

# SCANSTA476

## Eight Input IEEE 1149.1 Analog Voltage Monitor

### General Description

The SCANSTA476 is a low power, Analog Voltage Monitor used for sampling or monitoring up to 8 analog/mixed-signal input channels. Analog Voltage Monitors are valuable during product development, environmental test, production, and field service for verifying and monitoring power supply and reference voltages. In a supervisory role, the 'STA476 is useful for card or system-level health monitoring and prognostics applications.

Instead of requiring an external microcontroller with a GPIO interface, the 'STA476 features a common IEEE 1149.1 (JTAG) interface to select the analog input, initiate a measurement, and access the results - further extending the capabilities of an existing JTAG infrastructure.

The SCANSTA476 uses the  $V_{REF}$  input as a reference. This enables the SCANSTA476 to operate with a full-scale input range of 0 to  $V_{DD}$ , which can range from +2.7V to +5.5V.

The SCANSTA476 is packaged in a 16-lead non-pullback LLP package that provides an extremely small footprint for applications where space is a critical consideration. This product operates over the industrial temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

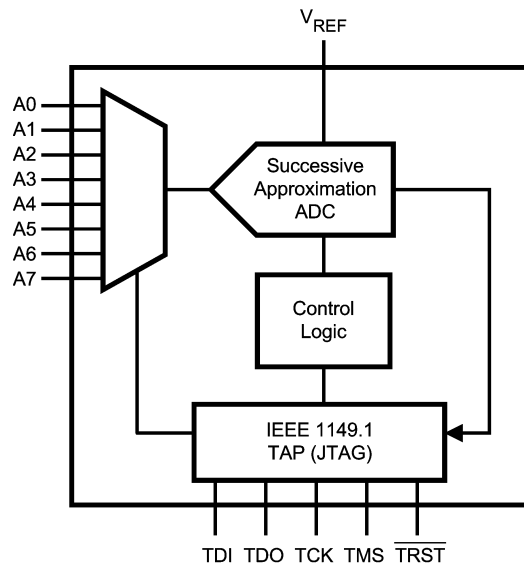
### Features

- Eight selectable Analog input channels
- Analog full-scale input range 0V to  $V_{DD}$
- Typical accuracy of 2 mV at maximum  $V_{DD}$
- Very low power operation
- Small package footprint in 16-lead, 5 x 5 x 0.8 mm LLP
- Single +2.7V to +5.5V supply operation
- IEEE 1149.1 (JTAG) compliant interface

### Applications

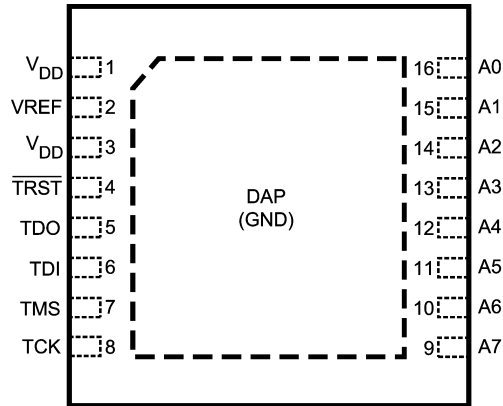
- Measurement of Point Voltages
- Real-time Signal Monitoring
- System Health Monitoring and Prognostics
- Debug, Environmental Test, Production Test, Field Service
- Supplement In-Circuit Tester (ICT) access
- Vital in Servers, Computing, Telecommunication and Industrial equipment
- Essential in Medical, Data Storage, and Networking equipment

