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Wearable Development Kit User Manual

ON Semiconductor®

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1 Introduction

This user manual is focused for the audience who is going to explore and gain the advantage of using Wearable Development Kit to get exposure about the ON Semiconductor Power management, Battery management, Glue Logics, Backlight driver, Haptic driver, Wireless charging solution. This user manual explains the list of features is developed for Wearable Development kit to demonstrate the ON Semiconductor solutions and provided provisions for developer interaction with kit to explore the solution by means practical methodology to get hands on experience.

It is preferred to read to this user manual to understand the complete functionality of WDK and list of options provided for developers before unboxing the WDK development kit to power up and rejoice the developed functionality and options are available for development.

2 Getting Started

2.1 Package Contents

The Wearable Development Kit contains the following:

- Smart Watch with Quick Release Watch Strap
- Docking Station with Snap fit holder and transparent lid.
- Power Adapter(5V/2000mA)
- Type A to Micro Type B USB Cable
- Product Brief Manual
- Warning Sheet

Figure 1: Wearable Development Kit

2.2 Highlighted Features of the Wearable Development Kit

Bluetooth

Bluetooth Low Energy communication is used to communicate with Smart Phone Application and used for Wireless Charging.

Batttery Powered

Battery charging is done with the support of Docking Station using Wired Power Supply.

Wireless Charging Enabled

Wearable WDK is the first to demonstrate loosely coupled wireless charging solution. Wireless charging is enabled only in the Smart Watch. To evaluate wireless charging, the user should use an aftermarket AirFuel™ compatible Power Transmit Units (PTU) such as Convenient Power and Gill Electronics.

Caution:The Smart Watch should be evaluated in a single device mode and should not be put on the PTU in the presence of other devices being charged or else there is a risk of damage to this Smart Watch

Display

The higher resolution display is for Smart Watchapplication and userinterface.

2.3 Smart Watch

ON/OFF button

- To **turn ON** the Smart Watch, press and hold the power button for 3 seconds.
- To **turn OFF** the Smart Watch, press and hold the power button for 3 seconds.
  - For more information on powering ON and powering OFF the Smart Watch, read Power ON/OFF descriptions.

LED

- Battery Charging indication is provided by this LED. When the watch is being charged either by Wired or Wireless Charging the LED will be blinking till the battery is completely charged. Once it has been charged the LED glows steadily in Green color.

Display with Touch panel

- User can interact with the Smart Watch through the touch panel.

Figure2: Model of Smart Watch showing Buttons and LEDs

Charging

Charging in Smart watch can be done as Wired or Wireless:

- In Wired Charging the supply can be provided by means of either USB bus power or by an external adapter. When wired supply is connected, an indication is provided on the LCD Display.
- In Wireless Charging the supply can be provided by means of an external PTU. When wireless supply is connected, an indication is provided on the LCD Display.

Figure 3: Wired and Wireless Charging Indication

Note that dead battery wireless charging is not supported by this wearable kit. AirFuel specification is not released to support Cat1 wireless charging. For additional information on how to support dead battery wireless charging, please contact your local ON Semiconductor support team

2.4 Dock Station Model

The Docking Station is mainly used for charging, programming and debugging the Smart Watch.

List of provisions available in the Docking Station

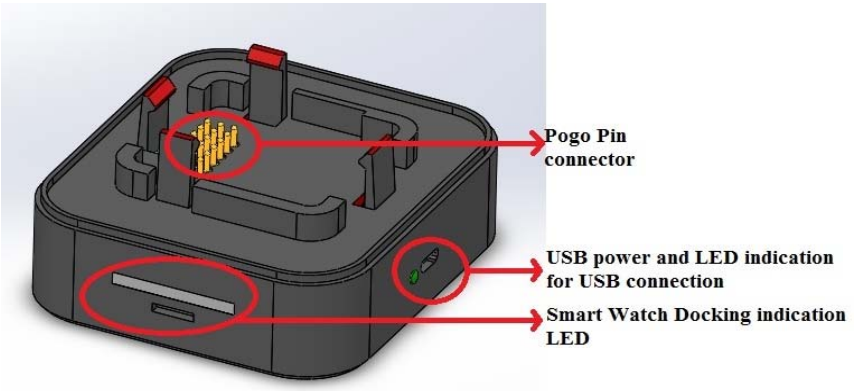

Figure4: Model of Docking Station showing Pogo Pins and USB

- **Pogo Pins**

The spring loaded type test probe like connectors establish the contact between Smart Watch and the Docking Station.

Purpose of Pogo Pins

1) Charging the Smart Watch

2) Programming and Debugging the Smart Watch

3) Additional features in the Smart Watch can be accessed through Docking Station.

Note: Features in Smart Watch are explained separately.

- **B2C Expansion Connector**

The B2C 2x13 Expansion Connector is at the opposite edge of the USB connector.

