OMRON Corporation
OMRON SWITCH & DEVICES Corporation

RoHS Directive Support

Issued By	Checked By	Approved By
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■For Reference

Product Specifications

Item Name Vibration Sensor

Model D7S-A0001

Registration Part Number for Customer
Item Name: Item Number:

Receipt Stamp (For Receipt Purpose Only)

Submitted Stamp
Handled By

Distribution

	Copies
Customer	
Sales	

OMRON

Product Specifications	Item Name: Vibration Sensor
	Model: D7S-A0001

1. Model

   D7S-A0001

2. Functions

   The D7S provides the following functions.

   (a) Basic Functions

   When an earthquake occurs with a seismic intensity equivalent to 5 Upper or higher on the JMA Seismic Intensity Scale, the D7S will activate the shutoff output to notify the user that an earthquake has occurred. (The basic functions can be used without using communications.)

   (b) Communications

   The D7S is equipped with I^2C communications to allow the user to acquire and set the following information.

   ① SI values of the past five earthquakes that occurred
   ② Peak acceleration of the past five earthquakes that occurred
   ③ Execute self-diagnostic instructions and get the results
   ④ Switch to Initial Installation Mode via communications

3. Purpose

   Vibration Sensor

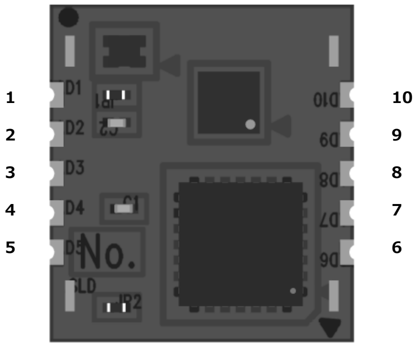
4. Appearance

1) Package: Surface-mounting

2) Outline Drawing: Drawing No. 9499978-7

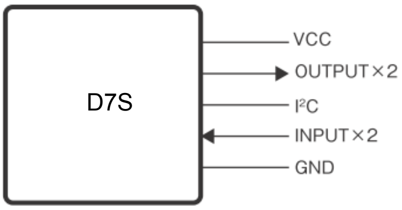
3）Taping and Packaging Outline Drawing: Drawing No. 9499980-9

4) Terminal Arrangement (Top View):

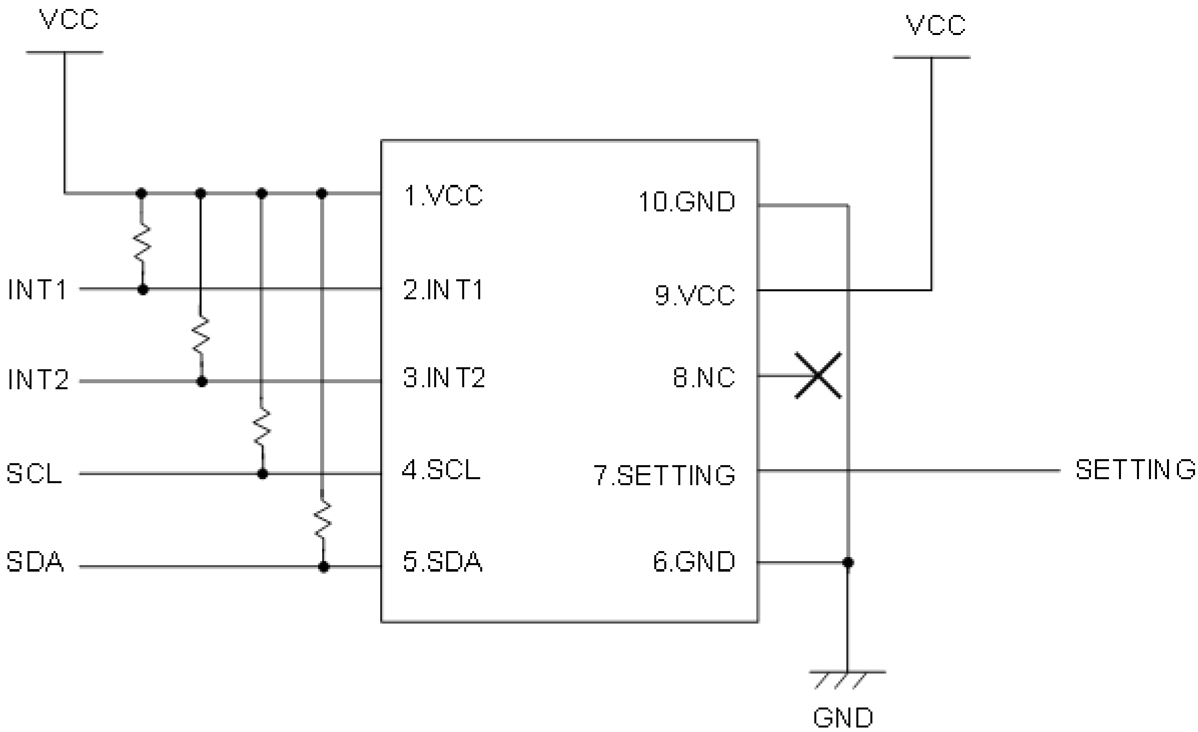


	Signal	Function	Direction	Description
1	VCC	Power supply voltage	-	
2	INT1	Shutoff output	OUT	An open-drain output. Goes active (ON) when the shutoff judgment condition and collapse detection condition are met.
3	INT2	Processing notification output	OUT	An open-drain output. Goes active (ON) during earthquake calculations, offset acquisition, and self-diagnostic processing.
4	SCL	I^2C clock	IN	Pull up the voltage to VCC even when you do not use I^2C.
5	SDA	I^2C data	IN/OUT	Pull up the voltage to VCC even when you do not use I^2C.
6	GND	Power supply ground	-	
7	SETTING	Initial setting input	IN	Changes the Sensor to Initial Installation Mode for an input from an external device. Normal Mode: High Initial Installation Mode: Low
8	NC	Not connected	-	Completely floating and cannot be connected to another line.
9	VCC	Power supply voltage	-	
10	GND	Power supply ground	-	

5. Block Diagram



6. Recommended Circuit Diagram



Note: Regardless of whether or not you are using I^2C, pull up pins 4 and 5 to Vcc with 2.2 to 10 kΩ resistors.

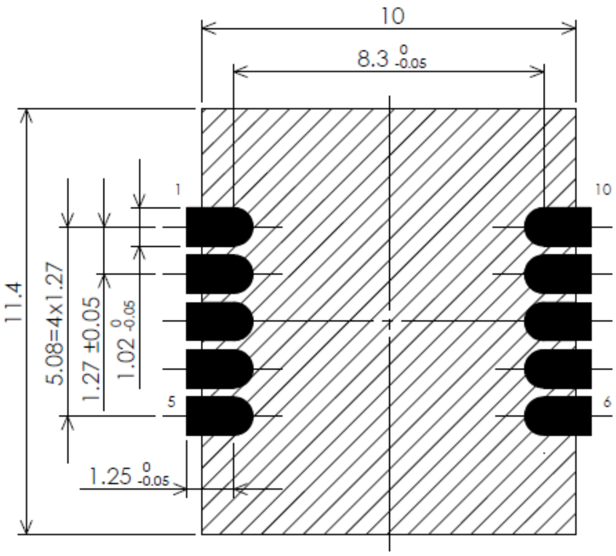
7. Recommended Mounting Pattern

Recommended Mounting Conditions

Peak Mounting Temperature: 245°C min. (260°C max.)

Reflow Time: 64 to 80 s (220°C)

Reflow Repetitions: Up to 2 times



∗Recommended Land Pattern
TOP VIEW

* Mounting other components or placing wiring patterns in the area marked with diagonal lines is prohibited. Also take care so that foreign material does not become stuck under the chip in the area marked with diagonal lines.

8. Ratings:

(1) Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Power Supply Voltage	Vcc	-0.3	6.0	V
I/O Terminals	Vin	-0.3	6.0	V

(2) Electrical Characteristics

Item	Symbol	Min.	Max.	Unit
Power Supply Voltage	Vcc	2.1	5.5	V
Current Consumption at Standby	Is	-	90	uA
Average Current Consumption during Processing	Iw	-	300	uA
Terminal Input Voltage Range	Vin	-0.3	5.5	V
Sink Current (INT1 and INT2)	Is	-	16	mA

(3) I²C Digital Characteristics (Vcc = 2.1 to 5.5 V and Ta = 25°C unless otherwise specified.)

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Input Voltage Range	Vin	-0.3	-	5.5	V	All input and output terminals.
Digital Input Low Voltage	Vil	-	-	0.6	V	
Digital Input High Voltage	Vih	1.4	-	-	V	
Pull-up Resistor	Rpullup	2.2		10	kΩ	Recommended value for external resistor.

(4) Environmental Performance

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Operating Temperature	Topr	-30	-	70	°C	With no condensation or icing.
Storage Temperature	Tstr	-40	-	80	°C	With no condensation or icing.
Ambient Humidity	Hopr	25	-	95	%RH	With no condensation or icing.
Storage Humidity	Hstr	25	-	95	%RH	With no condensation or icing.
Mounting Angle	θ	-5	0	+5	Degree	-

9. Sensor Characteristics (Vcc = 3.0 V and Ta = 25°C unless otherwise specified.)

Item	Min.	Typ.	Max.	Unit	Remarks
Vibration Output Specification	Signal output in the following waveforms. (Activated by a sine wave of 250 gal and a period of 0.3 s, 0.5 s, or 0.7 s. Not activated by a sine wave of 80 gal and a period of 0.3 s, 0.5 s, or 0.7 s or by a sine wave of 250 gal and a period of 0.1 s.)				Japan Electrical Wiring Devices and Equipment Industries Association standard. Compliant with Appendix 2 of JWDS 0007.
Acceleration Output Specification (Gain)	95		105	%	
Acceleration Output Specification (Offset)	-180		180	gal	

10. Operation Overview

The Sensor has the following functions.

1) Shutoff Signal Output Function

This function calculates the SI value and PGA (peak acceleration value) based on the acceleration values acquired from the acceleration sensor, and then it outputs the shutoff signal by pulling the INT1 pin low if the waveform conditions defined in JEWA standard JWDS 0007 Appendix 2 are met. The acceleration offset is automatically updated at this time to eliminate successive offset drift in the acceleration sensor.

2) Collapse Detection Function

This function compares the Initial Installation Mode offset values and the offset values that were automatically updated. If the values differ by a large degree, the function will detect this as significant tilting compared to initial installation (an amount approximately equivalent to a 20° inclination), and it will output the collapse detection output from INT1.

3) Information Acquisition Function via I^2C Communications

The following functions have been implemented via the integrated I^2C communications.

・The SI value and PGA that are being calculated during an earthquake can be read via I^2C communications.

・After the end of earthquake processing, the SI value and PGA for that earthquake can be read from the Vibration Sensor's memory (up to five waveforms).