### Block Diagram



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## Connection Diagram



**DAP = GND  
(Top View)**

## Pin Descriptions

Pin No.	Symbol	Description
<b>ANALOG I/O</b>		
16	A0	Analog input 0. This signal can range from 0V to $V_{REF}$ .
15	A1	Analog input 1. This signal can range from 0V to $V_{REF}$ .
14	A2	Analog input 2. This signal can range from 0V to $V_{REF}$ .
13	A3	Analog input 3. This signal can range from 0V to $V_{REF}$ .
12	A4	Analog input 4. This signal can range from 0V to $V_{REF}$ .
11	A5	Analog input 5. This signal can range from 0V to $V_{REF}$ .
10	A6	Analog input 6. This signal can range from 0V to $V_{REF}$ .
9	A7	Analog input 7. This signal can range from 0V to $V_{REF}$ .
2	$V_{REF}$	Analog reference voltage input. $V_{REF}$ must be $\leq V_{DD}$ . This pin should be connected to a quiet +2.7V to +5.5V source (not directly to $V_{DD}$ ) and bypassed to GND with 0.1 $\mu$ F and 1 $\mu$ F monolithic capacitors located within 1 cm of the $V_{REF}$ pin.
<b>DIGITAL I/O</b>		
6	TDI	Test Data Input to support IEEE 1149.1 features
5	TDO	Test Data Output to support IEEE 1149.1 features
7	TMS	Test Mode Select to support IEEE 1149.1 features
8	TCK	Test Clock to support IEEE 1149.1 features
4	$\overline{TRST}$	Test Reset to support IEEE 1149.1 features
<b>POWER SUPPLY</b>		
1,3	$V_{DD}$	Positive supply pin. These pins should be connected to a quiet +2.7V to +5.5V source and bypassed to GND with 0.1 $\mu$ F and 1 $\mu$ F monolithic capacitors located within 1 cm of the power pin.
(Note 1)	GND	Ground reference for CMOS circuitry. DAP is the exposed metal contact at the bottom of the LLP package. The DAP is used as the primary GND connection to the device. It should be connected to the ground plane with at least 4 vias for optimal low-noise and thermal performance.

**Note 1:** Note that GND is not an actual pin on the package, the GND is connected thru the DAP on the back side of the LLP package.

**Absolute Maximum Ratings** (Note 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage $V_{DD}$	-0.3V to +6.5V
Voltage on Any Analog Pin to GND	-0.3V to $V_{DD}+0.3V$
Voltage on Any Digital Pin to GND	-0.3V to $V_{DD}+0.3V$
Input Current at Any Pin (Note 4)	$\pm 10$ mA
ESD Susceptibility	
Human Body Model	8000V
Machine Model	>250V
Soldering Temperature	Refer to AN-1187

Junction Temperature	+150°C
Storage Temperature	-65°C to +150°C
Thermal Resistance, $\theta_{JA}$	42°C/W
Thermal Resistance, $\theta_{JC}$	14.3°C/W

**Recommended Operating Conditions**

Operating Temperature Range	$-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$
$V_{DD}$ Supply Voltage	+2.7V to +5.5V
Digital Input Pins Voltage Range	+0V to $V_{DD}$
Analog Input Pins Voltage Range (Note 5)	+0V to $V_{REF}$

**SCANSTA476 Electrical Characteristics**

The following specifications apply for  $V_{DD} = +2.7V$  to 5.5V,  $f_{TCK} = 20$  MHz, unless otherwise noted.