Purpose of Expansion Connector

1) Mainly to utilize the additional features in Smart Watch

2) When Smart Watch is not connected to Dock Station, External Expansion Card can be connected to the Docking and its SWD Interface Programming can be utilized.

3) At the same time 5V, 3V/1A supply can be provided to power up the Expansion Card using Dock Station.

- **USB Connector and LED**

The Docking Station is powered using the USB Connector through an external adapter 5V/2A or by a USB Down Stream Port. A Blue LED near the USB Connector is provided to indicate when the Docking Station is powered ON

- **Swart Watch Detect Indication**

A Blue LED bar is provided on the side of the Docking Station. The LED blinks when the Docking Station is powered ON and the Smart Watch is not docked. When the Smart Watch is docked, the blinking of LEDs comes to a halt and the Blue LED glows continuously.

- **Docking Indication**

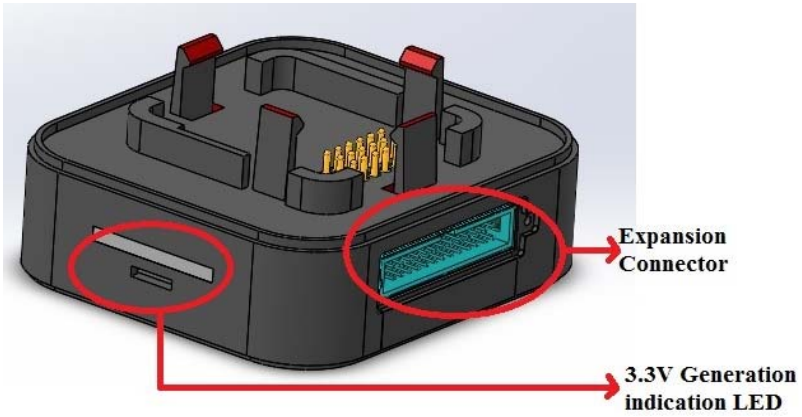

Figure 5: Model of Docking Station showing the Expansion Connector

- **3.3V Indication LED**

  A Green LED is present opposite of the Dock Indication LED. This is used to indicate the generation of 3.3V in the dock.

- **Expansion Card Detection Indication**

  Once the Expansion Card is connected via Expansion Connector a Red LED glows and green LED will be turned OFF.

- **Snap Fit Holder**

  This is used to hold the Smart Watch to the Docking Station. First, the Smart Watch is placed followed by the Snap Fit Holder.

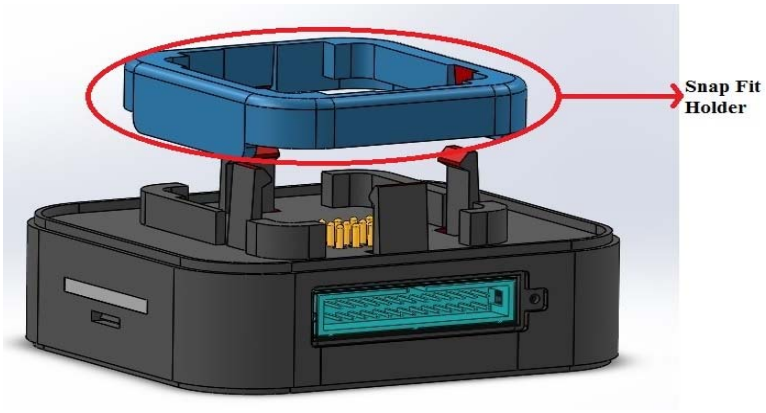

Figure 6:Model of Docking Station showing the Snap Fit Holder

2.5 Application Download

- For Android devices, install the ON Semiconductor WDK Mobile Application from the Play Store.
  - For Information about the ON Semiconductor WDK Android Mobile Application functionality, features and supported mobile phones read Android Mobile Application.
- For iOS devices, install ON Semiconductor WDK Mobile Application from the App Store.
  - For Information about ON Semiconductor WDK iOS Mobile Application functionality, features and supported mobile phones read iOS Mobile Application.

3 Charging

The Smart Watch is connected to the Docking Station for Wired Charging. The Docking Station is powered either by an External adapter or through USB bus supply. .

3.1 Wired Charging

- Plug the USB cable into a power outlet and insert the micro USB Connector in the Dock Station. The Blue LED to the side of the Docking Station will blink until the Smart Watch is docked Smart Watch.
- Once the Smart Watch has been docked, the Blue LED will start glowing continuously
- Figure 7- shows the connection of Smart Watch to the Docking Station.
  - The Smart Watch is docked to the Docking Station such that the Pogo pins in the Docking Station are connected with the Pogo Connector in Smart Watch.
  - The Snap Fit Holder is then placed on top of the Smart Watch such that it attaches to the Snap Fit Pillars

