SS-WALL-TH

User Manual

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Introduction

The SS-WAL-TH and SS-WALL-C-TH is a 1-Wire™ slave (referred to as “subscriber” for the rest of the manual) housing a SI17021 temperature and humidity sensor. The SS-WALL-TH contains the electronics to interface to a 1-Wire™ network to communicate with a 1-Wire™ master (referred to as “Publisher” for the rest of the manual).

Copyright Notices

Contact Information

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Description

The SS-WALL-TH is part of iButtonLink's family of temperature and humidity sensors. This device houses a SI17021 temperature and humidity sensor, which can be communicated with using a 1-Wire™ publisher. The sensor comes with pre-stripped 18-gauge wires for easy connection using wire nuts.

The SS-Wall-TH uses iButtonLink smart sensor technology to embed a microprocessor into a 1-Wire® sensor, which gives the product more accurate sensing abilities than in other 1-Wire® humidity sensor designs.

Casing and Part Numbers

There are two versions of the SS-WALL-TH. In this manual, they are both referred to as the SS-WALL-TH because they both use the same commands. That part numbers are found below:

- The SS-WALL-TH **has no case** that inserts it into walls

- The SS-WALL-C-TH **has a case that can be embedded into walls or fixtures** to monitor temperature and humidity using a simple insert design. The case has a threaded wall holder that can be screwed into drywall with a few twists, allowing the sensor body to slide in and be almost flush with the wall. A small opening in the front allows the sensor to measure the temperature and humidity; this opening should **never** be covered or filled.

Wire Colors and Power

The SS-WALL-TH interfaces with 1-Wire™ using three 20-gauge wires connected to the 1-Wire™ bus, +, -, and 5V signals with wire nuts.

The wire colors are as follows:

- Red = 5 volt
- Black = Ground
- Blue = 1-Wire™ Data

The SS-WALL-TH requires 5-volt power for normal operation.

Operating Range

SS-WALL-TH

The sensor has a maximum operating temperature range of -40°C to +85°C.

The sensor will work in 0 – 100% relative humidity (non-condensing). While the sensor does have a HDPE cover to protect it from occasional condensation, exposure to frequent condensation is not recommended. T

SS-WALL-C-TH

The sensor has a maximum operating temperature range of -40°C to +50°C. The +50°C upper limit is due to the PLA plastic case, which may deform at higher temperatures.

The sensor will work in 0 – 100% relative humidity (non-condensing). While the sensor does have a HDPE cover to protect it from occasional condensation, exposure to frequent condensation is not recommended. The humidity sensor's accuracy is typically minimum ±2% and max ±3.5% from 0 – 80% RH, with a max error of ±5% above 80% RH.

Like all silicon-based humidity sensors, the SS-WALL-TH does drift over time, and can be adversely affected by continuous exposure to very humid or very dry environments. However, the low maximum drift of 0.5% RH per year allows the sensor to be used for a longer time than other silicon sensors before calibration or testing

Accuracy

For both the SS-WALL-TH and the SS-WALL-C-TH, the humidity sensor's accuracy is typically minimum ±2% and max ±3.5% from 0 – 80% RH, with a max error of ±5% above 80% RH. If operated above 95% RH, at significantly higher temperatures, or both the error rate may increase dramatically, especially when operated at higher temperatures and for longer times. The absolute maximum ratings of the SS-WALL-TH or the SS-WALL-C-TH should always be observed even if an accuracy is specified for a higher, or lower, temperature than is described in the Absolute Maximum Ratings.

Like all silicon-based humidity sensors, the SS-WALL-TH and the SS-WALL-C-TH do drift over time and can be adversely affected by continuous exposure to very humid or very dry environments. However, the low maximum drift of 0.5% RH per year allows the sensor to be used for a longer time than other silicon sensors before calibration or testing.

Error Conditions

The SS-WALL-TH and SS-WALL-C-TH do not mask error conditions. The reported value of the sensor is passed on even if the value is out of the expected range. This feature is provided to allow error conditions to be detected. However, it can lead to results that do not appear to make sense.

Family Code and Serial Number

iButtonLink SmartSubscriber™ devices have a family code of 0xFE. The high twelve bits of the 1-Wire™ address contain a 0x002 indicating that this subscriber is produced by iButtonLink, LLC.

