E210 Engineering Cyber-Physical Systems

Accelerometer

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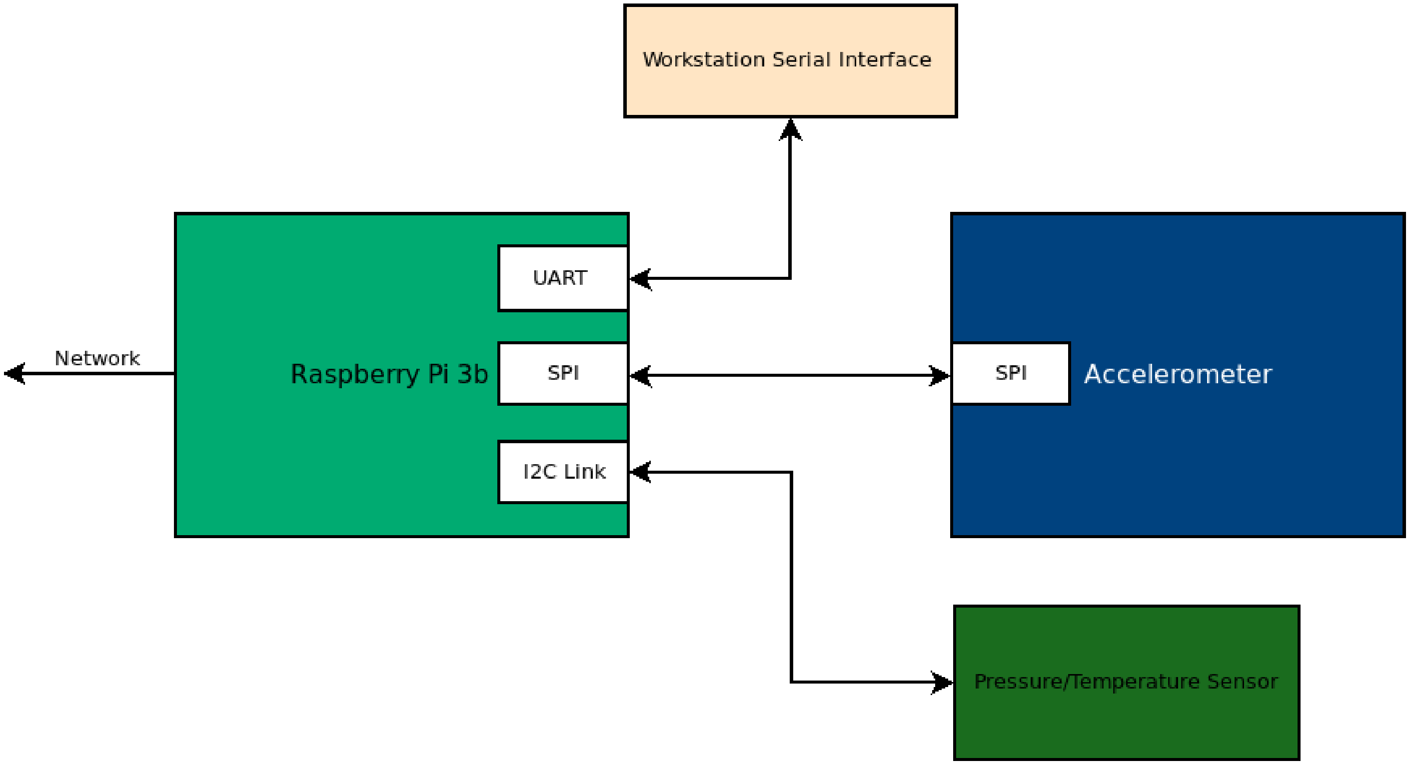
Weekly Focus	Reading	Monday	Wed	Lab
CPS Intro/UART		1/10: CPS Introduction	1/12: Pi Intro/UART Bus	Project 0 Raspberry PI Setup
I2C Bus		1/17: MLK Day	1/19: I2C Bus Overview	Project 1 I2C Pressure/Temperature Sensor
I2C and SPI Bus		1/24: Pressure Sensor	1/26: SPI Bus Overview	Project 2 SPI Accelerometer
SPI/Networking		1/31: Accelerometer	2/2: Networking Overview	Project 3 Flask Web Server
Networking		2/7: Flask	2/9: Redis/matplotlib	Project 3 Continued
Web Server		2/14: CPS Wrapup	2/16: Exam Review	P5 Demultiplexer