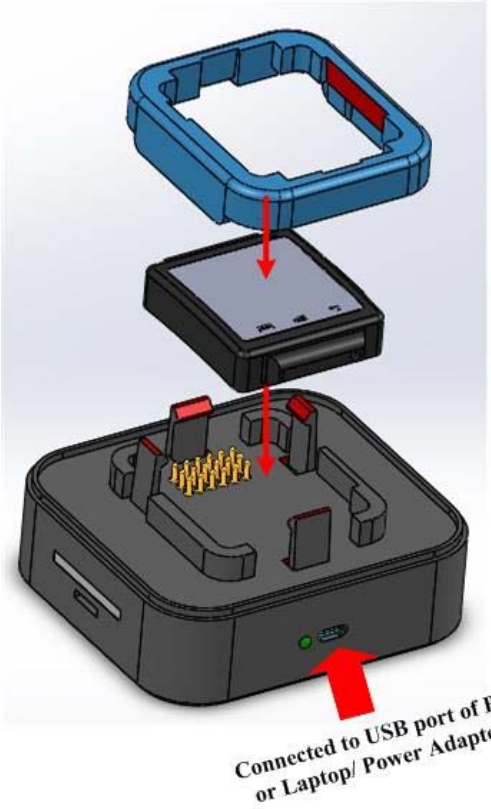

Figure 7: Steps for Charging Smart Watch

- Battery level can be seen through battery bars or in the Mobile Application (If Connected).
- The Green Charging Indication LED on top right corner of the WDK will blink every second when charging.
- When the Battery is Fully Charged, the Green LED on the Watch will glow steadily.
- User can remove the watch from the Dock Station when the Green LED glows steadily.

4 Programming/Debugging

Programming/Debugging can be done for the following devices. The Microcontroller to be programmed will be selected based on the below priority

1. Smart Watch nRF52832
2. Expansion Card ARM processor
3. Docking Station nRF52832

4.1 Smart Watch

- Once the Smart Watch is docked properly on the charging dock. User can program or Debug the code in the Smart Watch.
- Refer IDE User guide for Programming /Debugging procedure.
- The Smart Watch can be removed from the Dock Programming/Debugging.

4.2 Expansion Card

The Expansion Card is mainly used to probe the signals from Smart Watch. It is also used to provide a provision for User to interact with the GPIO of the Smart Watch. The below figure shows the overall Block Diagram including the Smart Watch, Docking Station, and Expansion Card.

The Docking Station can also Program the Expansion Card through its SWD signals.