SmartSubscribers™ produced by iButtonLink have a serial number in the form "CC002xxxxxxxxxFE," where:

- "CC" is the CRC8 of the next 7 bytes, "002" is the manufacturer code assigned to iButtonLink, LLC by Maxim Integrated Products, Inc. and
- "0xFE" is the family code indicating that the subscriber is NOT produced by Maxim

Integrated Products, Inc.

- “xxxxxxxxx” (36 bits) is the unique serial number for all SmartSubscriber™ produced by iButtonLink.

It is impossible to infer the functionally of a SmartSubscriber™ from the family code or manufacturer ID. A Read Memory (0xF000) command should be issued to acquire the subscriber characteristics byte and software version number (always the 1stand 2nd by of the first memory page).

Each SS-WALL-TH has a unique serial number. The serial number and family code determine that the device is made by iButtonLink, LLC. However, the serial number does not indicate that the device is a temperature and humidity sensor.

To determine the type of iButtonLink, LLC sensor, the publisher should issue “Read Memory” (0xF000) command as shown in the example below.

The first and second byte of the first memory page indicate the device type and software version number. The first byte, byte zero, will contain a “1” if the device is an SS-WALL-TH. The second byte, byte one, will contain the software version number, which is currently 0x10 (16).

Programming the 1-Wire™ System

Four steps are necessary for any 1-Wire™ transaction:

1. Initialization of the bus by reset command
2. Sending a ROM Function command to select a device
3. Sending a command to the subscriber
4. Receiving data from the subscriber (if the command generates data)

This sequence of four steps must be executed twice to retrieve data from the SS-WALL-TH to read the temperature and humidity. The second sequence will read the results from the SS-WALL-TH. **There must be at least one second of delay between the two command sequences to give the SS-WALL-TH time to read the sensor.**

Each step of these sequences will be detailed below with examples to follow.

Initialization of the Bus by a Reset Command

All transactions on the 1-Wire™ bus begin with an initialization sequence. The initialization sequence consists of a reset pulse transmitted by the bus publisher followed by the presence pulse(s). The presence pulse lets the bus publisher know that the SS-WALL-TH is on the bus and ready to operate.

For iButtonLink publishers, the ASCII command is " r " (reset).

> **NOTE:** If a reset is issued in the middle of a 1-Wire transaction when the SS-Wall-TH is selected, a presence pulse will not be issued by the SS-Wall-TH . This will be fixed in future versions of the code. Two possible workarounds are: 1) Always have the SS-Wall-TH on a network with another type of subscriber, 2) Issue the reset twice.

Response	Description	Notes
P	No error; at least one subscriber is on the bus	
N	No error; no subscribers are on the bus.	If a SmartSubscriber™ device is expected to be present on this bus, the wrong bus is selected, there is a wiring issue, there is a power issue, or the device has failed.
S	Short; the 1-Wire™ bus is shorted.	If this error is received, the problem should be addressed by troubleshooting the cabling, T-Boxes, and subscribers on the bus. This is most likely not an issue with the base.
E	Undefined protocol error; this error indicates that a subscriber did not respond properly to the reset or the publisher has an internal problem	If this is a consistent problem, try to power-cycle the publisher or remove subscribers from the bus until the problem is found.

Selecting a Subscriber or Group of Subscribers

Once the bus publisher has detected a presence pulse generated by the reset command, it can issue one of the four ROM function commands. All ROM function commands are 8 bits long. The ROM code to use depends on the number of subscribers on the bus and if the 1-Wire™ addresses of each subscriber are known.

Exactly One Subscriber on the Bus

If the SmartSubscriber™ device is the only subscriber on the bus, a "Skip" ROM [CCh] is the easiest way to address the subscriber. This command selects all the subscribers on the bus; this is only valid if there is exactly one subscriber on the bus.

The proper command on an iButtonLink publisher is ***bCC***.

The " b " tells the publisher to enter "byte mode," where hexadecimal character pairs are sent to the 1-Wire™ bus. The publisher echoes the response from the bus; this response should be the same as the issued command. **Table 1** below gives an example of the "Skip" ROM command sequence.

Full Command	Send	Receive	Notes
Skip ROM	*rbCC*	*P* *CC*	Response to reset "r." Subscriber is present. When in byte mode, the Link returns characters received.
Command Breakdown:			
Reset	*r*	*P*	
Byte Mode	*b*		No characters returned in response.
Skip ROM Function Command	CC	CC	

Figure 1: Full command and command breakdown of "Skip" ROM

NOTE: If the received data returned from the Link does not match the above examples, the command has not been sent to the bus properly. This can be due to noise, a subscriber error, a short, or other external conditions. The command should be retired and, if the failure continues, the bus should be repaired.