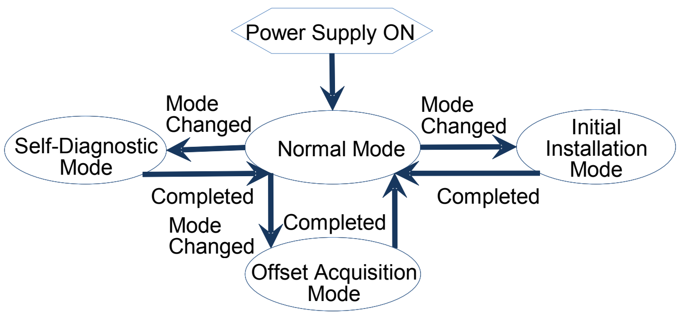
11. Operation Mode Details

(1) Status Transitions

This Sensor switches to Normal Mode when the power supply is turned ON.

The types of modes are Normal Mode (the mode that determines earthquakes and performs the shutoff judgment with the SI calculation), Initial Installation Mode, Offset Acquisition Mode, and Self-Diagnostic Mode. The mode is changed by changing the content of register address MODE (0x1003) via I^2C communications.

You can switch to Initial Installation Mode, Offset Acquisition Mode, and Self-Diagnostic Mode only from Normal Mode. The mode is restored to Normal Mode after Initial Installation Mode, Offset Acquisition Mode, and Self-Diagnostic Mode are ended.



(2) Normal Mode

In Normal Mode, the Sensor first acquires the current 3-axis acceleration values and holds them as the offset. If the CTRL register (0x1004) setting is 0: YZ axes, 1: XZ axes, 2: XY axes, or 4: Switch axes at installation, the latest offset data (register addresses 0x4100 to 0x4114) values are updated. If the CTRL register (0x1004) setting is 3: Auto switch axes, the latest offset data (register addresses 0x4100 to 0x4114) values and initial installation data (register addresses 0x4000 to 0x4014) values are automatically updated. Then the current tilting of the Sensor is judged and the two axes in the horizontal direction are automatically calculated to determine the axes to use for the SI value.

After the offset values are calculated, the offset values in the initial installation data and latest offset data are compared. If there is a large difference in those values, the Sensor is judged as having titled from the initial installation state, and the collapse detection output is output from the INT1 pin. To set the INT1 output to inactive after it has become active, you must read the EVENT register (0x1002), switch to Initial Installation Mode, or turn OFF the power supply.

The Sensor then transitions to the standby status. This status is normally maintained while an earthquake does not occur.

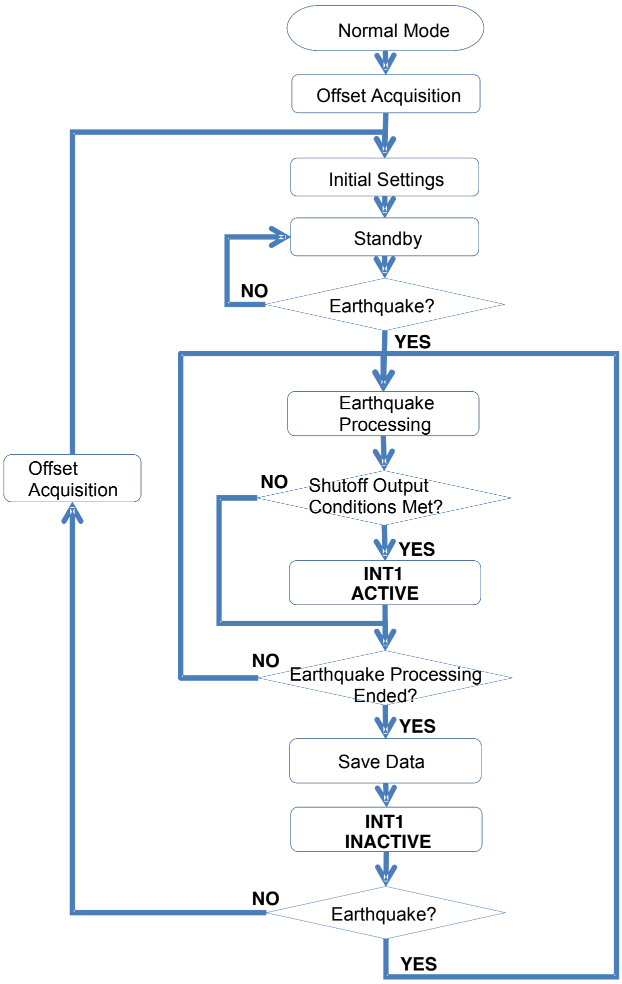
When an earthquake occurs, the earthquake processing starts. The Vibration Sensor calculates the SI value and PGA (peak acceleration value) based on the acceleration values acquired from the acceleration sensor every 320 ms. If the waveform conditions defined in JEWA standard JWDS 0007 Appendix 2 are met during the calculations, the shutoff signal is output from the INT1 pin. The SI value and PGA that are being calculated during this earthquake processing can be read via I^2C communications. The INT2 output is also activated (ON) during earthquake processing. Earthquake processing is performed for two minutes.

After the end of earthquake processing, the SI value and PGA for that earthquake are stored in the Vibration Sensor's memory (up to five waveforms). The data for the five latest waveforms are stored in memory, as well as the data for the five waveforms with the largest SI values. If INT1 is being output after the data is stored, INT1 is set to inactive.

The Sensor then checks if the earthquake is still occurring. If the earthquake is still occurring, earthquake processing is once again performed. If the Sensor judges that the earthquake has ended, the offset values are acquired. The latest offset data (register addresses 0x4100 to 0x4114) values are updated at this time.

After the offset values are calculated, the offset values in the initial installation data and latest offset data are compared. If there is a large difference in those values, the Sensor is judged as having titled from the initial installation state, and the collapse detection output is output from the INT1 pin. To set the INT1 output to inactive after it has become active, you must read the EVENT register (0x1002), switch to Initial Installation Mode, or turn OFF the power supply.

The Sensor then returns to the initial settings and switches to the standby status.

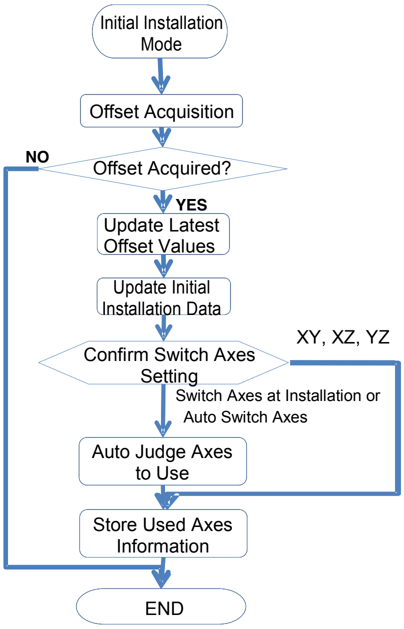


(3) Initial Installation Mode

The Sensor switches to Initial Installation Mode when that mode is specified in the MODE register (0x1003) or when the SETTING pin is pulled low.

In Initial Installation Mode, the Sensor first acquires the current 3-axis acceleration values and holds them as the offset. The latest offset data (register addresses 0x4100 to 0x4114) values and initial installation data (register addresses 0x4000 to 0x4014) values are updated at this time.

If the CTRL register (0x1004) setting is 3: Auto switch axes or 4: Switch axes at installation, the current tilting of the Sensor is judged and the two axes in the horizontal direction are automatically calculated to determine the axes to use for the SI value.

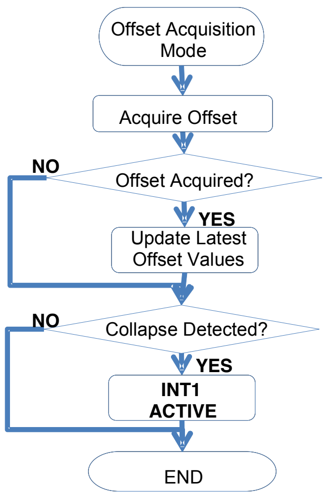


(4) Offset Acquisition Mode

The Sensor switches to Offset Acquisition Mode when that mode is specified in the MODE register (0x1003).

In Offset Acquisition Mode, the Sensor first acquires the current 3-axis acceleration values and holds them as the offset. The latest offset data (register addresses 0x4100 to 0x4114) values are updated at this time.

After the offset values are calculated, the offset values in the initial installation data and latest offset data are compared. If there is a large difference in those values, the Sensor is judged as having titled from the initial installation state, and the collapse detection output is output from the INT1 pin. To set the INT1 output to inactive after it has become active, you must read the EVENT register (0x1002), switch to Initial Installation Mode, or turn OFF the power supply.



(5) Self-Diagnostic Mode

The Sensor switches to Self-Diagnostic Mode when that mode is specified in the MODE register (0x1003).

When an acceleration sensor failure has been determined and is judged as a fault, the event_selftest bit in the EVENT register (0x1002) changes to 1. The self-diagnostic data (register addresses 0x4200 to 0x420E) is also updated.

12. I²C Communications Protocol

Device Type	Slave
Communications Method	I²C
Baud Rate	400 kbps
Transmission Code	Binary
Slave Address	0x55
I²C Clock Stretching	Enabled

The I²C slave address (0x55) is expressed as follows.

Bit	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
	Add[6]	Add[5]	Add[4]	Add[3]	Add[2]	Add[1]	Add[0]	R / W
Value	**1**	**0**	**1**	**0**	**1**	**0**	**1**	**1 / 0**

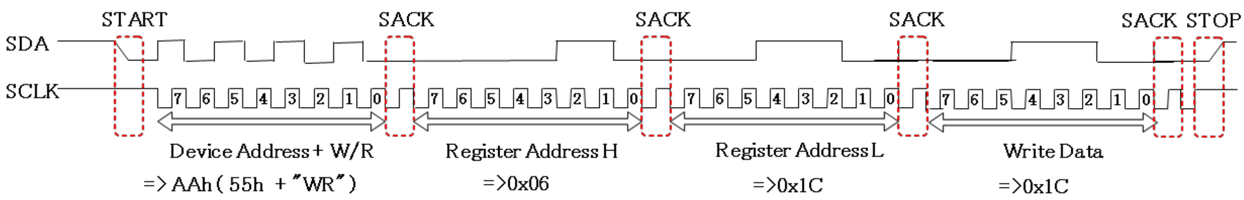
When writing: Set the LSB of the slave address to 0 so that the address is AAh (1010_1010b).
When reading: Set the LSB of the slave address to 1 so that the address is ABh (1010_1011b).

Symbols
START: START condition
STOP: STOP condition
SACK: Acknowledge by Slave
MACK: Acknowledge by Master
MNACK: Not Acknowledge by Master

*Attention: When the non-volatile memory in the Sensor is being updated, NACK may be returned for an I²C communications request to prevent memory data corruption.