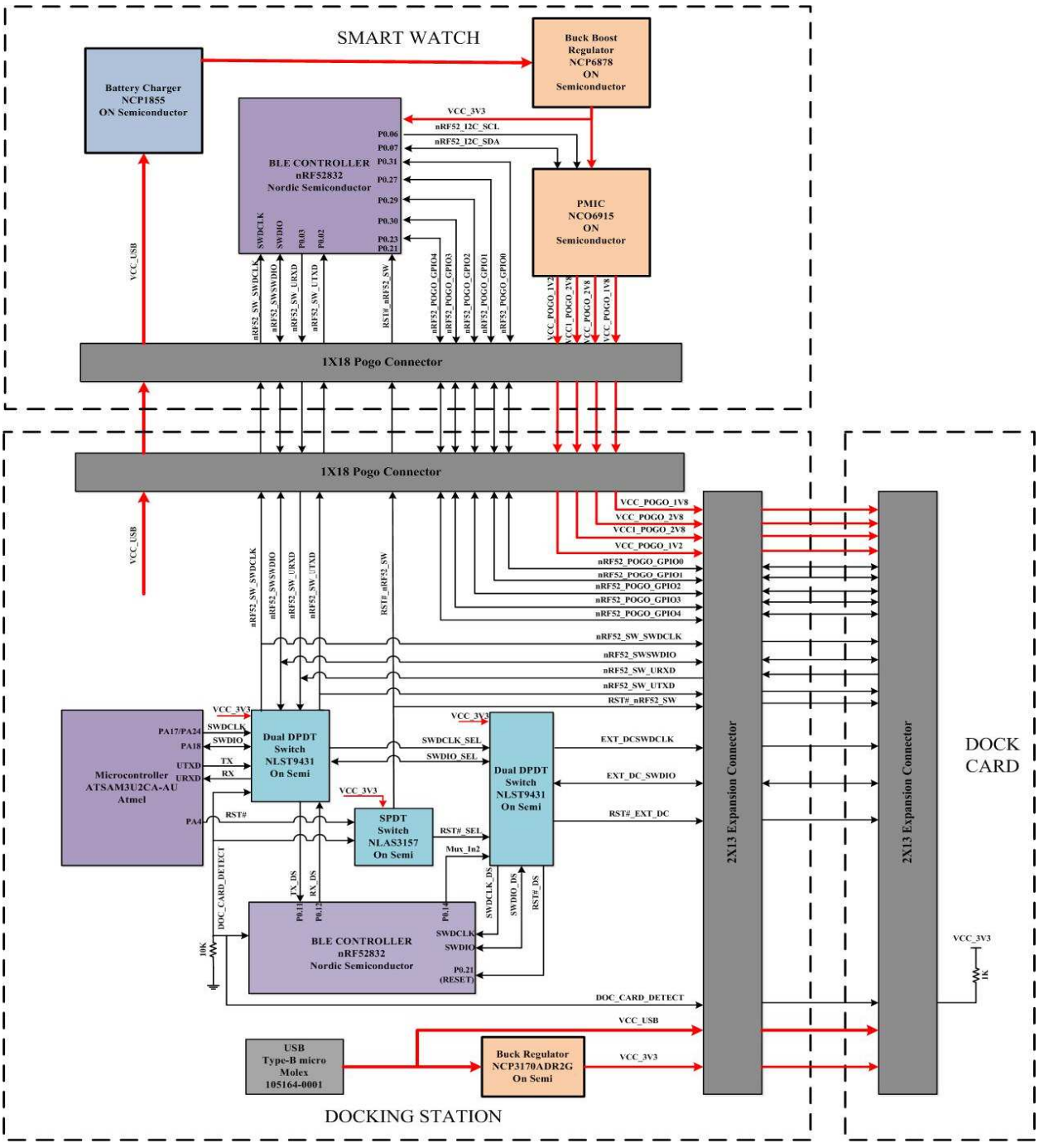

Figure 8: Expansion Card Block Diagram

Note:

Programming of External Expansion Card SWD interface is alone supported. Debugging feature is not provided.

4.2.1 Expansion Connector

- An Expansion Connector provides a provision for accessing the various reserved signals from the Smart Watch.
- The below image shows the image of the Expansion Connector and its first pin marking. The below table shows the various pins in the connector and its corresponding functionalities

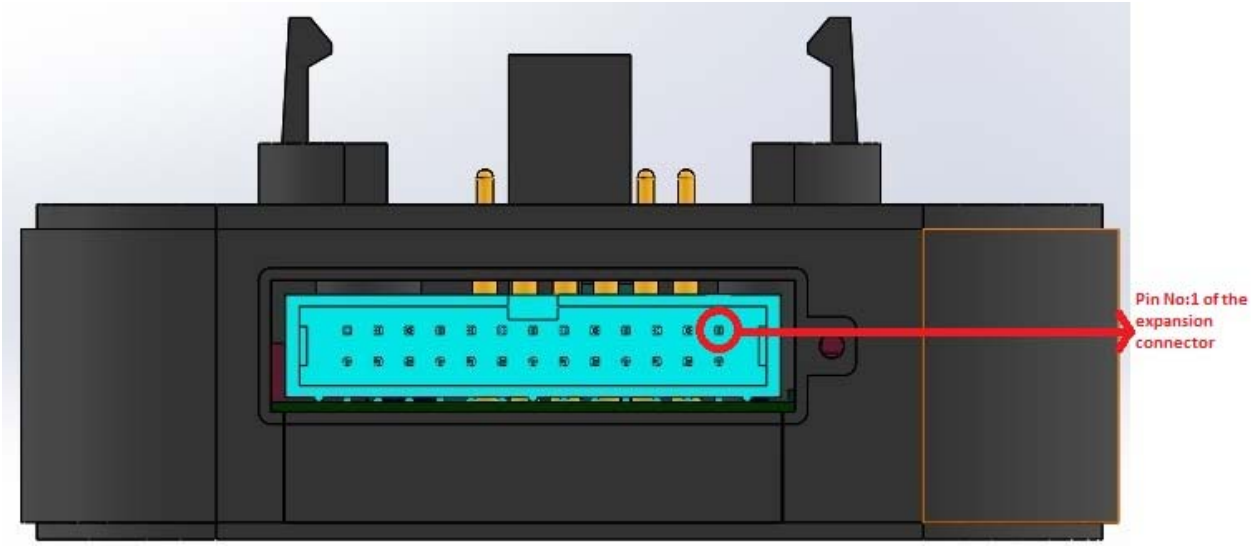

Figure 9: Expansion Connector Pin 1 Indication

Pin No	Connection Net	Functionality
1	VCC_USB	5V power supply from USB. Used to power up the Expansion Card devices.
2	VCC_POGO_1V2	1.2V power supply from Smart Watch. Used to connect to an external device
3	VCC_USB	5V power supply from USB. Used to power up the Expansion Card devices
4	VCC_3V3	3.3V power supply generated in Docking Station from 5V.
5	VCC_POGO_2V8	2.8V power supply from Smart Watch. Used to connect to an external device
6	VCC_3V3	3.3V power supply generated in Docking board from 5V.
7	VCC1_POGO_2V8	2.8V power supply from Smart Watch. Used to connect to an external device
8	nRF52_SW_SWCLK	To probe the JTAG clock signals used for coding the Smart Watch from Docking Station
9	EXT_DC_SWCLK	JTAG clock signals used for coding an external device by the Docking Station
10	nRF52_SW_SWDIO	To probe the JTAG data lines used for coding the Smart