Symbol	Parameter	Conditions	Typical	Limits	Units
<b>POWER SUPPLY CHARACTERISTICS</b>					
$V_{DD}$	Supply Voltage	$-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$		2.7 5.5	V (min) V (max)
$I_{DD}$	Normal Mode (Static)	$V_{DD} = +2.7V$ to +5.5V,	3.5	5.0	mA
	Normal Mode (Operational)	$V_{DD} = +2.7V$ to +5.5V, $f_{TCK} = 1$ MSPS		5.0	mA (max)
$P_D$	Power Consumption, Normal Mode (Operational)	$V_{DD} = +5.5V$ , $f_{TCK} = 1$ MSPS		27.5	mW (max)
<b>ANALOG INPUT CHARACTERISTICS (A0-A7)</b>					
$V_{IN}$	Analog Input Range	$V_{REF} \leq V_{DD}$		0 to $V_{REF}$	V
$V_{REF}$	Reference Voltage Range			$V_{DD} - 0.5V$ to $V_{DD}$	V
$I_{DCL}$	DC Leakage Current		0.1	$\pm 10$	$\mu\text{A}$ (max)
$V_{MEAS}$	Analog Input Measurement Accuracy	$V_{DD} = +2.7V$	1	7.5	mV
		$V_{DD} = +5.5V$	2	15	
<b>DIGITAL INPUT CHARACTERISTICS (TDI, TMS, TCK, TRST)</b>					
$V_{IH}$	Input High Voltage	$V_{DD} = +2.7V$ to +3.6V		2.0	V (min)
		$V_{DD} = +5.5V$		2.1	
$V_{IL}$	Input Low Voltage	$V_{DD} = +5V$		0.8	V (max)
$V_{CL}$	Input Clamp Voltage	$I_{CL} = -18\text{mA}$	-0.8	-1.5	V (max)
$I_{IN}$	Input Current	$V_{IN} = 0V$ or $V_{DD}$	0.2	$\pm 10$	$\mu\text{A}$ (max)
$I_{ILR}$	Input Current	$\overline{\text{TRST}}$ , TDI, TMS only		-300	$\mu\text{A}$ (max)
<b>DIGITAL OUTPUT CHARACTERISTICS (TDO)</b>					
$V_{OH}$	Output High Voltage	$I_{OH} = -100 \mu\text{A}$ , $2.7V \leq V_{DD} \leq 5.5V$		$V_{DD} - 0.2$	V (min)
		$I_{OH} = -4 \text{mA}$ , $3.0V \leq V_{DD} \leq 5.5V$		2.4	V (min)
		$I_{OH} = -4 \text{mA}$ , $V_{DD} = 2.7V$		2.2	V (min)
$V_{OL}$	Output Low Voltage	$I_{OL} = 100 \mu\text{A}$ , $2.7V \leq V_{DD} \leq 5.5V$		0.2	V (max)
		$I_{OL} = 4 \text{mA}$ , $2.7V \leq V_{DD} \leq 5.5V$		0.4	V (max)
$I_{OS}$	Output Short Circuit Current	$V_{OUT} = 0V$ , $V_{DD} = 5.5V$		-85	mA (max)
$I_{OZ}$	TRI-STATE Leakage Current			$\pm 10$	$\mu\text{A}$ (max)
	Output Coding		Straight (Natural) Binary		

**SCANSTA476 Electrical Characteristics** (Continued)

The following specifications apply for  $V_{DD} = +2.7V$  to  $5.5V$ ,  $f_{TCK} = 20$  MHz, unless otherwise noted.

Symbol	Parameter	Conditions	Typical	Limits	Units
<b>AC ELECTRICAL CHARACTERISTICS</b>					
$F_{MAX}$	Throughput Rate	TCK = 20MHz		1	MSPS (max)
<b>INPUT TIMING CHARACTERISTICS</b>					
$t_{SET}$	TDI to TCK (H/L)	(Note 3)		2.0	ns (min)
$t_{HOLD}$	TDI to TCK (H/L)	(Note 3)		1.5	ns (min)
$t_{SET}$	TMS to TCK (H/L)	(Note 3)		2.0	ns (min)
$t_{HOLD}$	TMS to TCK (H/L)	(Note 3)		2.0	ns (min)
$t_W$	TCK Pulse Width (H/L)	(Note 3)		10.0	ns (min)
$t_{REC}$	Recovery Time $\overline{TRST}$ to TCK	(Note 3)		2.0	ns (min)
$t_W$	TRST Pulse Width (L)	(Note 3)		2.5	ns (min)
$F_{MAX}$	TCK			20	MHz (min)

**Note 2:** Absolute maximum ratings are limiting values, to be applied individually, and beyond which the serviceability of the circuit may be impaired. Functional operability under any of these conditions is not implied. Exposure to maximum ratings for extended periods may affect device reliability.