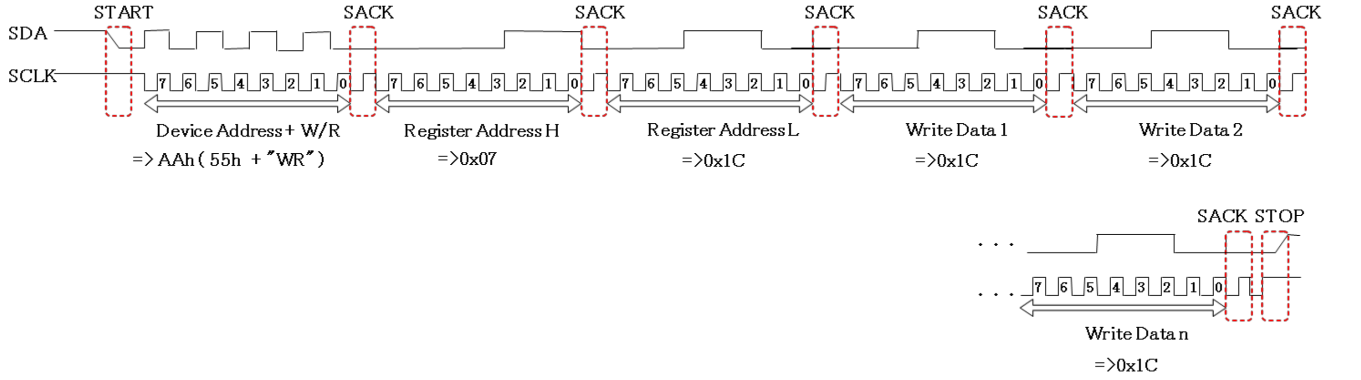
(1) Single Write Access Protocol

The following diagram is an example of the protocol when overwriting a register address specified as a 16-bit value with an 8-bit setting value.



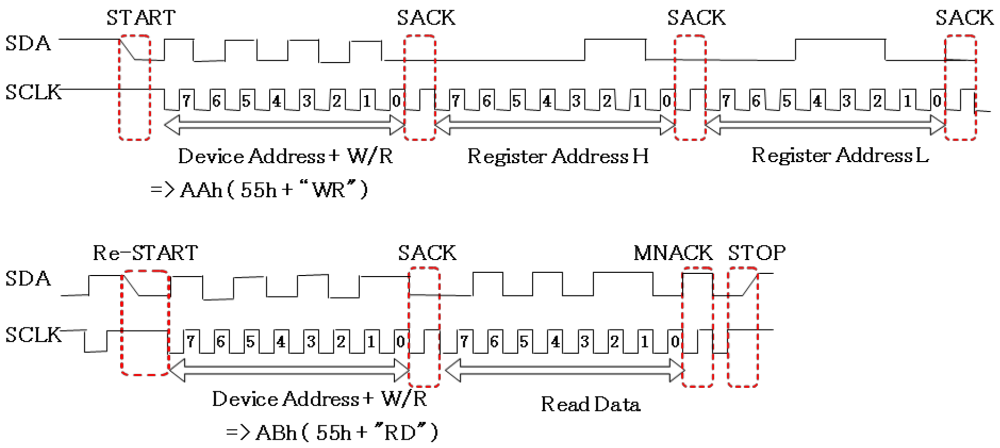
(2) Multi Write Access Protocol

The following diagram is an example of the protocol when overwriting a register address specified as a 16-bit value with consecutive setting values. The register address is incremented in the amount of register addresses specified by the master, and the setting values for those register addresses are overwritten.



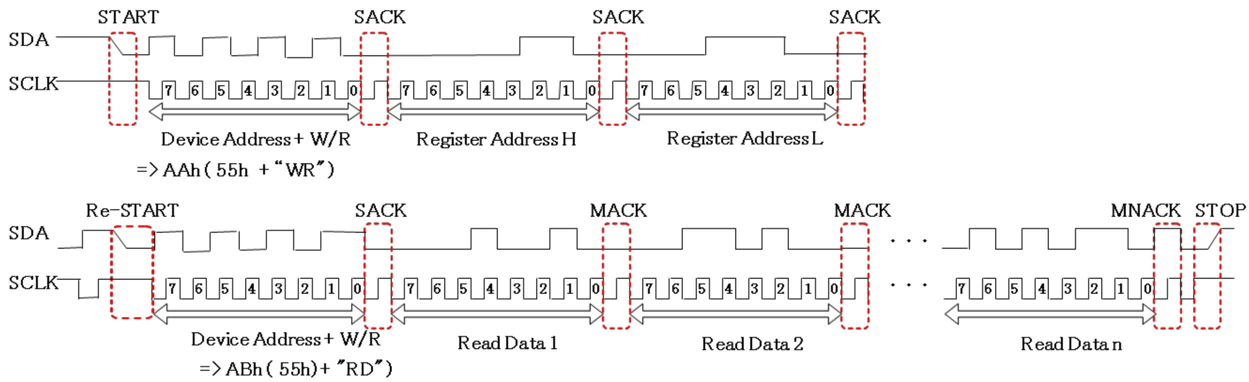
(3) Single Read Access Protocol

The following diagram is an example of the protocol when reading data from a register address specified as a 16-bit value.



(4) Multi Read Access Protocol

The following diagram is an example of the protocol when reading consecutive items of data starting from a register address specified as a 16-bit value. The register address is incremented in the amount of register addresses specified by the master, and the data held in those register addresses can be read.



13. Implemented Registers

(1) Registers List

Item	Register Address			Register Name	R/W	Data bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Default Value
Status	0x	10	00	STATE	R	-	-	-	-	-	state[2:0]			0x00
	0x	10	01	AXIS_STATE	R	-	-	-	-	-	-	axis_state [1:0]		0x02
	0x	10	02	EVENT	R	-	-	-	-	event_offset	event_selftest	event_collapse	event_shut	0x00
Change Status	0x	10	03	MODE	R/W	-	-	-	-	-	mode[2:0]			0x01
	0x	10	04	CTRL	R/W	-	ctrl_axis[2:0]			ctrl_thresh	-	-	-	0x40
	0x	10	05	CLEAR_COMMAND	R/W	-	-	-	-	clear_set_offset	clear_recent_offse	clear_selftest	clear_quake	0x00
Earthquake-Related Data (During an Earthquake)	0x	20	00	MAIN_SI_H	R	main_si[15:0]								0x0000
	0x	20	01	MAIN_SI_L										
	0x	20	02	MAIN_PGA_H	R	main_pga[15:0]								0x0000
	0x	20	03	MAIN_PGA_L										
Latest Data 1	0x	30	00	N1_MAIN_OFFSET_X_H	R	n1_main_offset_x[15:0]								0x0000
	0x	30	01	N1_MAIN_OFFSET_X_L										
	0x	30	02	N1_MAIN_OFFSET_Y_H	R	n1_main_offset_y[15:0]								0x0000
	0x	30	03	N1_MAIN_OFFSET_Y_L										
	0x	30	04	N1_MAIN_OFFSET_Z_H	R	n1_main_offset_z[15:0]								0x0000
	0x	30	05	N1_MAIN_OFFSET_Z_L										
	0x	30	06	N1_MAIN_T_AVE_H	R	n1_main_t_ave[15:0]								0x0000
	0x	30	07	N1_MAIN_T_AVE_L										
	0x	30	08	N1_MAIN_SI_H	R	n1_main_si[15:0]								0x0000
	0x	30	09	N1_MAIN_SI_L										
	0x	30	0A	N1_MAIN_PGA_H	R	n1_main_pga[15:0]								0x0000
	0x	30	0B	N1_MAIN_PGA_L										
Latest Data 2	0x	31	00	N2_MAIN_OFFSET_X_H	R	n2_main_offset_x[15:0]								0x0000
	0x	31	01	N2_MAIN_OFFSET_X_L										
	0x	31	02	N2_MAIN_OFFSET_Y_H	R	n2_main_offset_y[15:0]								0x0000
	0x	31	03	N2_MAIN_OFFSET_Y_L										
	0x	31	04	N2_MAIN_OFFSET_Z_H	R	n2_main_offset_z[15:0]								0x0000
	0x	31	05	N2_MAIN_OFFSET_Z_L										
	0x	31	06	N2_MAIN_T_AVE_H	R	n2_main_t_ave[15:0]								0x0000
	0x	31	07	N2_MAIN_T_AVE_L										
	0x	31	08	N2_MAIN_SI_H	R	n2_main_si[15:0]								0x0000
	0x	31	09	N2_MAIN_SI_L										
	0x	31	0A	N2_MAIN_PGA_H	R	n2_main_pga[15:0]								0x0000
	0x	31	0B	N2_MAIN_PGA_L										
Latest Data 3	0x	32	00	N3_MAIN_OFFSET_X_H	R	n3_main_offset_x[15:0]								0x0000
	0x	32	01	N3_MAIN_OFFSET_X_L										
	0x	32	02	N3_MAIN_OFFSET_Y_H	R	n3_main_offset_y[15:0]								0x0000
	0x	32	03	N3_MAIN_OFFSET_Y_L										
	0x	32	04	N3_MAIN_OFFSET_Z_H	R	n3_main_offset_z[15:0]								0x0000
	0x	32	05	N3_MAIN_OFFSET_Z_L										
	0x	32	06	N3_MAIN_T_AVE_H	R	n3_main_t_ave[15:0]								0x0000
	0x	32	07	N3_MAIN_T_AVE_L										
	0x	32	08	N3_MAIN_SI_H	R	n3_main_si[15:0]								0x0000
	0x	32	09	N3_MAIN_SI_L										
	0x	32	0A	N3_MAIN_PGA_H	R	n3_main_pga[15:0]								0x0000
	0x	32	0B	N3_MAIN_PGA_L										