Multiple devices on the bus and the SmartSubscriber™ device address is known

If there are multiple subscribers on the bus and the address of the subscriber of interest is known, then a "Match" ROM [55h] function command should be used. To use the "Match" ROM command, the order of the 1-Wire™ address byte must be reversed. **Table 2** below shows an example of this.

1-Wire™ address to be selected as labeled	**1000021B1000001FE**	
1-Wire™ address to be selected split into bytes	**10 00 21 B1 00 00 01 FE**	
1-Wire™ address to be selected with bytes in reverse order	**FE 01 00 00 B1 21 00 10**	
1-Wire™ address to be selected as used in publisher commands	**FE010000B1210010**	
Full Command	**Send:** ***rb55FE010000B1210010***	
Response	***P*** ***55FE010000B1210010***	Response to reset "r". Subscriber is present. When in byte mode, the Link returns characters received.
Command Breakdown:		
Reset	Send ***r*** Receive ***P***	
Byte mode	Send ***b*** No characters are returned in response.	
Match ROM Function	Send ***55*** Receive ***55***	
1-Wire™ address reversed	**Send:** ***FE010000B1210010***	

Figure 2: Example of using the "Match" ROM function to select a subscriber

Multiple subscribers on the bus and the address of the SmartSubscriber™ device is NOT known

There are multiple ways to get the address of a 1-Wire® subscriber. In the IBM environment, there are three ways. These are:

1. Scan the barcode on the sensor. All production sensors will have a label with a barcode. Scanning the barcode will obtain the address or the address may be read from below the barcode.

2. Connect the subscriber to the publisher and issue the " f " ("first") command. This will display the first 1-Wire™ subscriber address on the bus. Then, issue the " n " ("next") command to show the next 1-Wire™ subscriber address. If there is only one subscriber on the bus and the publisher does not have an ID chip, you will get one result. If the publisher does have an ID chip, perform the "first" and "next" commands, then remove the subscriber and issue the same " f " and " n " commands. Look at the difference and the missing ID will be the one needed.

NOTE: All SmartSubscriber™ units have an ID that ends with "FE."

The SS-WALL-TH can perform four basic functions:

1. Read and convert data from the sensor
2. Display results
3. Turn on its LED light
4. Turn off its LED light

Read and Convert Data from the Sensor

In order to tell in the SS-WALL-TH to read the temperature and humidity sensors, the convert command [B4h] must be sent. This will tell the SS-WALL-TH to read both the temperature and humidity sensors and store the results in the local RAM on the SmartSubscriber™. This process takes a little less than one second, so the SS-WALL-TH will not respond for a second after the command is issued. Examples of this can be found below.

1-Wire™ address to be converted as labeled	**1000 21 B1 00 00 01 FE**
1-Wire™ address to be converted split into bytes	**10 00 21 B1 00 00 01 FE**
1-Wire™ address to be converted with bytes in reverse order	**FE 01 00 00 B1 21 00 10**
1-Wire™ address to be converted as used in publisher	**FE010000B1210010**
Full Command	**Send:** ***rb55FE010000B1210010B4***

Response	***P*** *55FE010000B1210010B4*	Response to reset “r”. Subscriber is present. When in byte mode, characters received by the Link are returned.
Breakdown of command as follows:		
Reset	Send *r* Receive *P*	

Byte mode	Send *b* No characters are returned in response.
Match ROM Function	Send *55* Receive *55*
1-Wire™ address reversed	Send: ***FE010000B1210010*** Receive: ***FE010000B1210010***
Send Convert command	Send: *B4* Receive: *B4*
Send a <CR> to end Byte mode	A <CR><LF> pair is returned.
Wait one second before additional commands.	

Figure 3: The SS-WALL-TH reading data from the temperature and humidity sensor using the "Match" function.

Full Command	**Send: *rbCCB4***	
Response	***P*** ***CCB4***	Response to reset "r". Subscriber is present. When in byte mode, characters received by the Link are returned.
Breakdown of command as follows:		
Reset	Send *r* Receive *P*	
Byte mode	Send *b* No characters are returned in response.	
"Match" ROM Function	Send *CC* Receive *CC*	
1-Wire™ address reversed	Send: ***FE010000B1210010*** Receive: ***FE010000B1210010***	
Send "Convert" command	Send: *B4* Receive: *B4*	
Send a <CR> to end Byte mode	A <CR><LF> pair is returned.	
Wait one second before additional commands.		