**Note 3:** Data sheet min/max specification limits are guaranteed by design or statistical analysis.

**Note 4:** Except power supply pins.

**Note 5:** For valid measurements, the analog  $V_{IN} < V_{REF} \leq V_{DD}$ .

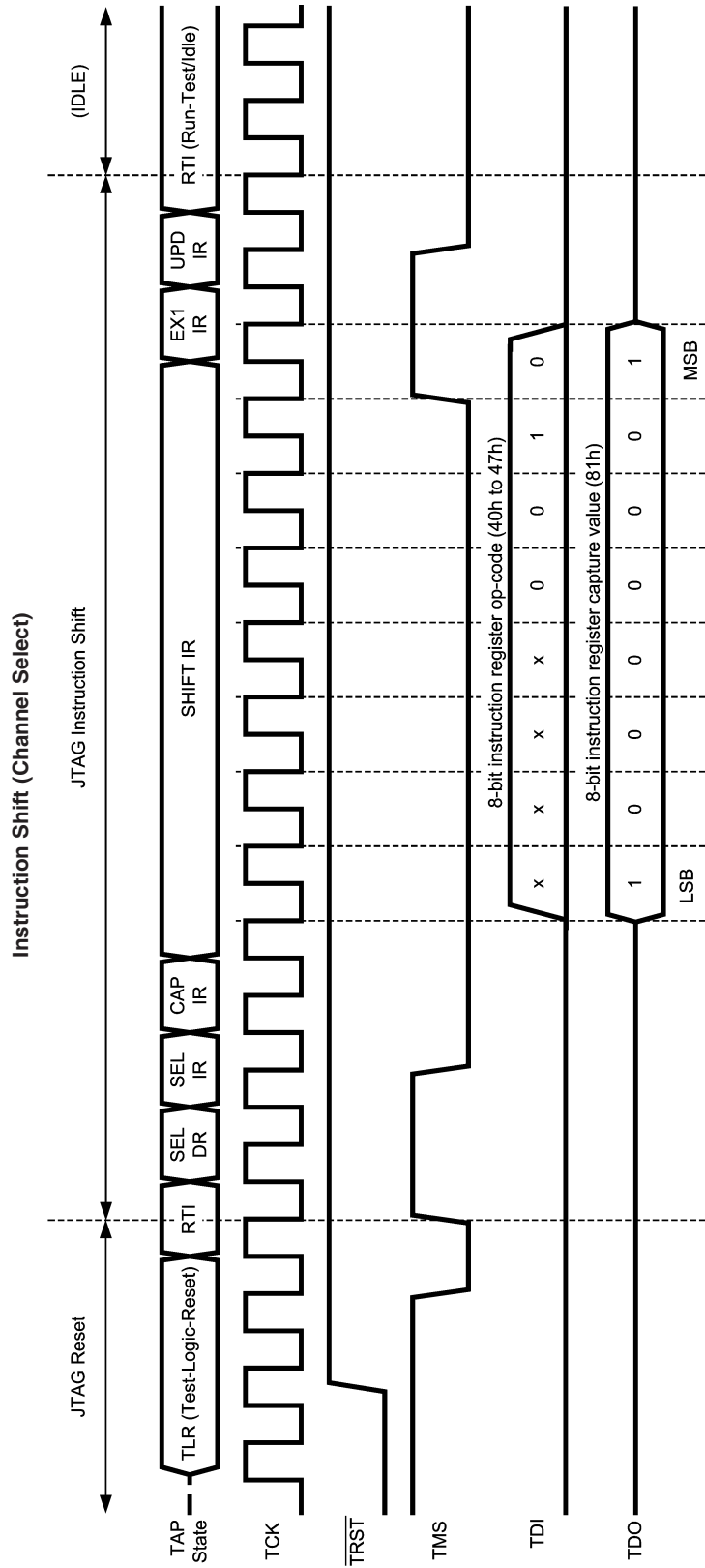
**Applications Information****POWER-UP TIMING**

The SCANSTA476 typically requires 1  $\mu s$  to power up, either after first applying  $V_{DD}$ , or after an incomplete conversion shift. To return to normal, one "dummy" conversion must be fully completed. After this first dummy conversion, the SCANSTA476 will perform conversions properly.

