NeoSpectra-Scanner BLE Specifications

Contents

About NeoSpectra-Scanner

NeoSpectra-Scanner is a portable and handheld spectral sensing device that can be used in a wide variety of material sensing applications. It shines light that interacts with the sample to be measured, collects its diffuse reflectance, and generates NIR spectra that corresponds to the spectral response of the material in the spectral range (1,350 - 2,500 nm). The scanner enables the development of in-field material analysis applications in various industries.

About this guide

If you are developing your app to interface with NeoSpectra-Scanner, this guide is your reference on how to interface with it through BLE to perform any action the scanner can perform.

1 Introduction

This document describes the BLE interface specifications of NeoSpectra-Scanner. NeoSpectra-Scanner has four services for BLE communication as shown in (Figure 1).
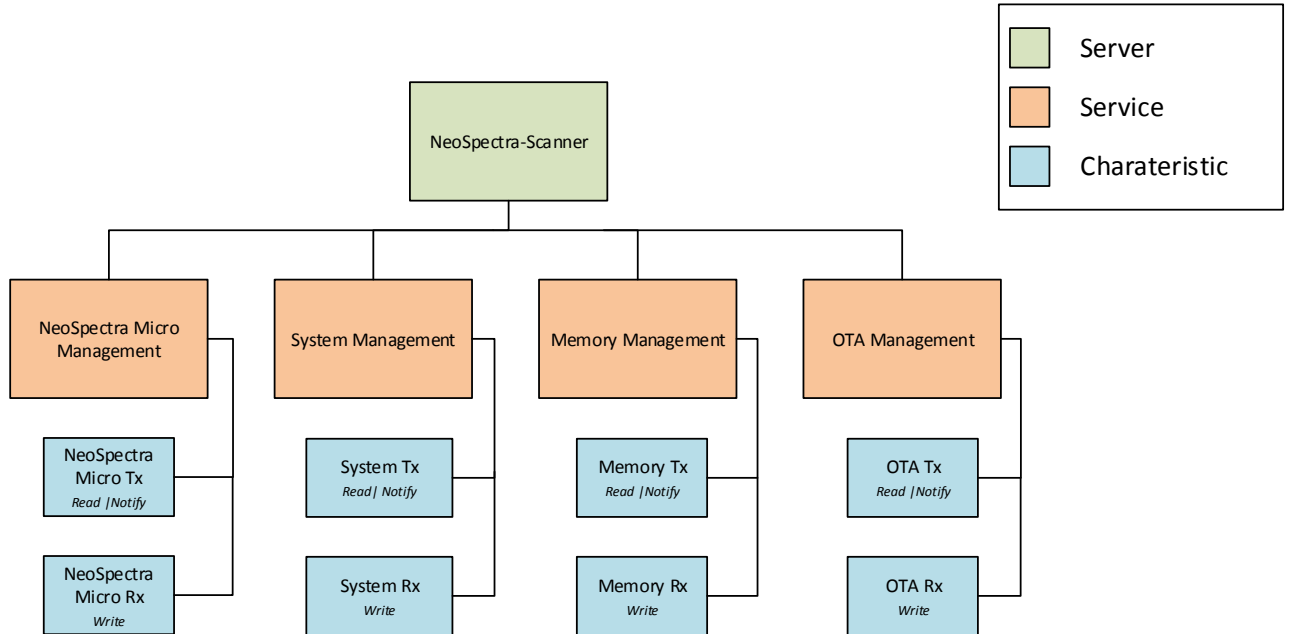
Figure 1 NeoSpectra–Scanner BLE Services

Each one of these services has two characteristics. One for read (Tx characteristic) and another one for write (Rx characteristic).

Note: For more detailed overview of the sample code of the supplied SDK, please refer to chapter (6) of "**NeoSpectra-Scanner Quick Start Guide**" document labeled "**Mobile Application Overview**".
It explains in details the different available user actions, implemented UI and views, as well as guiding the user experience on how to use the mobile app.

2 Communication services' UUIDs

Here are the UUIDs for each characteristic of each service in NeoSpectra-Scanner server.

