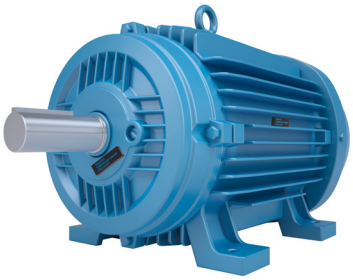
Predictive Maintenance System

Temperature Monitoring



Motors not included

APPLICATIONS

Protect mechanical plants

Ensure efficient operation

Predictive maintenance

Monitor electric motors

Monitor HVAC efficiency

Monitor AC switchgear

KEY FEATURES

Normal sensor range
-40 °C to +85 °C

High-temperature alarm
up to +125 °C

Small sensor size
25.4 x 9.1 x 3.2 mm

Integrated software

What's in the system?

This portable predictive maintenance system allows maintenance teams to monitor equipment operating temperatures, and it alerts on out-of-range performance when equipment exceeds baseline alarms. For frequently restarted equipment subject to overheating risks, the system includes restart alarm settings to alert when additional cooling time is needed. The system includes a handheld reader with software for Smart Passive Sensing™ devices, as well as rugged RFM3250 temperature sensors for use in industrial and harsh environments.

How is it used?

The system is used in three phases. Each sensor is physically installed on the equipment to be monitored. The location and ID number for each sensor must be assigned or registered with the software. Once the sensor installation is complete, operators can read and record sensor values as needed. Data files from the system enable analysis and historical tracking.

Part numbers

The RFM5104-AF/BF include sensors and a reader conforming to FCC frequency ranges, while the RFM5104-AE/BE conform to EU/ETSI frequency ranges. The RFM5114 system does not include sensors, but additional sensors can be purchased separately.

CONTENTS

1. INTRODUCTION

Thank you for purchasing the RFMicron Predictive Maintenance System. The RFM5104-A/B Predictive Maintenance system enables temperature monitoring for a large number of locations using wireless, battery-free, rugged sensors. A radio-enabled handheld is used to read and record sensor values. The results are saved to a CSV text file that can be can be exported for database and trend analysis.

RFM5114 System Components:

Reader: The reader is used to communicate with the sensors and retrieve their temperatures. The reader runs the Microsoft® Windows® CE operating system and operates in a way that should be familiar to PC users. Morphic and Merlin readers are supported.

Docking Cradle: The docking cradle connects the reader to a PC for transferring files.

Charger and cables: The system includes a DC charger and a USB cable for the reader.

Temperature Scanner Software: The Temperature Scanner software comes preinstalled on the reader and is launched by double-clicking on the icon on the reader desktop screen.

Excel program: Data and sensor files can be easily transferred to and from the reader using an Excel® macro when the reader is in mass storage mode.

The reader also supports a Windows® Mobile Device manager option for computers equipped with this software. The using Excel method using mass storage mode is recommended.

RFM5104 System Components:

The RFM5104 System includes the complete RFM5114 system as well as sensors.

Temperature Sensors:
RFMicron's Smart Passive Sensing™ RFM3250 wireless temperature sensors, with adhesive backing, are designed to be attached to a metal surface.

Merlin reader

Morphic reader in cradle

2. THE READER

The reader communicates with the sensors and retrieves their temperature data. The Morphic reader includes an integrated antenna that must be rotated into the open position before reading sensors.

2.1. Turning the Reader ON and OFF

Press the power button in the lower right corner of the keypad to turn the reader on. If the reader is already on, pressing the power button again will bring up the Shutdown screen, which allows the reader to be turned off, rebooted, or placed in sleep mode. When in sleep mode, pressing the power button wakes the reader.

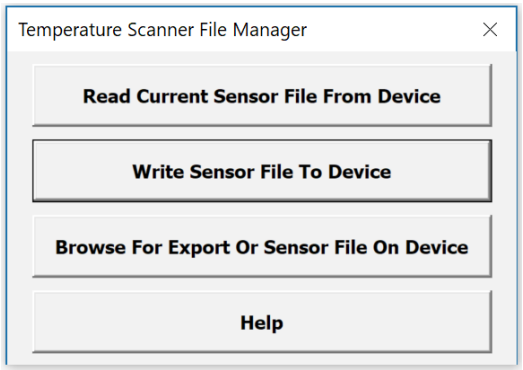
2.2. Connecting To a PC

Files are transferred to or from the reader by placing it in the docking cradle and connecting the cradle to a Windows® PC. 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 tilt the reader to the back to lock it in place.

2.3. Mass Storage Mode

The reader can communicate with a Windows PC using mass storage mode. An Excel macro simplifies the management of SENSOR FILE settings, and the transfer of RESULTS FILE data. Please see section 4.5 for additional information.

NOTE: The reader must be placed in mass storage mode, and the reader software should be version 1.0.3 or later.



2.4. Windows Mobile Device Center

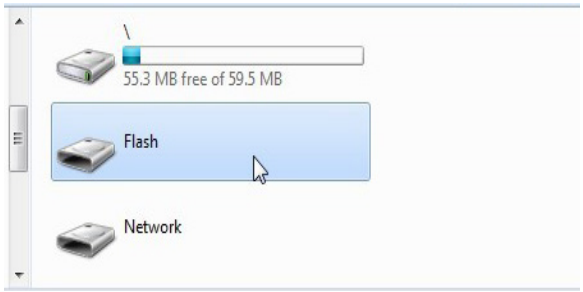
The reader can communicate with a Windows PC using Windows Mobile Device Center if that software is available on the PC. Because Windows Mobile Device Center is an older technology, it may not be pre-loaded on your PC.

This communication mode is not recommended.

When the reader is connected, Windows Should automatically install the needed communication driver. Once the driver is installed, the Windows Mobile Device Center screen will launch.

Select “Connect without setting up your device” option, and then “Browse the contents of your device” under “File Management.”

Double-click on the \Flash\ icon to access the reader flash storage.



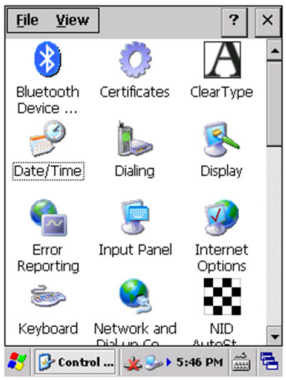
If Windows does not recognize the reader, install the driver software in the WinDriverInstall folder provided on the USB drive included with the Kit.

2.5. Issues with Windows.

In some cases Windows may not load all needed components automatically. If you suspect issues with the Windows installation, please refer to section 6 “VERIFYING WINDOWS CONNECTIVITY” for a step-by-step process for configuring and verifying the Windows setup.

2.6. Setting the Date and Time

The date and time should be set on the reader before making measurements. To set the date and time, double-click the My Device icon on the desktop, then double-click the Control Panel shortcut. Within the Control Panel, click the Date/Time icon to make changes.



2.7. Screen Sleep Timing

The Power icon on the Control Panel can be used to adjust the sleep timing that controls when the system powers down after the designated amount of inactivity.

3. USING THE SYSTEM

3.1. Identifying and Organizing Sensors

RFMicron's wireless, battery-free temperature sensors are uniquely identifiable by an Electronic Product Code (EPC) stored in each sensor's memory. Because the EPC does not, by itself, indicate where the sensor is installed or what device it is monitoring, each sensor must be registered and assigned within the Temperature Scanner software. A meaningful location description for each installed sensor is very helpful.