Latest Data 4	0x	33	00	N4_MAIN_OFFSET_X_H	R	n4_main_offset_x[15:0]	0x0000
	0x	33	01	N4_MAIN_OFFSET_X_L			
	0x	33	02	N4_MAIN_OFFSET_Y_H	R	n4_main_offset_y[15:0]	0x0000
	0x	33	03	N4_MAIN_OFFSET_Y_L			
	0x	33	04	N4_MAIN_OFFSET_Z_H	R	n4_main_offset_z[15:0]	0x0000
	0x	33	05	N4_MAIN_OFFSET_Z_L			
	0x	33	06	N4_MAIN_T_AVE_H	R	n4_main_t_ave[15:0]	0x0000
	0x	33	07	N4_MAIN_T_AVE_L			
	0x	33	08	N4_MAIN_SI_H	R	n4_main_si[15:0]	0x0000
	0x	33	09	N4_MAIN_SI_L			
	0x	33	0A	N4_MAIN_PGA_H	R	n4_main_pga[15:0]	0x0000
	0x	33	0B	N4_MAIN_PGA_L			
Latest Data 5	0x	34	00	N5_MAIN_OFFSET_X_H	R	n5_main_offset_x[15:0]	0x0000
	0x	34	01	N5_MAIN_OFFSET_X_L			
	0x	34	02	N5_MAIN_OFFSET_Y_H	R	n5_main_offset_y[15:0]	0x0000
	0x	34	03	N5_MAIN_OFFSET_Y_L			
	0x	34	04	N5_MAIN_OFFSET_Z_H	R	n5_main_offset_z[15:0]	0x0000
	0x	34	05	N5_MAIN_OFFSET_Z_L			
	0x	34	06	N5_MAIN_T_AVE_H	R	n5_main_t_ave[15:0]	0x0000
	0x	34	07	N5_MAIN_T_AVE_L			
	0x	34	08	N5_MAIN_SI_H	R	n5_main_si[15:0]	0x0000
	0x	34	09	N5_MAIN_SI_L			
	0x	34	0A	N5_MAIN_PGA_H	R	n5_main_pga[15:0]	0x0000
	0x	34	0B	N5_MAIN_PGA_L			
SI Ranked Data 1	0x	35	00	M1_MAIN_OFFSET_X_H	R	m1_main_offset_x[15:0]	0x0000
	0x	35	01	M1_MAIN_OFFSET_X_L			
	0x	35	02	M1_MAIN_OFFSET_Y_H	R	m1_main_offset_y[15:0]	0x0000
	0x	35	03	M1_MAIN_OFFSET_Y_L			
	0x	35	04	M1_MAIN_OFFSET_Z_H	R	m1_main_offset_z[15:0]	0x0000
	0x	35	05	M1_MAIN_OFFSET_Z_L			
	0x	35	06	M1_MAIN_T_AVE_H	R	m1_main_t_ave[15:0]	0x0000
	0x	35	07	M1_MAIN_T_AVE_L			
	0x	35	08	M1_MAIN_SI_H	R	m1_main_si[15:0]	0x0000
	0x	35	09	M1_MAIN_SI_L			
	0x	35	0A	M1_MAIN_PGA_H	R	m1_main_pga[15:0]	0x0000
	0x	35	0B	M1_MAIN_PGA_L			
SI Ranked Data 2	0x	36	00	M2_MAIN_OFFSET_X_H	R	m2_main_offset_x[15:0]	0x0000
	0x	36	01	M2_MAIN_OFFSET_X_L			
	0x	36	02	M2_MAIN_OFFSET_Y_H	R	m2_main_offset_y[15:0]	0x0000
	0x	36	03	M2_MAIN_OFFSET_Y_L			
	0x	36	04	M2_MAIN_OFFSET_Z_H	R	m2_main_offset_z[15:0]	0x0000
	0x	36	05	M2_MAIN_OFFSET_Z_L			
	0x	36	06	M2_MAIN_T_AVE_H	R	m2_main_t_ave[15:0]	0x0000
	0x	36	07	M2_MAIN_T_AVE_L			
	0x	36	08	M2_MAIN_SI_H	R	m2_main_si[15:0]	0x0000
	0x	36	09	M2_MAIN_SI_L			
	0x	36	0A	M2_MAIN_PGA_H	R	m2_main_pga[15:0]	0x0000
	0x	36	0B	M2_MAIN_PGA_L			
SI Ranked Data 3	0x	37	00	M3_MAIN_OFFSET_X_H	R	m3_main_offset_x[15:0]	0x0000
	0x	37	01	M3_MAIN_OFFSET_X_L			
	0x	37	02	M3_MAIN_OFFSET_Y_H	R	m3_main_offset_y[15:0]	0x0000
	0x	37	03	M3_MAIN_OFFSET_Y_L			
	0x	37	04	M3_MAIN_OFFSET_Z_H	R	m3_main_offset_z[15:0]	0x0000
	0x	37	05	M3_MAIN_OFFSET_Z_L			
	0x	37	06	M3_MAIN_T_AVE_H	R	m3_main_t_ave[15:0]	0x0000
	0x	37	07	M3_MAIN_T_AVE_L			
	0x	37	08	M3_MAIN_SI_H	R	m3_main_si[15:0]	0x0000
	0x	37	09	M3_MAIN_SI_L			
	0x	37	0A	M3_MAIN_PGA_H	R	m3_main_pga[15:0]	0x0000
	0x	37	0B	M3_MAIN_PGA_L			
ntlp SI Ranked Data 4	0x	38	00	M4_MAIN_OFFSET_X_H	R	m4_main_offset_x[15:0]	0x0000
	0x	38	01	M4_MAIN_OFFSET_X_L			
	0x	38	02	M4_MAIN_OFFSET_Y_H	R	m4_main_offset_y[15:0]	0x0000
	0x	38	03	M4_MAIN_OFFSET_Y_L			
	0x	38	04	M4_MAIN_OFFSET_Z_H	R	m4_main_offset_z[15:0]	0x0000
	0x	38	05	M4_MAIN_OFFSET_Z_L			
	0x	38	06	M4_MAIN_T_AVE_H	R	m4_main_t_ave[15:0]	0x0000
	0x	38	07	M4_MAIN_T_AVE_L			
	0x	38	08	M4_MAIN_SI_H	R	m4_main_si[15:0]	0x0000
	0x	38	09	M4_MAIN_SI_L			
	0x	38	0A	M4_MAIN_PGA_H	R	m4_main_pga[15:0]	0x0000
	0x	38	0B	M4_MAIN_PGA_L			
SI Ranked Data 5	0x	39	00	M5_MAIN_OFFSET_X_H	R	m5_main_offset_x[15:0]	0x0000
	0x	39	01	M5_MAIN_OFFSET_X_L			
	0x	39	02	M5_MAIN_OFFSET_Y_H	R	m5_main_offset_y[15:0]	0x0000
	0x	39	03	M5_MAIN_OFFSET_Y_L			
	0x	39	04	M5_MAIN_OFFSET_Z_H	R	m5_main_offset_z[15:0]	0x0000
	0x	39	05	M5_MAIN_OFFSET_Z_L			
	0x	39	06	M5_MAIN_T_AVE_H	R	m5_main_t_ave[15:0]	0x0000
	0x	39	07	M5_MAIN_T_AVE_L			
	0x	39	08	M5_MAIN_SI_H	R	m5_main_si[15:0]	0x0000
	0x	39	09	M5_MAIN_SI_L			
	0x	39	0A	M5_MAIN_PGA_H	R	m5_main_pga[15:0]	0x0000
	0x	39	0B	M5_MAIN_PGA_L			

Initial Installation Data	0x	40	00	OFFSET_SET_X_H	R	offset_set_x[15:0]								0x0000
	0x	40	01	OFFSET_SET_X_L										
	0x	40	02	OFFSET_SET_Y_H	R	offset_set_y[15:0]								0x0000
	0x	40	03	OFFSET_SET_Y_L										
	0x	40	04	OFFSET_SET_Z_H	R	offset_set_z[15:0]								0x0000
	0x	40	05	OFFSET_SET_Z_L										
	0x	40	06	OFFSET_SET_T_AVE_H	R	offset_set_t_ave[15:0]								0x0000
	0x	40	07	OFFSET_SET_T_AVE_L										
	0x	40	08	OFFSET_SET_MAX_X_H	R	offset_set_max_x[15:0]								0x0000
	0x	40	09	OFFSET_SET_MAX_X_L										
	0x	40	0A	OFFSET_SET_MAX_Y_H	R	offset_set_max_y[15:0]								0x0000
	0x	40	0B	OFFSET_SET_MAX_Y_L										
	0x	40	0C	OFFSET_SET_MAX_Z_H	R	offset_set_max_Z[15:0]								0x0000
	0x	40	0D	OFFSET_SET_MAX_Z_L										
	0x	40	0E	OFFSET_SET_MIN_X_H	R	offset_set_min_x[15:0]								0x0000
	0x	40	0F	OFFSET_SET_MIN_X_L										
	0x	40	10	OFFSET_SET_MIN_Y_H	R	offset_set_min_y[15:0]								0x0000
	0x	40	11	OFFSET_SET_MIN_Y_L										
	0x	40	12	OFFSET_SET_MIN_Z_H	R	offset_set_min_Z[15:0]								0x0000
	0x	40	13	OFFSET_SET_MIN_Z_L										
	0x	40	14	OFFSET_SET_AXIS	R							offset_set_axis[1:0]		0x00
Latest Offset Data	0x	41	00	OFFSET_RECENT_X_H	R	offset_recent_x[15:0]								0x0000
	0x	41	01	OFFSET_RECENT_X_L										
	0x	41	02	OFFSET_RECENT_Y_H	R	offset_recent_y[15:0]								0x0000
	0x	41	03	OFFSET_RECENT_Y_L										
	0x	41	04	OFFSET_RECENT_Z_H	R	offset_recent_z[15:0]								0x0000
	0x	41	05	OFFSET_RECENT_Z_L										
	0x	41	06	OFFSET_RECENT_T_AVE_H	R	offset_recent_t_ave[15:0]								0x0000
	0x	41	07	OFFSET_RECENT_T_AVE_L										
	0x	41	08	OFFSET_RECENT_MAX_X_H	R	offset_recent_max_x[15:0]								0x0000
	0x	41	09	OFFSET_RECENT_MAX_X_L										
	0x	41	0A	OFFSET_RECENT_MAX_Y_H	R	offset_recent_max_y[15:0]								0x0000
	0x	41	0B	OFFSET_RECENT_MAX_Y_L										
	0x	41	0C	OFFSET_RECENT_MAX_Z_H	R	offset_recent_max_Z[15:0]								0x0000
	0x	41	0D	OFFSET_RECENT_MAX_Z_L										
	0x	41	0E	OFFSET_RECENT_MIN_X_H	R	offset_recent_min_x[15:0]								0x0000
	0x	41	0F	OFFSET_RECENT_MIN_X_L										
	0x	41	10	OFFSET_RECENT_MIN_Y_H	R	offset_recent_min_y[15:0]								0x0000
	0x	41	11	OFFSET_RECENT_MIN_Y_L										
	0x	41	12	OFFSET_RECENT_MIN_Z_H	R	offset_recent_min_Z[15:0]								0x0000
	0x	41	13	OFFSET_RECENT_MIN_Z_L										
	0x	41	14	OFFSET_RECENT_STATE	R							offset_recent_state[1:0]		0x00
Self-Diagnostic Data	0x	42	00	SELFTEST_BEFORE_X_H	R	selftest_before_x[15:0]								0x0000
	0x	42	01	SELFTEST_BEFORE_X_L										
	0x	42	02	SELFTEST_AFTER_X_H	R	selftest_after_x[15:0]								0x0000
	0x	42	03	SELFTEST_AFTER_X_L										
	0x	42	04	SELFTEST_BEFORE_Y_H	R	selftest_before_y[15:0]								0x0000
	0x	42	05	SELFTEST_BEFORE_Y_L										
	0x	42	06	SELFTEST_AFTER_Y_H	R	selftest_after_y[15:0]								0x0000
	0x	42	07	SELFTEST_AFTER_Y_L										
	0x	42	08	SELFTEST_BEFORE_Z_H	R	selftest_before_z[15:0]								0x0000
	0x	42	09	SELFTEST_BEFORE_Z_L										
	0x	42	0A	SELFTEST_AFTER_Z_H	R	selftest_after_z[15:0]								0x0000
	0x	42	0B	SELFTEST_AFTER_Z_L										
	0x	42	0C	SELFTEST_T_AVE_H	R	selftest_t_ave[15:0]								0x0000
	0x	42	0D	SELFTEST_T_AVE_L										
	0x	42	0E	SELFTEST_ERROR	R								selftest_error	0x00

*OMRON assumes no responsibility for operation after accessing registers where access is prohibited.

