

# NCV7001

## Quad Variable Reluctance Sensor Interface IC

The NCV7001 is a four-channel variable reluctance sensor interface IC. Microprocessor control functions include two polarity 5.0 V programmable resets, two programmable watchdog inputs, and an enable function (OLE). Two watchdog inputs allow control from two independent microprocessors.

Open sensor detection capability is provided. During test mode (NTEST = Low), a high on the OLE pin should provide a high on the output. A low under these conditions indicates an open load.

This part has been designed to operate in an automotive environment.

### Features

- Four Channel Capability
- Differential Inputs
- Open Sensor Detect
- 5.0 V Supply Operation with RESET and Watchdog Features
- On-Chip Input Voltage Clamping
- NCV Prefix for Automotive and Other Applications Requiring Site and Change Control
- Pb-Free Packages are Available

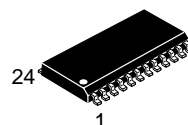
### Typical Applications

- Antilock Braking Systems (ABS)
- Traction Control Systems (TCS)
- Vehicle Dynamics Control (VDC)



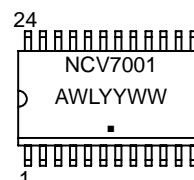
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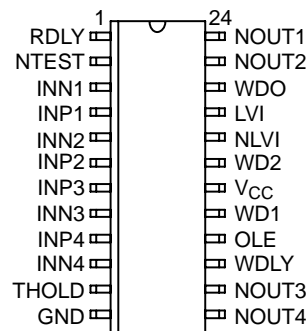
SO-24L  
DW SUFFIX  
CASE 751E

### MARKING DIAGRAM



- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- = Pb-Free Package

### PIN CONNECTIONS

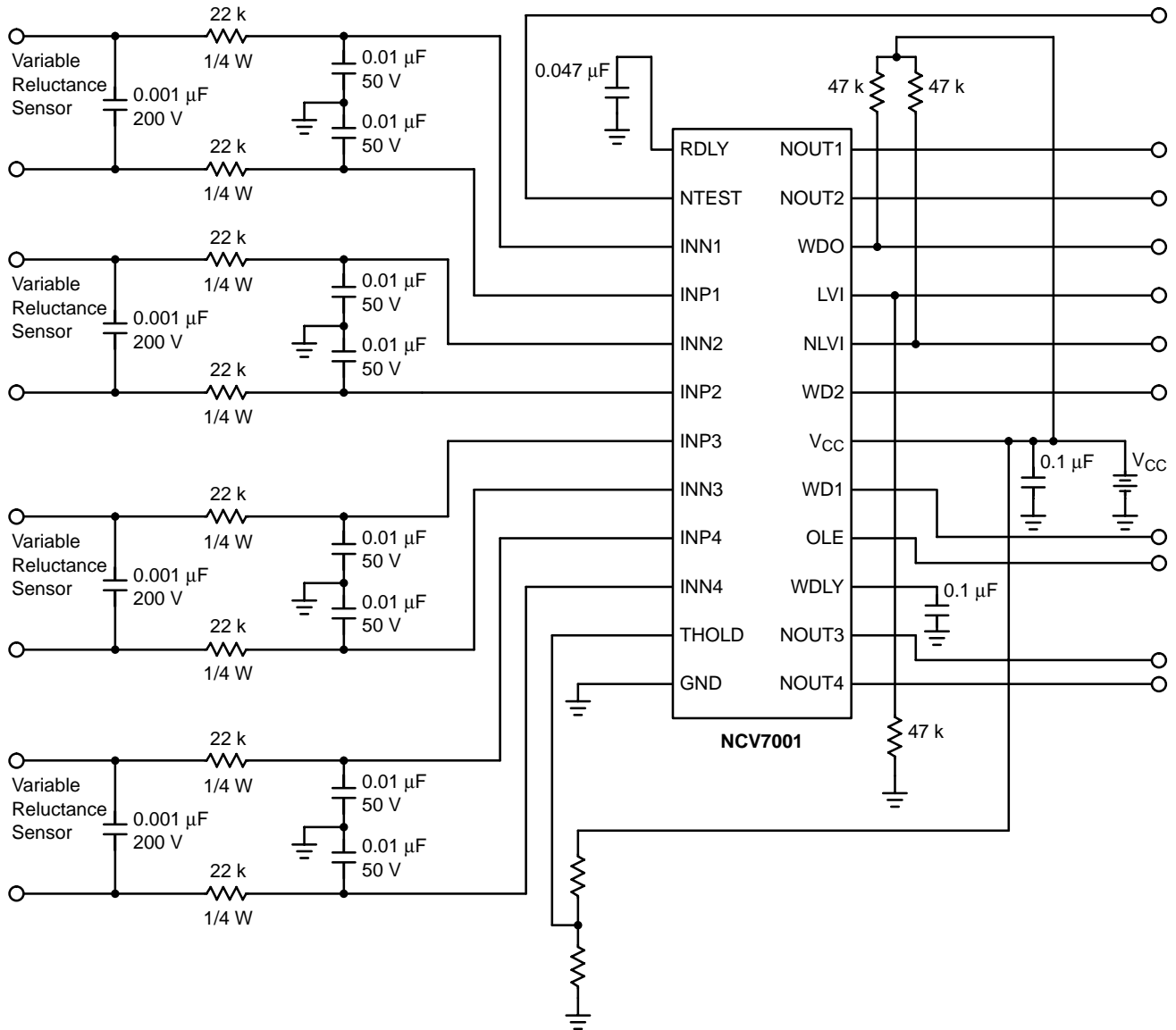


### ORDERING INFORMATION

Device	Package	Shipping†
NCV7001DW	SO-24L	30 Units/Rail
NCV7001DWG	SO-24L (Pb-Free)	30 Units/Rail
NCV7001DWR2	SO-24L	1000 Tape & Reel
NCV7001DWR2G	SO-24L (Pb-Free)	1000 Tape & Reel

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

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**Figure 1. Application Diagram**

**MAXIMUM RATINGS\***

Rating	Value	Unit
DC Supply Voltage (V <sub>CC</sub> )	-0.3 to 7.0	V
Input Clamp Current	-10, 10	mA
ESD Capability (Human Body Model)	2.0	kV
Storage Temperature	-55 to 150	°C
Operating Junction Temperature	-40 to 150	°C
Package Thermal Resistance: Junction-to-Case, R <sub>θJC</sub> Junction-to-Ambient, R <sub>θJA</sub>	16 80	°C/W °C/W
Lead Temperature Soldering:	Reflow: (SMD styles only) (Notes 1, 2)	240 peak

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

\*The maximum package power dissipation must be observed.

1. 60 second maximum above 183°C.
2. -5°C/+0°C allowable conditions.

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## ELECTRICAL CHARACTERISTICS (4.5 V ≤ V<sub>CC</sub> ≤ 5.5 V, -40°C ≤ T<sub>J</sub> ≤ 125°C; unless otherwise noted.)

Characteristic	Test Conditions	Min	Typ	Max	Unit
<b>General Characteristics</b>					
Quiescent Current	-	-	-	24	mA

### Input

Positive Input Threshold	R <sub>series</sub> = 22 k between INPX & INNX Thold Pin = 0 V	30	45	60	mV
Negative Input Threshold	R <sub>series</sub> = 22 k between INPX & INNX Thold Pin = 0 V	-60	-45	-30	mV
Positive Input Threshold	R <sub>series</sub> = 22 k between INPX & INNX Thold Pin = 2.0 V	84	126	168	mV
Negative Input Threshold	R <sub>series</sub> = 22 k between INPX & INNX Thold Pin = 2.0 V	-168	-126	-84	mV
Positive Input Threshold	R <sub>series</sub> = 22 k between INPX & INNX ±90 mV at V <sub>CC</sub> = V <sub>THOLD</sub> = 4.5 V	110	140	200	mV
Negative Input Threshold	R <sub>series</sub> = 22 k between INPX & INNX ±90 mV at V <sub>CC</sub> = V <sub>THOLD</sub> = 4.5 V	-200	-140	-110	mV
Input Resistance	-	225	400	800	kΩ
Input Bias/Single Ended	Thold = 0 V	0.46 V <sub>CC</sub>	0.5 V <sub>CC</sub>	0.54 V <sub>CC</sub>	V
Input Clamp Current	For Correct Reset & Watchdog During Power Up	-6.0	-	6.0	mA
Input Clamp Voltage	(-10 mA) (+10 mA)	-0.5 V <sub>CC</sub> - 0.6	0 V <sub>CC</sub>	0.5 V <sub>CC</sub> + 0.6	V V
Open Sensor Threshold	22 k in Series with INNX and INPX	12	-	120	kΩ

### Output (NOUTX)

Output Low Voltage	I <sub>OUT</sub> = 1.0 mA	-	0.2	0.4	V
Output High Voltage	I <sub>OUT</sub> = -100 μA	V <sub>CC</sub> - 0.7	-	-	V
Output During Test / Normal Sensor (V <sub>CC</sub> - V <sub>OUT</sub> )	OLE = 1.0, I <sub>OUT</sub> = -100 μA	-	-	0.7	V
Output During Test / Open Sensor (V <sub>CC</sub> - V <sub>OUT</sub> )	OLE = 1.0, I <sub>OUT</sub> = -1.0 mA	-	-	0.4	V
Output (V <sub>CC</sub> - V <sub>OUT</sub> )	OLE (= Low), I <sub>OUT</sub> = -100 μA,	-	-	0.7	V
Output (V <sub>CC</sub> - V <sub>OUT</sub> )	OLE (= 1.0)/Normal Sensor, NO Signal from Sensor, I <sub>OUT</sub> = -100 μA	-	-	0.4	V

### Logic

Watchdog Output Low Voltage	I <sub>WDO</sub> = 1.0 mA	-	0.2	0.4	V
Watchdog Output High Leakage	V <sub>WDO</sub> = V <sub>CC</sub>	-	-	10	μA
Watchdog Input Voltage High	-	-	1.5	2.0	V
Watchdog Input Voltage Low	-	0.8	1.4	-	V
Watchdog Input Pullup Current	WD1 = WD2 = 2.0 V	-30	-	-450	μA
Watchdog Input Pullup Current	WD1 = WD2 = 0.8 V	-50	-	-600	μA
Thold Pin Input Current	0.3 V < V <sub>THOLD</sub> < V <sub>CC</sub>	-	5.0	40	μA
Test Input Low Threshold	-	0.3 V <sub>CC</sub>	-	-	V
Test Input High Threshold	-	-	-	0.7 V <sub>CC</sub>	V
Test Input Current	V <sub>IN</sub> = 0.7 V <sub>CC</sub> , TEST = 1	-25	-	220	μA
OLE Input Low Threshold	-	0.8	1.4	-	V
OLE Input High Threshold	-	-	1.5	2.0	V
OLE Input Current	OLE = 1.0, V <sub>IN</sub> = 2.0 V	-30	-	-450	μA
OLE Input Current	OLE = Low, V <sub>IN</sub> = 0.8 V	-50	-	-600	μA

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## ELECTRICAL CHARACTERISTICS (continued) ( $4.5\text{ V} \leq V_{CC} \leq 5.5\text{ V}$ , $-40^{\circ}\text{C} \leq T_J \leq 125^{\circ}\text{C}$ ; unless otherwise noted.)

Characteristic	Test Conditions	Min	Typ	Max	Unit
<b>Low Voltage Reset</b>					
Timeout Delay	$V_{CC}$ – Increasing 0 to 5.0 V	30	50	70	ms
Reset Delay	$V_{CC}$ – Decreasing 5.0 to 4.25 V	–	–	1.0	ms
NLVI Rise and Fall Time	10 k Pullup & $CL = 30\text{ pF}$	–	–	50	$\mu\text{s}$
LVI Rise and Fall Time	57 k Pulldown & $CL = 30\text{ pF}$	–	–	50	$\mu\text{s}$
Threshold High $V_{CC}$ Going Up	–	–	4.66	4.75	V
Threshold Low $V_{CC}$ Going Low	–	4.5	4.59	–	V
Threshold Hysteresis	LVTH – LVTL	30	70	–	mV
NLVI Output Low	$25^{\circ}\text{C} \leq T \leq 125^{\circ}\text{C}$ , $V_{CC} = 1.0\text{ V}$ , $I_{NLVI} = 1.0\text{ mA}$	–	150	300	mV
	$-40^{\circ}\text{C} \leq T \leq 125^{\circ}\text{C}$ , $V_{CC} = 1.2\text{ V}$ , $I_{NLVI} = 1.0\text{ mA}$	–	150	300	mV
NLVI Output Low	$V_{CC} = 4.5\text{ V}$ @ $-40^{\circ}\text{C}$ , $I_{NLVI} = 2.5\text{ mA}$	–	150	300	mV
NLVI Output Leakage	$V_{NLI} = V_{CC}$	–10	–	10	$\mu\text{A}$
LVI Output High	$V_{CC} = 1.0\text{ V}$ , $I_{LV} = -36\text{ }\mu\text{A}$	0.8	0.9	–	V
LVI Output High	$V_{CC} = 4.5\text{ V}$ , $I_{LV} = -250\text{ }\mu\text{A}$	3.6	4.3	–	V
LVI Output Leakage	$4.75 < V_{CC} \leq 5.25\text{ V}$ , $V_{LVC} = 0\text{ V}$	–7.5	–	7.5	$\mu\text{A}$
<b>Timing Specs</b>					
Watchdog Short Time Detect	(Watchdog Running at 300 Hz)	4.56	6.075	7.59	ms
Watchdog Long Time Detect	(Watchdog Running at 33 Hz)	13.7	18.25	22.8	ms
Watchdog Skew Time Detect	(Difference between WD1 & WD2)	0.7	–	2.1	ms
Watchdog Timeout Delay Time	–	30	50	70	ms
Output Rise Time	$CL = 30\text{ pF}$	–	0.5	2.0	$\mu\text{s}$
Output Fall Time	$CL = 30\text{ pF}$	–	0.05	2.0	$\mu\text{s}$
Delay Input to Output	–	–	1.0	20	$\mu\text{s}$
OLE Delay to $N_{OUT}$	–	–	1.0	20	$\mu\text{s}$

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## PIN DESCRIPTION

Pin No.	Symbol	Description
1	RDLY	Determines the low voltage reset delay and watchdog enable and disable delay.
2	NTEST	Low = test, high = normal operation.
3	INN1	Minus input to channel 1 comparator.
4	INP1	Plus input to channel 1 comparator.
5	INN2	Minus input to channel 2 comparator.
6	INP2	Plus input to channel 2 comparator.
7	INP3	Plus input to channel 3 comparator.
8	INN3	Minus input to channel 3 comparator.
9	INP4	Plus input to channel 4 comparator.
10	INN4	Minus input to channel 4 comparator.
11	THOLD	Variable threshold adjustment.
12	GND	Ground.
13	NOUT4	Inverted output of comparator 4.
14	NOUT3	Inverted output of comparator 3.
15	WDLY	Determines watchdog timing.
16	OLE	Disables outputs. High = normal operation. Low = forces all outputs and comparators high.
17	WD1	Watchdog input.
18	V <sub>CC</sub>	5.0 V input to IC.
19	WD2	Watchdog input.
20	NLVI	Reset output (in reset when low).
21	LVI	Reset output (in reset when high).
22	WDO	Watchdog output (low for valid watchdog signal).
23	NOUT2	Inverted output of comparator 2.
24	NOUT1	Inverted output of comparator 1.

## Wheel Speed Output Functionality

Sensor	NTEST	OLE	NOUTx
OPEN	L	L	H
OPEN	L	H	L
OPEN	H	L	H
OPEN	H	H	X
NORMAL	L	L	H
NORMAL	L	H	H
NORMAL	H	L	H
NORMAL	H	H	X

X = Do not care (dependent on presence of sensor signal).

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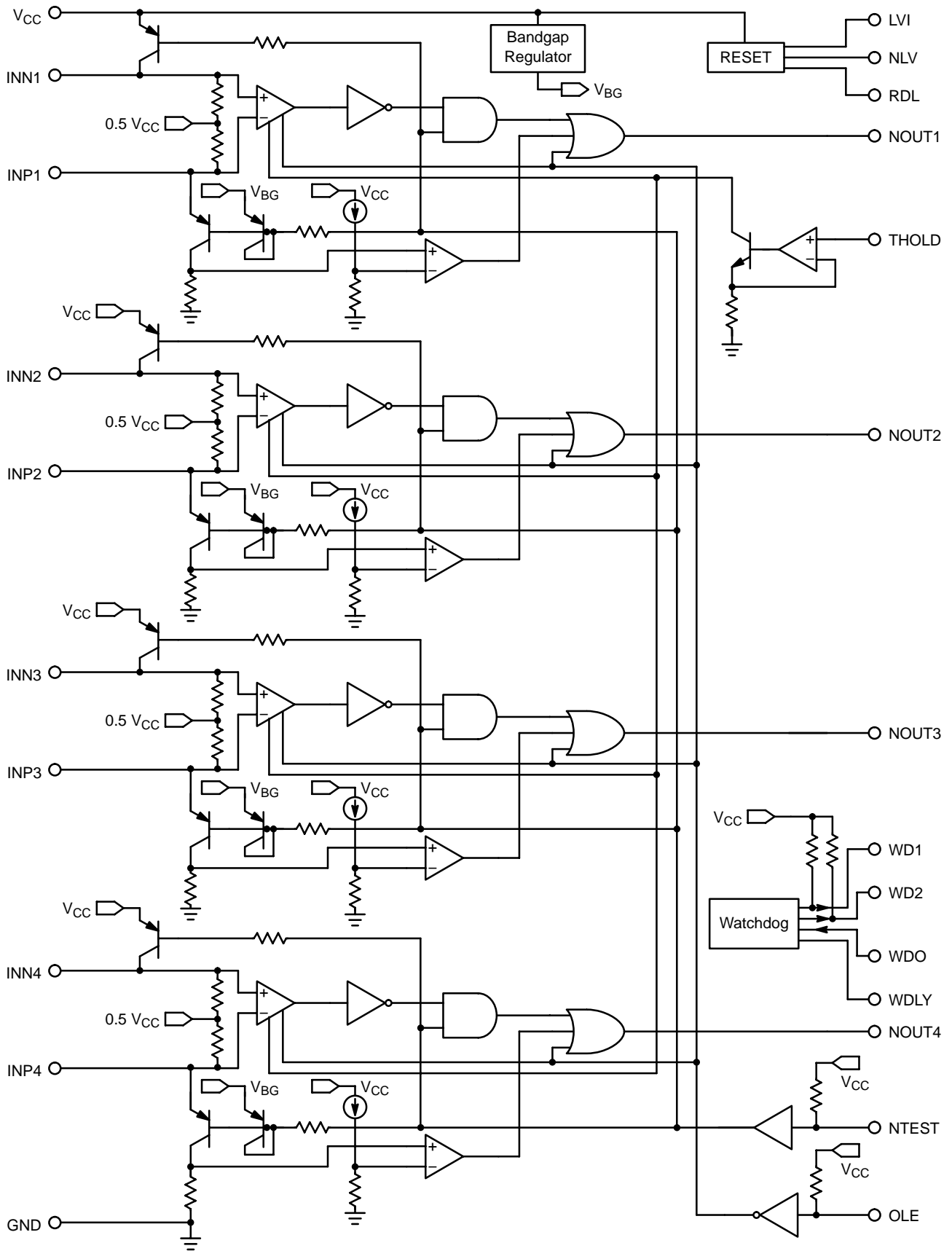
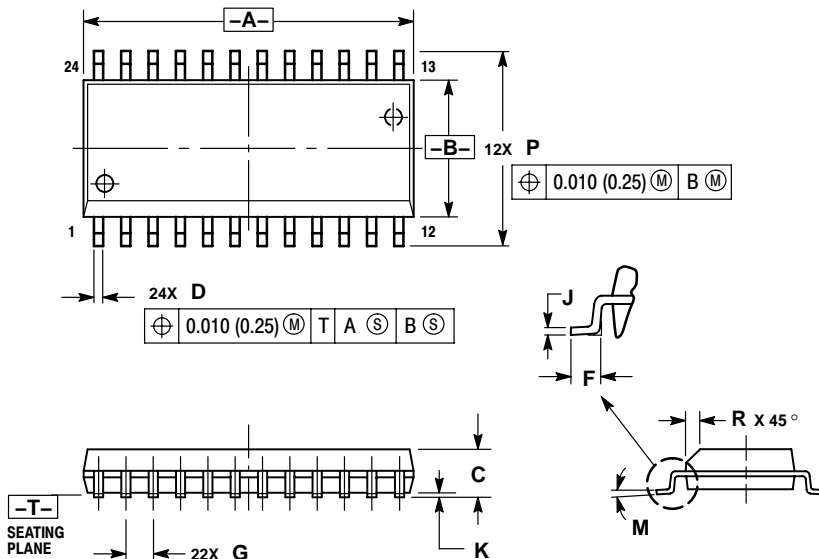


Figure 2. Block Diagram

# NCV7001

## PACKAGE DIMENSIONS

SO-24L  
DW SUFFIX  
CASE 751E-04  
ISSUE E



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	15.25	15.54	0.601	0.612
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.41	0.90	0.016	0.035
G	1.27 BSC		0.050 BSC	
J	0.23	0.32	0.009	0.013
K	0.13	0.29	0.005	0.011
M	0°	8°	0°	8°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

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