		Watch from Docking Station
11	EXT_DC_SWDIO	SWD data lines used for coding an external device by the Docking Station
12	RST#_nRF52_SW	To probe the SWD Reset signals used for resetting the Smart Watch from Docking Station
13	RST#_EXT_DC	SWD reset signal to reset an external device from the Docking Station
14	VCC_POGO_1V8	1.8V power supply from Smart Watch. Used to power an external device
15	GND	Ground
16	GND	Ground
17	GND	Ground
18	GND	Ground
19	nRF52_SW_URXD	Used for probing the UART Receiver signals from Docking Station to Smart Watch
20	nRF52_POGO_GPIO1	GPIO reserved for User interaction with the Smart Watch
21	nRF52_SW_UTXD	Used for probing the UART Transmitter signals from Docking Station to Smart Watch
22	nRF52_POGO_GPIO2	GPIO reserved for User interaction with the Smart Watch
23	nRF52_POGO_GPIO0	GPIO reserved for User interaction with the Smart Watch
24	nRF52_POGO_GPIO3	GPIO reserved for User interaction with the Smart Watch
25	DOC_CARD_DETECT	Used to detect when an external Expansion Card is connected to the docking board. User must add an external pull up of 1K to 3.3V to this line
26	nRF52_POGO_GPIO4	GPIO reserved for User interaction with the Smart Watch

The below table provides the maximum current that can be consumed from each rail.

Maximum Current consumed (mA)					
VCC_USB	**VCC_3V3**	**VCC_ POGO_2V8**	**VCC1_ POGO_2V8**	**VCC_ POGO_1V8**	**VCC_ POGO_1V2**
Based on input source	1000	200	200	200	600

- When powered from USB downstream post, Maximum Input power is 2.5W. In this Smart Watch consumes maximum of around 1.5W. Balance power to be consumed from all other rails must be around 1W to Expansion Card.
- When powered from an External Adapter, Maximum Input power is 10W. In this Smart Watch consumes maximum of 1.5W. Balance power to be consumed from all other rails must be 8.5W

Power rails of 2.8V, 1.8V and 1.2V are solely obtained from the Smart Watch. It is generated from a PMIC (NCP6915). Each of these rails can be programmed through the I2C interface present in the nRF52832 present in Smart Watch.

The below table shows the Register 08 which needs to be configured to enable each power rails.

Name: ENABLE				Address: $08			
Type: RW				Default: $80			
D7	D6	D5	D4	D3	D2	D1	D0
DCDC_V2/V1	spare = 0	DCDC_ EN	LDO5_ EN	LDO4_ EN	LDO3_ EN	LDO2_ EN	LDO1_ EN

4.2.2 Expansion Card Details

The following points to be followed by User when connecting an Expansion Card to the Docking Station and to program it

Automatic Expansion Card Detect

- The Expansion Card must have a 1K pull up to the connector Pin No 25 externally for the Docking Station to sense the connection of Expansion Card
- The Smart Watch must be removed from the Docking Station in order to program the Expansion Card.