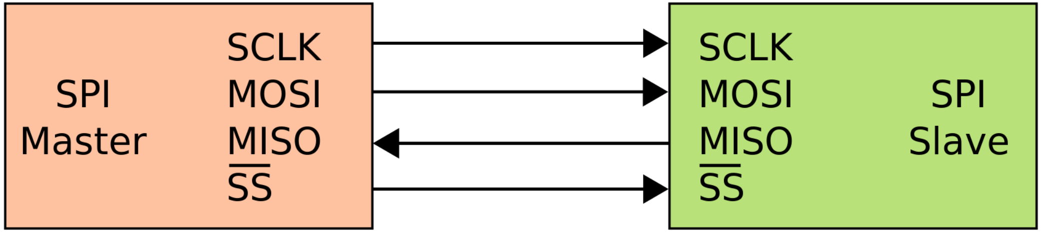
https://engr210.github.io/

Raspberry SPI Link



SPI Review

Single Peripheral



Bus Protocol

Reading

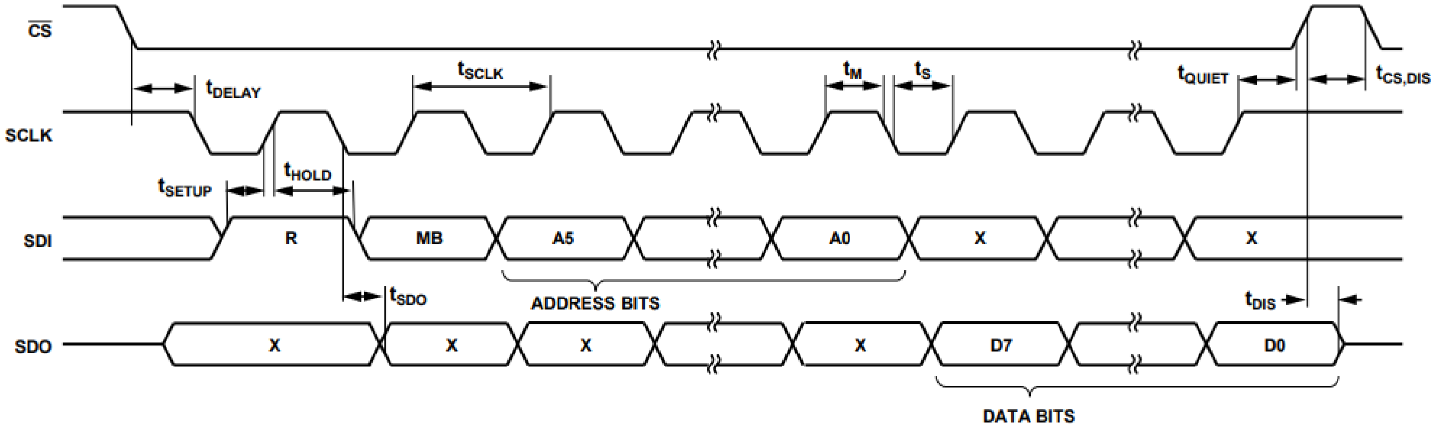


Figure 28. SPI 4-Wire Read

Writing

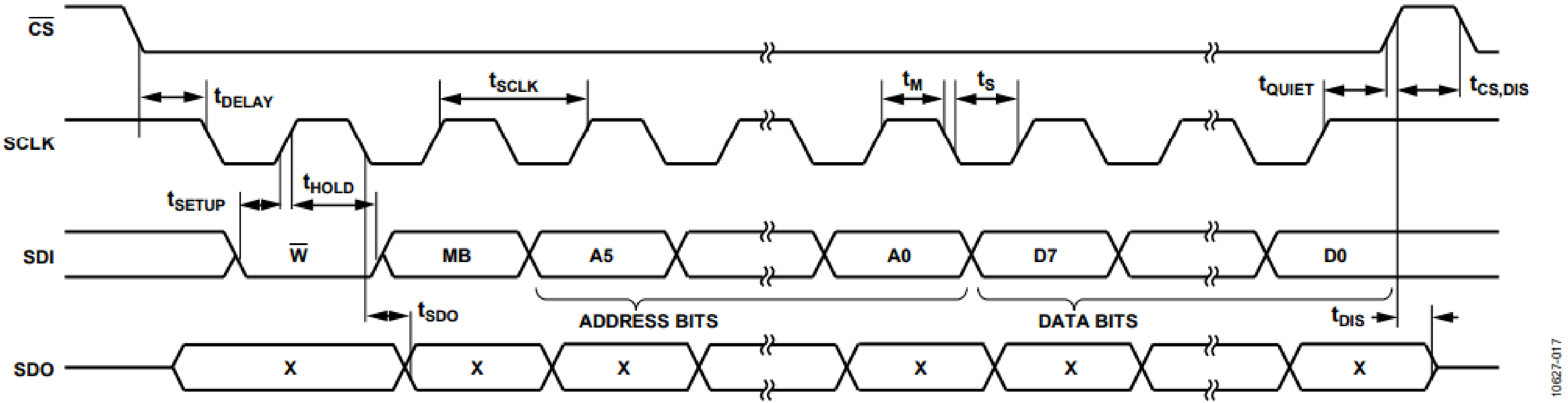
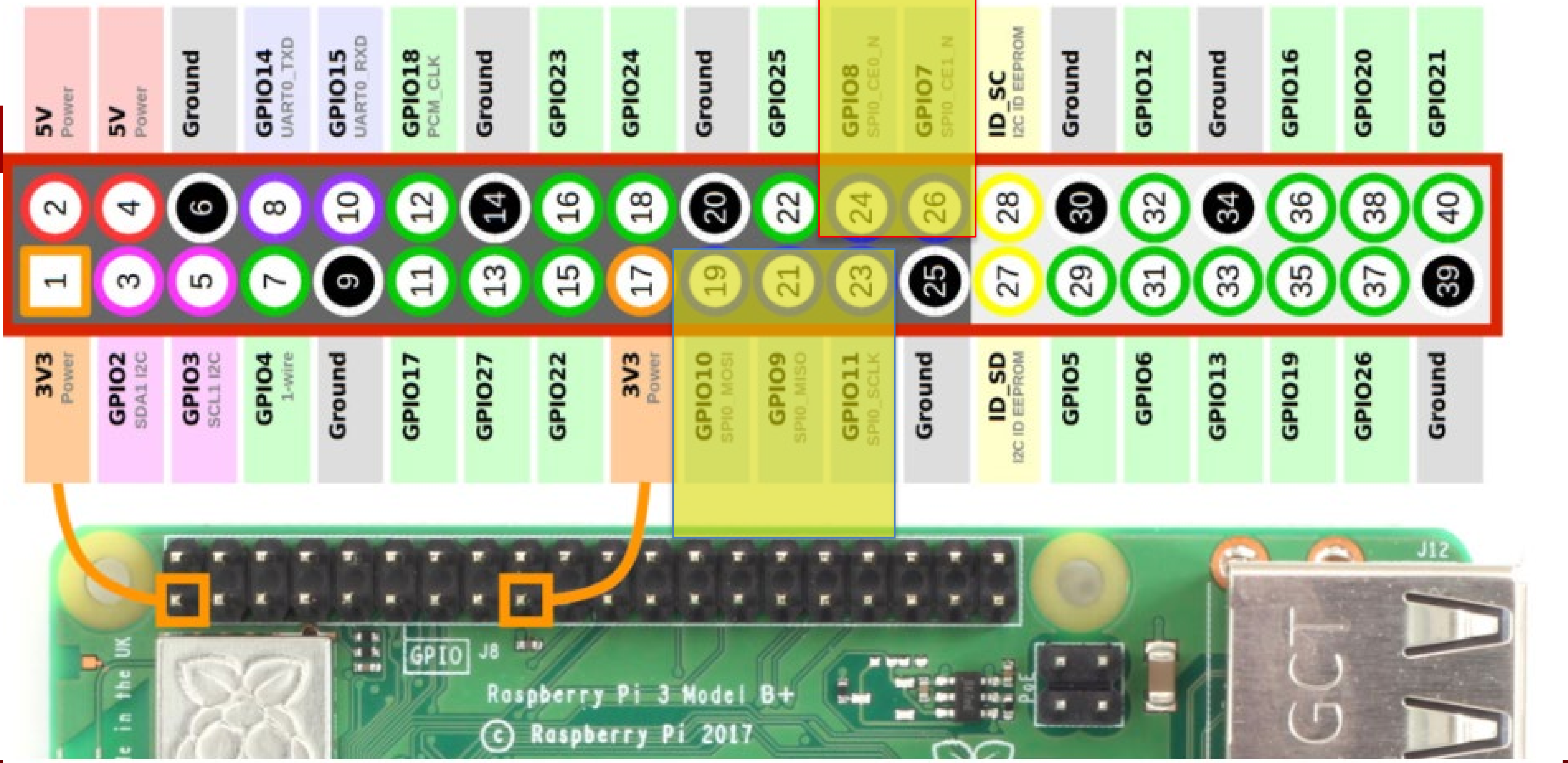