Multiple sensors can be associated with each other in groups. Sensor groups can be used to organize sets of sensors by the equipment or machine they are monitoring, or sensors can be grouped according to which sensors are visible to the reader from a particular reading location.

Sensor locations and group definitions are stored in a text file called the SENSOR FILE. The SENSOR FILE employs a comma-separated-value (CSV) format and can be edited in a spreadsheet or text editor application. For example, various location and group descriptions can be added to the original SENSOR FILE to speed the sensor installation and assignment process.

When Temperature Scanner reads the EPC ID code from a sensor, it uses the information in the SENSOR FILE to display its location description and group descriptions.

3.2. Temperature Thresholds

In addition to displaying the temperature reported by installed sensors, Temperature Scanner also compares the temperature to alarm thresholds set by the user. When the measured temperature of a sensor exceeds a threshold, a warning is displayed on the screen, where the sensor is shown as failing the temperature test.

Two thresholds are defined for each sensor. These thresholds are named according to terminology associated with electric motors but can be used for any purpose by the user. The RUN THRESHOLD is the temperature limit that the motor or equipment should not exceed during normal operation. The RESTART THRESHOLD is typically a higher temperature limit that the equipment can not exceed without risking thermal damage to the equipment itself.

For motors, the RESTART THRESHOLD alarm is calculated as the motor's electrical insulation thermal limit, minus the typical heat increase of restarting that motor in that particular installation, minus 30 °C to 40 °C to account for the difference in temperature between the motor core and the measurement point where the sensor is located. The motor's restart heating can be measured by recording the motor's temperature increase immediately before stopping and then after restarting the motor.

> NOTE: If Run and Restart alarms don't apply to your application, feel free to treat these as two independent alarm thresholds.

3.3. Preparing Sensors for Use

The first step to using the Predictive Maintenance System is to decide where sensors will be installed, how sets of sensors will be grouped together, and what their RUN THRESHOLD and RESTART THRESHOLD should be. For example, two sensors might be placed on a particular electric motor, one on the stator core and one on the bearing cover to measure bearing temperature. The stator sensor might have a RUN THRESHOLD and a RESTART THRESHOLD of 55 and 90 °C, and the bearing sensor might have a RUN THRESHOLD and a RESTART THRESHOLD of 45 and 50 °C. Since the two sensors are measuring different locations on the same machine, they might be added to a single group.

The group identification code must be no more than four alphanumeric characters. The group description should be kept brief to fit easily on the screen. For example, the group could be given the ID code "EM1" and the description "Electric Motor 1". The two sensors could then be given the location descriptions "Stator core" and "Bearing."

3.4. Sensor and Results Files

Human-readable text files are used to store sensor description information and to log measurement results. A SENSOR FILE contains the details of each sensor and can be edited or created using a text editor or spreadsheet application. In this example, the SENSOR FILE would include:

```
EM1,Electric Motor1,Stator core,55,90
EM1,Electric Motor1,Bearing,45,50
```

Although there is only one group in this example, an arbitrary number of groups can be listed in a SENSOR FILE, with each group containing one or more sensors.

The RESULTS FILE can simply be an empty text file. The software will log the measured results in the RESULTS FILE, appending to the end of the file as new results are gathered.

The SENSOR FILE and RESULTS FILE are transferred to the reader file system and placed in a known location in the \Flash\ directory of the reader. The Manage Files screen is used to set the application to the desired SENSOR FILE and RESULTS FILE targets.

3.5. Installing and Assigning Sensors

The final step in preparing to use the Predictive Maintenance System is to install the temperature sensors and assign the unique EPC code of each sensor to the predefined location descriptions contained in the SENSOR FILE. The software handles the assignment process and updates the SENSOR FILE.

The user does not need to know the EPC code of the sensor when it is assigned.

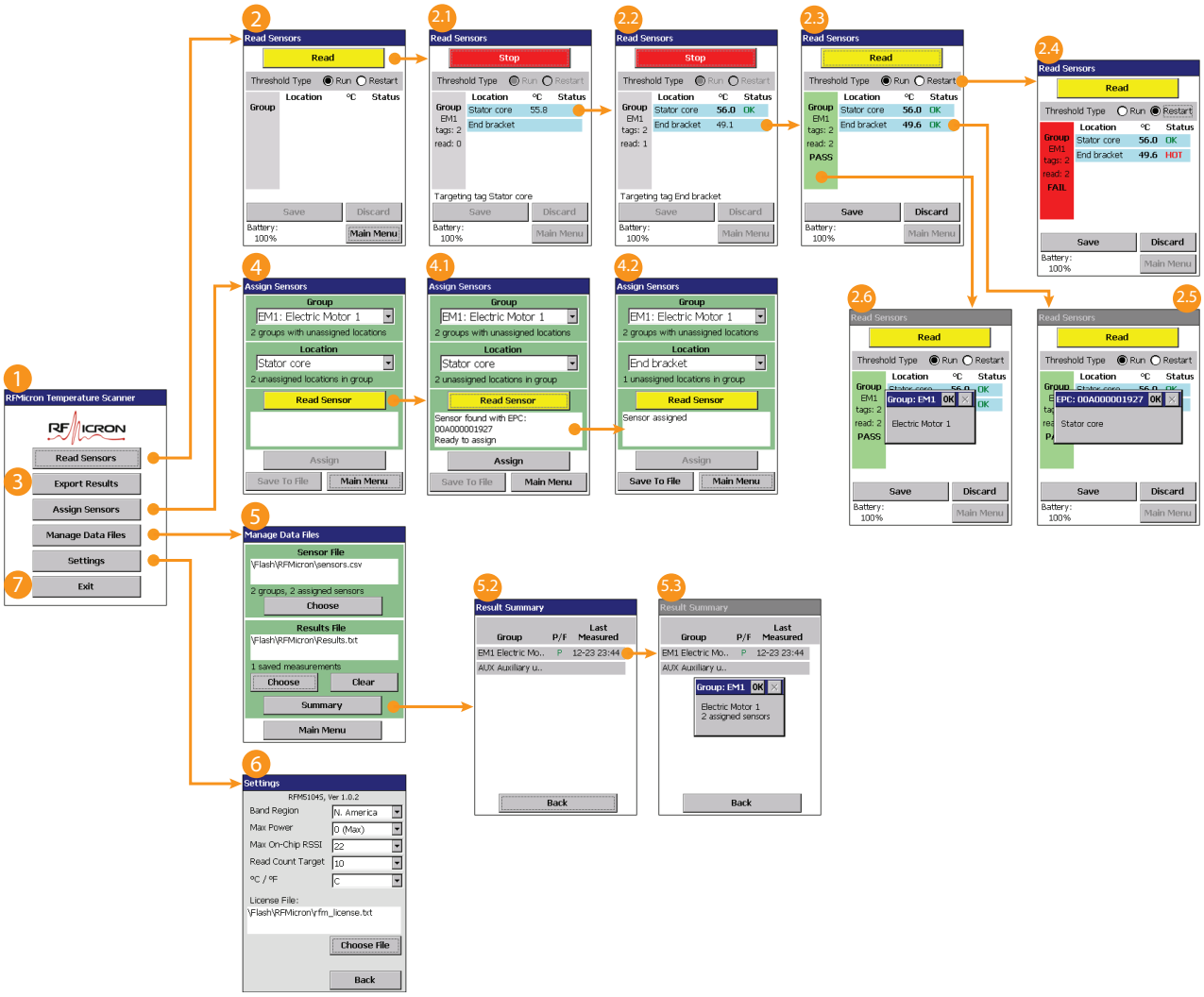
3.6. Measuring Sensor Temperatures

After sensors are installed and assigned, the reader can be used to retrieve their temperatures. The reader antenna is aimed at each sensor before initiating a read operation. The reader and sensor must be within range of each other. The reader will display the temperature of the sensor as the read operation is completed. The reader will also list all of the other sensors in a group, whether or not they are immediately visible to the reader. This reminds the user to help avoid overlooking sensors.

