CAT5128

32-Tap Digital Up/Down Control Potentiometer

Description

The CAT5128 is a single digitally programmable potentiometer (DPP™) designed as an electronic replacement for mechanical potentiometers and trim pots. Ideal for automated adjustments on high volume production lines, they are also well suited for applications where equipment requiring periodic adjustment is either difficult to access or located in a hazardous or remote environment.

The CAT5128 contains a 32−tap series resistor array connected between two terminals A and B. An up/down counter and decoder that are controlled by two input pins, determines which tap is connected to the wiper, W. Wiper−control of the CAT5128 is accomplished with two input control pins, $\overline{UP}$ and $\overline{DOWN}$. A high−to−low transition on the $\overline{UP}$ input increments the wiper position and a high−to−low transition on the $\overline{DOWN}$ input decrements the wiper position. The tap position is not stored in memory. The wiper is always set to the mid point, tap 15 at power up.

The digitally programmable potentiometer can be used as a three−terminal resistive divider or as a two−terminal variable resistor. DPPs bring variability and programmability to a wide variety of applications including control, parameter adjustments, and signal processing.

Features

- 32−position Linear Taper Potentiometer
- Low Power CMOS Technology
- Single Supply Operation: 2.5 V – 5.5 V
- Discrete Step−up/Step−down Digital Control
- Resistance Values: 10 kΩ, 50 kΩ and 100 kΩ
- Available in SOT−23 8−lead Package
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Automated Product Calibration
- Remote Control Adjustments
- Offset, Gain and Zero Control
- Tamper−proof Calibrations
- Contrast, Brightness and Volume Controls
- Motor Controls and Feedback Systems
- Programmable Analog Functions

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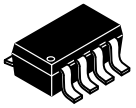
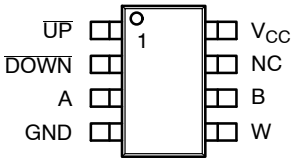


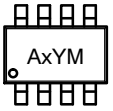
SOT−23
TB SUFFIX
CASE 527AK

PIN CONFIGURATION



(Top View)

MARKING DIAGRAM



x	= H, B or C
AH	= CAT5128TBI−00GT3
AB	= CAT5128TBI−10GT3
AC	= CAT5128TBI−50GT3
Y	= Production Year (Last Digit)
M	= Production Month (1−9, O, N, D)

PIN DESCRIPTIONS

Pin Name	Function
$\overline{UP}$	Step−Up Control
$\overline{DOWN}$	Step−Down Control
A	Potentiometer High Terminal
GND	Ground
W	Wiper Terminal
B	Potentiometer Low Terminal
NC	Not Connected
V_{CC}	Supply Voltage