Figure 27. SPI 4-Wire Write

Accelerometer Connections


5V Power
5V Power
Ground
GPIO14 UART0_TXD
GPIO15 UART0_RXD
GPIO18 PCM_CLK
Ground
GPIO23
GPIO24
Ground
GPIO25
GPIO8 SPI0_CE0_N
GPIO7 SPI0_CE1_N
ID_SC I2C ID EEPROM
Ground
GPIO12
Ground
GPIO16
GPIO20
GPIO21
2
4
6
8
10
12
14
16
18
20
22
24
26
28
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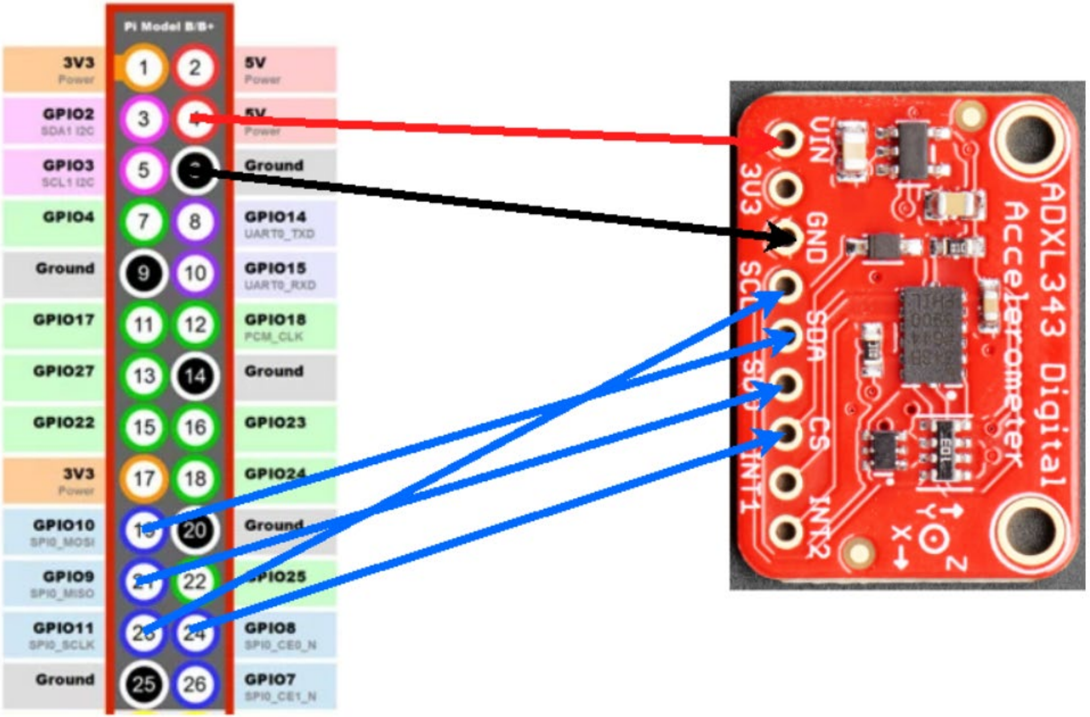
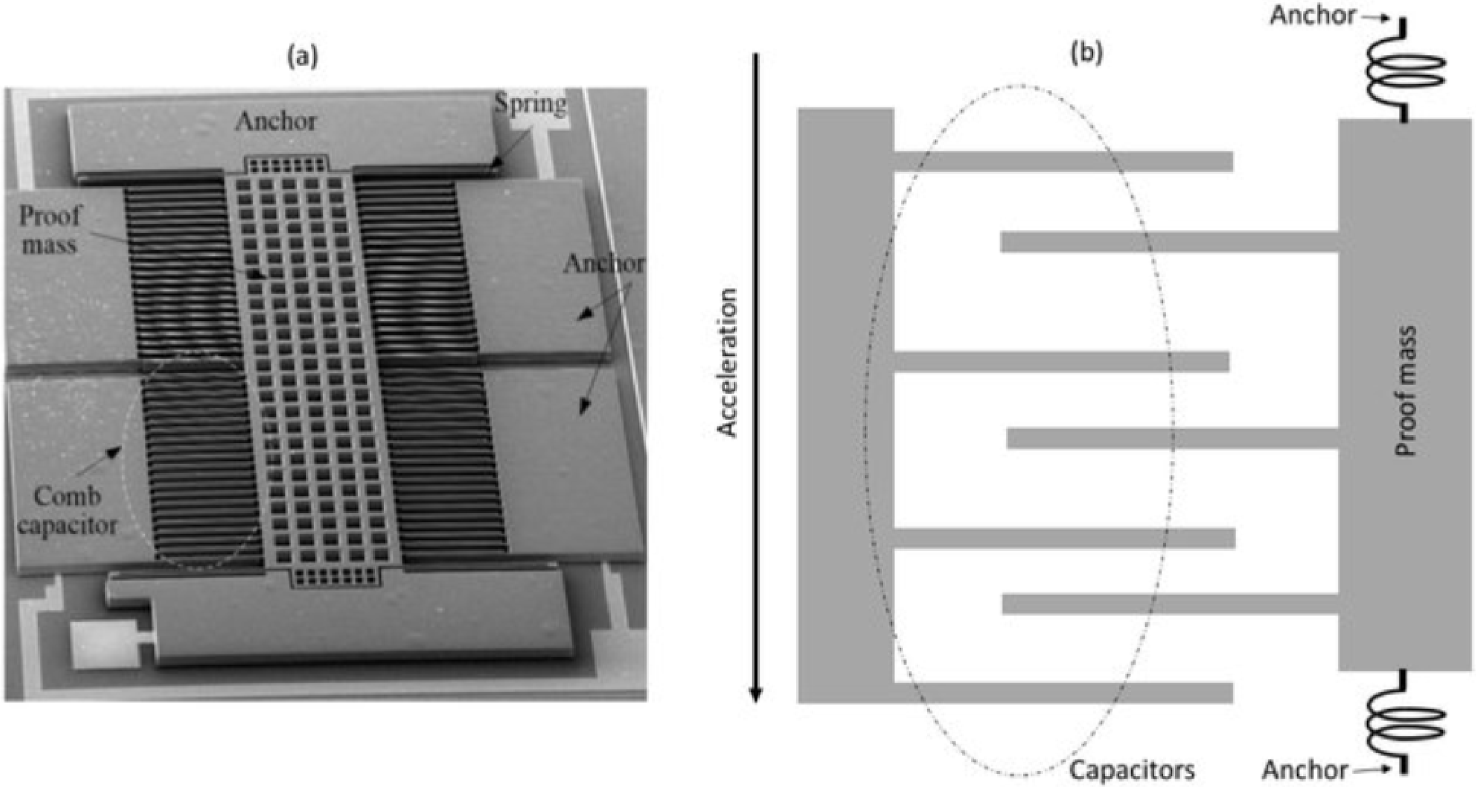
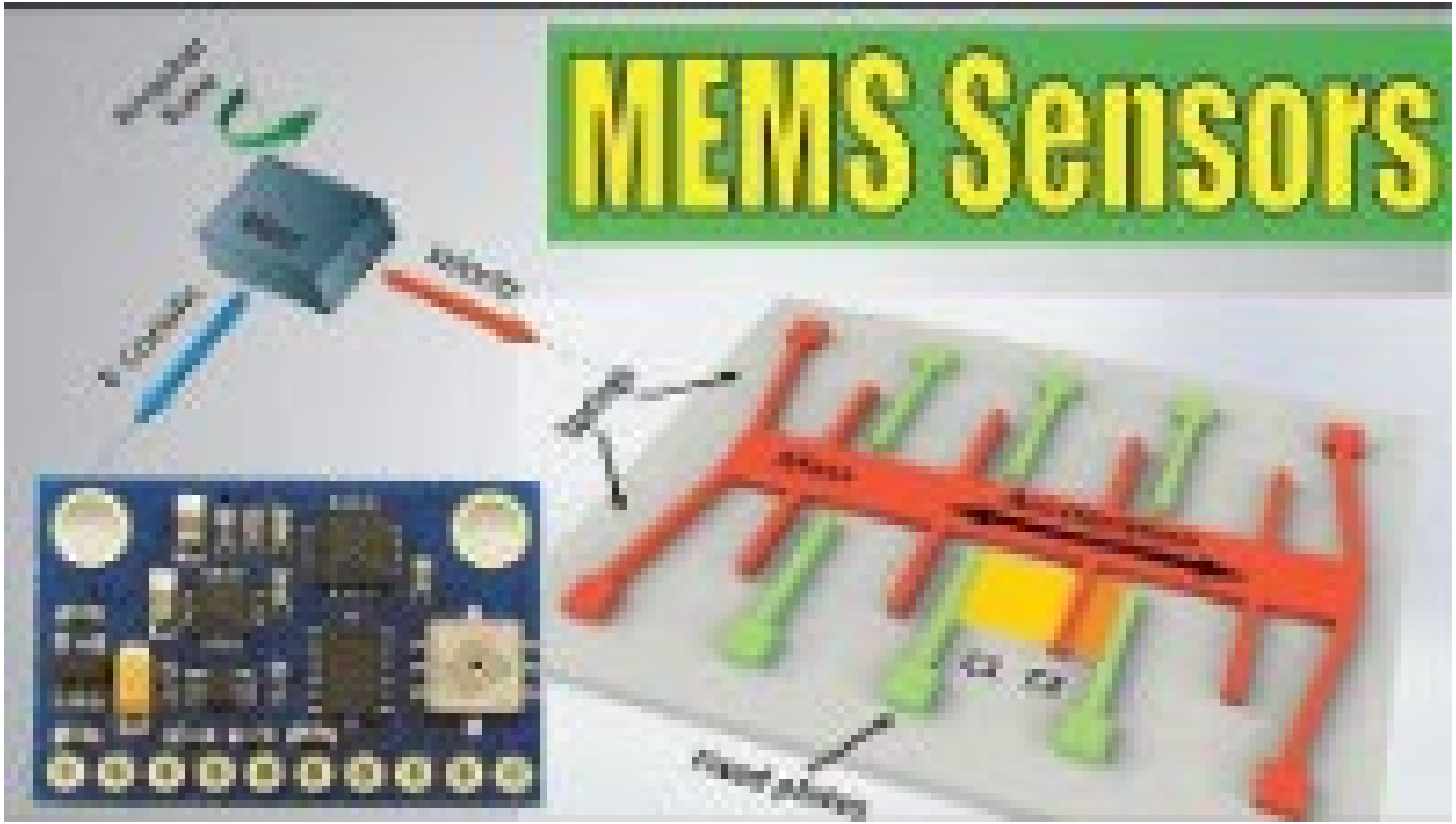
32
34
36
38
40
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
3V3 Power
GPIO2 SDA1 I2C
GPIO3 SCL1 I2C
GPIO4 1-wire
Ground
GPIO17
GPIO27
GPIO22
3V3 Power
GPIO10 SPI0_MOSI
GPIO9 SPI0_MISO
GPIO11 SPI0_SCLK
Ground
ID_SD I2C ID EEPROM
GPIO5
GPIO6
GPIO13
GPIO19
GPIO26
Ground
J12
GPIO
J8
Raspberry Pi 3 Model B+
© Raspberry Pi 2017