Figure 4: The SS-WALL-TH being told to read the sensors if it is the only subscriber on the bus using the "Skip" function.

Sending Data from the Sensor to the Publisher

The "Read Memory Page" command tells the SS-WALL-TH to return data to the publisher. 32 bytes of data are returned. The format of the returned data from the "Read Memory Page" is found in the table below.

Example String:		Sent: b55FE010000B1210010F000m Received: P Received: **55FE010000B1210010F000** **04120000 0D9614D52B3032372E31372B3038302E39312B3034312E3636000 000A513**	
Word	**Byte**	**Example**	**Contents**
0	0	04	IBL Subscriber type (always 4 for the SS-WALL-TH)
	1	12	Subscriber software version number (two nibbles … high nibble is version number, low nibble is minor release number. The initial release of the SS-WALL-TH contains an 0x12 (high nibble of 1, low nibble of 2)
1	2	00	Conversion status. Must be zero for a valid conversion.
	3	00	Conversion status. Must be zero for a valid conversion.

2	4	0D	Binary temperature in Celsius. High byte. Conversion formula is .0078125 * (temperature high byte * 256 + temperature low byte)/125. Negative values are in binary 2's complement. . If unfamiliar with binary 2's complement, then add the following code:
			
			If (TemperatureCelsius > 128.8592749023438)
			{
			TemperatureCelsius = 128.8592749023438 – TemperatureCelsius;
			}

	5	96	Binary temperature in Celsius. Low byte.

3	6	14	Binary relative humidity. High byte. Conversion formula is Humidity = 0.0078125 * (humidity high byte * 256 + humidty low byte)
			
			OR
			
			Humidity = (humidity high byte * 256 + humidity low byte)/128
			
			Negative values are in binary 2's complement. If unfamiliar with binary 2's complement, then add the following code:
			
			If (humidity > 118.9923706054688)
			{
			humidity = 118.9923706054688 – humidity;
			}

	7	D5	Binary relative humidity. Low byte.
4	8	2B	Temperature in Celsius sign in ASCII
	9	30	Temperature in Celsius 100's digit in ASCII
5	10	32	Temperature in Celsius 10's digit in ASCII
	11	36	Temperature in Celsius 1's digit in ASCII
6	12	2E	Temperature in Celsius decimal point in ASCII
	13	37	Temperature in Celsius 0.1's digit in ASCII
7	14	35	Temperature in Celsius 0.01's digit in ASCII
	15	2B	Temperature in Fahrenheit sign in ASCII
8	16	30	Temperature in Fahrenheit 100's digit in ASCII
	17	37	Temperature in Fahrenheit 10's digit in ASCII
9	18	39	Temperature in Fahrenheit 1's digit in ASCII
	19	2E	Temperature in Fahrenheit decimal point in ASCII
10	20	33	Temperature in Fahrenheit 0.1's digit in ASCII
	21	31	Temperature in Fahrenheit 0.01's digit in ASCII
11	22	2B	Relative Humidity sign in ASCII
	23	30	Relative Humidity 100's digit in ASCII
12	24	33	Relative Humidity 10's digit in ASCII
	25	36	Relative Humidity 1's digit in ASCII
13	26	2E	Relative Humidity decimal point in ASCII
	27	36	Relative Humidity 0.1's digit in ASCII
14	28	33	Relative Humidity 0.01's digit in ASCII
	29	00	Reserved
15	30	00	Reserved
	31	00	Reserved
16	32	A5	CRC16 of preceding 32 bytes (LSB)
	33	13	CRC16 of preceding 32 bytes (MSB)

Figure 5: Data return from F0 Read Memory Page command

The following two examples show a complete Read Memory Page command sequence.