**STARTUP MODE**

When the  $V_{DD}$  supply is first applied, the SCANSTA476 requires one dummy conversion after start-up.

# Timing Diagrams

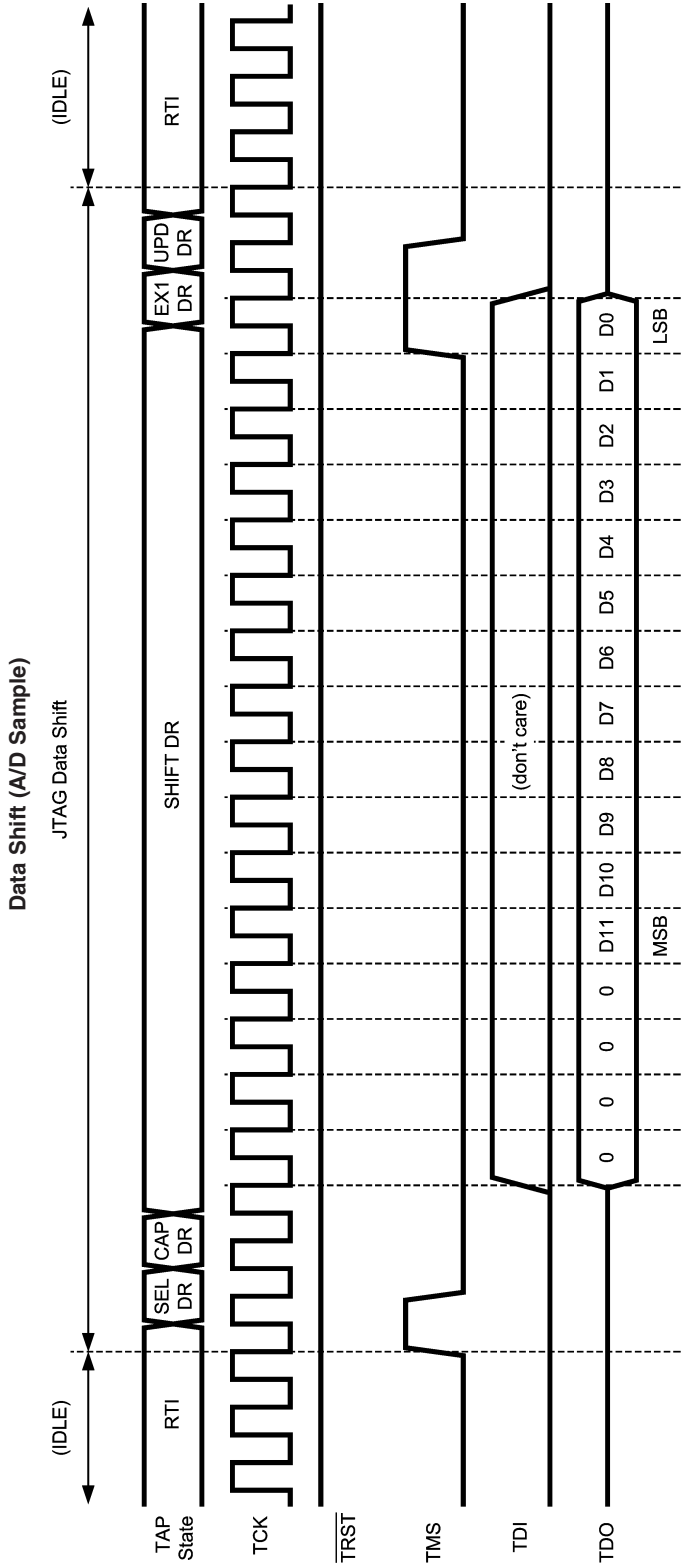


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Op-codes 40h to 47h select pins A0 to A7 respectively.

Note the JTAG reset preamble places the JTAG TAP controller in a stable state (RTI). Both the instruction and data shifts start in - and return to - the RTI state.

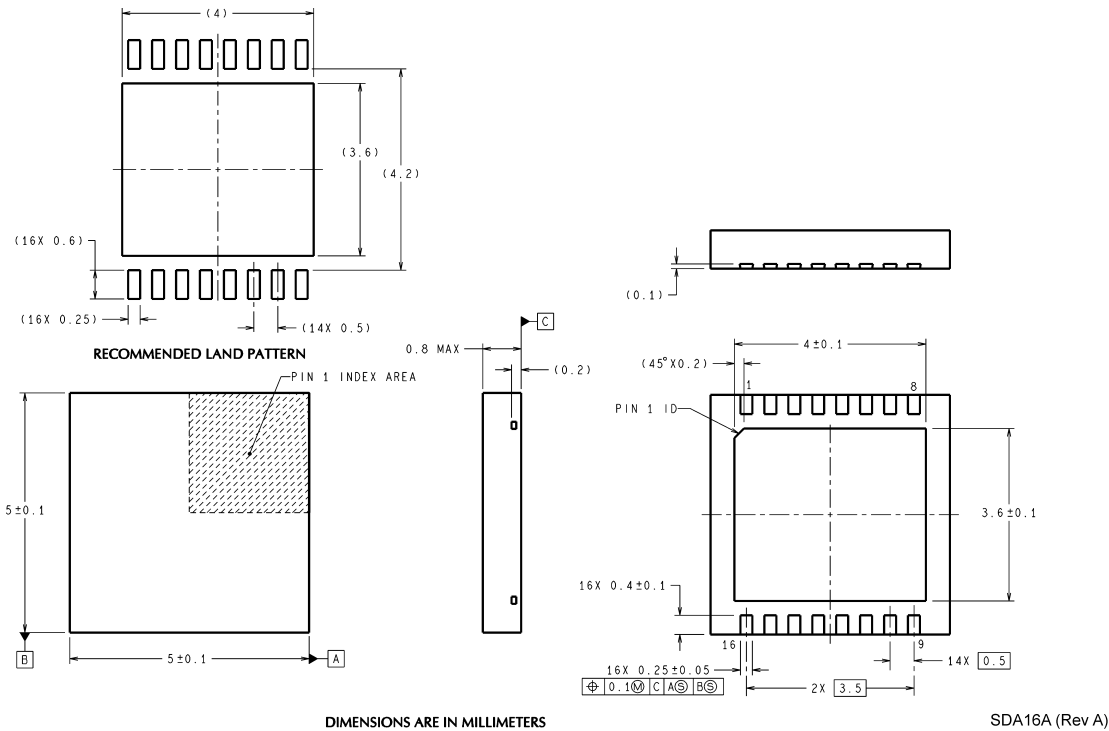
Timing Diagrams (Continued)



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D11 through D0 correspond to the 12-bit sample from the ADC Core.  
 Note that Data shifts can be run back-to-back for continuous sampling of a single channel, or can be interleaved with instruction shifts for rippling through all 8 channels.

**Physical Dimensions** inches (millimeters) unless otherwise noted



DIMENSIONS ARE IN MILLIMETERS

SDA16A (Rev A)

**LLP, Plastic, Dual**  
**Order Number SCANSTA476TSD,**  
**NS Package Number SDA16A**

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