ORDERING INFORMATION

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

Functional Diagrams

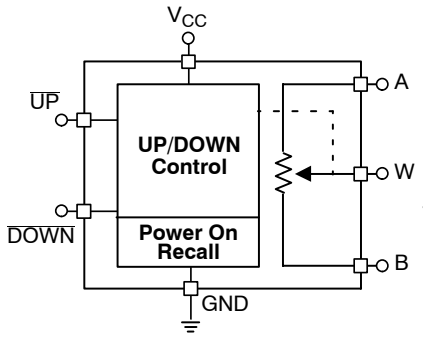


Figure 1. General

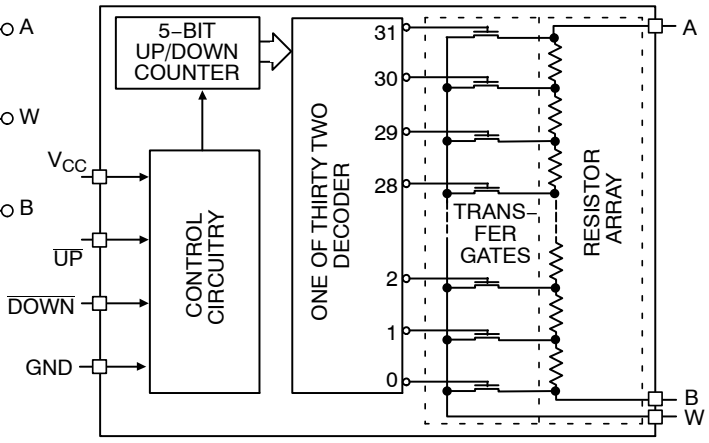


Figure 2. Detailed

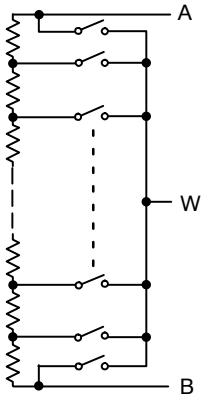


Figure 3. Electronic Potentiometer Implementation

Pin Description

$\overline{\text{UP}}$: Step−Up Control Input

When $\overline{\text{DOWN}}$ input is high, a high−to−low transition on $\overline{\text{UP}}$ input will cause the wiper to move one increment toward the A terminal.

$\overline{\text{DOWN}}$: Step−Down Control Input

A high−to−low transition on $\overline{\text{DOWN}}$ input will cause the wiper to move one increment towards the B terminal.

A: High End Potentiometer Terminal

A is the high end terminal of the potentiometer. It is not required that this terminal be connected to a potential greater than the B terminal. Voltage applied to the A terminal cannot exceed the supply voltage, V_{CC} or go below ground, GND.

W: Wiper Potentiometer Terminal

W is the wiper terminal of the potentiometer. Its position on the resistor array is controlled by the control inputs, $\overline{\text{UP}}$ and $\overline{\text{DOWN}}$. Voltage applied to the W terminal cannot exceed the supply voltage, V_{CC} or go below ground, GND.

B: Low End Potentiometer Terminal

B is the low end terminal of the potentiometer. It is not required that this terminal be connected to a potential less than the A terminal. Voltage applied to the B terminal cannot exceed the supply voltage, V_{CC} or go below ground, GND. B and A are electrically interchangeable.

Device Operation

The CAT5128 operates like a digitally controlled potentiometer with A and B equivalent to the high and low terminals and W equivalent to the mechanical potentiometer's wiper. There are 32 available tap positions including the resistor end points, A and B. There are 31 resistor elements connected in series between the A and B terminals. The wiper terminal is connected to one of the 32 taps and controlled by two inputs, $\overline{\text{UP}}$ and $\overline{\text{DOWN}}$. These inputs control a five−bit up/down counter whose output is decoded to select the wiper position.

A high−to−low transition on $\overline{\text{DOWN}}$ input will decrement one step the wiper position (R_{WB} will decrease with 1LSB and R_{WA} will increase with 1LSB). If and only if $\overline{\text{DOWN}}$ input is high, a high−to−low transition on $\overline{\text{UP}}$ input will increment one step the wiper position (R_{WB} will increase with 1LSB and R_{WA} will decrease with 1LSB).

The wiper, when at either fixed terminal, acts like its mechanical equivalent and does not move beyond the last position. When the CAT5128 is powered−down, the wiper position is reset. When power is restored, the counter is set to the mid point, tap 15.

Table 1. OPERATION MODES

$\overline{UP}$	$\overline{DOWN}$	Operation
High to Low	High	Wiper toward A – R_W Increment
X	Low	Wiper does not change
High	High to Low	Wiper toward B – R_W Decrement
High to Low	High to Low	Wiper toward B – R_W Decrement
Low	X	Wiper does not change
High	High	Wiper does not change