(2) Register Details

Basic Settings

Item	Register Address			Register Name	R/W	Data bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	Default Value
Status	0x	10	00	STATE	R	-	-	-	-	-	state[2:0]			0x00
	0x	10	01	AXIS_STATE	R	-	-	-	-	-	-	axis_state [1:0]		0x02
	0x	10	02	EVENT	R	-	-	-	-	event_offset	event_selftest	event_collapse	event_shut	0x00
Change Status	0x	10	03	MODE	R/W	-	-	-	-	-	mode[2:0]			0x01
	0x	10	04	CTRL	R/W	-	ctrl_axis[2:0]			ctrl_thresh	-	-	-	0x40
	0x	10	05	CLEAR_COMMAND	R/W	-	-	-	-	clear_set_offset	clear_recent_offse	clear_selftest	clear_quake	0x00

state	Current status	0x00: Normal Mode standby 0x01: Normal Mode not in standby 0x02: Initial Installation Mode 0x03: Offset Acquisition Mode 0x04: Self-Diagnostic Mode

*You can read the current status with this register.

Normal Mode can be separated into the standby status and not-in-standby status (primarily during earthquake processing).

axis_state	Current axes used for SI value calculation	0: Use 2 axes YZ 1: Use 2 axes XZ 2: Use 2 axes XY

*The SI value is calculated from the acceleration values of the two horizontal axes. You can read information about the two axes that are used in the SI value calculation with this register.

event_shut	INT1 pin ACTIVE information (shutoff signal in earthquake)	0: Default 1: Shutoff signal ON in earthquake
event_collapse	INT1 pin ACTIVE information (shutoff signal in collapse)	0: Default 1: Shutoff signal ON in collapse
event_selftest	Self-diagnostic result information	0: Self-diagnostic OK 1: Self-diagnostic error
event_offset	Acquire offset result information	0: Acquire offset OK 1: Acquire offset error

*When these events occur, the corresponding bit changes to 1.

The bits will change from 1 to 0 when this register is read.

mode	Current mode	0x01: Normal Mode 0x02: Initial Installation Mode 0x03: Offset Acquisition Mode 0x04: Self-Diagnostic Mode

*You can read the current mode with this register.

You can also switch the Sensor’s mode by writing that mode to the register.

You can switch to Initial Installation Mode, Offset Acquisition Mode, and Self-Diagnostic Mode only from Normal Mode.

The mode is restored to Normal Mode after Initial Installation Mode, Offset Acquisition Mode, and Self-Diagnostic Mode are ended.

ctrl_thresf	Earthquake shutoff judgement threshold	0: Threshold level H 1: Threshold level L
ctrl_axis	SI value calculation axes setting pattern	0: YZ axes, 1: XZ axes, 2: XY axes, 3: Auto switch axes (auto axes calculation by automatically switching to Initial Installation Mode at the start of Normal Mode), 4: Switch axes at installation (auto axes calculation in switching to Initial Installation Mode)

*The earthquake shutoff judgment threshold is active only when using I^2C communications (i.e., when the SELECT pin is high).

The default is threshold level H, and the shutoff signal will be output if an earthquake occurs with a seismic intensity equivalent to 5 Upper or higher on the JMA Seismic Intensity Scale.

*You can change the SI value calculation axes setting pattern by writing the corresponding value to ctrl_axis.

The default is 4: Switch axes at installation. When the Sensor has switched to Initial Installation Mode, the current tilting of the Sensor is judged and the two axes in the horizontal direction are automatically calculated to determine the axes to use for the SI value.

With 0: YZ axes, 1: XZ axes, and 2: XY axes, the SI value is calculated with the specified fixed axes.

With 3: Auto switch axes, the current tilting of the Sensor is judged and the two axes in the horizontal direction are automatically calculated to determine the axes to use for the SI value each time the power supply is turned ON or Normal Mode is started.

clear_quake	Clear earthquake data memory	0: Default 1: Start clear earthquake data memory
clear_selftest	Clear self-diagnostic data memory	0: Default 1: Start clear self-diagnostic data memory
clear_recent_offset	Clear latest offset data memor	0: Default 1: Start clear latest offset data memory
clear_set_offset	Clear initial installation data memory	0: Default 1: Start clear initial installation data memory

*Change the corresponding bit from 0 to 1 to clear the corresponding memory (the data will be written with zeros). Earthquake data is located in register addresses 0x3000 to 0x391D. Self-diagnostic data is located in register addresses 0x4200 to 0x420E. Latest offset data is located in registered addresses 0x4100 to 0x4114. Initial installation data is located in register addresses 0x4000 to 0x4014.

Earthquake-Related Data (During an Earthquake)

During an earthquake, you can acquire the SI value and PGA currently being calculated by executing a read on the following register addresses.

Item	Register Address			Register Name	R/W	Data								Default Value
						bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
Earthquake-Related Data (During an Earthquake)	0x	20	00	MAIN_SI_H	R	main_si[15:0]								0x0000
	0x	20	01	MAIN_SI_L										
	0x	20	02	MAIN_PGA_H	R	main_pga[15:0]								0x0000
	0x	20	03	MAIN_PGA_L										

main_si	SI value	0x0000 to 0xFFFF (0.0 to 6,553.5) *Precision fixed to one digit after the decimal point.

*The SI value during an earthquake. The value becomes 0 when the earthquake ends.

main_pga	PGA (2-axis synthetic peak acceleration)	0x0000 to 0xFFFF (0 to 65,535) *Integer

*The PGA value during an earthquake. The value becomes 0 when the earthquake ends.

Earthquake-Related Data (Latest Data)

After the earthquake ends, you can read the data for the past five earthquakes by accessing the following register addresses via I²C. Latest Data 1 (register addresses 0x3000 to 0x300B) always holds the latest data.

Item	Register Address			Register Name	R/W	Data								Default Value
						bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
Latest Data 1	0x	30	00	N1_MAIN_OFFSET_X_H	R	n1_main_offset_x[15:0]								0x0000
	0x	30	01	N1_MAIN_OFFSET_X_L										
	0x	30	02	N1_MAIN_OFFSET_Y_H	R	n1_main_offset_y[15:0]								0x0000
	0x	30	03	N1_MAIN_OFFSET_Y_L										
	0x	30	04	N1_MAIN_OFFSET_Z_H	R	n1_main_offset_z[15:0]								0x0000
	0x	30	05	N1_MAIN_OFFSET_Z_L										
	0x	30	06	N1_MAIN_T_AVE_H	R	n1_main_t_ave[15:0]								0x0000
	0x	30	07	N1_MAIN_T_AVE_L										
	0x	30	08	N1_MAIN_SI_H	R	n1_main_si[15:0]								0x0000
	0x	30	09	N1_MAIN_SI_L										
	0x	30	0A	N1_MAIN_PGA_H	R	n1_main_pga[15:0]								0x0000
	0x	30	0B	N1_MAIN_PGA_L										
Latest Data 2	0x	31	00	N2_MAIN_OFFSET_X_H	R	n2_main_offset_x[15:0]								0x0000
	0x	31	01	N2_MAIN_OFFSET_X_L										
	0x	31	02	N2_MAIN_OFFSET_Y_H	R	n2_main_offset_y[15:0]								0x0000
	0x	31	03	N2_MAIN_OFFSET_Y_L										
	0x	31	04	N2_MAIN_OFFSET_Z_H	R	n2_main_offset_z[15:0]								0x0000
	0x	31	05	N2_MAIN_OFFSET_Z_L										
	0x	31	06	N2_MAIN_T_AVE_H	R	n2_main_t_ave[15:0]								0x0000
	0x	31	07	N2_MAIN_T_AVE_L										
	0x	31	08	N2_MAIN_SI_H	R	n2_main_si[15:0]								0x0000
	0x	31	09	N2_MAIN_SI_L										
	0x	31	0A	N2_MAIN_PGA_H	R	n2_main_pga[15:0]								0x0000
	0x	31	0B	N2_MAIN_PGA_L										
Latest Data 3	0x	32	00	N3_MAIN_OFFSET_X_H	R	n3_main_offset_x[15:0]								0x0000
	0x	32	01	N3_MAIN_OFFSET_X_L										
	0x	32	02	N3_MAIN_OFFSET_Y_H	R	n3_main_offset_y[15:0]								0x0000
	0x	32	03	N3_MAIN_OFFSET_Y_L										
	0x	32	04	N3_MAIN_OFFSET_Z_H	R	n3_main_offset_z[15:0]								0x0000
	0x	32	05	N3_MAIN_OFFSET_Z_L										
	0x	32	06	N3_MAIN_T_AVE_H	R	n3_main_t_ave[15:0]								0x0000
	0x	32	07	N3_MAIN_T_AVE_L										
	0x	32	08	N3_MAIN_SI_H	R	n3_main_si[15:0]								0x0000
	0x	32	09	N3_MAIN_SI_L										
	0x	32	0A	N3_MAIN_PGA_H	R	n3_main_pga[15:0]								0x0000
	0x	32	0B	N3_MAIN_PGA_L										
Latest Data 4	0x	33	00	N4_MAIN_OFFSET_X_H	R	n4_main_offset_x[15:0]								0x0000
	0x	33	01	N4_MAIN_OFFSET_X_L										
	0x	33	02	N4_MAIN_OFFSET_Y_H	R	n4_main_offset_y[15:0]								0x0000
	0x	33	03	N4_MAIN_OFFSET_Y_L										
	0x	33	04	N4_MAIN_OFFSET_Z_H	R	n4_main_offset_z[15:0]								0x0000
	0x	33	05	N4_MAIN_OFFSET_Z_L										
	0x	33	06	N4_MAIN_T_AVE_H	R	n4_main_t_ave[15:0]								0x0000
	0x	33	07	N4_MAIN_T_AVE_L										
	0x	33	08	N4_MAIN_SI_H	R	n4_main_si[15:0]								0x0000
	0x	33	09	N4_MAIN_SI_L										
	0x	33	0A	N4_MAIN_PGA_H	R	n4_main_pga[15:0]								0x0000
	0x	33	0B	N4_MAIN_PGA_L										
Latest Data 5	0x	34	00	N5_MAIN_OFFSET_X_H	R	n5_main_offset_x[15:0]								0x0000
	0x	34	01	N5_MAIN_OFFSET_X_L										
	0x	34	02	N5_MAIN_OFFSET_Y_H	R	n5_main_offset_y[15:0]								0x0000
	0x	34	03	N5_MAIN_OFFSET_Y_L										
	0x	34	04	N5_MAIN_OFFSET_Z_H	R	n5_main_offset_z[15:0]								0x0000
	0x	34	05	N5_MAIN_OFFSET_Z_L										
	0x	34	06	N5_MAIN_T_AVE_H	R	n5_main_t_ave[15:0]								0x0000
	0x	34	07	N5_MAIN_T_AVE_L										
	0x	34	08	N5_MAIN_SI_H	R	n5_main_si[15:0]								0x0000
	0x	34	09	N5_MAIN_SI_L										
	0x	34	0A	N5_MAIN_PGA_H	R	n5_main_pga[15:0]								0x0000
	0x	34	0B	N5_MAIN_PGA_L										

n1_main_offset_x to n5_main_offset_x	X-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*X-axis acceleration offset value that was used when calculating the saved SI value and PGA.