ADXL343 Accelerometer



MEMS Accelerometer


(a)
Anchor
Spring
Proof mass
Anchor
Comb capacitor
(b)
Anchor
Acceleration
Proof mass
Capacitors
Anchor


MEMS Sensors

ADXL343 Datasheet

3-Axis, ±2 *g*/±4 *g*/±8 *g*/±16 *g* Digital MEMS Accelerometer

ANALOG DEVICES

Data Sheet **ADXL343**

FEATURES

Multipurpose accelerometer with 10- to 13-bit resolution for use in a wide variety of applications
Digital output accessible via SPI (3- and 4-wire) and I²C
Built-in motion detection features make tap, double-tap, activity, inactivity, and free-fall detection trivial
User-adjustable thresholds
Interrupts independently mappable to two interrupt pins
Low power operation down to 23 µA and embedded FIFO for reducing overall system power
Wide supply voltage range: 2.0 V to 3.6 V
I/O voltage 1.7 V to V_S
Wide operating temperature range (−40°C to +85°C)
10,000 *g* shock survival
Small, thin, Pb free, RoHS compliant 3 mm × 5 mm × 1 mm LGA package

APPLICATIONS

Handsets
Gaming and pointing devices
Hard disk drive (HDD) protection

GENERAL DESCRIPTION

The ADXL343 is a versatile 3-axis, digital-output, low *g* MEMS accelerometer. Selectable measurement range and bandwidth, and configurable, built-in motion detection make it suitable for sensing acceleration in a wide variety of applications. Robustness to 10,000 *g* of shock and a wide temperature range (−40°C to +85°C) enable use of the accelerometer even in harsh environments.

The ADXL343 measures acceleration with high resolution (13-bit) measurement at up to ±16 *g*. Digital output data is formatted as 16-bit twos complement and is accessible through either an SPI (3- or 4-wire) or I²C digital interface. The ADXL343 can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (3.9 m*g*/LSB) enables measurement of inclination changes less than 1.0°.

Several special sensing functions are provided. Activity and inactivity sensing detect the presence or lack of motion. Tap sensing detects single and double taps in any direction. Free-fall sensing detects if the device is falling. These functions can be mapped individually to either of two interrupt output pins.