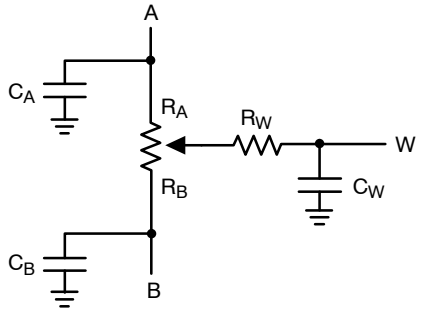


Figure 4. Potentiometer Equivalent Circuit

Table 2. ABSOLUTE MAXIMUM RATINGS

Parameters	Ratings	Units
Supply Voltage V_{CC} to GND	 –0.5 to +7 V	V
Inputs $\overline{UP}$ to GND $\overline{DOWN}$ to GND A, B, W to GND	 –0.5 to V_{CC} +0.5 –0.5 to V_{CC} +0.5 –0.5 to V_{CC} +0.5	V
Operating Ambient Temperature Industrial ('I' suffix)	–40 to +85	°C
Junction Temperature	+150	°C
Storage Temperature	–65 to 150	°C
Lead Soldering (10 seconds max)	+300	°C
Thermal Resistance θ_{JA}	230	°C/W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 3. DC ELECTRICAL CHARACTERISTICS (V_{CC} = +2.5 V to +5.5 V unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
POWER SUPPLY						
V_{CC}	Operating Voltage Range		2.5	–	5.5	V
I_{CC1}	Supply Current (Increment)	V_{CC} = 5.5 V, f = 1 MHz, I_W = 0	–	–	100	μA
		V_{CC} = 5.5 V, f = 250 kHz, I_W = 0	–	–	50	μA
I_{SB1} (Note 1)	Supply Current (Standby)	$\overline{UP}$, $\overline{DOWN}$ = V_{CC} or GND	–	0.01	1	μA

1. These parameters are periodically sampled and are not production tested.

Table 4. LOGIC INPUTS (V_{CC} = +2.5 V to +5.5 V unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
I_{IH}	Input Leakage Current	$V_{IN} = V_{CC}$	–	–	10	μA
I_{IL}	Input Leakage Current	V_{IN} = 0 V	–	–	–10	μA
V_{IH1}	TTL High Level Input Voltage	4.5 V ≤ V_{CC} ≤ 5.5 V	2	–	V_{CC}	V
V_{IL1}	TTL Low Level Input Voltage		0	–	0.8	V
V_{IH2}	CMOS High Level Input Voltage	2.5 V ≤ V_{CC} ≤ 5.5 V	V_{CC} x 0.7	–	V_{CC} + 0.3	V
V_{IL2}	CMOS Low Level Input Voltage		–0.3	–	V_{CC} x 0.2	V

Table 5. POTENTIOMETER CHARACTERISTICS (V_{CC} = +2.5 V to +5.5 V unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ (Note 2)	Max	Units
R_{POT}	Potentiometer Resistance	–10 Device		10		kΩ
		–50 Device		50		
		–00 Device		100		
	Pot. Resistance Tolerance				±20	%
V_A	Voltage on A pin		0		V_{CC}	V
V_B	Voltage on B pin		0		V_{CC}	V
	Resolution			3.2		%
INL	Integral Linearity Error	I_W ≤ 2 μA	–0.5	0.1	0.5	LSB
DNL	Differential Linearity Error	I_W ≤ 2 μA	–0.5	0.05	0.5	LSB
R_{WI}	Wiper Resistance	V_{CC} = 5 V, I_W = 1 mA		70		Ω
		V_{CC} = 2.5 V, I_W = 1 mA		150	300	Ω
I_W	Wiper Current	(Note 3)			1	mA
TC_{RPOT}	TC of Pot Resistance	(Note 4)		50		ppm/°C
TC_{RATIO}	Ratiometric TC	(Note 4)		5	20	ppm/°C
V_N (Note 4)	Noise	100 kHz / 1 kHz		8/24		nV/√Hz
$C_A/C_B/C_W$	Potentiometer Capacitances	(Note 4)		8/8/25		pF
fc (Note 4)	Frequency Response	Passive Attenuator, 10 kΩ		1.7		MHz

2. Typical values are for T_A = 25°C and nominal supply voltage.
3. I_W = source or sink.
4. These parameters are periodically sampled and are not production tested.

Table 6. AC CONDITIONS OF TEST

V_{CC} Range	2.5 V ≤ V_{CC} ≤ 5.5 V
Input Pulse Levels	0.2 V_{CC} to 0.7 V_{CC}
Input Rise and Fall Times	10 ns
Input Reference Levels	0.5 V_{CC}

Table 7. AC OPERATING CHARACTERISTICS (V_{CC} = +2.5 V to +5.5 V, V_H = V_{CC}, V_L = 0 V, unless othewise specified)