If a convert command immediately preceded this command, wait one second.		
Full Command	Send: ***rbCCF000m***	
Response	***P*** ***CCF000*** 0110000000C05EE7A099D50C 00000000000000000000000000 0000000000150009CC7	Response to reset " r ". Subscriber is present. Characters entered in byte mode are echoed. Return data is sent from F000m command.
Breakdown of command as follows:		
Reset	Send ***r*** Receive ***P***	
Byte mode	Send ***b*** No characters are returned in response.	
SkipROM Function Command	Send ***CC*** Receive ***CC***	
Send Read Memory Page command	Send: ***F000m*** Receive: ***F000***0110000000C05EE7A099D50C00 00000000000000000000000000000000000015009CC7	
Send a <CR> to end Byte mode	A <CR><LF> pair is returned.	
Wait one second before additional commands.		

Figure 6: "Read Memory Page" command example using "Skip" ROM selection. This can only be used if there is one subscriber on the bus.

If a convert command immediately preceded this command, wait one second.		
1-Wire™ address to be converted as labeled	1000 21B1 0000 01FE	
1-Wire™ address to be converted split into bytes	10 00 21 B1 00 00 01 FE	
1-Wire™ address to be converted with bytes in reverse order	FE 01 00 00 B1 21 00 10	
1-Wire™ address to be converted as used in publisher commands	FE010000B1210010	
Full Command	Send: ***rb55FE010000B1210010F000m***	
Response	***P*** ***55FE010000B1210010F000*** 0110000000C05EE7A099D50C00000000000000000000000000000000015009CC7	Response to reset " r ". Subscriber is present. Characters entered in byte mode are echoed. Return data is sent from F000m command.
Breakdown of command as follows:		
Reset	Send ***r*** Receive ***P***	
Byte mode	Send ***b*** No characters are returned in response.	
Match ROM Function Command	Send ***55*** Receive ***55***	
1-Wire™ address reversed	Send: ***FE010000B1210010*** Receive: ***FE010000B1210010***	
Send Read Memory Page command	Send: ***F000m*** Receive: ***F000***0110000000C05EE7A099D50C00000000000000000000000000000000015009CC7	
Send a <CR> to end Byte mode	A <CR><LF> pair is returned.	
Wait one second before additional commands.		

Figure 7: "Read Memory Page" command example using "Match" ROM selection

Turn off/on the LED

This command can be used to turn on the LED on the SS-WALL-TH.

Full Command	**Send: *rbCCA50001***	
Response	***P*** ***CCA50001***	Response to reset " r ". Subscriber is present. Characters entered in byte mode are echoed.
Breakdown of command as follows:		
Reset	Send ***r*** Receive ***P***	
Byte mode	Send ***b*** No characters are returned in response.	
SkipROM Function Command	Send ***CC*** Receive ***CC***	
Send LED control command	Send: ***A50001*** Receive: ***A50001***	0001 = Turn on LED
Send a <CR> to end Byte mode	A <CR><LF> pair is returned.	

Figure 8: This command will cause the SS-WALL-TH to turn on its LED if it is the only subscriber on the bus. This uses the "Skip" ROM function.

This command can be used to turn off the LED on the SS-WALL-TH.

Full Command	**Send: *A50000***	
Response	***P*** ***CCA50000***	Response to reset " r ". Subscriber is present. Characters entered in byte mode are echoed.
Breakdown of command as follows:		
Reset	Send ***r*** Receive ***P***	
Byte mode	Send ***b*** No characters are returned in response.	
SkipROM Function Command	Send ***CC*** Receive ***CC***	
Send LED control command	Send: ***A50000*** Receive: ***A50000***	0000 = turn off LED
Send a <CR> to end Byte mode	A <CR><LF> pair is returned.	

Figure 9: This command will cause the SS-WALL-TH to turn off its LED if it is the only subscriber on the bus. This uses the "Skip" ROM function.

Glossary of Terms

#

<CR>

A single ASCII carriage return

<LF>

Line feed; a single ASCII line feed character that indicates the line should be scrolled

A

ASCII

Coding language

H

HDPE

High-density polyethylene

M

Master

The device that communicates with the slaves (subscribers) and communicates the information from the slaves (subscribers) to another source. Also referred to as Publisher in this manual.

P

Publisher

The device that communicates with the slaves (subscribers) and communicates the information from the slaves (subscribers) to another source. Also referred to as Publisher in this manual.

R

ROM

Read-only memory

S

Slave

Sensors that communicate with the master (publisher)

Subscriber

Sensors that communicate with the master (publisher)

Revision History

Date	Revision	Initials
7.24.17	• Complete document revision	SI
1.31.18	• Updated formula for humidity conversion and temperature range, as well as accuracy and temperature ratings	SI