The newest value is n1 and the oldest value is n5.

n1_main_offset_y to n5_main_offset_y	Y-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Y-axis acceleration offset value that was used when calculating the saved SI value and PGA.

The newest value is n1 and the oldest value is n5.

n1_main_offset_z to n5_main_offset_z	Z-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Z-axis acceleration offset value that was used when calculating the saved SI value and PGA.

The newest value is n1 and the oldest value is n5.

n1_main_t_ave to n5_main_t_ave	Temperature during SI calculation	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	°C

*Temperature during calculation of the saved SI value and PGA.

The newest value is n1 and the oldest value is n5.

n1_main_si to n5_main_si	SI value	0x0000 to 0xFFFF (0.0 to 6,553.5) *Precision fixed to one digit after the decimal point.	kine

*SI values stored in order from newest to oldest.

The newest value is n1 and the oldest value is n5.

n1_main_pga to n5_main_pga	PGA (2-axis synthetic peak acceleration)	0x0000 to 0xFFFF (0.0 to 6,553.5) *Precision fixed to one digit after the decimal point.	gal

*PGA stored in order from newest to oldest.

The newest value is n1 and the oldest value is n5.

Earthquake-Related Data (SI Ranked Data)

After the earthquake ends, you can read the data for five earthquakes with the largest SI values, out of all earthquakes that occurred in the past, by accessing the following register addresses via I^{2}C. SI Ranked Data 1 (register addresses 0x3500 to 0x350B) always holds the largest SI value.

Item	Register Address			Register Name	R/W	Data								Default Value
						bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
SI Ranked Data 1	0x	35	00	M1_MAIN_OFFSET_X_H	R	m1_main_offset_x[15:0]								0x0000
	0x	35	01	M1_MAIN_OFFSET_X_L										
	0x	35	02	M1_MAIN_OFFSET_Y_H	R	m1_main_offset_y[15:0]								0x0000
	0x	35	03	M1_MAIN_OFFSET_Y_L										
	0x	35	04	M1_MAIN_OFFSET_Z_H	R	m1_main_offset_z[15:0]								0x0000
	0x	35	05	M1_MAIN_OFFSET_Z_L										
	0x	35	06	M1_MAIN_T_AVE_H	R	m1_main_t_ave[15:0]								0x0000
	0x	35	07	M1_MAIN_T_AVE_L										
	0x	35	08	M1_MAIN_SI_H	R	m1_main_si[15:0]								0x0000
	0x	35	09	M1_MAIN_SI_L										
	0x	35	0A	M1_MAIN_PGA_H	R	m1_main_pga[15:0]								0x0000
	0x	35	0B	M1_MAIN_PGA_L										
SI Ranked Data 2	0x	36	00	M2_MAIN_OFFSET_X_H	R	m2_main_offset_x[15:0]								0x0000
	0x	36	01	M2_MAIN_OFFSET_X_L										
	0x	36	02	M2_MAIN_OFFSET_Y_H	R	m2_main_offset_y[15:0]								0x0000
	0x	36	03	M2_MAIN_OFFSET_Y_L										
	0x	36	04	M2_MAIN_OFFSET_Z_H	R	m2_main_offset_z[15:0]								0x0000
	0x	36	05	M2_MAIN_OFFSET_Z_L										
	0x	36	06	M2_MAIN_T_AVE_H	R	m2_main_t_ave[15:0]								0x0000
	0x	36	07	M2_MAIN_T_AVE_L										
	0x	36	08	M2_MAIN_SI_H	R	m2_main_si[15:0]								0x0000
	0x	36	09	M2_MAIN_SI_L										
	0x	36	0A	M2_MAIN_PGA_H	R	m2_main_pga[15:0]								0x0000
	0x	36	0B	M2_MAIN_PGA_L										
SI Ranked Data 3	0x	37	00	M3_MAIN_OFFSET_X_H	R	m3_main_offset_x[15:0]								0x0000
	0x	37	01	M3_MAIN_OFFSET_X_L										
	0x	37	02	M3_MAIN_OFFSET_Y_H	R	m3_main_offset_y[15:0]								0x0000
	0x	37	03	M3_MAIN_OFFSET_Y_L										
	0x	37	04	M3_MAIN_OFFSET_Z_H	R	m3_main_offset_z[15:0]								0x0000
	0x	37	05	M3_MAIN_OFFSET_Z_L										
	0x	37	06	M3_MAIN_T_AVE_H	R	m3_main_t_ave[15:0]								0x0000
	0x	37	07	M3_MAIN_T_AVE_L										
	0x	37	08	M3_MAIN_SI_H	R	m3_main_si[15:0]								0x0000
	0x	37	09	M3_MAIN_SI_L										
	0x	37	0A	M3_MAIN_PGA_H	R	m3_main_pga[15:0]								0x0000
	0x	37	0B	M3_MAIN_PGA_L										
SI Ranked Data 4	0x	38	00	M4_MAIN_OFFSET_X_H	R	m4_main_offset_x[15:0]								0x0000
	0x	38	01	M4_MAIN_OFFSET_X_L										
	0x	38	02	M4_MAIN_OFFSET_Y_H	R	m4_main_offset_y[15:0]								0x0000
	0x	38	03	M4_MAIN_OFFSET_Y_L										
	0x	38	04	M4_MAIN_OFFSET_Z_H	R	m4_main_offset_z[15:0]								0x0000
	0x	38	05	M4_MAIN_OFFSET_Z_L										
	0x	38	06	M4_MAIN_T_AVE_H	R	m4_main_t_ave[15:0]								0x0000
	0x	38	07	M4_MAIN_T_AVE_L										
	0x	38	08	M4_MAIN_SI_H	R	m4_main_si[15:0]								0x0000
	0x	38	09	M4_MAIN_SI_L										
	0x	38	0A	M4_MAIN_PGA_H	R	m4_main_pga[15:0]								0x0000
	0x	38	0B	M4_MAIN_PGA_L										
SI Ranked Data 5	0x	39	00	M5_MAIN_OFFSET_X_H	R	m5_main_offset_x[15:0]								0x0000
	0x	39	01	M5_MAIN_OFFSET_X_L										
	0x	39	02	M5_MAIN_OFFSET_Y_H	R	m5_main_offset_y[15:0]								0x0000
	0x	39	03	M5_MAIN_OFFSET_Y_L										
	0x	39	04	M5_MAIN_OFFSET_Z_H	R	m5_main_offset_z[15:0]								0x0000
	0x	39	05	M5_MAIN_OFFSET_Z_L										
	0x	39	06	M5_MAIN_T_AVE_H	R	m5_main_t_ave[15:0]								0x0000
	0x	39	07	M5_MAIN_T_AVE_L										
	0x	39	08	M5_MAIN_SI_H	R	m5_main_si[15:0]								0x0000
	0x	39	09	M5_MAIN_SI_L										
	0x	39	0A	M5_MAIN_PGA_H	R	m5_main_pga[15:0]								0x0000
	0x	39	0B	M5_MAIN_PGA_L										

m1_main_offset_x to m5_main_offset_x	X-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*X-axis acceleration offset value that was used when calculating the saved SI value and PGA.

The largest SI value during an earthquake is m1, followed by m2, m3, m4, and m5 in descending order.

m1_main_offset_y to m5_main_offset_y	Y-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Y-axis acceleration offset value that was used when calculating the saved SI value and PGA.

The largest SI value during an earthquake is m1, followed by m2, m3, m4, and m5 in descending order.

m1_main_offset_z to m5_main_offset_z	Z-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Z-axis acceleration offset value that was used when calculating the saved SI value and PGA.

The largest SI value during an earthquake is m1, followed by m2, m3, m4, and m5 in descending order.

m1_main_t_ave to m5_main_t_ave	Temperature during SI calculation	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	°C

*Temperature during calculation of the saved SI value and PGA.

The largest SI value during an earthquake is m1, followed by m2, m3, m4, and m5 in descending order.

m1_main_si to m5_main_si	SI value	0x0000 to 0xFFFF (0.0 to 6,553.5) *Precision fixed to one digit after the decimal point.	kine

*SI values stored in order from the largest value.

The largest SI value during an earthquake is m1, followed by m2, m3, m4, and m5 in descending order.

m1_main_pga to m5_main_pag	PGA (2-axis synthetic peak acceleration)	0x0000 to 0xFFFF (0.0 to 6,553.5) *Precision fixed to one digit after the decimal point.	gal

* *PGA values stored in order from the largest SI value.

The largest SI value during an earthquake is m1, followed by m2, m3, m4, and m5 in descending order.

Initial Installation Data

Item	Register Address			Register Name	R/W	Data								Default Value
						bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
Initial Installtion Data	0x	40	00	OFFSET_SET_X_H	R	offset_set_x[15:0]								0x0000
	0x	40	01	OFFSET_SET_X_L										
	0x	40	02	OFFSET_SET_Y_H	R	offset_set_y[15:0]								0x0000
	0x	40	03	OFFSET_SET_Y_L										
	0x	40	04	OFFSET_SET_Z_H	R	offset_set_z[15:0]								0x0000
	0x	40	05	OFFSET_SET_Z_L										
	0x	40	06	OFFSET_SET_T_AVE_H	R	offset_set_t_ave[15:0]								0x0000
	0x	40	07	OFFSET_SET_T_AVE_L										
	0x	40	08	OFFSET_SET_MAX_X_H	R	offset_set_max_x[15:0]								0x0000
	0x	40	09	OFFSET_SET_MAX_X_L										
	0x	40	0A	OFFSET_SET_MAX_Y_H	R	offset_set_max_y[15:0]								0x0000
	0x	40	0B	OFFSET_SET_MAX_Y_L										
	0x	40	0C	OFFSET_SET_MAX_Z_H	R	offset_set_max_Z[15:0]								0x0000
	0x	40	0D	OFFSET_SET_MAX_Z_L										
	0x	40	0E	OFFSET_SET_MIN_X_H	R	offset_set_min_x[15:0]								0x0000
	0x	40	0F	OFFSET_SET_MIN_X_L										
	0x	40	10	OFFSET_SET_MIN_Y_H	R	offset_set_min_y[15:0]								0x0000
	0x	40	11	OFFSET_SET_MIN_Y_L										
	0x	40	12	OFFSET_SET_MIN_Z_H	R	offset_set_min_Z[15:0]								0x0000
	0x	40	13	OFFSET_SET_MIN_Z_L										
	0x	40	14	OFFSET_SET_AXIS	R							offset_set_axis[1:0]		0x00

offset_set_x	X-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*X-axis acceleration offset value during initial installation.

offset_set_y	Y-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Y-axis acceleration offset value during initial installation.

offset_set_z	Z-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Z-axis acceleration offset value during initial installation.

offset_set_ave	Temperature during initial installation	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	°C

*Temperature during initial installation.

offset_set_max_x	Maximum value of X-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Maximum value of X-axis acceleration when calculating the offset during initial installation.

offset_set_max_y	Maximum value of Y-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Maximum value of Y-axis acceleration when calculating the offset during initial installation.

offset_set_max_z	Maximum value of Z-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Maximum value of Z-axis acceleration when calculating the offset during initial installation.

offset_set_min_x	Minimum value of X-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Minimum value of X-axis acceleration when calculating the offset during initial installation.

offset_set_min_y	Minimum value of Y-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Minimum value of Y-axis acceleration when calculating the offset during initial installation.

offset_set_min_z	Minimum value of Z-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Minimum value of Z-axis acceleration when calculating the offset during initial installation.

offset_set_axis	Axes information during initial installation	0: Use 2 axes YZ 1: Use 2 axes XZ 2: Use 2 axes XY	□

*Information about the axes that were decided during initial installation and will be used in the SI value calculation.