Symbol	Parameter	Min	Typ (Note 5)	Max	Units
t_{UP}	$\overline{UP}$ LOW Period	500	–	–	ns
t_{DOWN}	$\overline{DOWN}$ LOW Period	500	–	–	ns
t_{UP_CYC}	$\overline{UP}$ Cycle Time	1	–	–	μs
t_{DOWN_CYC}	$\overline{DOWN}$ Cycle Time	1	–	–	μs
t_{UP_R}, t_{UP_F} (Note 6)	$\overline{UP}$ Rise and Fall Time	–	–	500	ns
t_{DOWN_R}, t_{DOWN_F} (Note 6)	$\overline{DOWN}$ Rise and Fall Time	–	–	500	ns
t_{UP_SET}	$\overline{UP}$ Settling Time	200	–	–	ns
t_{DOWN_SET}	$\overline{DOWN}$ Settling Time	200	–	–	ns
t_{PU} (Note 6)	Power−up to Wiper Stable	–	–	1	ms

5. Typical values are for T_A = 25°C and nominal supply voltage.
6. This parameter is periodically sampled and not 100% tested.

Interface Timing Diagrams

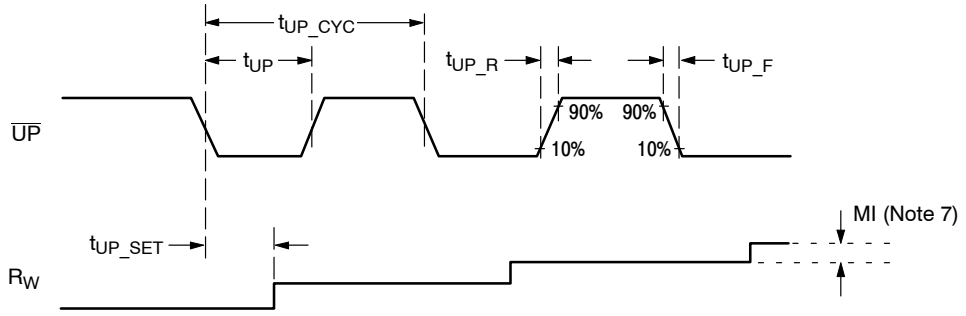


Figure 5. Increment R_W in Discrete Steps

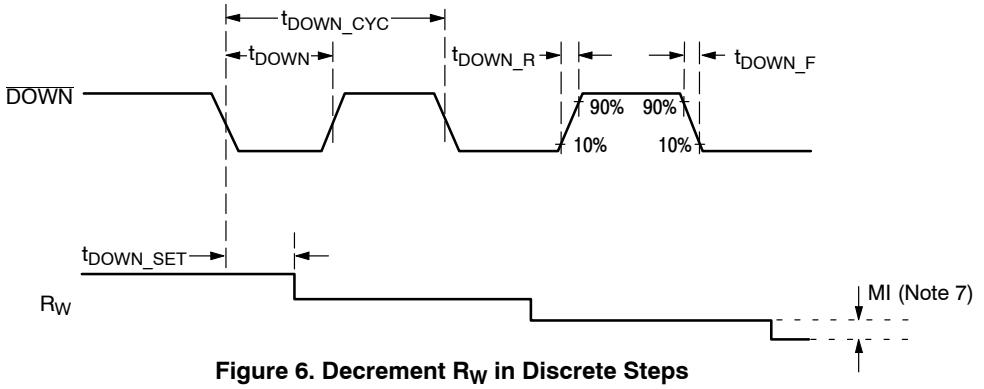
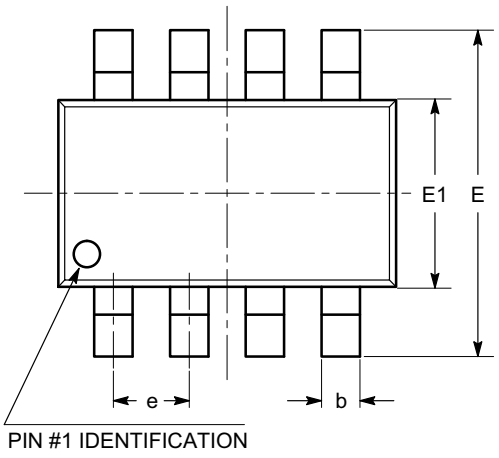


Figure 6. Decrement R_W in Discrete Steps

7. MI in the A.C. Timing diagram refers to the minimum incremental change in the W output due to a change in the wiper position.