After all the sensors in a group are read, the results for that group can be saved to the RESULTS FILE, and then additional sensor groups can be measured. The RESULTS FILE accumulates measured results until it is cleared, or until a different file is chosen. Results can also be saved to the EXPORT FILE in comma-separated value (CSV) format for viewing in a spreadsheet or importing into a database system.

4. TEMPERATURE SCANNER SOFTWARE

The Temperature Scanner software is preinstalled on the reader. This program is launched by double-clicking on the icon on the reader desktop.

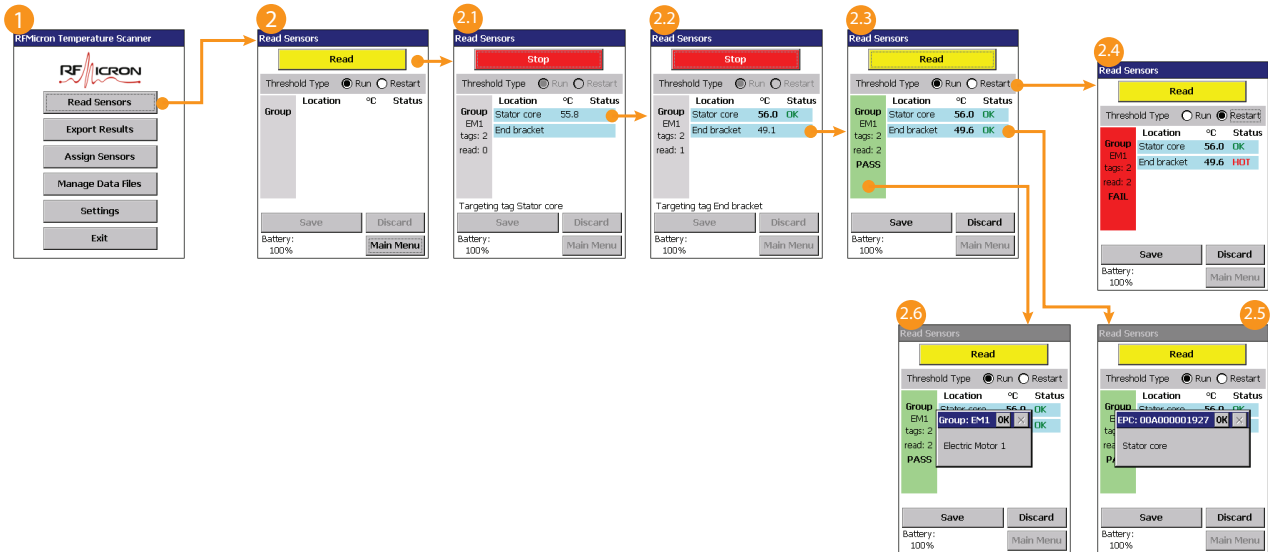


1	Main Menu Screen	Primary access to all program functions
2	Read Sensors Screen	Opens the window for reading installed sensors
2.1	Reading Sensors	Reading sensors is in process with partial temperature data
2.2	Partial Sensor Read	Reading one sensor is complete, with temp in allowable range
2.3	Read Completed	Reading of all sensors in a group is complete with passing RUN limits
2.4	RESTART Temp. Fail	Selection of RESTART shows that one device is too hot for a restart
2.5	Sensor Drill Down	Selecting individual sensor brings up detailed sensor designation
2.6	Group Drill Down	Selecting group, brings up group details

3	Export Results	Creates a new file containing current results and group descriptions
4	Assign Sensors Screen	Installs sensors and maps their EPC to the predefined locations in Sensor file
4.1	Sensor Found	Reports details for sensor during installation and assignment process
4.2	Sensor Assigned	Reports the sensor as assigned
5	Manage Data Files Screen	Selects file name for sensor and result files
5.2	Summary Results Screen	Reports summary pass/fail at the group level
5.3	Group Details	Provides group details from the summary screen
6	Settings Screen	Settings screen allows the reader and program settings to be modified

4.1. Read Sensors Screen

The READ SENSORS screen is used to retrieve temperature data from installed sensors. A SENSOR FILE must be defined and must contain assigned sensors before sensors can be read.



Screen 2: The RUN or RESTART radio buttons are selected to indicate which alarm thresholds are used when checking sensor values. The running thresholds are typically used to monitor a running motor. The restart thresholds are typically set to indicate whether a stopped motor is cool enough to be restarted without suffering thermal damage. This selection can also be made when the measurement completes.

Click the READ button, or press the yellow button on the reader keyboard, to begin measuring the sensors within range of the reader.

Screen 2.1: When a sensor is found, this sensor's GROUP assignment will be displayed in the group panel on the left side of the window. If a group is identified, all the sensors within that group will be listed in the output table, regardless of whether they have all been found and read by the reader.

Screen 2.2/2.3/2.4: The table will be updated in real time as sensor data is read. The number of samples required for each sensor is controlled by the READ COUNT TARGET setting available on the SETTINGS screen (Screen 6). Once the read operation completes, the sensor temperature is displayed in bold. OK, or HOT is displayed in the STATUS column based on whether the value exceeds the selected threshold.

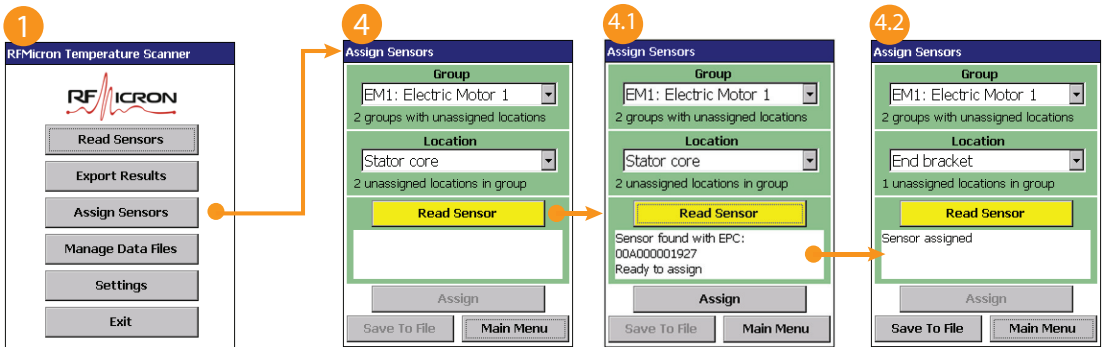
When the measurement is complete, click the SAVE button to write the results to the current RESULTS FILE, or click DISCARD to ignore them.

The read efficiency can be improved by slowly adjusting the reader's position and antenna aiming point. The measurement stops automatically after all the sensors in the group have each been read. The read operation can be terminated by clicking the STOP button.

Screen 2.5/2.6: The group description can be displayed by clicking the GROUP PANEL. The LOCATION DESCRIPTION for each sensor can be displayed by clicking its entry in the results table.