An integrated memory management system with a 32-level first in, first out (FIFO) buffer can be used to store data to minimize host processor activity and lower overall system power consumption.

The ADXL343 is supplied in a small, thin, 3 mm × 5 mm × 1 mm, 14-terminal, plastic package.

FUNCTIONAL BLOCK DIAGRAM

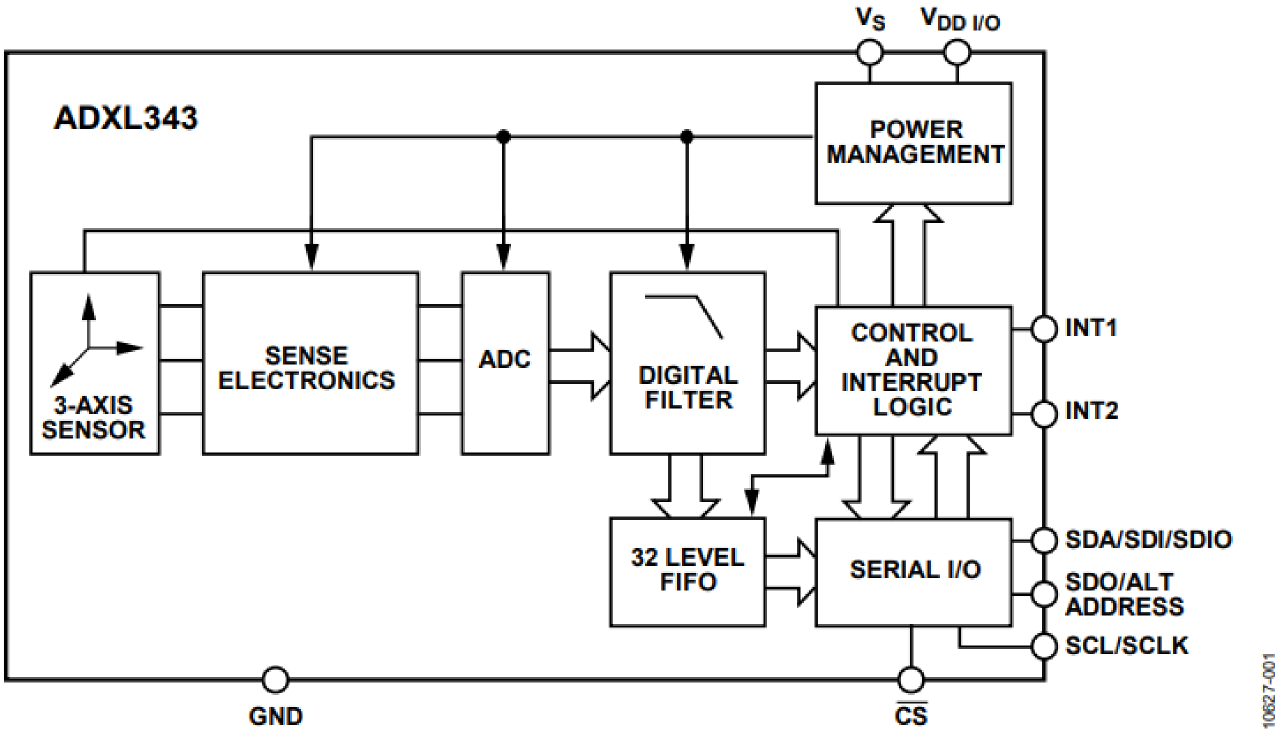


Figure 1.

SPECIFICATIONS

T_A = 25°C, V_S = 2.5 V, $V_{DD I/O}$ = 1.8 V, acceleration = 0 g, C_S = 10 μF tantalum, $C_{I/O}$ = 0.1 μF, output data rate (ODR) = 800 Hz, unless otherwise noted. All minimum and maximum specifications are guaranteed. Typical specifications are not guaranteed.

Table 1.

Parameter	Test Conditions/Comments	Min	Typ[1]	Max	Unit
SENSOR INPUT	Each axis				
Measurement Range	User selectable		±2, ±4, ±8, ±16		g
Nonlinearity	Percentage of full scale		±0.5		%
Inter-Axis Alignment Error			±0.1		Degrees
Cross-Axis Sensitivity[2]			±1		%
OUTPUT RESOLUTION	Each axis				
All g Ranges	10-bit resolution		10		Bits
±2 g Range	Full resolution		10		Bits
±4 g Range	Full resolution		11		Bits
±8 g Range	Full resolution		12		Bits
±16 g Range	Full resolution		13		Bits
SENSITIVITY	Each axis				
Sensitivity at X_{OUT}, Y_{OUT}, Z_{OUT}	All g ranges, full resolution		256		LSB/g
	±2 g, 10-bit resolution		256		LSB/g
	±4 g, 10-bit resolution		128		LSB/g
	±8 g, 10-bit resolution		64		LSB/g
	±16 g, 10-bit resolution		32		LSB/g
Sensitivity Deviation from Ideal	All g ranges		±1.0		%
Scale Factor at X_{OUT}, Y_{OUT}, Z_{OUT}	All g ranges, full resolution		3.9		mg/LSB
	±2 g, 10-bit resolution		3.9		mg/LSB
	±4 g, 10-bit resolution		7.8		mg/LSB
	±8 g, 10-bit resolution		15.6		mg/LSB
	±16 g, 10-bit resolution		31.2		mg/LSB
Sensitivity Change Due to Temperature			±0.01		%/°C
0 g OFFSET	Each axis				
0 g Output Deviation from Ideal, X-, Y-, Z-Axes			±35		mg
0 g Offset vs. Temperature for X-, Y-, Z-Axes			±0.8		mg/°C
NOISE					
X-, Y-, Z-Axes	ODR = 100 Hz for ±2 g, 10-bit resolution or all g-ranges, full resolution		1.1		LSB rms
OUTPUT DATA RATE AND BANDWIDTH	User selectable				
Output Data Rate (ODR)[3, 4, 5]		0.1		3200	Hz
SELF-TEST[6]					
Output Change in X-Axis		0.20		2.10	g
Output Change in Y-Axis		−2.10		−0.20	g
Output Change in Z-Axis		0.30		3.40	g
POWER SUPPLY					
Operating Voltage Range (V_S)		2.0	2.5	3.6	V
Interface Voltage Range ($V_{DD I/O}$)		1.7	1.8	V_S	V
Supply Current	ODR ≥ 100 Hz		140		μA
	ODR < 10 Hz		30		μA
Standby Mode Leakage Current			0.1		μA
Turn-On and Wake-Up Time[7]	ODR = 3200 Hz		1.4		ms

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Acceleration	
Any Axis, Unpowered	10,000 *g*
Any Axis, Powered	10,000 *g*
V_S	−0.3 V to +3.9 V
$V_{DD I/O}$	−0.3 V to +3.9 V
Digital Pins	−0.3 V to $V_{DD I/O}$ + 0.3 V or 3.9 V, whichever is less
All Other Pins	−0.3 V to +3.9 V
Output Short-Circuit Duration (Any Pin to Ground)	Indefinite
Temperature Range	
Powered	−40°C to +105°C
Storage	−40°C to +105°C

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

THERMAL RESISTANCE

Table 3. Package Characteristics

Package Type	θ_{JA}	θ_{JC}	Device Weight
14-Terminal LGA	150°C/W	85°C/W	30 mg

PACKAGE INFORMATION

The information in Figure 2 and Table 4 provide details about the package branding for the ADXL343. For a complete listing of product availability, see the Ordering Guide section.