Latest Offset Data

Item	Register Address			Register Name	R/W	Data								Default Value
						bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
Latest Offset Data	0x	41	00	OFFSET_RECENT_X_H	R	offset_recent_x[15:0]								0x0000
	0x	41	01	OFFSET_RECENT_X_L										
	0x	41	02	OFFSET_RECENT_Y_H	R	offset_recent_y[15:0]								0x0000
	0x	41	03	OFFSET_RECENT_Y_L										
	0x	41	04	OFFSET_RECENT_Z_H	R	offset_recent_z[15:0]								0x0000
	0x	41	05	OFFSET_RECENT_Z_L										
	0x	41	06	OFFSET_RECENT_T_AVE_H	R	offset_recent_t_ave[15:0]								0x0000
	0x	41	07	OFFSET_RECENT_T_AVE_L										
	0x	41	08	OFFSET_RECENT_MAX_X_H	R	offset_recent_max_x[15:0]								0x0000
	0x	41	09	OFFSET_RECENT_MAX_X_L										
	0x	41	0A	OFFSET_RECENT_MAX_Y_H	R	offset_recent_max_y[15:0]								0x0000
	0x	41	0B	OFFSET_RECENT_MAX_Y_L										
	0x	41	0C	OFFSET_RECENT_MAX_Z_H	R	offset_recent_max_Z[15:0]								0x0000
	0x	41	0D	OFFSET_RECENT_MAX_Z_L										
	0x	41	0E	OFFSET_RECENT_MIN_X_H	R	offset_recent_min_x[15:0]								0x0000
	0x	41	0F	OFFSET_RECENT_MIN_X_L										
	0x	41	10	OFFSET_RECENT_MIN_Y_H	R	offset_recent_min_y[15:0]								0x0000
	0x	41	11	OFFSET_RECENT_MIN_Y_L										
	0x	41	12	OFFSET_RECENT_MIN_Z_H	R	offset_recent_min_Z[15:0]								0x0000
	0x	41	13	OFFSET_RECENT_MIN_Z_L										
	0x	41	14	OFFSET_RECENT_STATE	R							offset_recent_state[		0x00

offset_recent_x	X-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Current X-axis acceleration offset value.

offset_recent_y	Y-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Current Y-axis acceleration offset value.

offset_recent_z	Z-axis acceleration offset	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Current Z-axis acceleration offset value.

offset_recent_ave	Latest temperature	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	°C

*Temperature when the current offset values were calculated.

offset_recent_max_x	Maximum value of X-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Maximum value of X-axis acceleration when the current offset values were calculated.

offset_recent_max_y	Maximum value of Y-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Maximum value of Y-axis acceleration when the current offset values were calculated.

offset_recent_max_z	Maximum value of Z-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Maximum value of Z-axis acceleration when the current offset values were calculated.

offset_recent_min_x	Minimum value of X-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Minimum value of X-axis acceleration when the current offset values were calculated.

offset_recent_min_y	Minimum value of Y-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Minimum value of Y-axis acceleration when the current offset values were calculated.

offset_recent_min_z	Minimum value of Z-axis acceleration when the offset values were acquired	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Minimum value of Z-axis acceleration when the current offset values were calculated.

offset_recent_state	Offset data type	0: Offset during earthquake judgment in Normal Mode 1: Offset from Initial Installation Mode 2: Offset from Offset Acquisition Mode	□

*Information about the mode used to acquire the offset values when the current offset values were calculated.

Self-Diagnostic Data

Item	Register Address			Register Name	R/W	Data								Default Value
						bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
Self-Diagnostic Dada	0x	42	00	SELFTEST_BEFORE_X_H	R	selftest_before_x[15:0]								0x0000
	0x	42	01	SELFTEST_BEFORE_X_L										
	0x	42	02	SELFTEST_AFTER_X_H	R	selftest_after_x[15:0]								0x0000
	0x	42	03	SELFTEST_AFTER_X_L										
	0x	42	04	SELFTEST_BEFORE_Y_H	R	selftest_before_y[15:0]								0x0000
	0x	42	05	SELFTEST_BEFORE_Y_L										
	0x	42	06	SELFTEST_AFTER_Y_H	R	selftest_after_y[15:0]								0x0000
	0x	42	07	SELFTEST_AFTER_Y_L										
	0x	42	08	SELFTEST_BEFORE_Z_H	R	selftest_before_z[15:0]								0x0000
	0x	42	09	SELFTEST_BEFORE_Z_L										
	0x	42	0A	SELFTEST_AFTER_Z_H	R	selftest_after_z[15:0]								0x0000
	0x	42	0B	SELFTEST_AFTER_Z_L										
	0x	42	0C	SELFTEST_T_AVE_H	R	selftest_t_ave[15:0]								0x0000
	0x	42	0D	SELFTEST_T_AVE_L										
	0x	42	0E	SELFTEST_ERROR	R								selftest_error	0x00

selftest_before_x	X-axis reference acceleration	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*X-axis acceleration before the self-diagnostic was run.

selftest_after_x	X-axis self-diagnostic acceleration	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*X-axis acceleration after the self-diagnostic was run.

selftest_before_y	Y-axis reference acceleration	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Y-axis acceleration before the self-diagnostic was run.

selftest_after_y	Y-axis self-diagnostic acceleration	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Y-axis acceleration after the self-diagnostic was run.

selftest_before_z	Z-axis reference acceleration	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Z-axis acceleration before the self-diagnostic was run.

selftest_after_z	Z-axis self-diagnostic acceleration	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	gal

*Z-axis acceleration after the self-diagnostic was run.

selftest_t_ave	Temperature during self-diagnostic	0x8000 to 0x7FFF (-3,276.8 to 3,276.7) *Precision fixed to one digit after the decimal point.	°C

*Temperature during self-diagnostic.

selftest_error	Self-diagnostic result	0: Self-diagnostic OK 1: Self-diagnostic error	–

*The result of the self-diagnostic.

14. Environmental Performance

(1) Low Temperature Exposure

The characteristics in Section 9 are met after the Sensor was exposed to an environment of -40±3°C in a constant temperature chamber for 72 hours.

(2) High Temperature Exposure

The characteristics in Section 9 are met after the Sensor was exposed to an environment of 80±3°C in a constant temperature chamber for 96 hours.

(3) High Temperature & Humidity Exposure

The characteristics in Section 9 are met after the Sensor was exposed to an environment of 40±2°C and 90% to 95% in a constant temperature chamber for 96 hours.

(4) Drop Resistance

The characteristics in Section 9 are met after the Sensor was freely dropped three times on a concrete surface from a height of 1 m.

(5) Vibration Endurance

The characteristics in Section 9 are met after the Sensor was exposed to vibrations with a frequency of 10 Hz to 55 Hz, total amplitude of 1.5 mm, and sweeping in the X, Y, and Z directions for two hours for each axis.

(6) Electrostatic Resistance

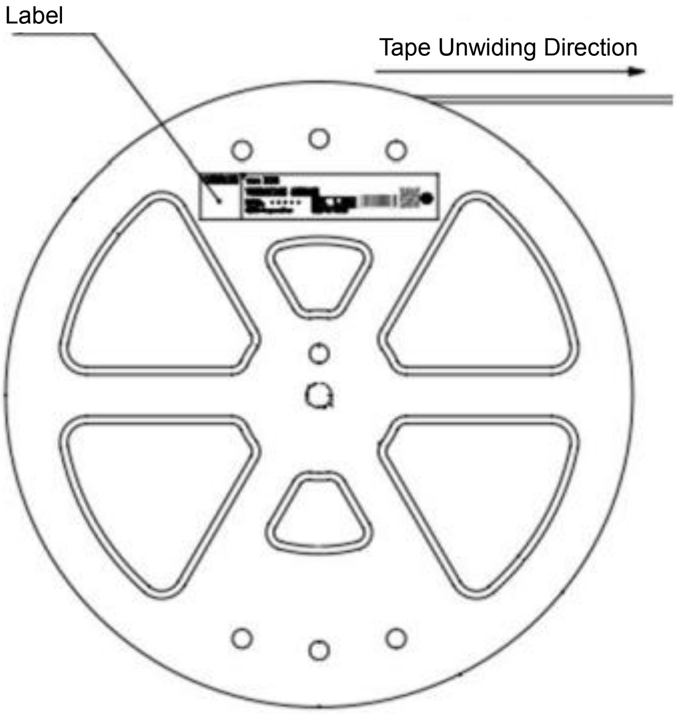
HBM: 1.5 kΩ and 100 pF, no abnormalities with an electrostatic discharge of ±2 kV.

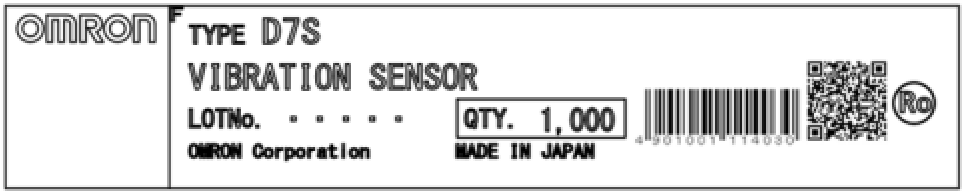
MM: 0 kΩ and 200 pF, no abnormalities with an electrostatic discharge of ±200 V.

Note: After the test ends, the Sensor is measured after it is exposed to ambient temperature and humidity for two hours.

