SPS1M-EVK

SPS1M-EVK Battery Free Wireless Sensor Handheld Evaluation System

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EVAL BOARD USER'S MANUAL

Introduction

This guide describes how to use the Handheld Evaluation System to carry out sensor measurements using Magnus®–S technology. The system consists of the handheld reader, charger, cradle, and sample sensor tags.

The reader is pre−loaded with application software which reads sensor tags and reports results with a single button click. If the reader sees more than one sensor tag, it will measure the tag with the highest reported received power, and ignore the others.

The cradle is used for connecting the reader to a PC. This is generally only required for updating the software on the reader; it is not necessary for normal use. The reader has a power plug for charging without the cradle. To use the cradle, plug in the USB cable and power cable to the back of the cradle, and connect the USB cable to the PC. Insert the reader vertically into the cradle and then rotate the reader backward to lock it in place (Figure 1).

Figure 1. Connecting the Reader to the Cradle

When the reader is connected, Windows should automatically install the driver necessary to communicate with it, and the Windows Mobile Device Center will launch. Access the reader memory by selecting "Connect without setting up your device", and then "Browse the contents of your device" under "File Management". See Figure 2.

If Windows does not recognize the reader, install the driver software in the WinDriverInstall folder provided with this Evaluation System.

Figure 2. Accessing Reader Memory through a PC Connection

Launching Sensor Software

To launch the handheld Sensor software, double−click the “My Device” icon on the Desktop. Then double−click “Flash”, then the “Sensor_xxxxx” folder, and finally the “Sensor” icon as shown in Figure 3.

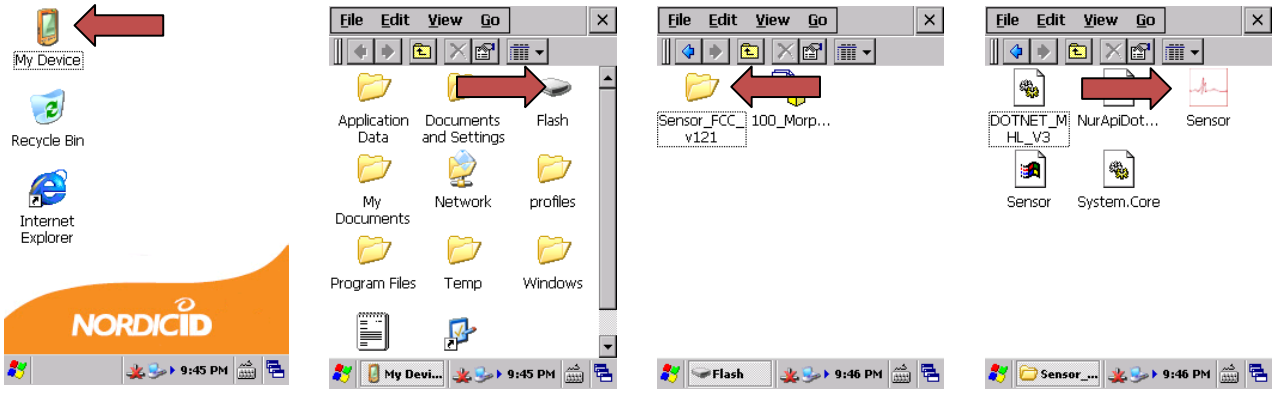

Figure 3. Launching the Sensor Software

At startup, the handheld screen looks like the screenshot in Figure 4. The following controls are available:

- **Read** button: Starts the sensor read process. Pressing the round yellow button on the keypad also starts a read
- **Setup** button: Opens the Setup screen with additional controls
- **Sound** button: Toggles on and off the beep which sounds when a read is complete

The battery indicator is at the bottom of the screen. It gives the battery charge percentage or reads “Charging” when the unit is plugged in.

Figure 4. Main Screen

The Setup screen is shown in Figure 5.