4.2. Assign Sensors Screen

The Assign Sensors screen is used to associate a sensor with a particular location and group. Sensors are typically placed in a group if all the sensors can read from one position. Sensors should preferably be installed and assigned one at a time. Once a sensor assignment is made and saved, it is permanent until a new or modified SENSOR FILE is chosen.



Screen 4: The reader operates in low-power mode when assigning sensors. Sensors are assigned one at a time. The sensor can be installed on the equipment before making assignments, or they can be assigned within the system and then installed on the equipment. Preinstalling the sensors reduces the opportunity to mix up sensors and locations. Please use caution if assigning the entire population of sensors before installing them on equipment. The risk of mixing sensors and locations is very high with that approach.

To assign a sensor, place the reader within 10-20 cm of the sensor before clicking the READ SENSOR button.

Screen 4.1: The sensor details are displayed in the window below the READ SENSORS button. Choose the GROUP and LOCATION description to be assigned from the pull-downs.

The GROUP pull-down menu contains a list of groups within the SENSOR FILE which contain at least one location that does not yet have a sensor assigned to it. The LOCATION pull-down contains a list of the unassigned locations in the selected group.

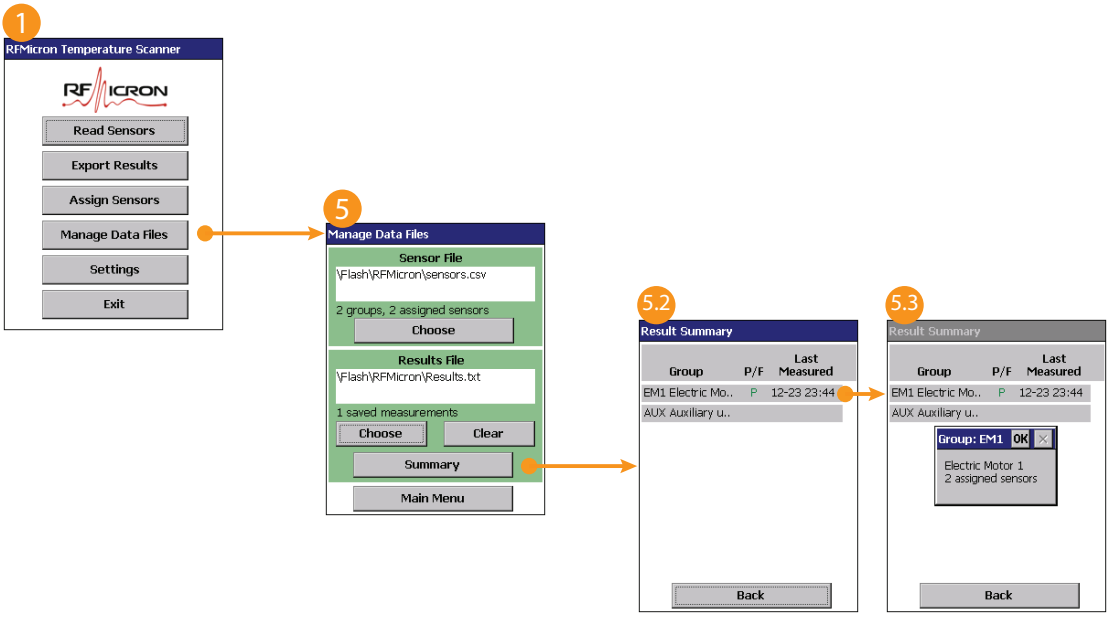
It is important that the only one unassigned sensor be visible to the reader during assignments. If multiple unassigned sensors are found, move the reader closer to the desired sensor, or block the undesired sensor by covering it with aluminum foil or your hand.

Screen 4.2: If a single unassigned sensor is found by the reader, its EPC will be displayed, and the ASSIGN button will be enabled. Click the ASSIGN button to assign the sensor.

The SAVE TO FILE button writes the sensor assignments to the currently selected SENSOR FILE. If a mistake is made in assigning sensors, it is possible to return to the main menu without saving.

4.3. Manage Data Files and Result Summary Screens

The MANAGE DATA FILES screen displays the file paths and names of the current SENSOR FILES and RESULT FILES. Multiple SENSOR FILES and RESULT FILES can exist in the \Flash\ storage directory of the reader, but only one of each are in use during any temperature measurement.



Screen 5: Individual SENSOR FILE and RESULTS FILE entries can be selected by clicking the CHOOSE buttons.

The CLEAR button deletes the contents of the RESULTS FILE.

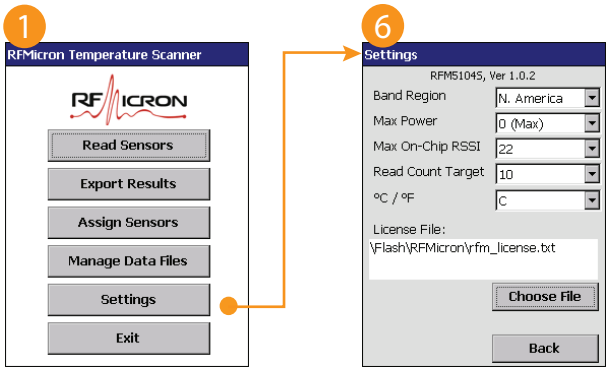
The SUMMARY button calls the RESULTS SUMMARY screen.

Screen 5.2: The RESULTS SUMMARY screen displays a table of all the groups defined in the SENSOR FILE, as well as the time stamp and pass/fail outcome of the most recent measurement.

Screen 5.3: If the group description is too long to be displayed in the table, the full text can be viewed by clicking on the group.

4.4. Settings Screen

The Settings screen provides access to software and reader controls.



Screen 6: BAND REGION sets the frequency band in which the reader will transmit. Transmission frequencies are controlled by various governmental agencies worldwide. If a band band-locking license is enabled for this software, this pull-down may only contain one option.

MAX POWER sets the transmit power level the reader will not exceed while communicating with sensors. A value of 0 attenuation corresponds to the highest output power the device is capable of, and 19 attenuation is the lowest output power level. The reader may transmit at powers less than the MAX POWER setting to satisfy individual sensor power needs. Setting the MAX POWER to 0 attenuation will maximize read range. Reducing the MAX POWER may help conserve battery power.

MAX ON-CHIP RSSI sets the target power levels at the sensor to ensure that temperature readings are more accurate. Sensor readings are more accurate when receiving moderate power from the reader. Sensors indicate the amount of power they are receiving through their On-Chip RSSI Code, which is a value between 0 and 31, where higher values indicate receiving more power. To improve accuracy, the reader automatically reduces its transmit power if the On-Chip RSSI Code of the sensor is above the MAX ON-CHIP RSSI threshold. Increasing the MAX ON-CHIP RSSI threshold above the default value can reduce the amount of time needed to complete a measurement, but at the expense of reduced temperature measurement accuracy.

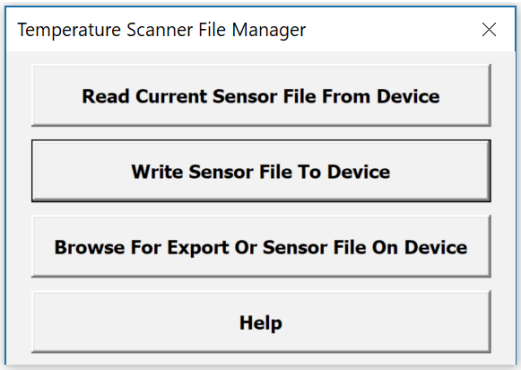
READ COUNT TARGET sets the number of averages used to enhance temperature accuracy. Each sensor is read multiple times and the results averaged to calculate a final value. The READ COUNT TARGET is the number of times each sensor is read for each measurement. Increasing this value improves the precision of the final result, but it also increases the time needed to complete a measurement.

