	Wiper Terminal of Resistor
6	H	High Terminal of Resistor

Table 2. ABSOLUTE MAXIMUM RATINGS

Parameters	Ratings	Units
V _{DD} to GND	-0.3 to +6	V
All Other Pins to GND	-0.3 to (V _{DD} + 0.3)	V
Input and Output Latch-Up Immunity	±200	mA
Maximum Continuous Current into H, L and W		mA
100 k Ω	±0.6	
50 k Ω	±1.3	
10 k Ω	±1.3	
Continuous Power Dissipation (T _A = +70°C) 6-pin SC-70 (Note 1)	245	mW
Operating Temperature Range	-40 to +85	°C
Junction Temperature	+150	°C
Storage Temperature Range	-65 to +150	°C
Soldering Temperature (soldering, 10 sec)	+300	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Derate 3.1 mW/°C above T_A = +70°C

N57L5125

Table 3. ELECTRICAL CHARACTERISTICS

($V_{DD} = 2.7\text{ V}$ to 5.5 V , $V_H = V_{DD}$, $V_L = 0$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$. Typical values are at $V_{DD} = 2.7\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
-----------	--------	------------	-----	-----	-----	-------

DC PERFORMANCE

Resolution			32			Taps
End-to-End Resistance (-00)			80	100	120	k Ω
End-to-End Resistance (-50)			40	50	60	
End-to-End Resistance (-10)			8	10	12	
End-to-End Resistance Tempco	TC_R			30	300	ppm/ $^\circ\text{C}$
Ratiometric Resistance Tempco				5		ppm/ $^\circ\text{C}$
Integral Nonlinearity	INL				± 0.5	LSB
Differential Nonlinearity	DNL				± 0.5	LSB
Full-Scale Error				± 0.1		LSB
Zero-Scale Error					1	LSB
Wiper Resistance	R_W			80	200	Ω

DIGITAL INPUTS

Input High Voltage	V_{IH}		$0.7 \times V_{DD}$			V
Input Low Voltage	V_{IL}				$0.3 \times V_{DD}$	V

TIMING CHARACTERISTICS (Figures 5, 6)

U/ \bar{D} Mode to \bar{CS} Setup	t_{CU}		25			ns
\bar{CS} to U/ \bar{D} Step Setup	t_{CI}		50			ns
\bar{CS} to U/ \bar{D} Step Hold	t_{IC}		25			ns
U/ \bar{D} Step Low Period	t_{IL}		25			ns
U/ \bar{D} Step High Period	t_{IH}		25			ns
Up/Down Toggle Rate (Note 2)	f_{TOGGLE}			1		MHz
Output Settling Time (Note 3)	t_{SETTLE}	100 k Ω variable resistor configuration, $C_L = 10\text{ pF}$		1		μs
		100 k Ω potentiometer configuration, $C_L = 10\text{ pF}$		0.25		

POWER SUPPLY

Supply Voltage	V_{DD}		2.7		5.5	V
Active Supply Current (Note 4)	I_{DD}				35	μA
Standby Supply Current (Note 5)	I_{SB}	$V_{DD} = +5\text{ V}$		0.3	1	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Up/Down Toggle Rate: $f_{TOGGLE} = 1 / t_{SETTLE}$
3. Typical settling times are dependent on end-to-end resistance.
4. Supply current measured while changing wiper tap, $f_{TOGGLE} = 500\text{ kHz}$.
5. Supply current measured while wiper position is fixed.

N57L5125

TYPICAL OPERATING CHARACTERISTICS

($T_A = 25^\circ\text{C}$, unless otherwise noted.)