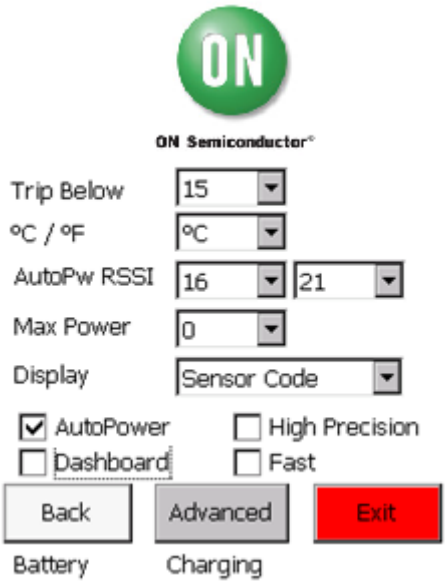

Figure 5. Setup Screen

The following controls are available:

- **Buttons**
  - **Back**: Returns to the main screen
  - **Advanced**: Opens the Advanced screen with additional settings
  - **Exit**: Quits the application
- **Pulldowns**
  - **Trip Below**: When the measured Sensor Code is lower than this value, the main screen can optionally display a message and a background color
  - **°C / °F**: For temperature measurements, chooses Celsius or Fahrenheit units

- **AutoPw RSSI**: Sets the minimum and maximum target values for the AutoPower feature. See Section 2.6.
- **Max Power**: Sets the maximum power level the unit will use. *Larger numbers correspond to lower powers.*
- **Display**: Sets the output type to be displayed when the read completes. See Section 2.5.

- **Checkboxes**
  - **Autopower**: Activates the AutoPower function. See Section 2.6.
  - **Dashboard**: Replaces the logo with the Dashboard which provides more detailed information about the result of a sensor tag read. See Section 2.7.
  - **High Precision**: Activates High Precision mode. In this mode, the unit will make 30 read attempts before displaying the results. This mode is recommended for temperature measurements and for Sensor Code measurements when precise values are desired. When turned off, 10 reads are attempted.
  - **Fast**: Activates Fast mode. This mode will display a result as quickly as possible, at the cost of lower precision.

The Advanced screen is shown in Figure 6.

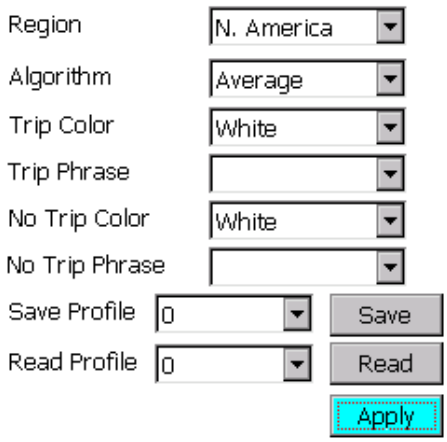

Figure 6. Advanced Screen

The following controls are available:

- **Pulldowns**
  - **Region**: Sets the RFID frequency band to use. Setting to a band not corresponding to the reader hardware will result in reduced performance.
  - **Algorithm**: Sensor Code values generally vary linearly with the frequency channel on which they are read. This pulldown selects whether the final result will be the average of the individual reads, or will be computed by performing a linear regression analysis on the data. See Application Note AN006 for more information.
  - **Trip Color**: If the Sensor Code result is below the trip value defined in the Setup screen, the result will displayed with this background color.
  - **Trip Phrase**: If the Sensor Code result is below the trip value defined in the Setup screen, this phrase will be displayed.
  - **No Trip Color**: If the Sensor Code result is above the trip value defined in the Setup screen, the result will displayed with this background color.
  - **No Trip Phrase**: If the Sensor Code result is above the trip value defined in the Setup screen, this phrase will be displayed.
  - **Save Profile**: Settings can be saved to one of five profiles, which will be stored on text files in Flash memory. This pulldown selects the profile number to be saved to. *Any settings saved to profile 0 will be loaded automatically when the application is launched.*
  - **Read Profile**: Selects the stored settings profile number to be read from.
- **Buttons**
  - **Save**: Save settings to the selected profile number
  - **Read**: Load settings from the selected profile number
  - **Apply**: Applies any changed settings and returns to the Setup screen

Result Types

The unit can display three different types of results: the Sensor Code, temperature, and the On-Chip RSSI Code.