Figure 2. Product Information on Package (Top View)

Table 4. Package Branding Information

Branding Key	Field Description
343B	Part identifier for the ADXL343
#	RoHS-compliant designation
yww	Date code
vvvv	Factory lot code
CNTY	Country of origin

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

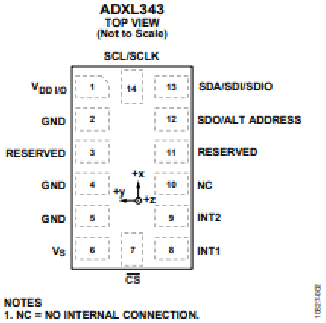


Figure 3. Pin Configuration (Top View)

Table 5. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	$V_{DD I/O}$	Digital Interface Supply Voltage.
2	GND	This pin must be connected to ground.
3	RESERVED	Reserved. This pin must be connected to V_S or left open.
4	GND	This pin must be connected to ground.
5	GND	This pin must be connected to ground.
6	V_S	Supply Voltage.
7	$\overline{CS}$	Chip Select.
8	INT1	Interrupt 1 Output.
9	INT2	Interrupt 2 Output.
10	NC	Not Internally Connected.
11	RESERVED	Reserved. This pin must be connected to ground or left open.
12	SDO/ALT ADDRESS	Serial Data Output (SPI 4-Wire)/Alternate I²C Address Select (I²C).
13	SDA/SDI/SDIO	Serial Data (I²C)/Serial Data Input (SPI 4-Wire)/Serial Data Input and Output (SPI 3-Wire).
14	SCL/SCLK	Serial Communications Clock. SCL is the clock for I²C, and SCLK is the clock for SPI.

TYPICAL PERFORMANCE CHARACTERISTICS

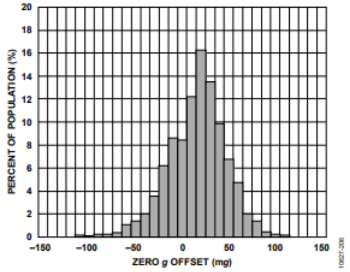


Figure 4. Zero g Offset at 25°C, V_S = 2.5 V, All Axes

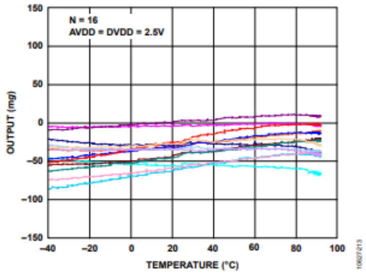


Figure 7. X-Axis Zero g Offset vs. Temperature—Eight Parts Soldered to PCB, V_S = 2.5 V

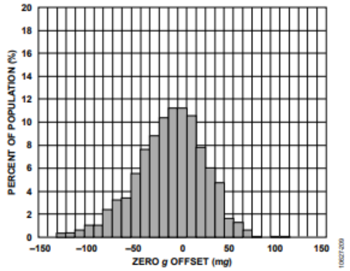


Figure 5. Zero g Offset at 25°C, V_S = 3.3 V, All Axes

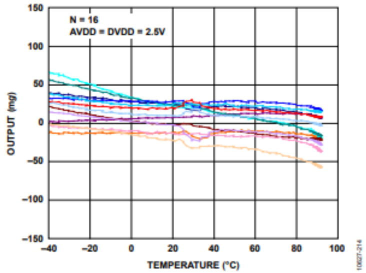


Figure 8. Y-Axis Zero g Offset vs. Temperature—Eight Parts Soldered to PCB, V_S = 2.5 V

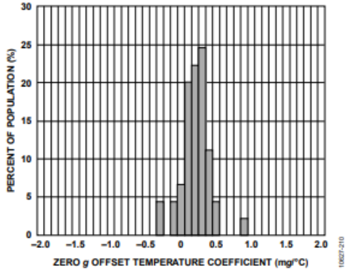


Figure 6. Zero g Offset Temperature Coefficient, V_S = 2.5 V, All Axes

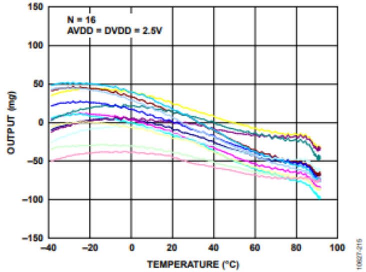


Figure 9. Z-Axis Zero g Offset vs. Temperature—Eight Parts Soldered to PCB, V_S = 2.5 V

POWER SAVINGS

Power Modes

The ADXL343 automatically modulates its power consumption in proportion to its output data rate, as outlined in Table 7. If additional power savings is desired, a lower power mode is available. In this mode, the internal sampling rate is reduced, allowing for power savings in the 12.5 Hz to 400 Hz data rate range at the expense of slightly greater noise. To enter low power mode, set the LOW_POWER bit (Bit 4) in the BW_RATE register (Address 0x2C). The current consumption in low power mode is shown in Table 8 for cases where there is an advantage to using low power mode. Use of low power mode for a data rate not shown in Table 8 does not provide any advantage over the same data rate in normal power mode. Therefore, it is recommended that only data rates shown in Table 8 are used in low power mode. The current consumption values shown in Table 7 and Table 8 are for a V_S of 2.5 V.