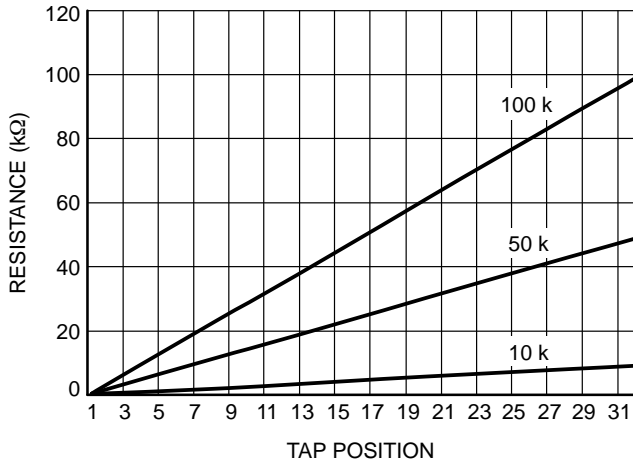


Figure 2. W-to-GND Resistance vs. Tap Position

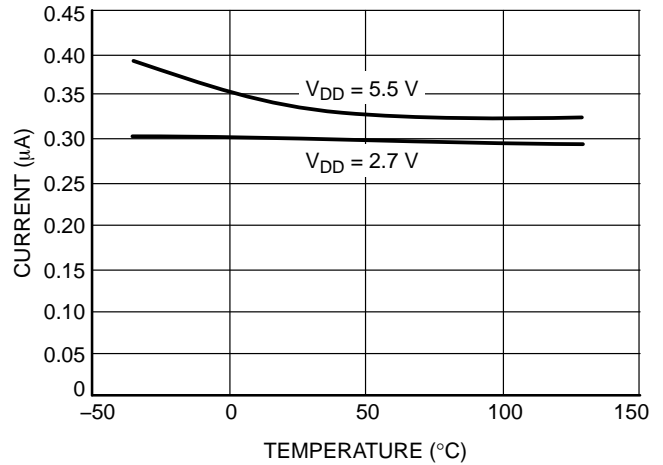


Figure 3. Supply Current vs. Temperature

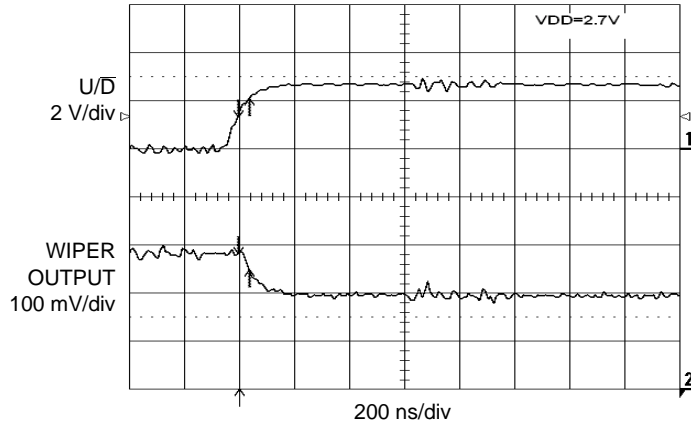


Figure 4. Tap-to-Tap Switching Transient

FUNCTIONAL DESCRIPTION

The N57L5125 consists of a fixed resistor and a wiper contact with 32-tap points that are digitally controlled through a 2-wire up/down serial interface. Three end-to-end resistance values are available: 10 kΩ, 50 kΩ and 100 kΩ.

The N57L5125 is designed to operate as a potentiometer. In this configuration, the low terminal of the resistor array is connected to ground (pin 2).

Digital Interface Operation

The devices have two modes of operation when the serial interface is active: increment and decrement mode. The serial interface is only active when \overline{CS} is low.

The \overline{CS} and U/\overline{D} inputs control the position of the wiper along the resistor array. When \overline{CS} transitions from high to low, the part will go into increment mode if U/\overline{D} input is high, and into decrement mode when U/\overline{D} input is low. Once

the mode is set, the device will remain in that mode until \overline{CS} goes high again. A low-to-high transition at the U/\overline{D} pin will increment or decrement the wiper position depending on the current mode (Figures 5 and 6).

When the \overline{CS} input transitions to high (serial interface inactive), the value of the counter is stored and the wiper position is maintained.

Note that when the wiper reaches the maximum (or minimum) tap position, the wiper will not wrap around to the minimum (or maximum) position.

Power-On Reset

All parts in this family feature power-on reset (POR) circuitry that sets the wiper position to midscale at power-up. By default, the chip is in the increment mode.