Sensor Code

The Sensor Code is a value between 0 and 31 for Magnus−S2 tags, and between 0 and 511 for Magnus−S3 tags. It varies depending on the environment of the tag and can be used to sense multiple quantities depending on the design of the tag antenna.

On-Chip RSSI Code

The On−Chip RSSI Code is a value between 0 and 31 which indicates how much power the tag is receiving from the reader (higher values indicate more power). The On−Chip RSSI code is used by the AutoPower function to control the amount of power the unit transmits to the tag.

Temperature

The unit can read the temperature code from the tag and convert it to a value in degrees C or F. To perform the conversion, the unit automatically reads temperature calibration information stored in the Magnus−S chip. Only Magnus−S3 tags support temperature measurements.

AutoPower and On-Chip RSSI

Sensor and temperature results can be distorted if the sensor tag receives high levels of power from the reader (see Application Note AN006 for more information). Because of this, the reader transmit power should be reduced if the

sensor tag is receiving enough power to cause distortion. The power should not be turned down too low, however, or reads could become unreliable. The AutoPower function addresses this issue, and it is recommended that AutoPower be turned on for sensor and temperature measurements.

The AutoPower function measures the power received by the sensor tag by reading the On− Chip RSSI Code. It then adjusts the reader transmit power and attempts to achieve an On− Chip RSSI value within the range specified in the AutoPower RSSI pulldowns in the Setup screen. The recommended minimum and maximum target On-Chip RSSI values are 16 and 21.

AutoPower attempts to quickly find a transmit power which results in an On-Chip RSSI within the target range, but is not guaranteed to succeed. If the average On-Chip RSSI value reported from the tag is outside the target range, a warning triangle will appear with the message “RSSI target not met”. If the On-Chip RSSI exceeds the upper target limit, the accuracy of the sensor or temperature measurement could be impacted.

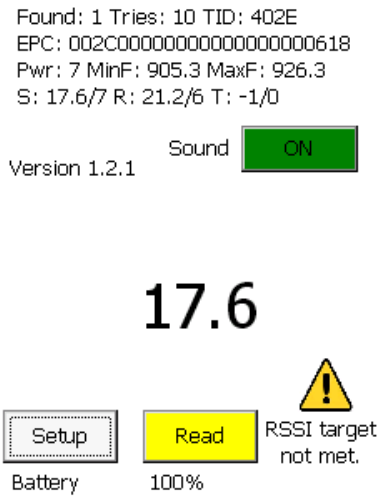

Figure 7. RSSI Target Not Met Warning

Dashboard

When the Dashboard is turned on, the logo is replaced by more detailed information about the measurement. This is explained in Figure 8.