Table 7. Typical Current Consumption vs. Data Rate (T_A = 25°C, V_S = 2.5 V, $V_{DD\,I/O}$ = 1.8 V)

Output Data Rate (Hz)	Bandwidth (Hz)	Rate Code	I_{DD} (µA)
3200	1600	1111	140
1600	800	1110	90
800	400	1101	140
400	200	1100	140
200	100	1011	140
100	50	1010	140
50	25	1001	90
25	12.5	1000	60
12.5	6.25	0111	50
6.25	3.13	0110	45
3.13	1.56	0101	40
1.56	0.78	0100	34
0.78	0.39	0011	23
0.39	0.20	0010	23
0.20	0.10	0001	23
0.10	0.05	0000	23

Table 8. Typical Current Consumption vs. Data Rate, Low Power Mode (T_A = 25°C, V_S = 2.5 V, $V_{DD\,I/O}$ = 1.8 V)

Output Data Rate (Hz)	Bandwidth (Hz)	Rate Code	I_{DD} (µA)
400	200	1100	90
200	100	1011	60
100	50	1010	50
50	25	1001	45
25	12.5	1000	40
12.5	6.25	0111	34

Auto Sleep Mode

Additional power can be saved if the ADXL343 automatically switches to sleep mode during periods of inactivity. To enable this feature, set the THRESH_INACT register (Address 0x25) and the TIME_INACT register (Address 0x26) each to a value that signifies inactivity (the appropriate value depends on the application), and then set the AUTO_SLEEP bit (Bit D4) and the link bit (Bit D5) in the POWER_CTL register (Address 0x2D). Current consumption at the sub-12.5 Hz data rates that are used in this mode is typically 23 µA for a V_S of 2.5 V.

Standby Mode

For even lower power operation, standby mode can be used. In standby mode, current consumption is reduced to 0.1 µA (typical). In this mode, no measurements are made. Standby mode is entered by clearing the measure bit (Bit D3) in the POWER_CTL register (Address 0x2D). Placing the device into standby mode preserves the contents of FIFO.

REGISTER MAP

Table 19.

Address					
Hex	Dec	Name	Type	Reset Value	Description
0x00	0	DEVID	R	11100101	Device ID
0x01 to 0x1C	1 to 28	Reserved			Reserved; do not access
0x1D	29	THRESH_TAP	R/$\overline{W}$	00000000	Tap threshold
0x1E	30	OFSX	R/$\overline{W}$	00000000	X-axis offset
0x1F	31	OFSY	R/$\overline{W}$	00000000	Y-axis offset
0x20	32	OFSZ	R/$\overline{W}$	00000000	Z-axis offset
0x21	33	DUR	R/$\overline{W}$	00000000	Tap duration
0x22	34	Latent	R/$\overline{W}$	00000000	Tap latency
0x23	35	Window	R/$\overline{W}$	00000000	Tap window
0x24	36	THRESH_ACT	R/$\overline{W}$	00000000	Activity threshold
0x25	37	THRESH_INACT	R/$\overline{W}$	00000000	Inactivity threshold
0x26	38	TIME_INACT	R/$\overline{W}$	00000000	Inactivity time
0x27	39	ACT_INACT_CTL	R/$\overline{W}$	00000000	Axis enable control for activity and inactivity detection
0x28	40	THRESH_FF	R/$\overline{W}$	00000000	Free-fall threshold
0x29	41	TIME_FF	R/$\overline{W}$	00000000	Free-fall time
0x2A	42	TAP_AXES	R/$\overline{W}$	00000000	Axis control for single tap/double tap
0x2B	43	ACT_TAP_STATUS	R	00000000	Source of single tap/double tap
0x2C	44	BW_RATE	R/$\overline{W}$	00001010	Data rate and power mode control
0x2D	45	POWER_CTL	R/$\overline{W}$	00000000	Power-saving features control
0x2E	46	INT_ENABLE	R/$\overline{W}$	00000000	Interrupt enable control
0x2F	47	INT_MAP	R/$\overline{W}$	00000000	Interrupt mapping control
0x30	48	INT_SOURCE	R	00000010	Source of interrupts
0x31	49	DATA_FORMAT	R/$\overline{W}$	00000000	Data format control
0x32	50	DATAX0	R	00000000	X-Axis Data 0
0x33	51	DATAX1	R	00000000	X-Axis Data 1
0x34	52	DATAY0	R	00000000	Y-Axis Data 0
0x35	53	DATAY1	R	00000000	Y-Axis Data 1
0x36	54	DATAZ0	R	00000000	Z-Axis Data 0
0x37	55	DATAZ1	R	00000000	Z-Axis Data 1
0x38	56	FIFO_CTL	R/$\overline{W}$	00000000	FIFO control
0x39	57	FIFO_STATUS	R	00000000	FIFO status

Register 0x2D—POWER_CTL (Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0
0	0	Link	AUTO_SLEEP	Measure	Sleep	Wakeup	

Link Bit

A setting of 1 in the link bit with both the activity and inactivity functions enabled delays the start of the activity function until inactivity is detected. After activity is detected, inactivity detection begins, preventing the detection of activity. This bit serially links the activity and inactivity functions. When this bit is set to 0, the inactivity and activity functions are concurrent. Additional information can be found in the Link Mode section.

When clearing the link bit, it is recommended that the part be placed into standby mode and then set back to measurement mode with a subsequent write. This is done to ensure that the device is properly biased if sleep mode is manually disabled; otherwise, the first few samples of data after the link bit is cleared may have additional noise, especially if the device was asleep when the bit was cleared.

AUTO_SLEEP Bit

If the link bit is set, a setting of 1 in the AUTO_SLEEP bit enables the auto-sleep functionality. In this mode, the ADXL343 automatically switches to sleep mode if the inactivity function is enabled and inactivity is detected (that is, when acceleration is below the THRESH_INACT value for at least the time indicated by TIME_INACT). If activity is also enabled, the ADXL343 automatically wakes up from sleep after detecting activity and returns to operation at the output data rate set in the BW_RATE register. A setting of 0 in the AUTO_SLEEP bit disables automatic switching to sleep mode. See the description of the Sleep Bit in this section for more information on sleep mode.

If the link bit is not set, the AUTO_SLEEP feature is disabled and setting the AUTO_SLEEP bit does not have an impact on device operation. Refer to the Link Bit section or the Link Mode section for more information on utilization of the link feature.

When clearing the AUTO_SLEEP bit, it is recommended that the part be placed into standby mode and then set back to measurement mode with a subsequent write. This is done to ensure that the device is properly biased if sleep mode is manually disabled; otherwise, the first few samples of data after the AUTO_SLEEP bit is cleared may have additional noise, especially if the device was asleep when the bit was cleared.

Measure Bit

A setting of 0 in the measure bit places the part into standby mode, and a setting of 1 places the part into measurement mode. The ADXL343 powers up in standby mode with minimum power consumption.

Sleep Bit

A setting of 0 in the sleep bit puts the part into the normal mode of operation, and a setting of 1 places the part into sleep mode. Sleep mode suppresses DATA_READY, stops transmission of data to FIFO, and switches the sampling rate to one specified by the wakeup bits. In sleep mode, only the activity function can be used. When the DATA_READY interrupt is suppressed, the output data registers (Register 0x32 to Register 0x37) are still updated at the sampling rate set by the wakeup bits (D1:D0).