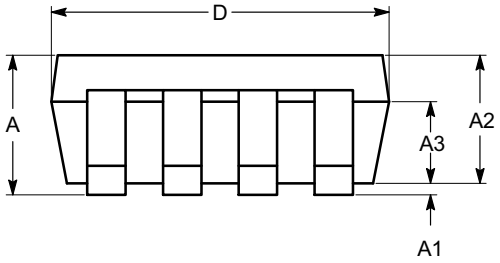
PACKAGE DIMENSIONS

SOT−23, 8 Lead
CASE 527AK−01
ISSUE A

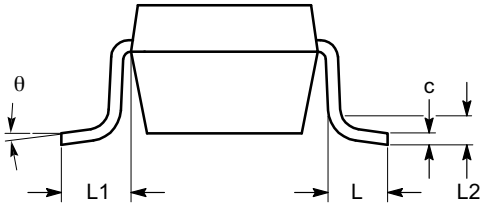


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	0.90		1.45
A1	0.00		0.15
A2	0.90	1.10	1.30
A3	0.60		0.80
b	0.28		0.38
c	0.08		0.22
D	2.90 BSC		
E	2.80 BSC		
E1	1.60 BSC		
e	0.65 BSC		
L	0.30	0.45	0.60
L1	0.60 REF		
L2	0.25 REF		
θ	0°		8°



SIDE VIEW



END VIEW

Notes:
(1) All dimensions in millimeters. Angles in degrees.
(2) Complies with JEDEC standard MO-178.

Example of Ordering Information (Note 10)

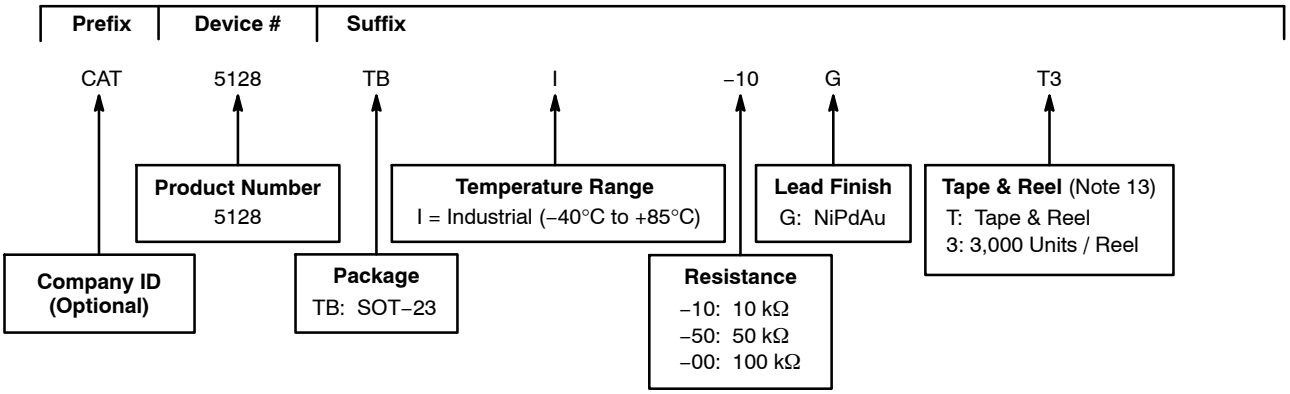


Table 8. ORDERING INFORMATION

Orderable Part Number	Resistance (kΩ)	Package	Lead Finish
CAT5128TBI−10GT3	10	SOT−23−8	NiPdAu
CAT5128TBI−50GT3	50		
CAT5128TBI−00GT3 (Note 12)	100		

8. All packages are RoHS−compliant (Lead−free, Halogen−free).
9. The standard lead finish is NiPdAu.
10. The device used in the above example is a CAT5128TBI−10GT3 (SOT−23, Industrial Temperature, 10 kΩ, NiPdAu, Tape & Reel, 3,000/Reel).
11. For additional package and temperature options, please contact your nearest ON Semiconductor Sales office.
12. Contact factory for availability.
13. 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.

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PUBLICATION ORDERING INFORMATION

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