2.1 <u>NeoSpectra Micro Management Service</u>

6E400001-B5A3-F393-E0A9-E50E24DCCA9E

2.1.1 NeoSpectra Micro Tx (Read/Notify from server)

6E400003-B5A3-F393-E0A9-E50E24DCCA9E

2.1.2 NeoSpectra Micro Rx (Write to server)

6E400002-B5A3-F393-E0A9-E50E24DCCA9E

2.2 <u>System Management Service</u>

B100B100-B100-B100-B100-B100B100B100

2.2.1 System Tx (Read/Notify from server)

B101B101-B101-B101-B101-B101B101B101

2.2.2 System Rx (Write to server)

B102B102-B102-B102-B102-B102B102B102

2.3 <u>Memory Management Service</u>

C100C100-C100-C100-C100-C100C100C100

2.3.1 Memory Tx (Read/Notify from server)

C101C101-C101-C101-C101-C101C101C101

2.3.2 Memory Rx (Write to server)

C102C102-C102-C102-C102-C102C102C102

2.4 <u>OTA Service</u>

D100D100-D100-D100-D100-D100D100D100

2.4.1 OTA Tx (Read/Notify from server)

D101D101-D101-D101-D101-D101D101D101

2.4.2 OTA Rx (Write to server)

D102D102-D102-D102-D102-D102D102D102

3 NeoSpectra Micro Management Service Packet Structure

Any sent/received packet should be 20 bytes long. If the payload of packet being transmitted is less than 20 bytes, pad the rest of the packet with zeros.

3.1 Command Packets Format (Sent on Rx characteristic)

Most command packets of NeoSpectra Micro Management service follow the below format.

Field	Size (bytes)	Data Type	Description
Operation ID	1	Int	Specify the operation number requested
scanTime	3	Int	Duration of the scan in milliseconds with a minimum of 10 ms and a maximum of 28000 ms
commonWavNum	1	Int	Specify the number of points used for the wave number: 0: Disable common wave number 1: 65 points. 2: 129 points. 3: 257 points. 4: 513 points. 5: 1024 points. 6: 2048 points. 7: 4096 points.
opticalGainSel	1	Int	0: use the optical gain settings saved on the DVK. 1: use the calculated optical gain settings. 2: use external optical gain settings.
apodizationSel	1	Int	Select one of the apodization windows: 0: Boxcar 1: Gaussian 2: Happ-Genzel 3: Lorenz
zeroPadding	1	Int	Specify the number of points used in the FFT: 1: 8k points. 2: 16k points. 3: 32k points.
Mode	1	Int	Select the required run mode: 0: Single mode 1: Reserved (Not supported)
Unused	11	x	x

3.2 Response Packets Format (Received on Tx characteristic)

The response which is received as a reply to different command packets has the following format:

Packet 1	Status(1 byte)	Data Length(2 bytes)	Zeros(rest of bytes)
N Packets	Payload packets (20 bytes maximum user data for each). The number of these packets depends on the data length sent in packet 1.		

According to the statue byte in packet 1, the payload packets can be received or not based on the following scheme:

- Status = 0 -> No Errors, payload packet can be acquired.
- Status = otherwise -> Error, no payload packet can be acquired.

3.3 Detailed Commands & Responses

3.3.1 Commands

3.3.1.1 runPSD

- Description: Requests to perform a raw scan and returns a Power Spectral Density (PSD) which is not divided by BG "raw".
  .

Operation ID	3
scanTime	Required
commonWavNum	Required
opticalGainSel	Required
apodizationSel	Required
zeroPadding	Required
Mode	Required
Unused	Not Required

3.3.1.2 runBackground

- Description: Request to perform a background reading (BG).

Operation ID	4
scanTime	Required
commonWavNum	Required
opticalGainSel	Required
apodizationSel	Required
zeroPadding	Required
Mode	Required
Unused	Not Required

3.3.1.3 runAbsorbance

- Description: Request to perform a scan and divide it by last BG measurement to return the absorbance.
- Prerequisite operation: "runBackground".

Operation ID	5
scanTime	Required
commonWavNum	Required
opticalGainSel	Required
apodizationSel	Required
zeroPadding	Required
Mode	Required
Unused	Not Required

3.3.1.4 runGainAdj

- Description: Calculate the required gain for a certain sample.

Operation ID	6
scanTime	Not Required
commonWavNum	Not Required
opticalGainSel	Not Required
apodizationSel	Not Required
zeroPadding	Not Required
Mode	Not Required
Unused	Not Required

3.3.1.5 burnGain

- Description: Burns the calculated gain adjustment on the DVK.

Operation ID	7
scanTime	Not Required
commonWavNum	Not Required
opticalGainSel	Not Required
apodizationSel	Not Required
zeroPadding	Not Required
Mode	Not Required
Unused	Not Required

3.3.1.6 burnSelf

- Description: Burns the self-correction parameters on the DVK.

Operation ID	8
scanTime	Not Required
commonWavNum	Not Required
opticalGainSel	Not Required

apodizationSel	Not Required
zeroPadding	Not Required
Mode	Not Required
Unused	Not Required

3.3.1.7 burnWLN

- Description: Burns the wavelength correction parameters on the DVK.

Operation ID	9
scanTime	Not Required
commonWavNum	Not Required
opticalGainSel	Not Required
apodizationSel	Not Required
zeroPadding	Not Required
Mode	Not Required
Unused	Not Required

3.3.1.8 runSelfCorr

- Description: Calculates the self-correction parameters.

Operation ID	10
scanTime	Required
commonWavNum	Required
opticalGainSel	Required
apodizationSel	Required
zeroPadding	Required
Mode	Not Required
Unused	Not Required

3.3.1.9 runWavelengthCorrBG

- Description: Takes a background reading for the wavelength correction.

Operation ID	11
scanTime	Required
commonWavNum	Required
opticalGainSel	Required
apodizationSel	Required
zeroPadding	Required
Mode	Not Required
Unused	Not Required

3.3.1.10   runWavelengthCorr

- Description: performs the wavelength correction.
- Prerequisite Operation: "runWavelengthCorrBG".

Operation ID	12
scanTime	Required

commonWavNum	Required
opticalGainSel	Required
apodizationSel	Required
zeroPadding	Required
Mode	Not Required
Unused	Not Required

3.3.1.11 restoreDefaults

- Description: restores the default gain and correction parameters.

Operation ID	13
scanTime	Required
commonWavNum	Required
opticalGainSel	Required
apodizationSel	Required
zeroPadding	Required
Mode	Required
Unused	Not Required

3.3.1.12 setSourceSettings

- Description: Set all light source configurations needed to turn on/off the light source.
- This operation has a special command packet format.

Operation ID	22 (1 byte)
Lamps Count	1 byte.
Lamp Select	1 byte.
Reserved	2 bytes.
T1	1 byte.
Delta T	1 byte.
Reserved	2 bytes.
T2_C1	1 byte.
T2_C2	1 byte.
T2 max	1 byte.
Unused	8 bytes

3.3.1.13 setOpticalSettings

- Description: Select the optical gain settings to be used during the scan.
- This operation has a special command packet format.

Operation ID	27 (1 byte)
opticalGainValue	2 bytes.
Unused	17 bytes

3.3.1.14 setCalibrationWells_1

- Description: Set the first three values of the calibration wells.
- This operation has a special command packet format.

- Note: The calibration wells must be quantized by fraction length of 20.

Operation ID	90 (1 byte)
first calibration wells value	4 bytes
second calibration wells value	4 bytes
third calibration wells value	4 bytes
Unused	7 bytes

3.3.1.15 setCalibrationWells_2

- Description: Set the last two values of the calibrationwells.
- This operation has a special command packet format.
- Note: The calibration wells must be quantized by fraction length of 20.

Operation ID	91 (1 byte)
fourth calibration wells value	4 bytes
fifth calibration wells value	4 bytes
Unused	11 bytes

3.3.2 Responses

3.3.2.1 runPSD and runAbsorbance

Number of payload packets is determined according to following rules:

1. commonWavNum in command packet is disabled (Taking value 0):
   - Data received contains y-axis (PSD/Absorbance) double values followed by x-axis (Wave Number) double values.
   - Data length received in packet 1 = number of double values of PSD/Absorbance
   - **Payload packets** = ceil[(data length in packet 1) * 8 * 2 / 20]
   - 8 -> length of double data.
   - 2 -> duplicate data length for both y and x values.
   - 20 -> maximum number of user data bytes per packet.
   - After receiving all bytes for double data from the payload packets, y-axis and x-axis values can be interpreted by constructing double values from the received bytes.
2. commonWavNum in command packet is enabled (Taking any value other than 0):
   - Data received contains y-axis (PSD/Absorbance) double values followed by x-initial and x-step Init64 values.
   - Data length received in packet 1 = number of values of PSD/Absorbance.
   - **Payload packets** = ceil[(data length in packet 1 + 2) * 8 / 20]
   - 2 -> two extra Init64 values for x-initial and x-step.
   - 8 -> length of double data.
   - 20 -> maximum number of user data bytes per packet.
   - After receiving all bytes from the payload packets, y-axis values can be interpreted by constructing double values from the received bytes.

- X-initial and x-step can be interpreted by constructing Int64 vales from the received bytes.
- X-axis values can be interpreted as follows:
    i. X(i+1) = X(i) + x-step
    ii. X-initial is value for X(1).
- After interpreting x-axis values, they have to be converted from Int64 to double as follows:
    i. X(i) = (X(i) >> 3) * 10000
    ii. X(i) = X(i) / (1 << 30)

3.3.2.2 runGainAdj

- Data length received in packet 1 = 2 bytes which represents the gain value.
- One payload packet is received (Packet 2) with gain value represented in the first two bytes.

3.3.2.3 Rest of Operations

- Data length received in packet 1 = 1
- One payload packet is received (Packet 2) with 20 bytes of random data.

4 System Management Service Packet Structure

Any sent/received packet should be 20 bytes long. If the payload of packet being transmitted is less than 20 bytes, pad the rest of the packet with zeros.