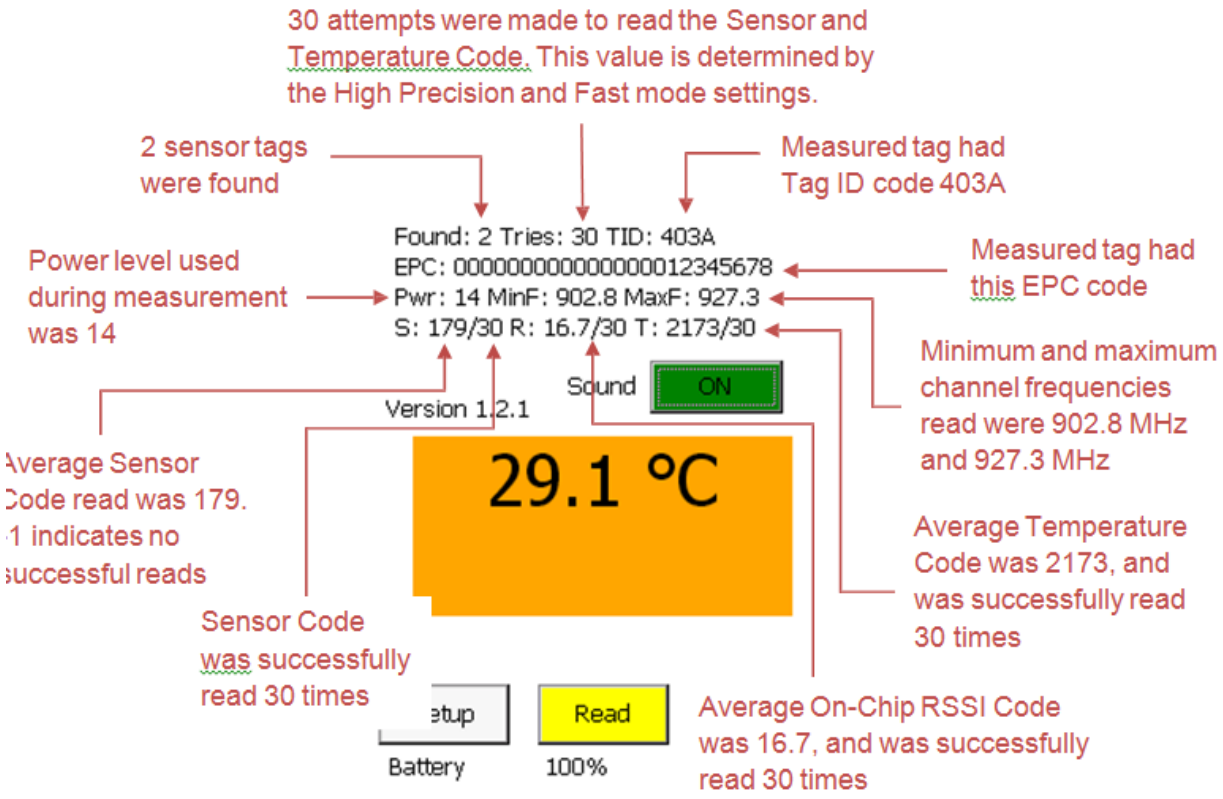

Figure 8. The Dashboard Feature

Read Counts

An individual measurement consists of multiple Sensor or Temperature Code reads. Taking multiple readings corrects for channel-frequency dependence in the Sensor Code and reduces random noise in the sensor and temperature measurements.

It is possible for some of the reads in a measurement to fail. The reader will report a result if only some reads succeed, but the accuracy of the result may be reduced. If fewer than half of the read attempts in a measurement are successful, a warning triangle will appear with the message “Few reads” (Figure 9). The Dashboard can be used to determine how many reads succeeded in a measurement.

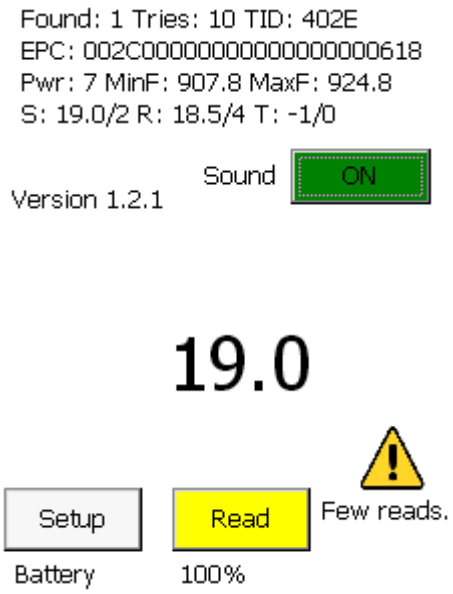

Figure 9. The “Few reads” Warning

Making Measurements

Antenna Orientation

The reader antenna must extended (folded out from the reader body) before reading tags. The RF beam is directed outward and perpendicular to the face of the antenna. The reader antenna should be aimed at the sensor tag, and the tag oriented such that its long axis is perpendicular to the RF beam (Figure 10).

Figure 10. Proper Reader Antenna and Tag Orientation

Read Time

The read process begins when the yellow read button on the touch screen or keypad is pressed. A progress bar will appear on the screen to indicate the progress of the read. The read process can take up to several seconds to complete. The reader should be held still during the read process. Click the Cancel button to stop the read process before it completes (Figure 11).