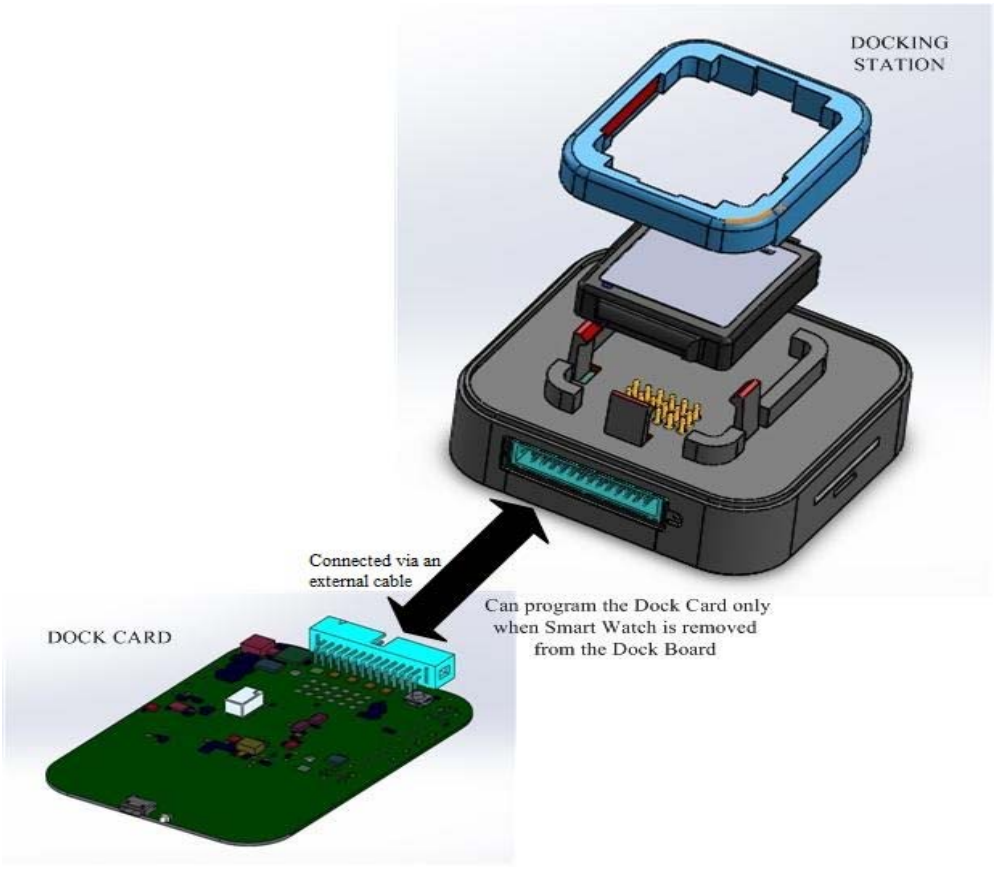

Figure 10: Programming of Dock Card

- The Docking Station by default provides 5V and 3.3V. During this period only Docking Station or Expansion Card can be programmed.

- The priority of programming using SWD signals comes in the following order:
  1. Smart Watch
  2. Dock Card
  3. Docking Station

- If the Smart Watch is connected to the Docking Station only, the signals from the Smart Watch can be probed.

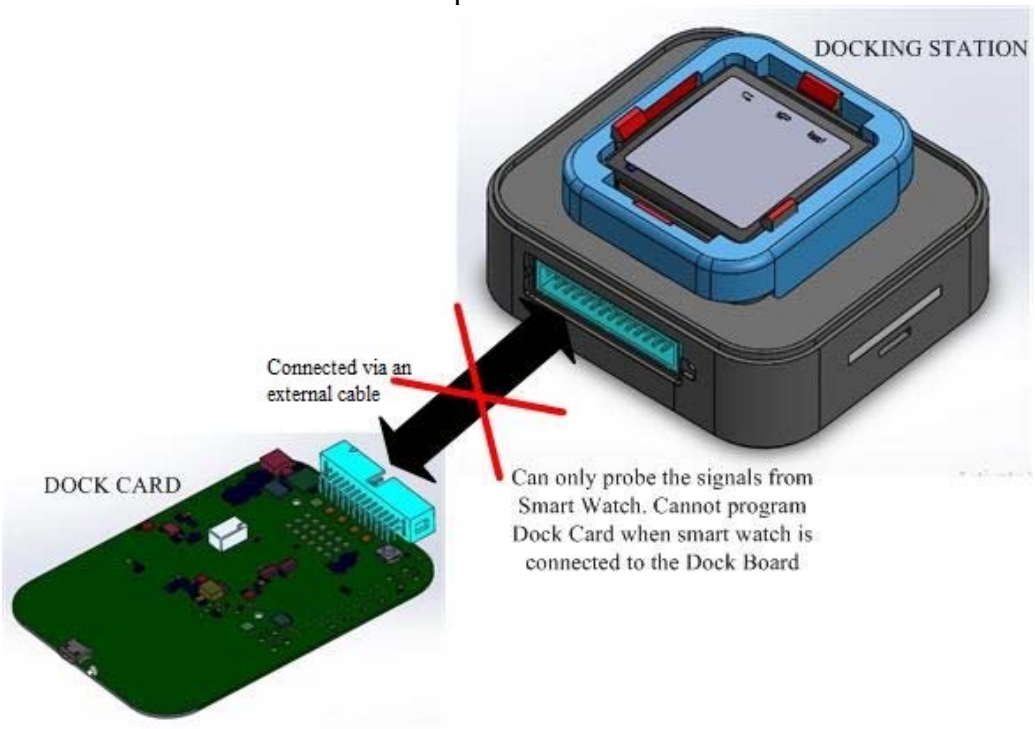

Figure 11: Probing of Smart Watch Signals

- The external SWD signals can be used to only program the Expansion Card. It cannot be used to debug the Expansion Card as the UART signals are not tapped out from the Expansion Card.
- The mating connector to be used to tap out signals from the expansion connector is the 30320-5002HB part from 3M INTERCONNECT SOLUTION is used. This Header part mates with the 3M Wire mount Socket, 79 Series, CHG series, 891 series, and 3000series.

4.3 Docking Station nRf52_BLE Chip

- Once the Watch & dock card are removed from the Charging dock, User can program or Debug the code in the Docking Station.
  - Refer IDE User guide to Program Dock Station nRF52832.

5 Features and Settings

This includes ON Semiconductor WDK Features.

5.1 List of Icons

	Menu Icon
	BLE Settings icon
	Settings icon
	BLE icon
	Close Icon
	Timer Icon
	Stopwatch icon
	Alerts Enabled
	Alerts Disabled

5.2 Screen Buttons

- Menu Button : Pressing will show the list of utilities.
- Home Button : Press to return to the Home Screen.
- Back Button : Press to return to the previous screen or exit the current utility.

5.3 System Control

5.3.1 Power ON/OFF

This includes how to Power ON and Power OFF the Smart Watch.

Power ON

- Press and hold the Power button for 3seconds to Power ON the Smart Watch.
- When the Smart Watch is Powered ON, the Display will activate and the **ON Semiconductor** logo will be displayed on the Screen for a short duration after which an Analog or Digital clock will be displayed based on the previous settings.

Figure 12: ON Semiconductor logo

Power OFF

- Press and hold the Power button for 3 seconds to Power OFF the Smart Watch.
- When Smart Watch is Powered OFF, a "Goodbye" message will be displayed on the Screen and Display will be turned OFF.

5.3.2 Battery Status

- Battery Status can be seen in Status Bar located at the top of the Home Screen and also in the Smart Phone Application when connected.

5.3.3 Low Battery/Critical Low Battery

Low Battery:

- When Battery level reaches **40%**, a **"Low Battery Alert"** Notification will be displayed in Smart Watch and an alert notification will be sent to the Smart Phone, if in a connected state.
- When Battery level reaches **20%**,**a"Low Battery"** Notification will be displayed in Smart Watch and Smart Watch will enter into **"Low Power Mode"**.

- In Low Power Mode,
  - Display will be turned OFF.
  - Touch Interrupt will be disabled.
  - All the peripherals will be disabled.
- Long Pressing the Power Button for 3seconds will show the Charging Status of the Smart Watch.
- If Smart watch is charging, by Long Pressing the Power Button, a **"Charging"** Notification will be displayed in the Smart Watch.
- If Smart Watch is not charging, by Long Pressing the Power Button, a **"Low Battery, Connect Charger"** Notification will be displayed in the Smart Watch.

Critical Low Battery:

- When battery level reaches **10%**, **"Critical Low Battery"** Notification will be displayed in Smart Watch and the Smart Watch will enter into **"Critical Low Power Mode"**.
- In Critical Low Power Mode,
  - Display will be turned OFF.
  - Touch interrupt will be disabled.
  - All the peripherals will be disabled.
  - Power Button is also disabled

NOTE:

- If Smart Watch is charging, and when the battery level reaches **25%,** Smart Watch will automatically enter into Active Mode.

5.3.4 Screen Lock

- When the Smart Watch is in an ON state, the screen will be locked automatically if there is no user input for 20seconds.
- A Short Press of Power Button can be used to lock and unlock the screen manually.

5.3.5 Auto-Sleep

- In Standby Mode, if there is no activity in the watch for one minute, then the Smart Watch will enter Sleep Mode.
- In Sleep Mode, all the peripherals will be disabled and the Smart Watch will consume less power.

5.3.6 Wake On Motion

- Wake On Motion is turned ON in standby mode and sleep mode.
- If any motion is detected in Standby Mode, the Smart Watch will remain in Standby Mode, and it will not enter Sleep Mode.
- If any motion is detected in Sleep Mode, the Smart Watch will exit from Sleep Mode and it will enter to Active Mode.

5.4 BLE Control

5.4.1 Turn ON BLE

- By default BLE is turned ON.
- BLE can be turned ON manually in the BLE Settings Screen.
- Click the BLE Settings icon on the Home Screen, and the BLE Settings screen will be displayed.
- Tap on the Status Button on the BLE Settings Screen from OFF to ON to turn on the BLE.
- Go back to the Home Page by pressing the Back Button in the BLE Settings Screen.
- Check Status Bar (Top bar) in Home Screen. If BLE is turned ON, BLE icon will be displayed. When the BLE is turned ON the Home Page will look like as shown in the below image.

Figure 13: Home page with BLE ON

5.4.2 BLE Advertisement

- By default, the Smart Watch will advertise with name of format “ON_xx:yy:zz” Where xx/yy/zz are last 3 bytes of the MAC address.
- The Smart Watch BLE Name can be configured from Smart Phone Application.

5.4.3 Turn OFF BLE

- BLE can be turned OFF in the BLE Settings Screen.
- Click the BLE Settings icon on the Home Screen, then BLE Settings Screen will be displayed.
- Tap on the Status Button on the BLE Settings Screen from ON to OFF to turn OFF the BLE.
- Go back to the Home Page by pressing the Back button in the BLE Settings Screen.
- Check the Status Barat the top of the Home Screen. If BLE is turned OFF, the BLE icon will not be displayed.

5.4.4 Connect/Disconnect with Smart Phone

5.4.4.1 Mobile Scanning

- Turn ON Bluetooth on the Mobile Device and the BLE on the Smart Watch. By Default Bluetooth is turned ON in Smart Watch.
- Search list of nearby devices from Mobile and Connect to required Smart Watch.
- Once connection has been established, a bond is created between Smart Watch and Smart Phone.
- Once a bond is created with Smart Phone, this Smart Watch cannot connect to any other Smart Phone.
  - For Information about pairing to an Android Device read Set-up and pair with Android Mobile App.
  - For Information about pairing to an iOS Device read Set-up and pair with iOS Mobile App.

5.4.4.2 Auto-Connect

- If the Smart Watch goes out of the Smart Phone's Range, it will disconnect. The Smart Watch will Auto-Connect once it enters back the range of Smart Phone.
- Auto-Connect do not happen, if the user manually disconnects the Smart Watch..

5.4.4.3 Disconnect from Smart Phone

5.4.4.3.1 With Bond Deletion

- Tap Delete Bond from Mobile Application.
- Tap Disconnect from Mobile Application.
- Now the Smart Phone will disconnect from the Smart Watch and any Bond information will be Deleted from Mobile Application
  - For more information on Deleting Bonds from the Smart Watch read BLE Forget Device.
  - For more information on Deleting Bond from an Android Device read Delete Bond from Android Mobile App.
  - For more information on Deleting Bond from iOS Device read Delete Bond from iOS Mobile App.

Caution:

If user wants to Delete Bond, User should Delete Bond on both Smart Watch and Smart Phone, otherwise the Smart Watch and Smart Phone behavior will be undefined.

5.4.4.3.2 Without Bond Deletion

- Tap Disconnect in Settings from Mobile Application.
- Now the Smart Phone will disconnect from the Smart Watch.

5.4.4.4 BLE Forget Device

- **"Forget Device"** button will be enabled and BLE Name of the Smart Phone is displayed in Smart Watch BLE Settings Screen.
- To connect to any other device, Click on **the "Forget Device"** button in BLE Settings Screen. Then Forget [BLE Name of Smart Phone] Button will be disabled in Smart Watch BLE Settings Screen.

5.5 In-built Utilities

5.5.1 Clock Selection

Clock Screen will be displayed when Back Button is pressed from Home Screen. The clock to be displayed (analog/digital) can be chosen from the Settings option.

5.5.1.1 Analog Clock

- Select the Analog Clock by tapping on the Analog Clock Icon on the Home Screen followed by Settings Icon.
- Then select the Analog Clock Button. After selecting Analog Clock User can see the clock by pressing Back Button on Home Screen.

5.5.1.2 Digital Clock

- Select the Digital Clock by tapping on the Digital Clock Menu Icon on the Home Screen followed by Settings Icon.
- Then select the Digital Clock Button. After selecting Digital Clock User can see the clock by pressing Back Button on Home Screen.

5.5.2 Time Settings

Time can be auto-synchronized with Smart Phone (if connected) or User can manually set the time.

5.5.2.1 Turn ON Auto-Synchronization

- To turn ON Auto-Synchronization tap Menu Icon on the Home Screen followed by Settings Icon.
- Tap on Clock Settings Button and select Auto-Sync
- A notification will be displayed on the Smart Watch once synchronization is completed.
- User can see the synchronized time on the Home Screen by tapping Home Button.

5.5.2.2 Manual Settings

- To enable Manual Settings, tap the Menu Icon on the Home Screen followed by Settings Icon.
- Tap on Clock Settings Button and disable Auto-Sync
- Tap on Manual Settings, now User can set the time manually.
- The user can see the newly set time on the Home Screen by pressing Home Button.

5.5.3 Timer

- To set Timer, tap Menu Icon on the Home Screen followed by **Timer** Icon.
- After setting the Timer, User can start it by clicking the Okay Button on the Timer Settings Screen.
- User can Cancel / Start / Stop the Timer.
- The Timer can run in background by pressing the Home Button in Timer Settings Screen.
- Once the set time is reached, a pop will be shown on the Smart Watch display with Vibration.
- Smart Watch will not enter Standby Mode, if it is in the Timer Screen.

5.5.4 Stopwatch

- To start the Stopwatch, tap the Menu Icon on the Home Screen followed by **"Stopwatch"** Icon.
- User can pause or reset the Stopwatch.
- The Stopwatch can run in background by pressing the Home Button in Stopwatch Settings Screen.
- The Smart Watch will not enter Standby mode, if it is in Stopwatch Screen.

5.5.5 Alerts

- By enabling Alerts User can see the Notifications on the Smart Watch.
  - To enable Alerts, tap the Menu Icon on the Home Screen and tap on **"Alerts Icon"**
- By disabling Alerts User will not see any Notifications on the Smart Watch.
  - To disable Alerts, tap Menu Icon on the Home Screen and tap on **"Alerts Icon".**

Figure 14: Menu Screen with Notification Alerts Enabled

5.6 Configurations from Smart Phone Application

For all the below configurations done from the Smart Phone Application, the Smart Watch and Smart Phone should be in a connected state.