Field	Size (bytes)	Data Type	Description
Operation ID	1	Int	Specify the operation number requested
Unused	19	x	x

4.1 Detailed Commands & Responses

4.1.1 Commands

4.1.1.1 getPowerUsage

- Description: Requests to retrieve the all power-related information

Operation ID	0
Unused	Not Required

4.1.2 Responses

4.1.2.1 getPowerUsage

Packet 1

Field	Size (bytes)	Data Type	Description
Status	1	Int	Status of the operation
Data Length	2	Int	Number of bytes to be received
Unused	17	x	x

Packet 2

Field	Size (bytes)	Data Type	Description
Operation ID	4	Int	ID of the operation this response belongs to (In this case = 0)
Battery Remaining %	4	Int	Percentage of the remaining battery
Charging State	4	Int	State of charging 0 → No charger connected 1 → Charging 2 → Fast Charging (15v adapter)
Unused	8	x	x

5 Memory Management Service Packet Structure

Any sent/received packet should be 20 bytes long. If the payload of packet being transmitted is less than 20 bytes, pad the rest of the packet with zeros.

5.1 Command Packets Format (Sent on Rx characteristic)

Most command packets of Memory Management service follow the below format.

Field	Size (bytes)	Data Type	Description
Operation ID	1	Int	Specify the operation number requested
File Number	1	Int	The scan file which is targeted by the operation (applicable only in readScanFile)
Unused	18	x	x

5.2 Detailed Commands & Responses

5.2.1 Commands

5.2.1.1 getMemInfo

- Description: Requests to retrieve the all memory-related information

Operation ID	0
File Number	Not Required
Unused	Not Required

5.2.1.2 getScanFile

- Description: Requests to retrieve the data of specific scan file.

Operation ID	1
File Number	Required
Unused	Not Required

5.2.1.3 clearMem

- Description: Requests to clear all the scans saved on memory.

Operation ID	2
File Number	Not Required
Unused	Not Required

5.2.1.4 saveScanParameters

- Description: Requests to save NeoSpectra Micro scanning parameters. (Please refer to Section 3.1 for more information on the attributes below).

Operation ID	3 (1 byte)
scanTime	3 bytes
opticalGainValue	2 bytes
commonWavNum	1 byte
opticalGainSel	1 byte
apodizationSel	1 byte
zeroPadding	1 byte
Mode	1 byte
Unused	9 bytes

5.2.2 Responses

5.2.2.1 getMemInfo

Packet 1

Field	Size (bytes)	Data Type	Description
Status	1	Int	Status of the operation
Data Length	2	Int	Number of bytes to be received
Unused	17	x	x

Packet 2

Field	Size (bytes)	Data Type	Description
Operation ID	4	Int	ID of the operation this response belongs to (In this case = 0)
Scans number	4	Int	Total number of scans saved on memory
FW version	4	Int	Firmware version of scanner
Unused	8	x	x

5.2.2.2 getScanFile

Packet 1

Field	Size (bytes)	Data Type	Description
Status	1	Int	Status of the operation
Data Length	2	Int	Number of bytes to be received
Unused	17	x	x

Packet 2…Packet N

Field	Size (bytes)	Data Type	Description
Operation ID	4	Int	ID of the operation this response belongs to (In this case = 1)
scanTAG	1	Int	0xA → Reference scan (Background) 0xC → Material scan (Absorbance) 0xD → Material scan (not divided by BG "raw")
Y-Axis data	Y-Axis data length * 8	Long long	Y-Axis data values
X-Axis data	X-Axis data length * 8	Long long	X-Axis data values

- **Note**: The first 5 bytes (OperationID, TAG) aren't repeated in all the packets. They exist only in Packet # 2.

5.2.2.3 clearMem

No response is returned for this operation!

***Note:** After completion of this command, you can call "getMemInfo" command to confirm that scans number has become zero.

5.2.2.4 saveScanParameters

Packet 1

Field	Size (bytes)	Data Type	Description
Status	1	Int	Status of the operation
Data Length	2	Int	Number of bytes to be received (= 1 In this case)
Unused	17	x	x

Packet 2

Field	Size (bytes)	Data Type	Description
Unused	20	x	x

6 Disclaimers

- Si-Ware Systems offers Alpha samples of NeoSpectra-Scanner to customers as a tool to evaluate the performance of the device. Production version can differ from Alpha samples.
- The Alpha samples are not yet IP65 or drop tested.
- The scanner body paint may be scratched in these Alpha samples.
- The high voltage USB charger is customized for NeoSpectra scanner. It must not be used with any other USB device. Its 15V DC output will damage normal USB devices.

7 Precautions

- Avoid long periods of exposure to infrared light coming out of the light source as heating may occur. Heating may affect the sample's surface.
- Avoid having direct eye contact with the light emitted from the light source.