Figure 11. The Read Progress Bar and Cancel Button

Maximum Read Range

The maximum distance at which a tag can be read depends on the design of the tag and the surface it is placed upon. Also, nearby objects can reflect the reader signal and cause multipath interference. Because of factors like these, the maximum read range cannot be precisely predicted in advance. In general, the handheld reader is designed to read tags from a distance of 1 to 2 meters.

Temperature Measurements

Temperature can be read from the Magnus−S3−based sensor tag. Set the Display value in the Setup screen to Temperature. High Precision and AutoPower mode will be automatically selected.

Moisture Measurements

Moisture measurements can be made with the Moisture Sensor tag. Set the Display value in the Setup screen to Sensor Code. AutoPower mode will be selected by default. The presence of moisture on the interdigitated capacitor of the tag will change the Sensor Code reading. Generally, moisture will cause a reduction in the Sensor Code value. The surface on which the tag is placed can also affect the Sensor Code, so the tag should stay in the same place under both dry and wet conditions. Illustrative results are given in Figure 12.

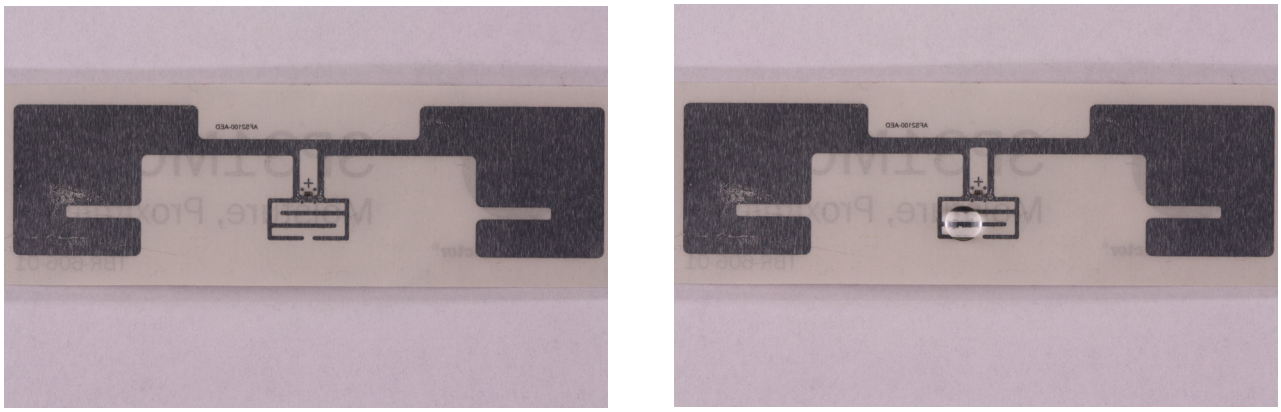

Figure 12. Sensor Code changes when a water droplet is placed on the tag

The Moisture Sensor tag can also detect a fine mist sprayed or wiped on the interdigitated capacitor area.

Troubleshooting

If the reader cannot read sensor tags, or only reads tags from a short distance, try the following steps

- Verify that the maximum reader power is set to 0.
- Move the tag to a different location or surface
- Rotate the reader 45 degrees while still pointing the surface of the antenna at the sensor tag
- Fully recharge the reader
- Reset the reader as described in Section 4.1.

Resetting the Reader

The reader can be reset to its factory settings with the process below. This will not delete the Sensor software from the flash memory.

1. Exit out of any application that may be running.
2. Start Nordic ID's demo program: **Start → Programs → RFID → RFID Demo**
3. Restore factory defaults: **Settings → Save → Factory default → Save Settings**
4. Exit the demo program: **Main Menu → Exit**
5. Reset Windows Registry to default: **Start → Programs → Nordic ID → Registry Backup → Factory Default → Defaults → Yes**
6. Reload Windows CE: Push the power button in the lower right-hand corner of the keypad, select "Reload Windows CE", then click "Reload" in the lower left-hand corner of the screen. Follow the instructions to re-calibrate the stylus input.

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