When clearing the sleep bit, it is recommended that the part be placed into standby mode and then set back to measurement mode with a subsequent write. This is done to ensure that the device is properly biased if sleep mode is manually disabled; otherwise, the first few samples of data after the sleep bit is cleared may have additional noise, especially if the device was asleep when the bit was cleared.

Wakeup Bits

These bits control the frequency of readings in sleep mode as described in Table 20.

Table 20. Frequency of Readings in Sleep Mode

Setting		
D1	D0	Frequency (Hz)
0	0	8
0	1	4
1	0	2
1	1	1

Register 0x32 to Register 0x37—DATAX0, DATAX1, DATAY0, DATAY1, DATAZ0, DATAZ1 (Read Only)

These six bytes (Register 0x32 to Register 0x37) are eight bits each and hold the output data for each axis. Register 0x32 and Register 0x33 hold the output data for the x-axis, Register 0x34 and Register 0x35 hold the output data for the y-axis, and Register 0x36 and Register 0x37 hold the output data for the z-axis. The output data is twos complement, with DATAx0 as the least significant byte and DATAx1 as the most significant byte, where x represent X, Y, or Z. The DATA_FORMAT register (Address 0x31) controls the format of the data. It is recommended that a multiple-byte read of all registers be performed to prevent a change in data between reads of sequential registers.

AXES OF ACCELERATION SENSITIVITY

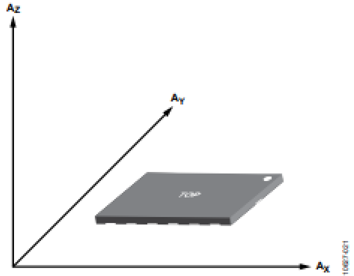


Figure 47. Axes of Acceleration Sensitivity (Corresponding Output Voltage Increases When Accelerated Along the Sensitive Axis)

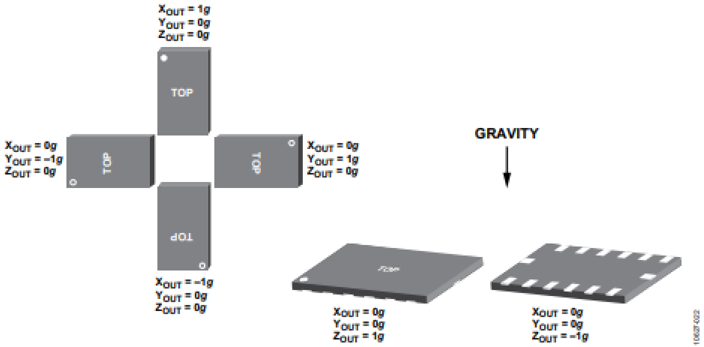


Figure 48. Output Response vs. Orientation to Gravity

Python

```python
#!/usr/bin/env python3

import spidev
import time
import numpy as np

class adxl343:
    ''' Enables communication between the raspberry pi and the ADXL343 board from Sparkfun '''
    def __init__(self,spi_device=0, ce_pin=0, speed=1000000):
        """
        spi_device: there are two spi ports. It is most common to use port 0.
        ce_pin: there are two CE pins that are automatically controlled by the pi.
        speed: the speed for the spi clock is specified here. used to limit spi speed.
        """
        self.spi = spidev.SpiDev()
        self.spi.open(spi_device, ce_pin)
        self.spi.max_speed_hz = speed   # Sets the maximum speed of the SPI link
        self.spi.mode = 0b11            # Sets the clock polarity and the phase respectively
        time.sleep(0.5)
        if self.get_device_id() == '0xe5':
            self.enable()
            print("found ADXL343")
        else:
            print("Device ID Incorrect")
```

spidev Documentation

1. https://pypi.org/project/spidev/

Registers

REGISTER MAP

Table 19.

Address		Name	Type	Reset Value	Description
Hex	Dec				
0x00	0	DEVID	R	11100101	Device ID
0x01 to 0x1C	1 to 28	Reserved			Reserved; do not access
0x1D	29	THRESH_TAP	R/$\overline{W}$	00000000	Tap threshold
0x1E	30	OFSX	R/$\overline{W}$	00000000	X-axis offset
0x1F	31	OFSY	R/$\overline{W}$	00000000	Y-axis offset
0x20	32	OFSZ	R/$\overline{W}$	00000000	Z-axis offset
0x21	33	DUR	R/$\overline{W}$	00000000	Tap duration
0x22	34	Latent	R/$\overline{W}$	00000000	Tap latency
0x23	35	Window	R/$\overline{W}$	00000000	Tap window
0x24	36	THRESH_ACT	R/$\overline{W}$	00000000	Activity threshold
0x25	37	THRESH_INACT	R/$\overline{W}$	00000000	Inactivity threshold
0x26	38	TIME_INACT	R/$\overline{W}$	00000000	Inactivity time
0x27	39	ACT_INACT_CTL	R/$\overline{W}$	00000000	Axis enable control for activity and inactivity detection
0x28	40	THRESH_FF	R/$\overline{W}$	00000000	Free-fall threshold
0x29	41	TIME_FF	R/$\overline{W}$	00000000	Free-fall time
0x2A	42	TAP_AXES	R/$\overline{W}$	00000000	Axis control for single tap/double tap
0x2B	43	ACT_TAP_STATUS	R	00000000	Source of single tap/double tap
0x2C	44	BW_RATE	R/$\overline{W}$	00001010	Data rate and power mode control
0x2D	45	POWER_CTL	R/$\overline{W}$	00000000	Power-saving features control
0x2E	46	INT_ENABLE	R/$\overline{W}$	00000000	Interrupt enable control
0x2F	47	INT_MAP	R/$\overline{W}$	00000000	Interrupt mapping control
0x30	48	INT_SOURCE	R	00000010	Source of interrupts
0x31	49	DATA_FORMAT	R/$\overline{W}$	00000000	Data format control
0x32	50	DATAX0	R	00000000	X-Axis Data 0
0x33	51	DATAX1	R	00000000	X-Axis Data 1
0x34	52	DATAY0	R	00000000	Y-Axis Data 0
0x35	53	DATAY1	R	00000000	Y-Axis Data 1
0x36	54	DATAZ0	R	00000000	Z-Axis Data 0
0x37	55	DATAZ1	R	00000000	Z-Axis Data 1
0x38	56	FIFO_CTL	R/$\overline{W}$	00000000	FIFO control
0x39	57	FIFO_STATUS	R	00000000	FIFO status

Write Register

```
def write_register(self, address, data):
        self.spi.xfer2([address,data])
        return(0)
```

Read Register

```
def read_register(self, address):
        address = address | 0x80
        read_bytes = self.spi.xfer2([address,0x00])
        return (read_bytes[1])
```

Assignment P2

1. https://engr210.github.io/P2