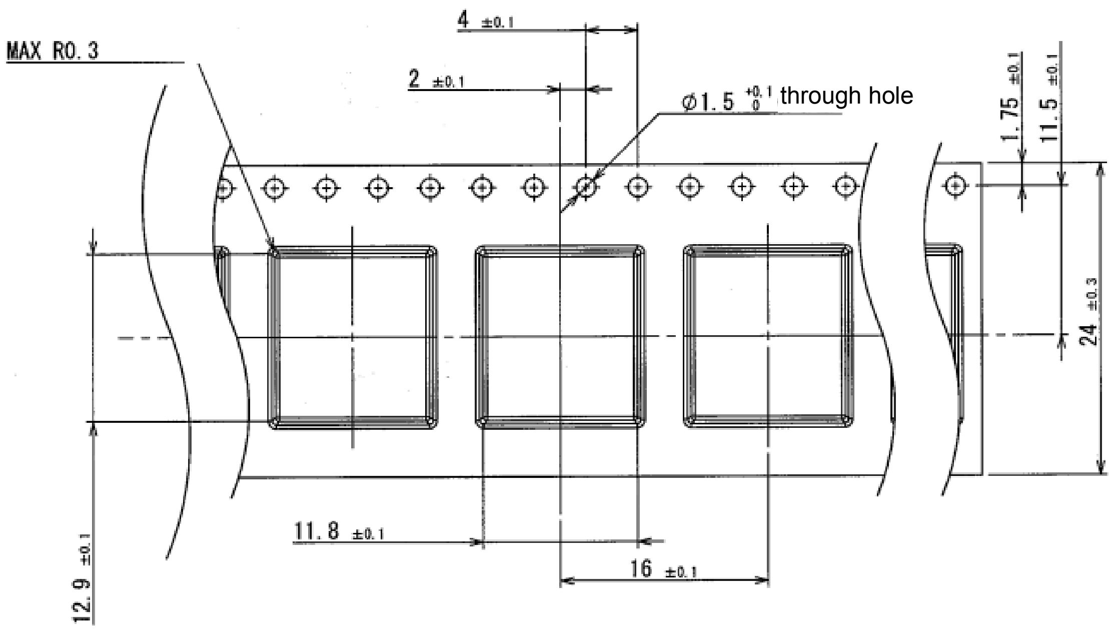
15. Shipped Form

The product is stored on a φ330 reel which stores 1,000 units.
The following diagram shows the appearance of the reel and label.





The following diagram shows the detailed dimensions of the carrier tape.



16. Handling Precautions

(1) Handling the Product

1) Do not use the Sensor in locations with volatile, flammable, or corrosive gas (organic solvent vapor, sulfite gas, chlorine, sulfide gas, ammonia gas, etc.) or other toxic gases. They may cause the Sensor to break down.)
2) Do not use the Sensor in locations subject to fresh water, salt water, water drops, or splattering oil.
3) Do not use the Sensor in an environment where condensation or icing may occur. Moisture freezing on the Sensor may cause output to fluctuate or may cause the Sensor to break down.
4) Do not use the Sensor in locations subject to direct sunlight. Doing so may cause the Sensor to break down.
5) Do not use the Sensor in locations subject to direct radiant heat from heating equipment. Doing so may cause the Sensor to break down.
6) Do not use the Sensor in locations with severe temperature changes. Doing so may cause the Sensor to break down.
7) Do not use the Sensor in environments with excess mechanical stress. Doing so may cause the Sensor to malfunction or break down.
8) Do not use the Sensor in locations with large vibration or shock. These may cause the Sensor to break down.
9) Do not use the Sensor in locations with strong electrical or magnetic fields. These may cause the Sensor to break down.
10) Static electricity can destroy the Sensor. Take countermeasures including grounded work benches, floors, and other charged objects and workers.
11) This Sensor is a precision device. Do not drop it or subject it to excessive shock or force. Doing so could break it or change its characteristics. Do not use the Sensor if it has been dropped.
12) Do not handle the Sensor in locations with excessive vapor, dust, dirt, etc.
13) Do not hold the Sensor with pliers, tweezers, or similar tools, and do not subject components to damage or excessive shock due to inadequate adjustment of the mounter.
14) When placing components near the edge of the PCB or near a connector, make sure that stress is not applied to the Sensor when the device is assembled or when the connector is connected or disconnected.
15) Do not apply any external force to components after soldering until everything has cooled off and do not allow mechanical stress due to PCB warping or other factors.
16) Under some usage conditions, ultrasound may cause the Sensor to resonate and be destroyed. OMRON cannot specify the detailed conditions under which the Sensor will be used, so we assume no responsibility if the Sensor is used in environments where ultrasound is used. If the Sensor must be used in an environment with ultrasound, check its performance in the actual environment beforehand.
17) The Sensor does not contain any protective circuits. Never allow the electrical load to exceed the absolute maximum ratings. Such loads may damage the circuits. If required, install protective circuits so that absolute maximum ratings are not exceeded.
18) Allow as much space as possible between the Sensor and devices that generate surges or high frequencies (such as high-frequency welders and high-frequency sewing machines). Attach a surge protector or noise filter on nearby noise-generating devices (in particular, motors, transformers, solenoids,

magnetic coils, or other devices that have an inductance component).

19) Wire the Sensor away from high-voltage and large-current power lines in order to prevent inductance noise. It is also helpful to separate conduits and ducts and to use shielded cables.

20) When using a switching regulator, power supply switching noise may cause malfunctions, so check this before use.

21) Stress due to plastic hardening may change Sensor characteristics. Do not mold seal the Sensor after mounting.

22) When applying a moisture preventing coating or other coating after mounting the Sensor, select a coating with minimal stress and check operation carefully.

23) Do not attempt to disassemble or modify the Sensor.

24) Do not use the Sensor in safety devices or for applications in which Sensor operation would directly affect human life.

25) Carefully read the precaution in the *Instruction Manual* before using the Sensor.

26) In addition, if you use the Sensor under conditions other than those in these specifications, check Sensor operation under those conditions beforehand.

(2) Transportation and Storage

27) Do not store the Sensor in locations with harmful corrosive gas (organic solvent vapor, sulfite gas, sulfide gas, etc.)

28) The Sensor is not drip proof, so do not store it anywhere that water might get on it.

29) Store the Sensor within appropriate temperature and humidity ranges.

30) Note: Before storing the Sensor in an environment other than the environment recommended by OMRON, evaluate the results in the actual storage environment and judge whether or not storage there is appropriate.

31) Do not store the Sensor in locations with excessive vapor, dust, dirt, etc.

(3) Measures for Product Failures

32) If a failure occurs where the Sensor does not meet these specifications in the receiving inspection at your factory after delivery, and the cause of the failure lies with OMRON, a replacement product will be provided at no charge. In this situation, the Sensors that have been judged as defective will be returned to OMRON.

33) If a failure occurs after your receiving inspection, measures for those Sensors may be decided after negotiations by both parties. As a general rule, Sensors that are rejected from receiving are to be returned to OMRON within 14 days of the receiving date after clearly specifying the details of the failure.

17.Conditions of Use

(4) The definition of terms used in item 17 are as follows:

1) Usage conditions: Usage conditions, rating, performance, operating environment, handling instructions, cautions, prohibited use, etc. of the Vibration Sensors described in the documents such as these Product Specifications, instruction sheets, or user′s manuals.

2) Customer application: Application of the Vibration Sensors by customers which include embedding and/or using the Vibration Sensors in their parts/components, electronic substrates, devices, equipment or systems manufactured by customers.

3) Fitness: (a) fitness, (b) performance, (c) non-infringement of third-party intellectual property, (d) compliance

with laws and regulations and (e) conformity to standards.

(5) Caution on Descriptions

Attention is required to the following points on descriptions in these Product Specifications.

1) Rated values and performance values are the product of tests performed for separate single conditions, including but not limited to temperature and humidity. It is not intended to warrant rated values and performance values for multiple combined conditions.
2) Reference data are provided for reference only. Omron does NOT warrant that the Vibration Sensors work properly at all time in the range of reference data.
3) Application examples are provided for reference only. Omron does NOT warrant the fitness of the Vibration Sensors under such application.
4) Omron may discontinue the production of the Vibration Sensors or change the specifications of them for the purpose of improving such products or other reasons entirely at its own discretion.

(6) Please be aware of and accept the following when you introduce or use the Vibration Sensors:

34) Please use the Vibration Sensors in compliance with usage conditions including rating and performance.
35) Please confirm fitness of the Vibration Sensors in your application and use your own judgment to determine the appropriateness of using them in such application. Omron shall not warrant the fitness of the Vibration Sensors in customer application.
36) Please confirm that the Vibration Sensors are properly wired and installed for their intended use in your overall system.
37) When using the Vibration Sensors, please make sure to (i) maintain a margin of safety vis- -vis the published rated and performance values, (ii) design to minimize risks to customer application in case of failure of the Vibration Sensors, such as introducing redundancy, (iii) introduce system-wide safety measures to notify risks to users, and (iv) conduct regular maintenance on the Vibration Sensors and customer application.
38) The Vibration Sensors are designed and manufactured as general-purpose products for use in general industrial products. They are not intended to be used in the following applications. If you are using the Vibration Sensors in the following applications, Omron shall not provide any warranty for such Vibration Sensors. Even in the case of the following applications to elevator/lift equipment and medical devices, etc, some case are likely applied to an usual guarantee prescribed on next article as general-purpose products used for general industrial products. So, please contact our sales person in charge.
    (a) Applications with stringent safety requirements, including but not limited to nuclear power control equipment, combustion equipment, aerospace equipment, railway equipment, elevator/lift equipment, amusement park equipment, medical equipment, safety devices and other applications that could cause danger/harm to people body and life.
    (b) Applications that require high reliability, including but not limited to supply systems for gas, water and electricity, etc., 24 hour continuous operating systems, financial settlement systems and other applications that handle rights and property.
    (c) Applications under severe conditions or in severe environment, including but not limited to outdoor equipment, equipment exposed to chemical contamination, equipment exposed to electromagnetic interference and equipment exposed to vibration and shocks.

(d) Applications under conditions and environment not described in these Product Specifications.

39) In addition to the applications listed in (a) to (d) above, the Vibration Sensors are not intended for use in automotive applications (including two wheeled vehicles). Please do NOT use the Vibration Sensors for automotive applications. Please contact Omron sales staff for products for automotive use.

(7) The terms and conditions for warranty of the Vibration Sensors are as follows:

1) Warranty period: One year after the purchase.
2) Coverage: Free replacement of the malfunctioning Vibration Sensors with the same number of replacement/alternative products.
3) Exceptions: Omron will not cover the Vibration Sensors under its warranty if the cause of the malfunction falls under any of the following:
   (a) Usage in a manner other than the original intended use for the Vibration Sensors.
   (b) Usage outside of the usage conditions.
   (c) Modification or repair made to the Vibration Sensors by other than Omron personnel.
   (d) Software program embedded by other than Omron or usage of such software.
   (e) Causes which could not have been foreseen with the level of science and technology at the time of shipping from Omron.
   (f) Causes originating from other than Omron or the Vibration Sensors (including force majeure such as but not limited to natural disasters).

(8) Limitation of Liability

The warranty set out in these Terms and Conditions is the whole and sole liability for the Vibration Sensors. There are no other warranties, expressed or implied. Omron and the distributors of the Vibration Sensors are not liable for any damages which may arise from or be related to the Vibration Sensors.

(9) Export Controls

Customers of the Vibration Sensors shall comply with all applicable laws and regulations of Japan and/or other relevant countries with regard to security export control, when exporting the Vibration Sensors and/or technical documents or providing such products and/or documents to a non-resident.

Omron may not provide customers with the Vibration Sensors and/or technical documents should they fail to comply with such laws and regulations.

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