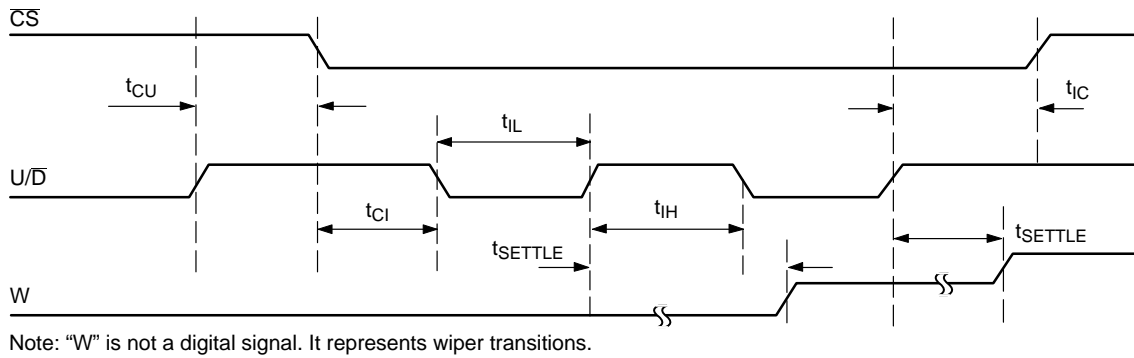


Figure 5. Serial Interface Timing Diagram, Increment Mode

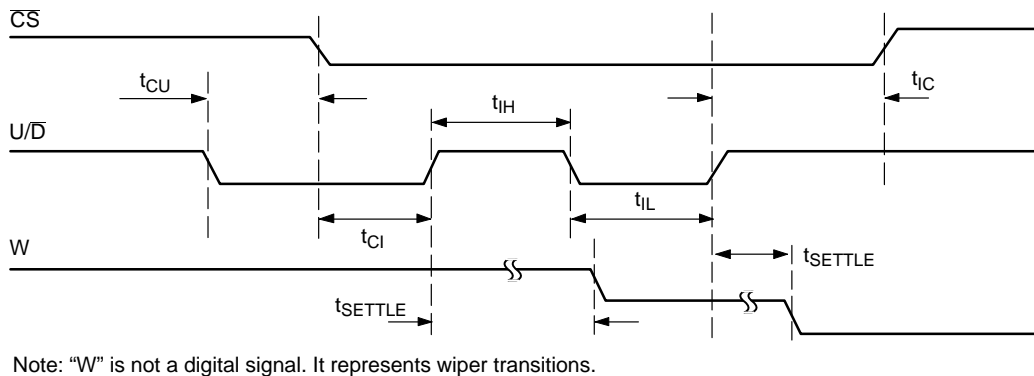


Figure 6. Serial Interface Timing Diagram, Decrement Mode

APPLICATIONS INFORMATION

The devices are intended for circuits requiring digitally controlled adjustable resistance, such as LCD contrast control, where voltage biasing adjusts the display contrast.

Alternative Positive LCD Bias Control

An op amp can be used to provide buffering and gain on the output of the N57L5125. This can be done by connecting the wiper output to the positive input of a noninverting op amp as shown in Figure 7.

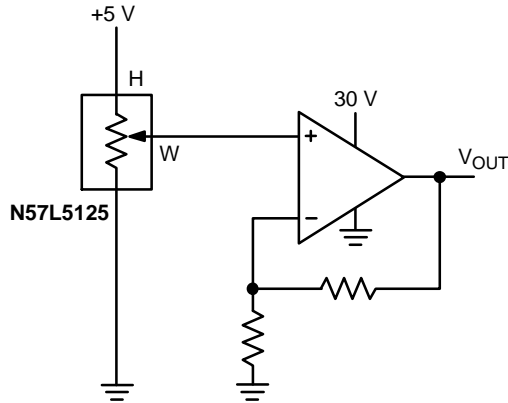


Figure 7. Positive LCD Bias Control

Adjustable Gain

Figure 8 shows how to use a potentiometer to digitally adjust the gain of a noninverting op amp configuration, by connecting the devices in series with a resistor to ground. The devices have a low 5 ppm/°C ratiometric tempco that allows for a very stable adjustable gain configuration over temperature.