°C/°F sets the temperature format to Fahrenheit or Centigrade.

LICENSE FILE name and directory path are set by pressing the CHOOSE FILE button.

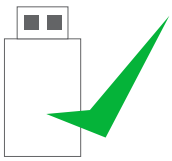
4.5. Temperature Scanner File Manager

This PC-based utility manages the transfer of key files to and from handheld readers running the Temperature Scanner program. The Temperature Scanner File Manager provides three capabilities, two facilitate reading and writing the SENSOR FILE to and from an Excel worksheet, and a third function opens the reader file directory to access data files.



Sensors have specific IDs, which must be registered with the software. Sensors can be assigned into groups, assigned names/locations, and alarms can be set. These assignments are managed in the SENSOR FILE which can be edited in an Excel spreadsheet and then written to the reader.

To prevent file corruption, please properly disconnect the handheld reader device from the PC before removing the device from the dock or unplugging the USB cable from the PC. To disconnect the reader, click the "Safely Remove Hardware" icon in the System Tray of the Windows Taskbar and eject the reader.



Starting the Utility: The Temperature Scanner File Manager is an Excel macro that runs on the PC and that generates a pop-up window. Excel macros must be enabled. The Temperature Scanner File Manager pop-up will start when the worksheet is opened.

Missing Pop-up Screen: If the Temperature Scanner File Manager is not visible, or if it was inadvertently closed, it can be re-opened by clicking the DEVELOPER tab on the top menu bar and then running the LaunchTemperatureScanner-FileManager macro that is available after clicking the MACROS button. If the DEVELOPER tab is not visible, please add it to your toolbar by clicking FILE → OPTIONS → CUSTOMIZE RIBBON and enabling the DEVELOPER item.

Read Sensor File: The READ button reads the SENSOR FILE currently selected within the Temperature Scanner application on the handheld, and copies it to the worksheet. Settings can be edited in Excel and written back to the reader using the WRITE button.

Please see section 5 for details on SENSOR FILE syntax.

Adding new sensors: New sensors are added to the file by populating new lines in the SENSOR FILE:

- GROUP ID is a short identifier for sensor groups. Up to 4 alphanumeric characters are allowed.
- GROUP DESCRIPTION is a text description/name for the GROUP ID. The reader displays up to 17 characters.
- SENSOR LOCATION is a text description field for the sensor name of the location. The reader displays up to 11 characters.

- RUN THRESHOLD and RESTART THRESHOLD are optional alarm settings. In many motor monitoring installations, the Running alarm is set just above the normal operating temperature for a particular motor; this alarm flags changes in expected operation or conditions. The Restart alarm is typically set at a much higher level; when motors are below their RESTART alarm, they can be safely restarted without risking thermal damage.

  NOTE: If Run and Restart alarms don't apply to your application, feel free to treat these as two independent alarm thresholds.

- EPC is the identification code stored in the sensor EPC memory location. The system uses the EPC IDs to identify specific sensors.

Verifying sensor assignments: The EPC column in the SENSOR FILE will be blank before a physical sensor is assigned. After a sensor is assigned, the sensor's EPC code will be added to the EPC column.

Removing a sensor assignment: Delete the EPC entry in the SENSOR FILE to "un-assign" a sensor. Once unassigned, the sensor can be assigned again as needed. Sensors are not damaged or modified by being assigned or un-assigned.

Write Sensor File: The WRITE button copies the contents of the active worksheet to the SENSOR FILE currently selected on the handheld. The contents of the existing SENSOR FILE on the handheld will be overwritten.

Several error checks will be run before writing the SENSOR FILE to the reader. The current worksheet must be a syntactically valid SENSOR FILE. Please see section 5 for details on SENSOR FILE syntax.

The reader should be removed from the docking cradle, and the Temperature Scanner program should be restarted to activate the new SENSOR FILE settings.

Browse Files: The BROWSE button opens a file explorer window for browsing the file system of the attached handheld. Selecting and opening a file on the handheld copies it to an Excel worksheet. This button can be used for viewing measurement results saved in RESULTS FILE(s), or for viewing other SENSOR FILE(s) not currently selected on the handheld.

Help: The pop-up screen provides basic help and troubleshooting advice.

Troublingshooting: If the utility cannot locate an attached handheld device:

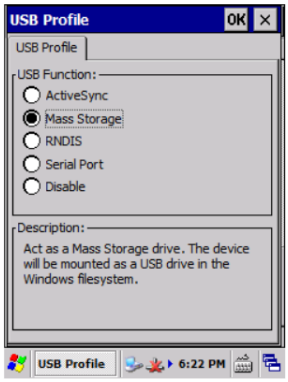
- Please remove the reader from the docking cradle and restart the Temperature Scanner program before using new SENSOR FILE settings.
- Verify that the device is properly seated in the dock, with the dock power cord plugged in.
- Verify that the USB cable is connected between the dock and the PC.
- Verify that the handheld device is not in sleep mode.
- Verify that the handheld USB profile is set to Mass Storage mode. This setting is available by clicking on the Windows START menu on the handheld and selecting SETTINGS → CONTROL PANEL → USB PROFILE. After changing the setting, initiate a warm reboot of the handheld by pressing the power button on the keypad and selecting WARM REBOOT.

The Temperature Scanner application on the handheld device should not be running while using this utility.

4.6. Configuring Mass Storage Mode

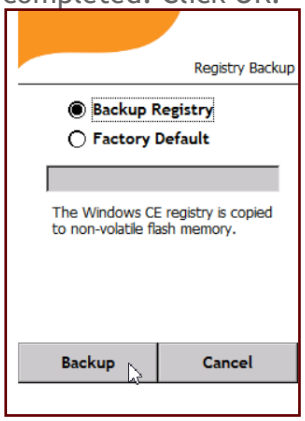
The mass storage mode is enabled using the reader control panel.

1. Click the Windows icon in the lower left corner of the screen. Click SETTINGS → CONTROL PANEL.
2. Find and open the USB PROFILE icon.
3. Click the MASS STORAGE radio button, then click OK.
4. Press the POWER button on the handheld, select the WARM REBOOT radio button, and click WARM REBOOT.



Saving these settings to the registry preserves them through power cycles on the reader.

1. Click the Windows icon on the handheld. Click PROGRAMS→ NordicID → REGISTRY BACKUP.
2. Select the BACKUP REGISTRY radio button and click Backup.
3. A dialog will appear when the backup has successfully completed. Click OK.
4. Press the POWER button on the lower-right corner of the device keypad, click the COLD BOOT radio button, and then the COLD BOOT button. When the device reboots, verify that the Mass Storage and Power Control settings are correct.



4.7. Getting the Handheld MAC Address

The MAC address is a 6-byte code, generally expressed as 12 hexadecimal digits. It is printed in the lower left corner of the box label, next to the title "Wlan Mac:"

It can also be found through Windows CE on the device by clicking the Windows icon, selecting SETTINGS → CONTROL PANEL → SCU, and clicking on the STATUS tab. The MAC address for this example device is 00 17 23 FA E5 8D.

5. DATA FILE FORMATS

5.1. Sensor File

The SENSOR FILE describes sensors with their group assignments, specifies their temperature thresholds, and stores their EPC codes once assigned. The SENSOR FILE is in comma-separated-value (CSV) format and can be created in a text editor or spreadsheet application. The following rules apply to the SENSOR FILE:

- Lines beginning with a # character are considered comment lines and are ignored.
- Blank lines are allowed and can be inserted along with comment lines for readability.
- All other lines describe a single sensor and must have either 5 or 6 fields, each separated by a single comma. From left to right, the fields are (1) the sensor group ID code, (2) the group description, (3) the sensor location, (4) the run temperature threshold, (5) the restart temperature threshold, and (6) the EPC code of the sensor. The EPC field is populated only after a sensor has been installed and assigned.
- If an EPC has not yet been assigned to a sensor, the trailing comma after the restart threshold is optional.
- Commas can not be used inside individual fields.
- The group ID code must be between one and four alphanumeric characters. All sensors with the same group code will be placed in the same group.
- A group description of one or more alphanumeric characters must be specified for at least one of the sensors in each group. The group description can be left blank for other sensors in the group. If specified more than once for a group, the multiple specifications for a group must be identical.
- The sensor location must be at least one alphanumeric character in length. Location descriptions do not need to be unique, but it is recommended that they be unique within their group.
- The run threshold must be a numerical value.
- The restart threshold must be a numerical value.
- To define the units of the Run and Restart thresholds, add to the beginning of the file the line “[THRESHOLD_UNIT],C” for Celsius or “[THRESHOLD_UNIT],F” for Fahrenheit. Units will default to Celsius if no unit is defined.

NOTE: If Run and Restart alarms don’t apply to your application, feel free to treat these as two independent alarm thresholds.

- The EPC field is not filled in by the user when creating the Sensor File. When a sensor is installed and assigned, the software writes the EPC code of the assigned sensor into this field. It should not be modified unless the sensor is to be removed and replaced. In that case, the EPC field can be deleted and a new sensor can be reassigned using the normal installation process.

Example SENSOR FILE

# Group ID	Group Description	Sensor Location	Run Threshold	Restart Threshold	EPC
[THRESHOLD_UNIT]	C				
EM1	Electric Motor 1	Stator core	60	80	
EM1		End bracket	45	65	
AUX	Auxiliary Unit	Winding A	55	67.5	
AUX		Winding B	55	67.5	
AUX		Housing	43	60	

5.2. Results File

The sensor measurements are logged in the RESULTS FILE. An entry is appended to the file when the SAVE button is pressed on the READ SENSOR screen. Each entry records the measurement results for that group. The RESULTS FILE format is intended to be concise so that it can be viewed on the reader. An example RESULTS FILE with 3 entries is shown below.

5.3. Export File

An EXPORT FILE combines information from both the SENSOR FILE and RESULTS FILE. The EXPORT FILE is in CSV format and is self-contained, including everything known and measured concerning the sensors. Data in an EXPORT FILE is sorted by sensor EPC, but data can be sorted by any column in a spreadsheet as desired.

Example RESULTS FILE

```
==============================
Group: EM1
Time: 10/6/2017 7:14 PM
Test Type: Run
Group Result: Pass
Units: deg C
Sensor Results:
EPC          Temp  Result
0A0010000A8E 22.8  Pass
0A0010000A84 23.7  Pass
==============================
Group: AUX
Time: 10/6/2017 7:15 PM
Test Type: Run
Group Result: Pass
Units: deg C
Sensor Results:
EPC          Temp  Result
0A0010000A8A 24.5  Pass
000000000000000000001787 22.9  Pass
0A0010000A92 23.1  Pass
==============================
Group: EM1
Time: 10/6/2017 7:16 PM
Test Type: Run
Group Result: Pass
Units: deg C
Sensor Results:
EPC          Temp  Result
0A0010000A8E 24.5  Pass
0A0010000A84 24.8  Pass
```

Example EXPORT FILE

```
# Groups:
# EM1, Electric Motor 1
# AUX, Auxiliary unit
#
# GroupID,Sensor EPC,Sensor Description,Run Threshold,Restart Threshold,Timestamp,Temperature (degC),Test Type,Margin,Result
EM1,0x00A000001927,Stator core,70,60,10/22/2016 2:34 PM,56.0,Run,14.0,Pass
EM1,0x00A000001927,Stator core,70,60,10/22/2016 4:11 PM,54.1,Restart,5.9,Pass
EM1,0x00A000001929,End bracket,55,45,10/22/2016 2:34 PM,49.6,Run,5.4,Pass
EM1,0x00A000001929,End bracket,55,45,10/22/2016 4:11 PM,52.8,Restart,-7.8,Fail
AUX,0x00A000001955,Winding A,62.5,55,10/23/2016 8:51 AM,38.4,Run,24.1,Pass
AUX,0x00A000002021,Winding B,62.5,55,10/23/2016 8:51 AM,42.2,Run,20.3,Pass
AUX,0x00A000008523,Housing,50,43,10/23/2016 8:51 AM,41.7,Run,8.3,Pass
```

# Groups:									
# EM1	Electric Motor 1								
# AUX	Auxiliary Unit								
#									
# GroupID	Sensor EPC	Sensor Description	Run Threshold (degC)	Restart Threshold (degC)	Timestamp	Temperature (degC)	Test Type	Margin (degC)	Result
EM1	0x0A0010000A8E	Stator core	60	80	10/6/2017 19:14	22.8	Run	37.2	Pass
EM1	0x0A0010000A8E	Stator core	60	80	10/6/2017 19:16	24.5	Run	35.5	Pass
EM1	0x0A0010000A84	End bracket	45	65	10/6/2017 19:14	23.7	Run	21.3	Pass
EM1	0x0A0010000A84	End bracket	45	65	10/6/2017 19:16	24.8	Run	20.2	Pass
AUX	0x0A0010000A8A	Winding A	55	67.5	10/6/2017 19:15	24.5	Run	30.5	Pass
AUX	0x000000000000000000001787	Winding B	55	67.5	10/6/2017 19:15	22.9	Run	32.1	Pass
AUX	0x0A0010000A92	Housing	43	60	10/6/2017 19:15	23.1	Run	19.9	Pass

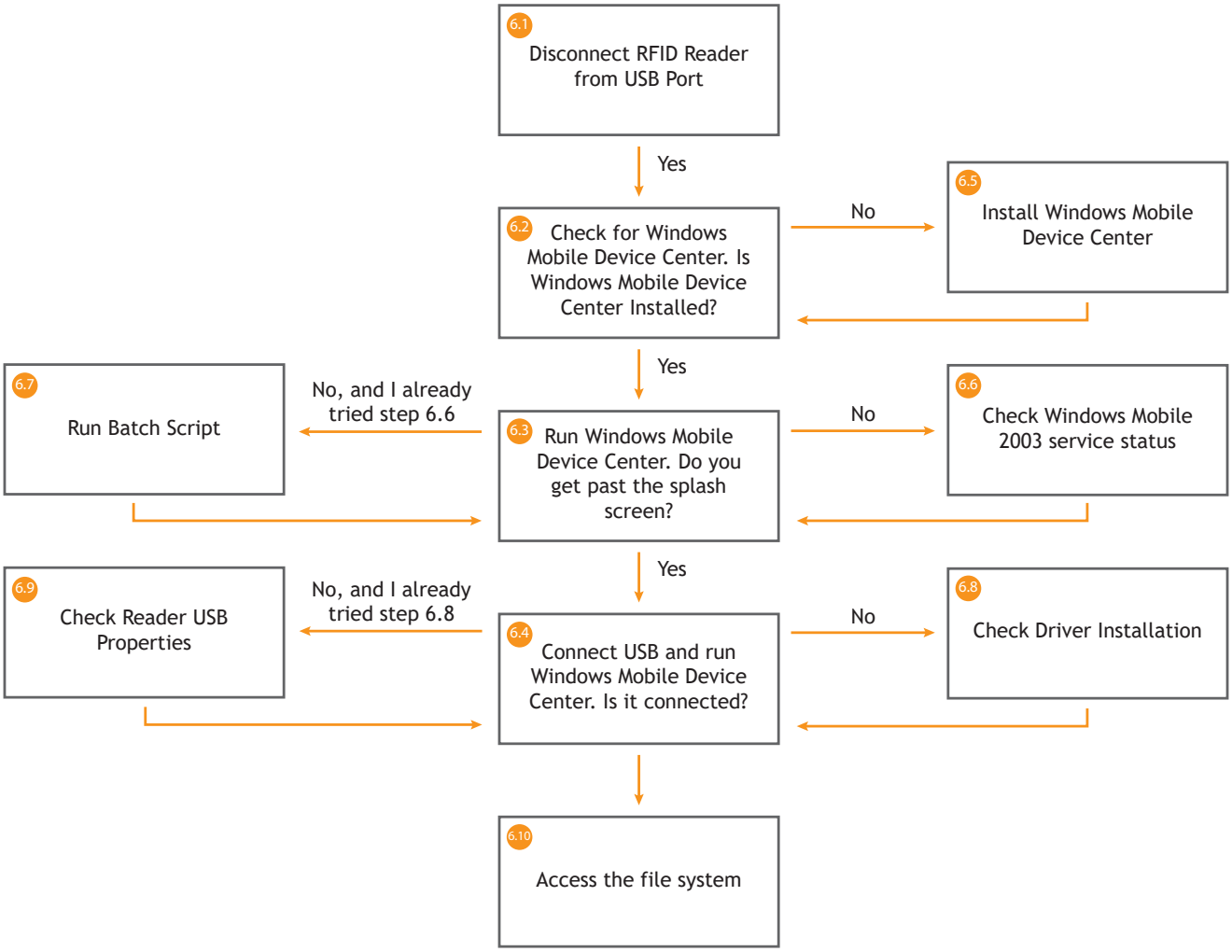
6. VERIFYING WINDOWS CONNECTIVITY

NOTE: If you are using the Excel macro software to manage SENSOR FILE(s) and RESULT FILE(s), you can skip this section.

NOTE: If you have already successfully run Windows Mobile Devices, you can skip this section.

The process for accessing the reader's file system from Windows® can vary depending on your operating system version and build. This troubleshooting guide allows you to verify each component needed for full communication support.

The screen shots were captured in Windows 10. If you are not using Windows 10, your views may be slightly different, but the verification approach supports all versions of Windows.



6.1. Disconnect the Reader from USB port

The troubleshooting flow assumes that your reader starts off disconnected from the PC. If it is plugged in, please unplug it and continue to step 6.2.

6.2. Check Windows Mobile Device Center

Check to see if Windows Mobile Device Center is installed. Windows uses this software to talk to the reader. There are three ways to check for Windows Mobile Device center.

A. Navigate to "C:\Windows\WindowsMobile". If the folder exists and "wmdc.exe" exists inside that folder, then Windows Mobile Device Center in installed.

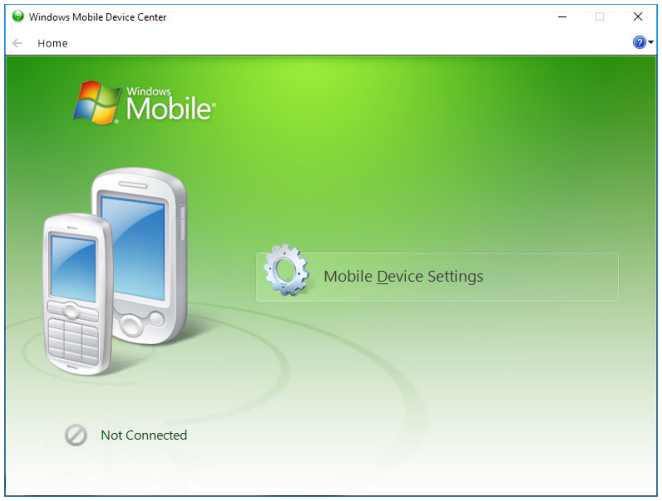
B. Go to "Control Panel" → "Network and Internet" on your PC. If Windows Mobile Device Center is installed you should see a link there.

C. Go to "Control Panel" → "Programs" → "Programs and Features" on your PC. If you find Windows Mobile Device center in the list, then it is installed.

If Windows Mobile Device Center is installed, proceed to step 6.3. If you have a newer version of Windows, it might not be installed by default. If Windows Mobile Device Center is not installed, proceed to step 6.5.

6.3. Run Windows Mobile Device Center

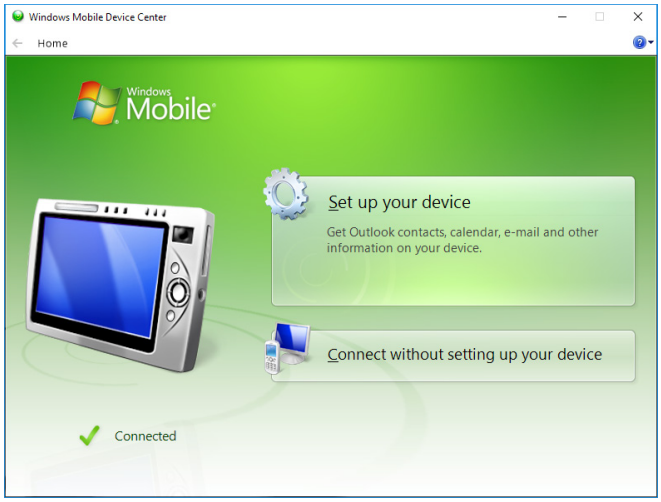
Start Windows Mobile Device Center. In Windows 10, you can search for the Windows Mobile Device Center application by hovering your mouse bear you start menu item to pull up a search box. A search on the word "mobile" is unusually sufficient to pull up the application icon for you to double-click. You should briefly see a splash screen, then the application should start, showing the screen shown below.



If you see the above screen, please move on to step 6.4. In some versions of Windows, the application will crash at the start screen, and you should move onto step 6.6 to check the Windows Mobile 2003 Service Status. If the application crashes after confirming Windows Mobile 2003 Service Status, then please move on to step 6.7 to run the suggested batch script.

6.4. Connecting USB

Once the Windows Mobile Device Center splash screen is visible, it is time to connect the USB. Make sure the handheld reader is charging and turned on. Connect the Reader to a USB port. At this point Windows may begin to automatically install drivers. Once Windows completes any needed driver installation, try to run Windows Mobile Device Center again. The status shown in the bottom left of the window should show "Connected" with a green checkmark.



If you see the "Connected" status, you are ready to continue to step 6.10 of this document. If the status is still "Not Connected" please move to step 6.8 to check driver installations. If you have already been to step 6.8, continue to step 6.9 to check reader properties.

6.5. Install Windows Mobile Device Center

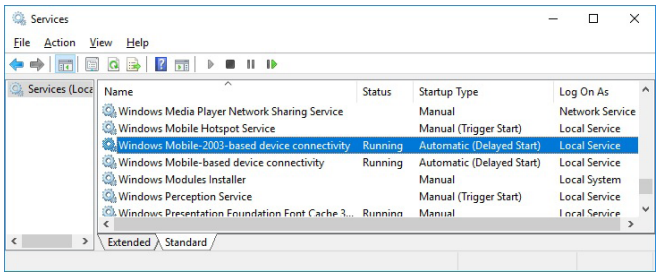
If Windows Mobile Device Center is not installed, you must install it. Follow the instructions here…

https://support.microsoft.com/en-gb/kb/931937

When you are done, continue to step 6.3 to run Windows Mobile Device Center.

6.6. Windows Mobile 2003 Service Status

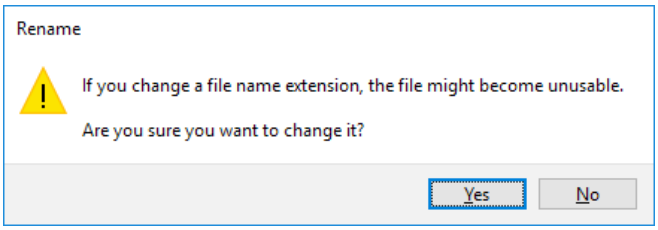
Go to "Control Panel" → "Administrative Tools" → "Services". Look for the "Windows Mobile 2003-based device connectivity" service. It should say "Running" in the status column. If not, right click on the item and select "Start". If this does not work, right click on the service and select "Properties". Go to the "Log On" tab. There are two radio button options: "Local System account" and "This account". Select the one that is not selected and try again. Once the status column displays "Running", you can return to step 2.3 to run Windows Mobile Device Center.



6.7. Run Batch Script

If you are running Windows 10 with the Creator's Update, Windows Mobile Device Center may still not run. If this is the case, create a new text document. Add the lines at the bottom of this page to the text document.

Save and exit the text document. Rename the text document "CreatorsUpdateFix.bat". Make sure that you change the extension of the file from .txt to .bat. If you do this correctly you should get a warning message. Please click yes to accept the file name change.



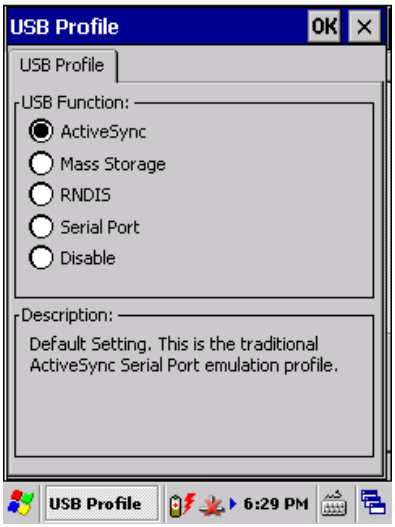
Right click on the newly created file and run it as an administrator. This will add variables needed by Window Mobile Device Center to your registry. Restart your computer and return to step 6.3 to run Windows Mobile Device Center.

6.8. Check Driver Installation

Run the driver in the WinDriverInstall folder on the provided USB drive. Return to step 6.4 to connect USB and run Windows Mobile Device Center.

6.9. Check Reader USB Properties

On the handheld reader click on the Windows icon, then "Control Panel" > "Settings". Click on the "USB Profile" application. Ensure that the "USB function" is set to "ActiveSync". Return to step 6.4 to connect USB and run Windows Mobile Device Center.



CreatorsUpdateFix.bat

```
REG ADD HKLM\SYSTEM\CurrentControlSet\Services\RapiMgr /v SvcHostSplitDisable /t REG_DWORD /d 1 /f
REG ADD HKLM\SYSTEM\CurrentControlSet\Services\WcesComm /v SvcHostSplitDisable /t REG_DWORD /d 1 /f
```

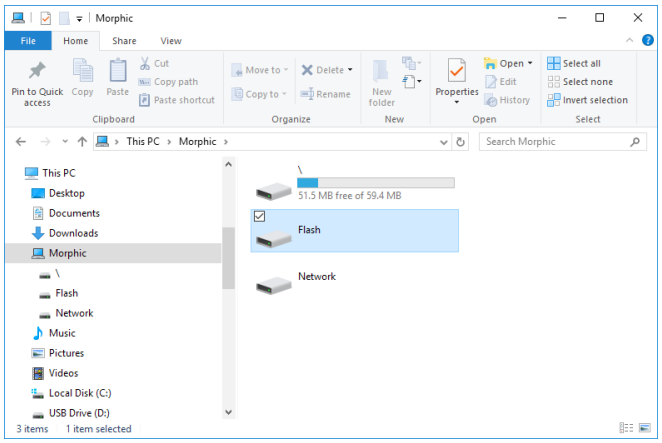
6.10. Access the File System

Now that you see the Connected status there are two ways to access the file system.

Option 1: Click on the “Connect Without Setting up your device” button. Then go to “File Management” then “Browse the contents of your device”

Option 2: Go to “This PC” if you are using Windows 10, or “My Computer” if you are using an older version of windows. You should see a new drive there called “Merlin” or “Morphic” depending on which handheld you are using.

You now have access to the file system. Note that any files not stored in the Flash folder will be erased when the reader is reset.



7. BEST PRACTICES

- RFM3250 rugged temperature sensors should be attached to a smooth metal surface for best adhesion.

- Ensure the mounting surface is clean and free of dust or contaminants to ensure good adhesion of the sensor.

- Sensors should be placed a few cm away from vertical metal edges that approach or exceed the height of the sensor. If a sensor must be placed next to a vertical metal edge, then the short edge of the sensor should be placed against the vertical metal edge.

- Metal corners with tall vertical edges are poor location choices and may significantly reduce read ranges.

- Sensors should be kept dry. Submerging a sensor in liquid can reduce the read range.

- Sensors should not be placed closer than 10 cm apart. Placing sensors too close together can make them difficult to read.

- A sensor generally requires line-of-sight to the reader for maximum read range.

- The maximum read range for the RFM3250 sensor and the reader depends on the environment of the sensor and reader. Read range can be reduced to around two meters in complex mechanical environments. The higher power Merlin reader can double the Morphic read range in most situations.

- When reading sensors, move and adjust the aim of the reader slowly to find and read all of the sensors within a group.

- Sensors report the power available at the sensor. ON-CHIP RSSI values of between 15 and 25 generally give the fastest read times.

8. TROUBLESHOOTING TIPS

Challenge: Reader cannot find the sensor when attempting to assign it.

Actions: Ensure sensor is attached to a metal surface. Check if the sensor is less than 10 cm away from other sensors, and increase the separation if so. Ensure that reader antenna is folded down and that the antenna surface is facing the sensor. Move the reader closer to the sensor.

Challenge: Multiple sensors are found when attempting to assign a sensor.

Actions: Cover all nearby sensors, other than the one to be assigned, with a layer of aluminum foil or your hand. Optionally, install and assign sensors one at a time.

Challenge: Sensor does not report temperature, or is slow in reporting temperature.

Actions: See the actions for difficulty reading a sensor during assignment. Check the MAX POWER setting, and try setting to zero. Zero is the no-attenuation full power setting. Avoid moving the reader around too quickly when reading sensors.

Challenge: SENSOR FILE updates are not active.

Actions: New SENSOR FILE settings will not be active until the program has been restarted. Please remove the reader from the cradle and restart the program.