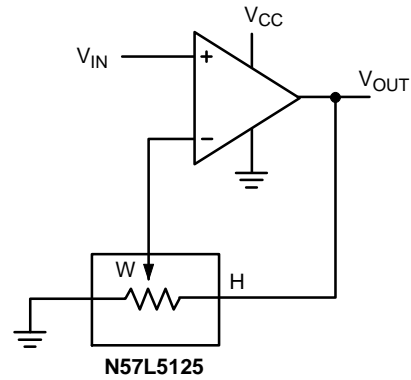


Figure 8. Adjustable Gain Circuit

N57L5125

Table 4. ORDERING INFORMATION

Device	Orderable Part Number	Resistor [kΩ]	Pin Package	Shipping†
N57L5125	N57L5125TBD10TG	10	SOT23–6	3000 / Tape & Reel
	N57L5125TBD50TG (Note 7)	50	SOT23–6	3000 / Tape & Reel
	N57L5125TBD00TG (Note 7)	100	SOT23–6	3000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

6. For detailed information and a breakdown of device nomenclature and numbering systems, please see the ON Semiconductor Device Nomenclature document, TND310/D, available at www.onsemi.com.

7. Contact factory for availability.

8. All packages are RoHS-compliant (Pb-Free, Halogen-Free).

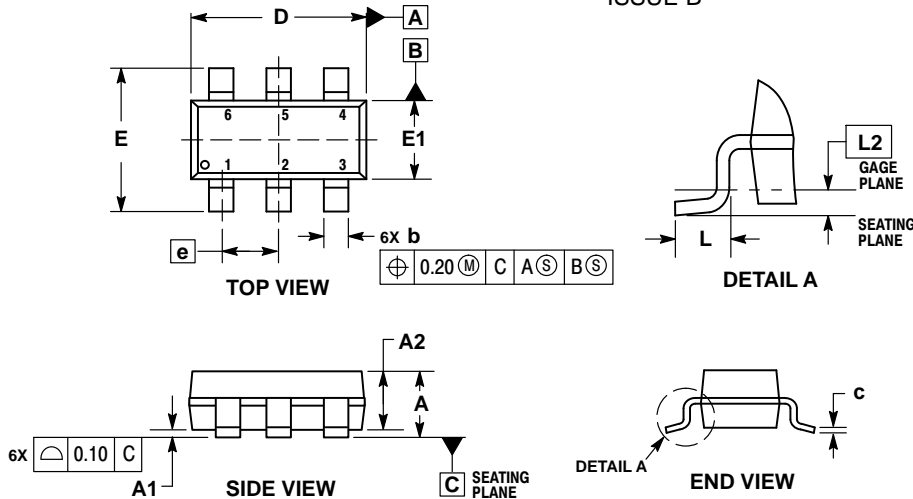
9. The standard finish is NiPdAu.

10. For additional package and temperature options, please contact your nearest ON Semiconductor Sales office.

N57L5125

PACKAGE DIMENSIONS

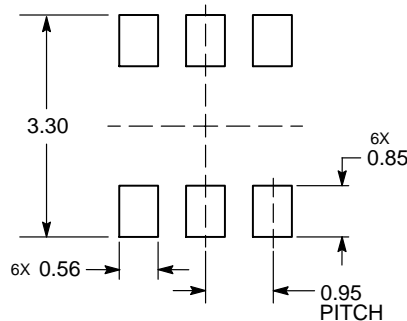
SOT-23, 6 Lead CASE 527AJ ISSUE B



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 2. CONTROLLING DIMENSION: MILLIMETERS.
 3. DATUM C IS THE SEATING PLANE.

MILLIMETERS		
DIM	MIN	MAX
A	---	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.20	0.50
c	0.08	0.26
D	2.70	3.00
E	2.50	3.10
E1	1.30	1.80
e	0.95 BSC	
L	0.20	0.60
L2	0.25 BSC	

RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marketing.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative