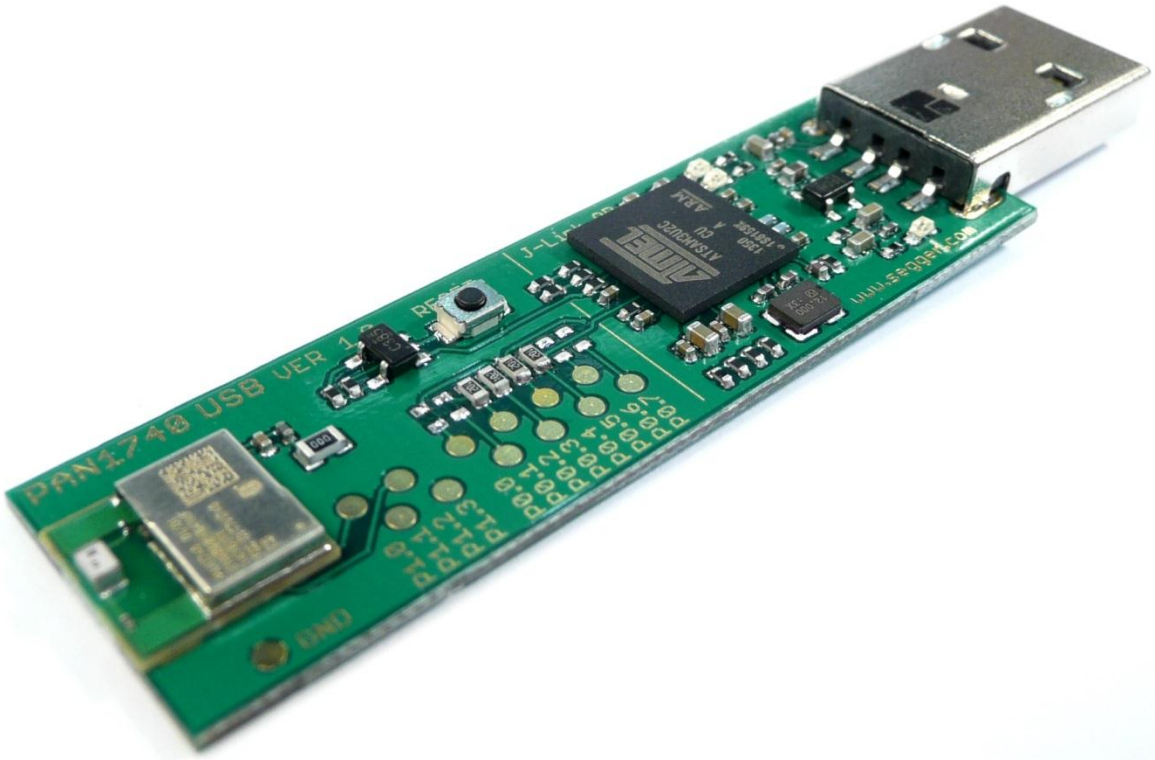
PAN1740 Design Guide



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1. SCOPE OF THIS DOCUMENT

This Design Guide applies to the Bluetooth development modules PAN1740ETU The intention is to enable our customers to easily and quickly integrate Panasonic's PAN1740 module in their product.

This guide describes the Hardware and gives useful hints.

2. KEY BENEFITS WHEN USING PAN1740

- Single-mode Bluetooth Smart System-on-Chip
- ARM CORTEX M0 CPU
- Small 9.0 x 9.5 x 1.8 mm SMD package with antenna
- Includes 16 MHz and 32.768 kHz crystal
- Temperature Range from -40°C to +85°C
- Pre-programmed calibration data and BT-Address
- Peak Power consumption 4.9mA Rx and Tx
- Less than a few µA in low power modes
- Link budget 93dBm (Rx Sensitivity -93, Tx 0 dBm)

3. BLUETOOTH LOW ENERGY

Bluetooth Low Energy (BLE), part of Bluetooth Ver. 4.0, specifies two types of implementation: Single mode and dual mode. Single mode chips implement the low energy specification and consume just a fraction of the power of classic Bluetooth, allowing the short-range wireless standard to extend to coin cell battery applications for the first time. Dual mode chips combine low energy with the power of classic Bluetooth and are likely to become a de facto feature in almost all new Bluetooth enabled cellular phones and computers.

Bluetooth marks

According to the new Bluetooth SIG marks "Bluetooth Smart" (single mode → mainly sensors) and "Bluetooth Smart Ready" (dual mode → gateway and hub devices) the PAN1740 fulfills criteria to label a product as a Bluetooth Smart device.

Bluetooth SMART

4. DESCRIPTION PAN1740

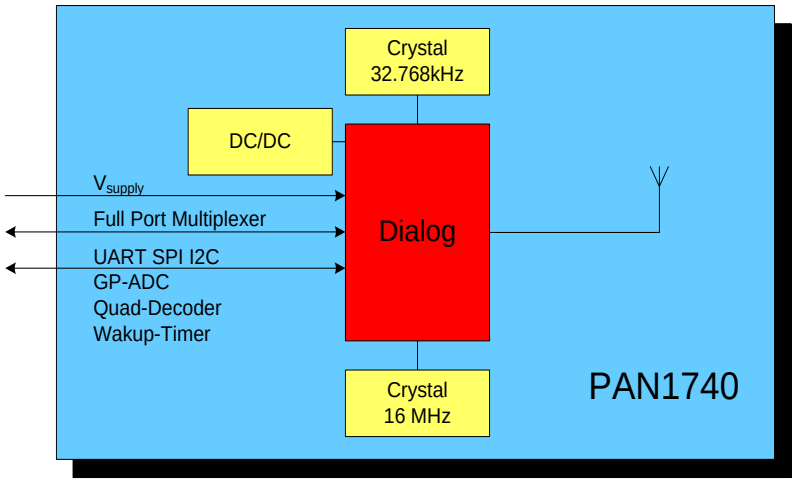
PAN1740 is the next generation Bluetooth Low Energy Module from Panasonic with reduced form factor, significantly lower power consumption and embedded Software Stack. The Single mode Bluetooth Smart System-on-Chip module is optimized for low power, small size and low system cost products. It reduces external component count, development effort and time to market.

The Module is manufactured in a very small 9.0* 9.5* 1.8 mm SMD package with shielded case and chip antenna. The power consumption of only 4.9mA in Tx and Rx mode makes the use of coin cell batteries possible or reduces the needed battery capacity and cost of existing solution by at least 50%. It is qualified according to Bluetooth 4.0 standard. FCC, IC and CE approvals are under preparation.

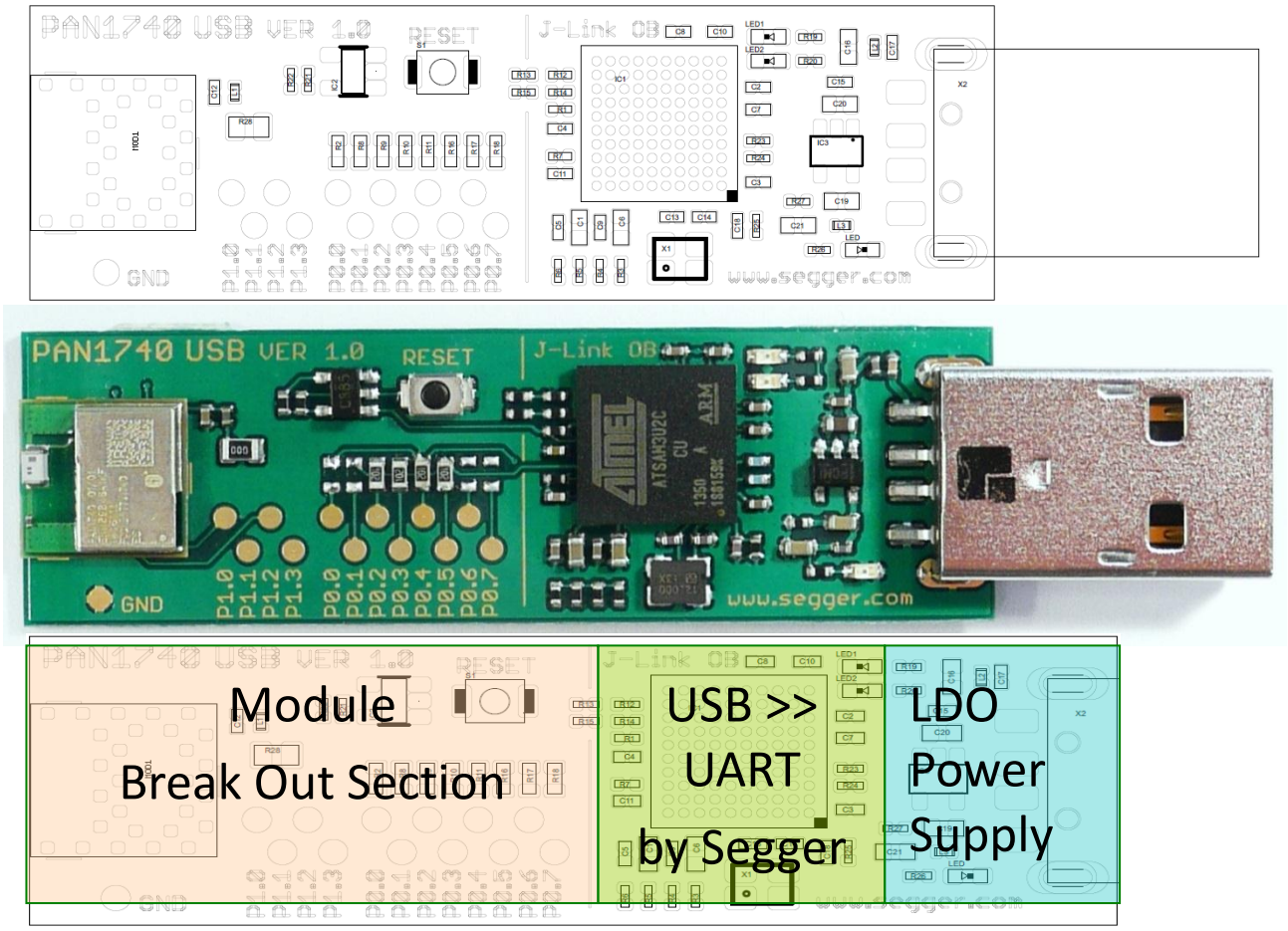
The PAN1740 comes with a complete software development platform, which includes a qualified Bluetooth Smart single-mode stack that can be compiled with a number of available BLE profiles, custom application and programmed on the module. Multiple Bluetooth Smart profiles for consumer wellness, sport, fitness, security and proximity applications are supplied as standard, while additional customer profiles can be developed and added as needed.

Please contact your local sales office for further details on additional options and services, by visiting www.panasonic.com/rfmodules for U.S. and http://industrial.panasonic.com/eu/ for Europe or write an e-mail to wireless@eu.panasonic.com

5. BLOCK DIAGRAM PAN1740 MODULE



6. COMPONENT LAYOUT DIAGRAM PAN1740 USB-DONGLE



6.1. FUNCTIONALITY

Atmel µC includes Segger USB-to-UART programmer (serial number on the backside)

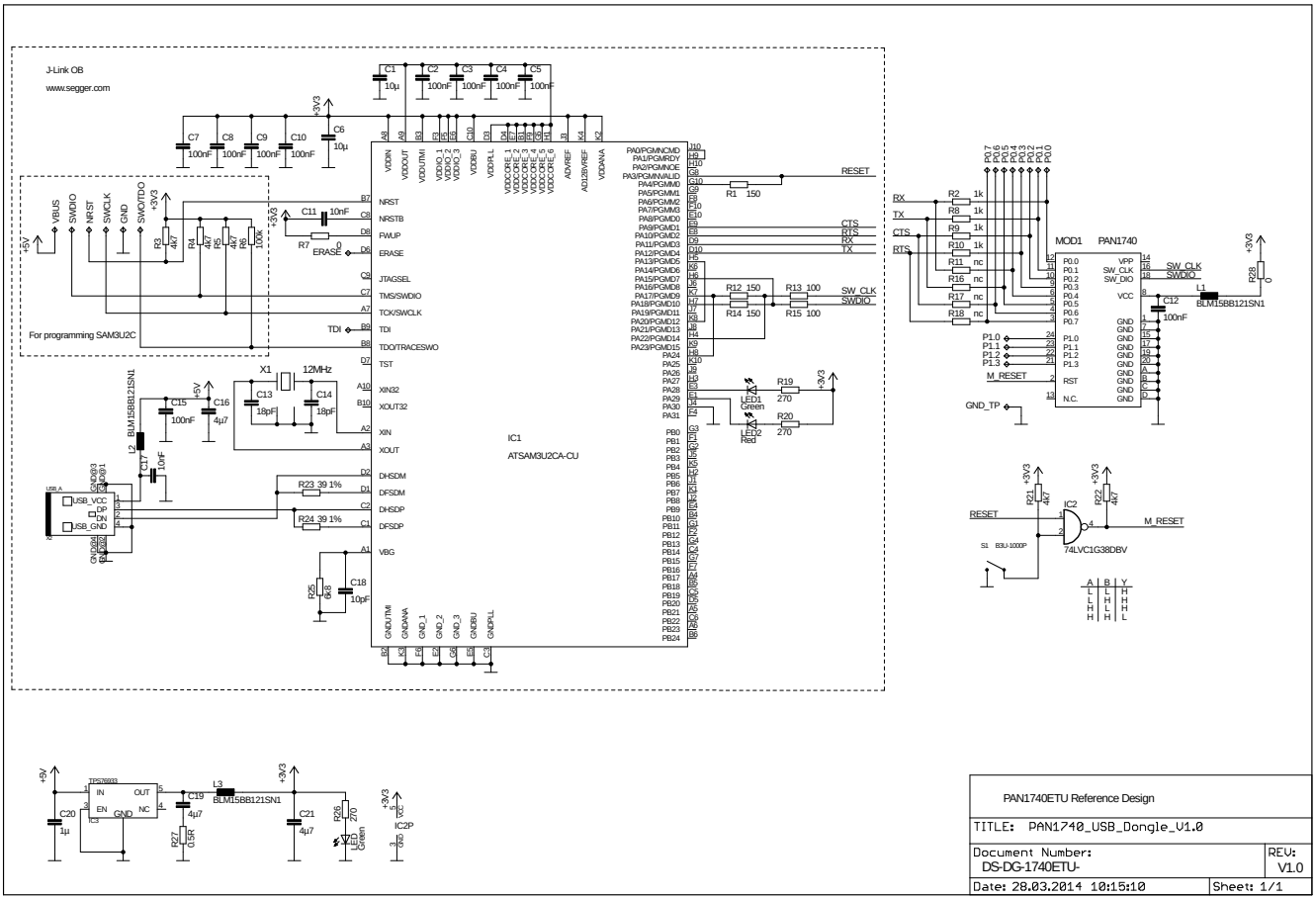
OTP cannot be damaged - Failsafe development

Runs with Dialog's Keil compiler projects

Runs with "Connection Manager"

Can be used for SW development "on the fly"

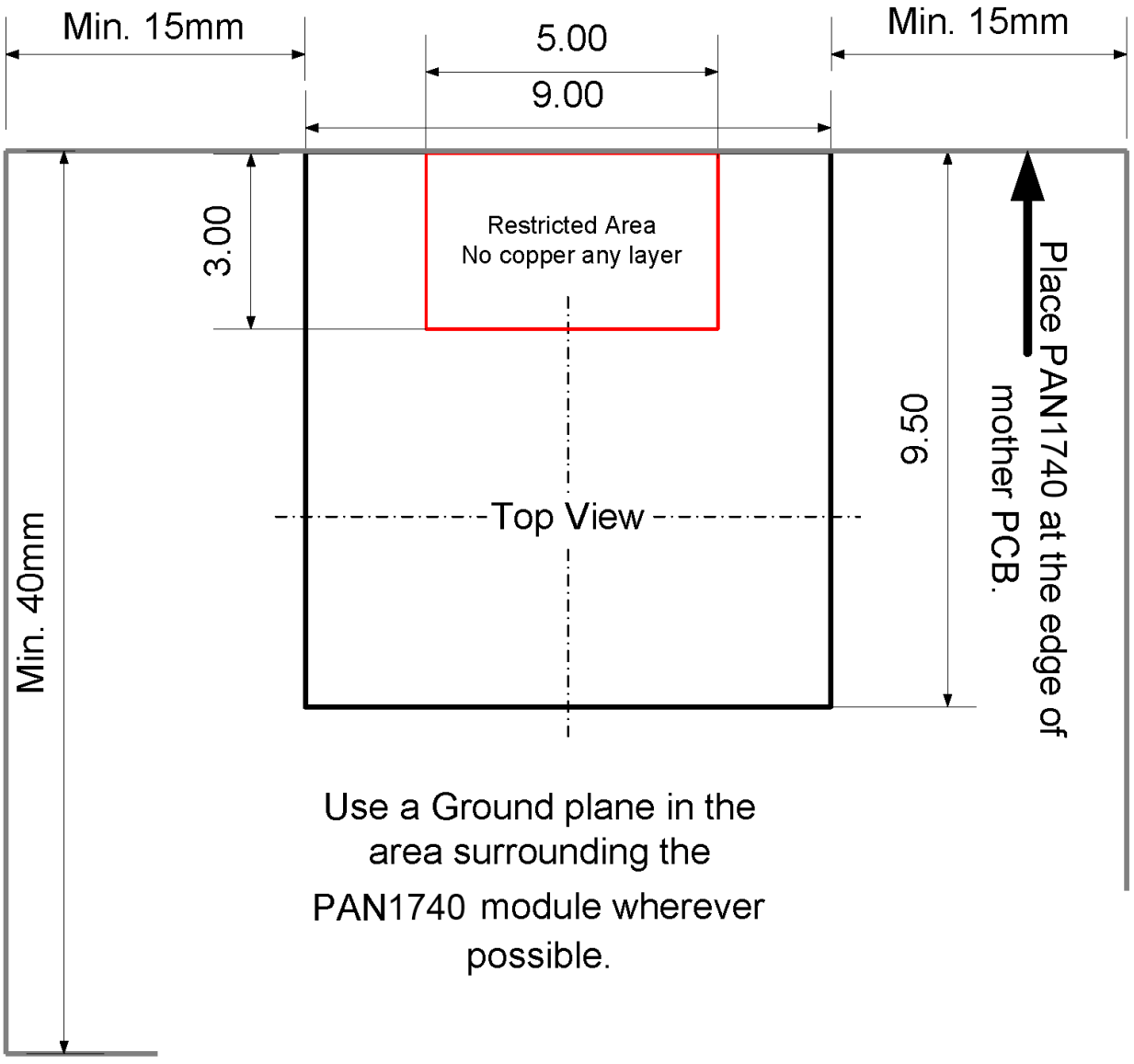
7. SCHEMATIC


J-Link OB
www.segger.com
For programming SAM3U2C
IC1
ATSAM3U2CA-CU
MOD1
PAN1740
X1
12MHz
RESET
M_RESET
GND_TP
LED1
Green
LED2
Red
74LVC1G38DBV
PAN1740ETU Reference Design
TITLE: PAN1740_USB_Dongle_V1.0
Document Number: DS-DG-1740ETU-
REV: V1.0
Date: 28.03.2014 10:15:10
Sheet: 1/1

8. LAYOUT RECOMMENDATION

PAN1740 WITH ANTENNA PLACEMENT

If possible place PAN1740 in the center of mother PCB.



Use a Ground plane in the area surrounding the PAN1740 module wherever possible.

Dimensions are in mm.

Note: The above recommendation for the Ground plane is based on a double layer PCB. If additional ground planes are implemented in other layers and connected by sufficient vias the minimum xy dimensions can be reduced.

9. DEVELOPMENT OF APPLICATIONS

In this chapter, the basic tools and some examples are shown to get the USB-dongles running. All examples use Windows7 OS and iPhone 5G, but also higher versions should work.

Installing and running HW drivers on any system requires time and each step may require re-booting your system. Contact your system administrator if any system related problems appear during the installation phase. Install the drivers step-by-step in the below order.

There are two basic approaches for implementation:

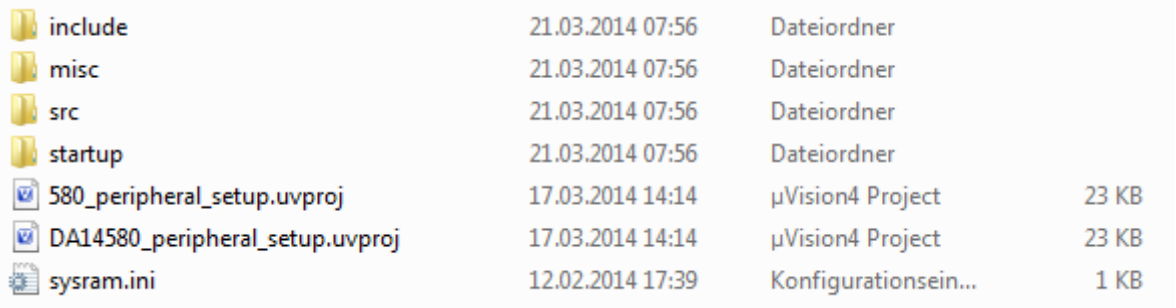
1. Full embedded HCI with external host controller

If BLE functionality is being added to a running application -- E.g. for porting the setup GUI from your application into a smart phone -- developing a smart phone "App" and installing either a proprietary BLE profile on the host controller and or a BT-Sig certified profile should be considered. The BT-Developers portal provides guidance for this process - http://developer.bluetooth.org/

2. Standalone sensor application

Applications requiring less than 32KB can reside and execute on the PAN1740 module. There are several examples in the Keil projects. The download link is in chapter 9.1. The profiles are located in the SDK folder:

\DA14580_SDK_3.0.4.0\dk_apps\src\ip\ble\hl\src\profiles



Smart Snippets is needed to burn the application into the module. If you are working with the PAN1740ETU USB-Dongle applications can be developed and executed in RAM, but for security reasons it is not possible burn the OTP. Panasonic's Experimenters' kit is required to access OTP is accessible. Please contact your local sales distributor for support. The Experimenters' kit may be mandatory for production. For items beyond the scope of this design guide, refer to the Smart Snippets guide on the Dialog's support website. Following is a list of supported profiles.

	Software Features List (note 1)	DA14580-00		DA14580-01	
		2.0.4		3.0.2	3.0.4
	"X" = Supported feature "NS" = Not Supported Feature	release date: 23/12/2014		release date: 28/03/2014	release date: 30/06/2014
1	**Embedded Development Tools**				
1.1	Keil project environment	X		X	X
1.2	JTAG debugger	X		X	X
1.3	GNU / GCC toolset	NS		NS	X
2	**Stack**				
2. 1	**Protocol features**				
2.1.1	Bluetooth Smart 4.1 core stack	X		X	X
2.1.2	MTU size	23		23	23
2.1.3	Large packet support (L2CAP fragmentation)	NS		X	X
2.1.4	Master mode	X		X	X
2.1.5	Slave mode	X		X	X
2.1.6	Master and Slave sequentially	X		X	X
2.1.7	Multilink support (maximum links)	4		6	6
2.1.8	UUID 128bits	X		X	X
2. 2	**Low Energy features**				
2.2.1	BLE timer wakeup	X		X	X
2.2.2	GPIO wakeup	X		X	X
2.2.3	Quadrature wakeup	X		X	X
2.2.4	Active mode	X		X	X
2.2.5	Extended Sleep Mode	X		X	X
2.2.6	Deep Sleep	X		X	X
3	**Profiles**				
3. 1	**Health Profile**				
3.1.1	Blood Pressure Profile	X		X	X
3.1.2	Blood Pressure Service	X		X	X
3.1.3	Glucose Profile	X		X	X
3.1.4	Glucose Service	X		X	X
3.1.5	Health Thermometer Profile	X		X	X
3.1.6	Health Thermometer Service	X		X	X
3. 2	**Sports and Fitness Profile**				
3.2.1	Cycling Power Profile	NS		NS	X
3.2.2	Cycling Power Service	NS		NS	X
3.2.3	Cycling Speed and Cadence Profile	X		X	X
3.2.4	Cycling Speed and Cadence Service	X		X	X
3.2.5	Location and Navigation Profile	NS		NS	X
3.2.6	Location and Navigation Service	NS		NS	X
3.2.7	Heart Rate Profile	X		X	X
3.2.8	Heart Rate Service	X		X	X
3.2.9	Running Speed and Cadence Profile	X		X	X
3.2.10	Running Speed and Cadence Service	X		X	X

..\DA14580_SDK_3.0.4.0\dk_apps\src\ip\ble\hl\src\profiles

	Software Features List (note 1)	DA14580-00		DA14580-01	
		2.0.4		3.0.2	3.0.4
	"X" = Supported feature "NS" = Not Supported Feature	release date: 23/12/2014		release date: 28/03/2014	release date: 30/06/2014
3. 3	**Proximity Profile**				
3.3.1	Proximity Profile	X		X	X
3.3.2	Find Me Profile	X		X	X
3. 4	**Alerts and time Profile**				
3.4.1	Time Profile	X		X	X
3.4.2	Current Time Service	X		X	X
3.4.3	Reference Time Update Service	X		X	X
3.4.4	Next DST Change Service	X		X	X
3.4.5	Phone Alert Status Profile	X		X	X
3.4.6	Phone Alert Status Service	X		X	X
3.4.7	Alert Notification Profile	X		X	X
3.4.8	Alert Notification Service	X		X	X
3.4.9	Immediate Alert Service	X		X	X
3. 5	**Peripherals Profile**				
3.5.1	HID over GATT Profile	X		X	X
3.5.2	HID Service	X		X	X
3. 6	**Generic Profile**				
3.6.1	Scan Parameters Profile	X		X	X
3.6.2	Scan Parameters Service	X		X	X
3.6.3	Battery Service	X		X	X
3.6.4	Device Information Service	X		X	X
3.6.5	Link Loss Service	X		X	X
3.6.6	Tx Power Service	X		X	X
3.6.7	Accelerometer	X		X	X
4	**Peripheral Device Drivers/HAL**				
4.1	UART driver	NS		X	X
4.2	GPIO driver	NS		X	X
4.3	SPI driver	NS		X	X
4.4	SPI Flash driver	NS		X	X
4.5	I2C EEPROM driver	NS		X	X
4.6	ADC driver	NS		X	X
4.7	Battery Level driver	NS		X	X
4.8	PWM driver	NS		X	X
4.9	Quadrature driver	NS		X	X
4.10	Wakeup timer driver	NS		X	X

9.1. BASIC PLATFORM TOOLS

1. Windows 7 or higher - www.microsoft.com
2. Keil Compiler 32K free license – www.keil.com/arm/mdk.asp
3. Segger J-Link software - www.segger.com/jlink-software.html

   Use the serial number from the bottom side of the USB-Dongle
4. Bluetooth 4.1 - www.bluetooth.org

9.2. DIALOG SPECIFIC TOOLS

Download in the support forum http://support.dialog-semiconductor.com under the top menu bar "Software".

1. Connection Manager

   Enables basic GATT connections between two BLE devices.
2. Dialogs Projects

   Keil Projects with BLE Profiles and examples. These project files are used to implement the customers application. The BLE profiles are already implemented and you can setup the full feature set and I/O capability of the module.
3. Smart Snippets

   Smart Snippets is the Tool for reading and writing the OTP. With this tool, the last step in the development chain can be performed by burning the OTP fuses. This tool does not work with the USB-Dongle for security reasons. The programming voltage of 6.8V needed to enable the programming is not supported.

9.3. BLUETOOTH ADDRESS AND CRYSTAL TRIM VALUES

1. Main Frequency Calibration up to 1ppm @ 2.4GHz

   Panasonic calibrates the 16 MHz crystal and writes this calibration data in the OTP header. This provides best performance and a stable frequency. Customers do not need to take care of this step in their production.
2. Pre-programmed Bluetooth/MAC Address

   Each Bluetooth device must have a unique MAC address which is provided from the IEEE. Since this may lead to additional costs and registration effort for customers Panasonic burns a unique address into the OTP header from our database. Customers do not need to take care of this step in their production.
3. Precise High Performance Crystal Sleep clock

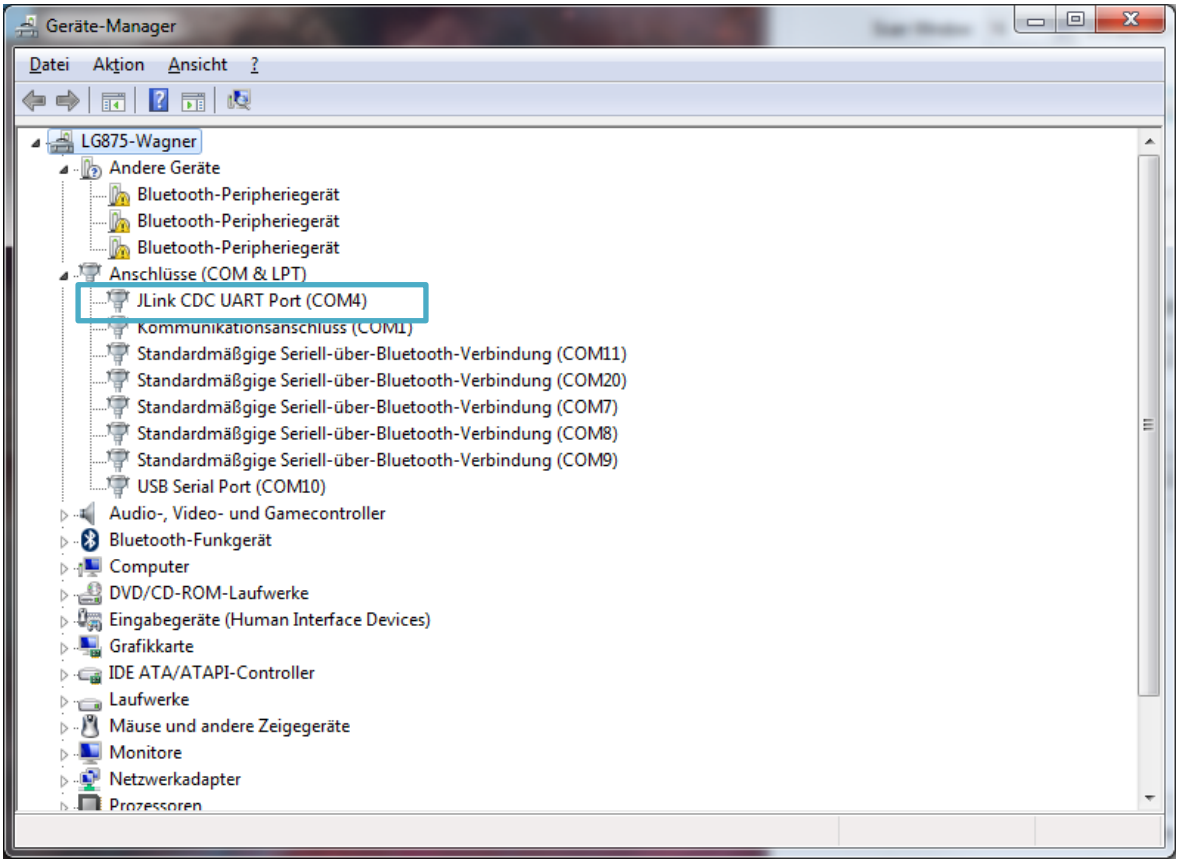
   Since this is a low energy device and the key functionalities are the sleep functions with just a few µA current draw Panasonic has integrated a 32.768 kHz crystal clock into the PAN1740 module. Therefore no external components are needed and there are no hidden costs.

9.4. EXAMPLE FOR CONNECTION MANAGER

In the following example two USB-dongles are used. PAN1026-USB works as a peripheral and the PAN1740-USB as central device.

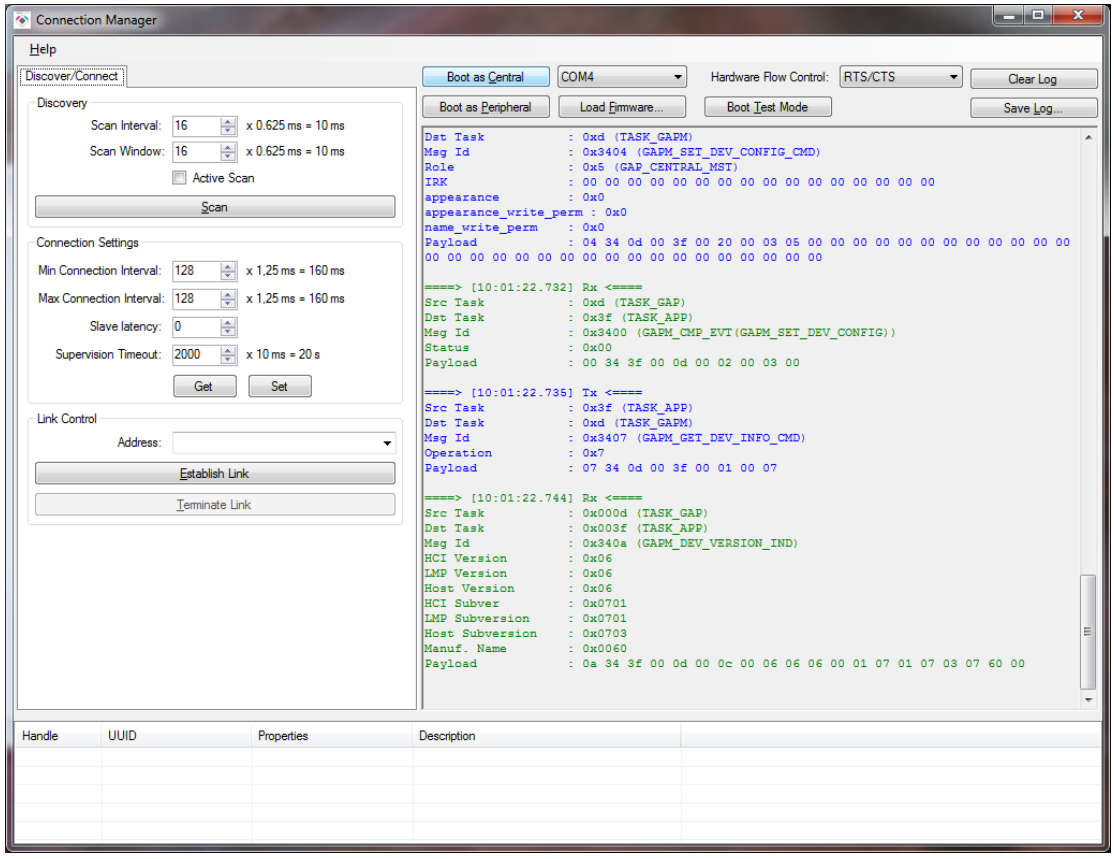
9.4.1. USB Driver

Download and install USB Drivers from Segger
www.segger.com/jlink-software.html



9.4.2. Start the Connection Manager

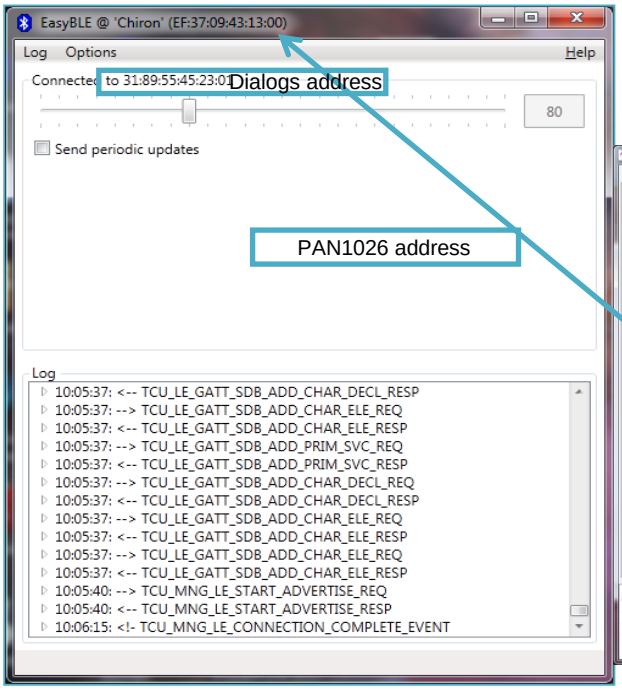
1. Make sure you have admin rights and access to the program folder
2. Wait until the init phase is finished
3. Press load Firmware and select "full_emb.hex"
4. Wait until the init phase is finished
5. Press either "Boot as Central" or "Boot as Peripheral" (Example shows Central)



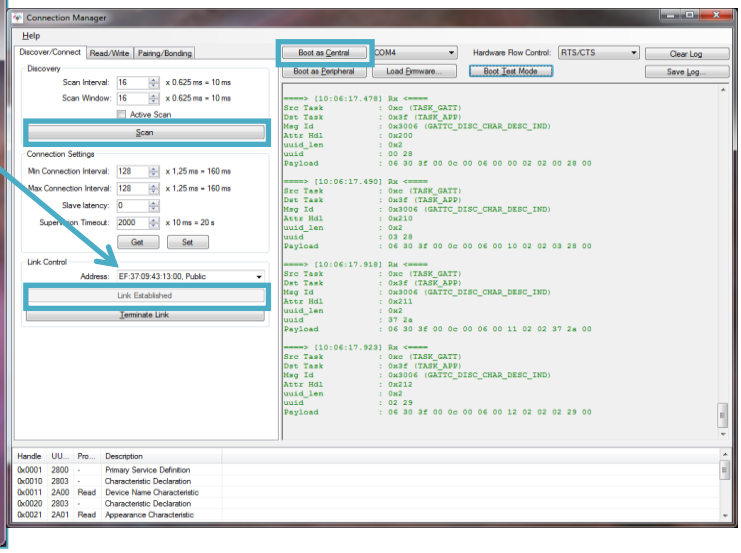
9.4.3. Make PAN1026 Peripheral visible

EasyBLE Tool and a PAN1026-USB dongle may be used to make a peripheral visible with the heart rate profile. Use this link to download EasyBLE:
http://pideu.panasonic.de/files/Documents/WM%20Documents/PAN1026/EasyBLE.zip

9.4.4. Open a Connection

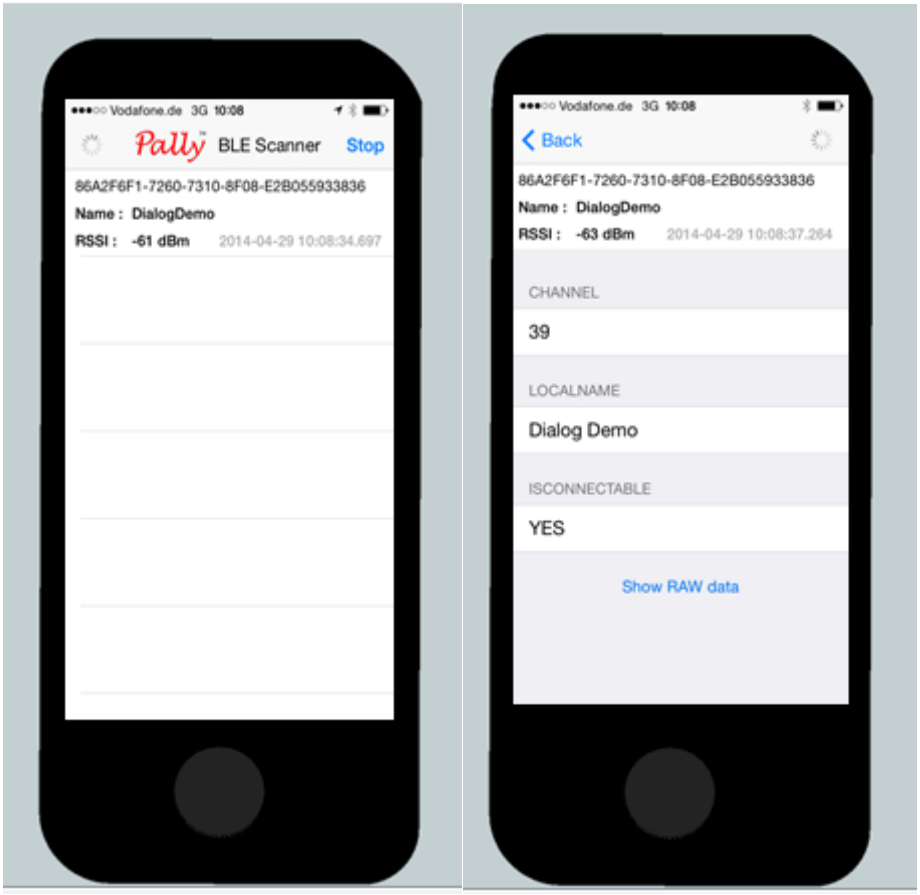


1. Press "Scan"
2. Select PAN1026 address and establish link



9.4.5. IPhone Demo

The PAN1026 used in the example above may be substituted with an iPhone (model 4S and up) and e.g. "Bluetooth Smart Scanner" App.



"Bluetooth Smart Scanner" may be replaced by other BLE Apps for Android or Windows based smart phones. Depending on the application, a proprietary app may be written or existing certified BLE profile used.

9.4.6. Next Steps

The PAN1026 was chosen to demonstrate sending a heart rate payload data, as Connection Manager cannot send data, since it installs only the central or peripheral functionality on the PAN1740, but not the profile. Two PAN1740 USB dongles can be connected by setting one side to Central and the other to Peripheral. To send data you need to run the Keil project in debug mode together with a profile e.g. peripheral example, chapter 10 describes this process.

10. RUN THE KEIL PROJECT EXAMPLE

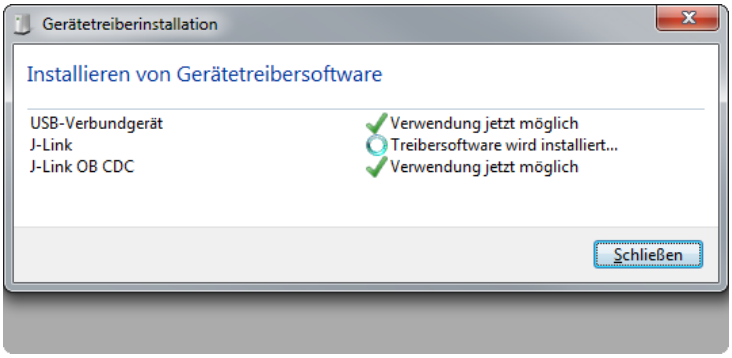
For more detailed information on project examples, refer to the Projects in Dialog's software download page. Recommended is the proximity example as this is the most common profile.

Download and install the SDK using the following URL:

http://support.dialog-semiconductor.com/software-downloads/index

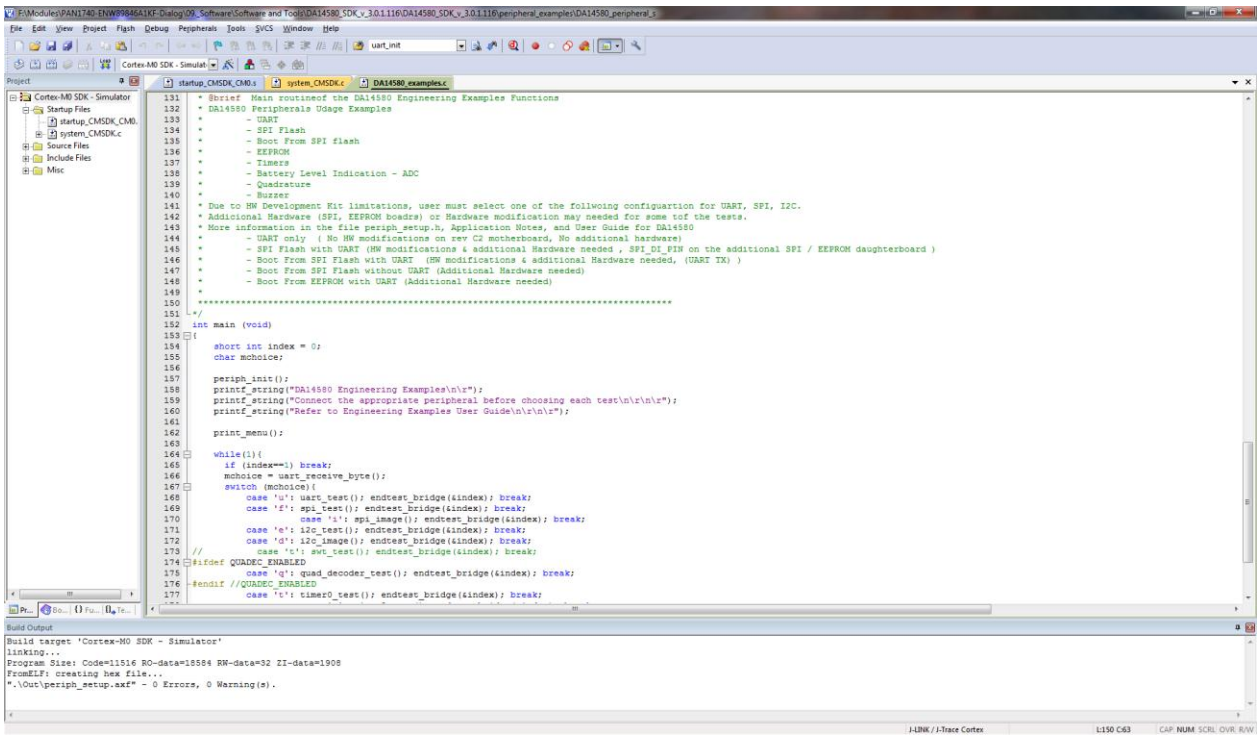
Install the dongle after the Segger J-Link software driver installation.

Refer to chapter 9.1 Basic Platform Tools to download them.

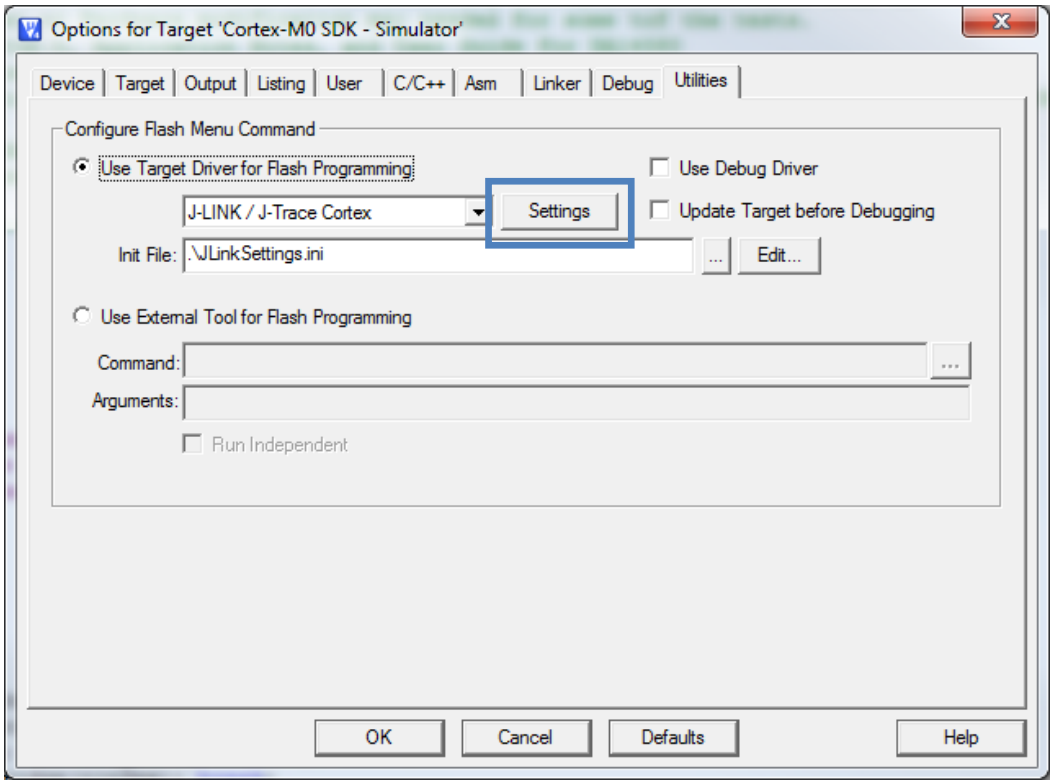


Open the proximity project example found in the Dialog SDK. The project is located in the following SDK folder:

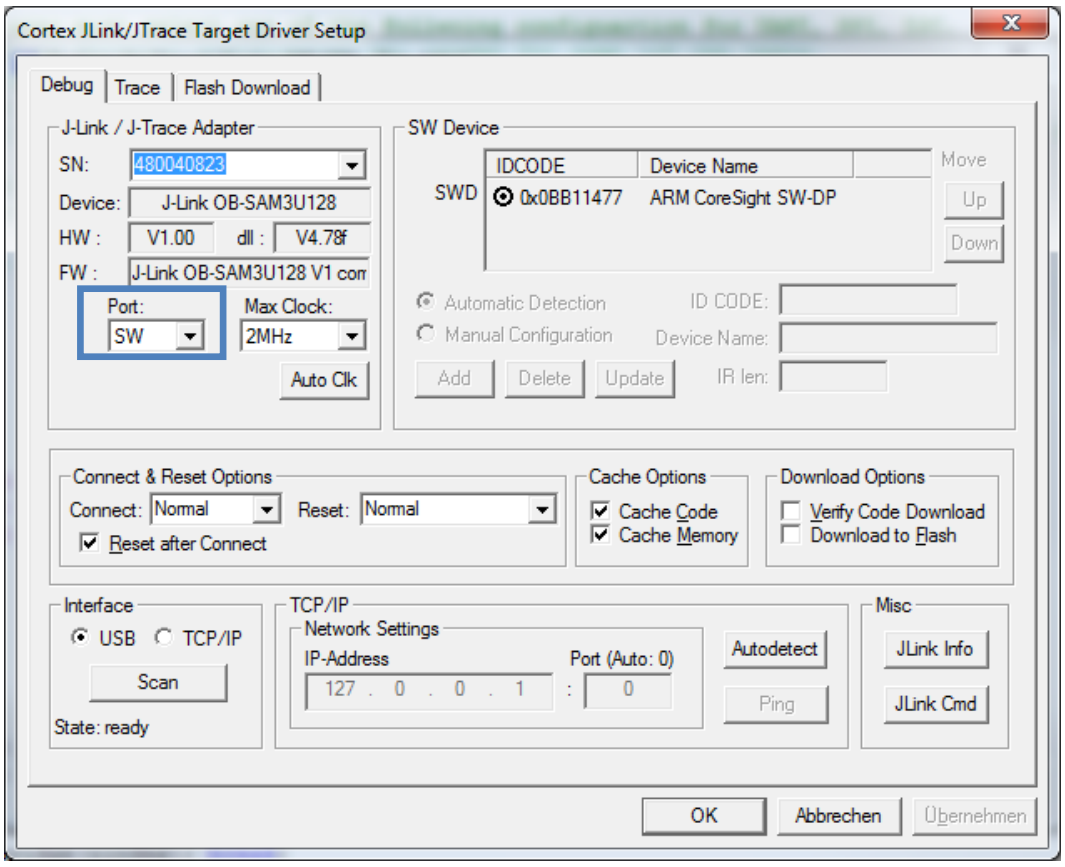
DA14580_SDK_3.0.2.1\dk_apps\keil_projects\proximity\monitor_fe_usb



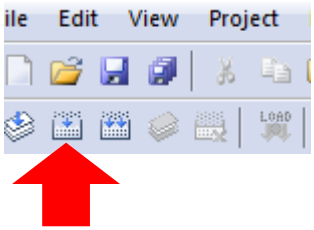
In the Keil compiler Configure the Flash Target (Flash >> Configure Flash Tools). Choose "Settings".



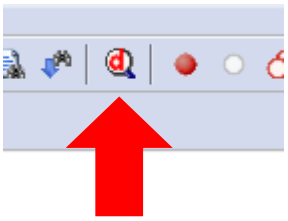
Click the Debug tab. Setup the Port in the J-Flash Settings to "SW". Press "OK".



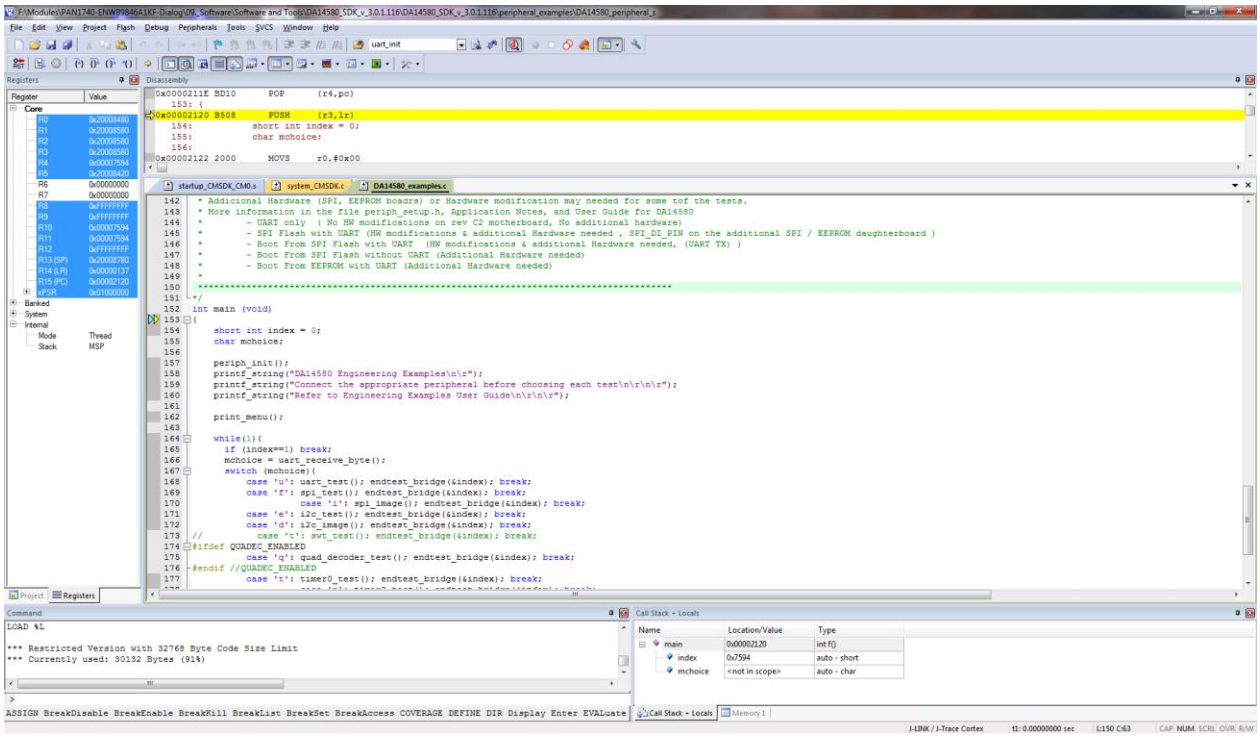
Build Target files (Press F7 or click on the build button) and run the debug session (Press "Ctrl"+F5 or click on the "Debug" button).



Build



Debug



The proximity project has now been compiled and downloaded into the RAM of the PAN1740ETU.

11. EXAMPLE PROXIMITY PROFILE WITH TWO PAN1740-USB DONGLES

Refer to the Basic Development Kit User Manual.

http://support.dialog-semiconductor.com/resources

Additional Tools:

Microsoft Visual C++ 2010 Express – Freeware Compiler

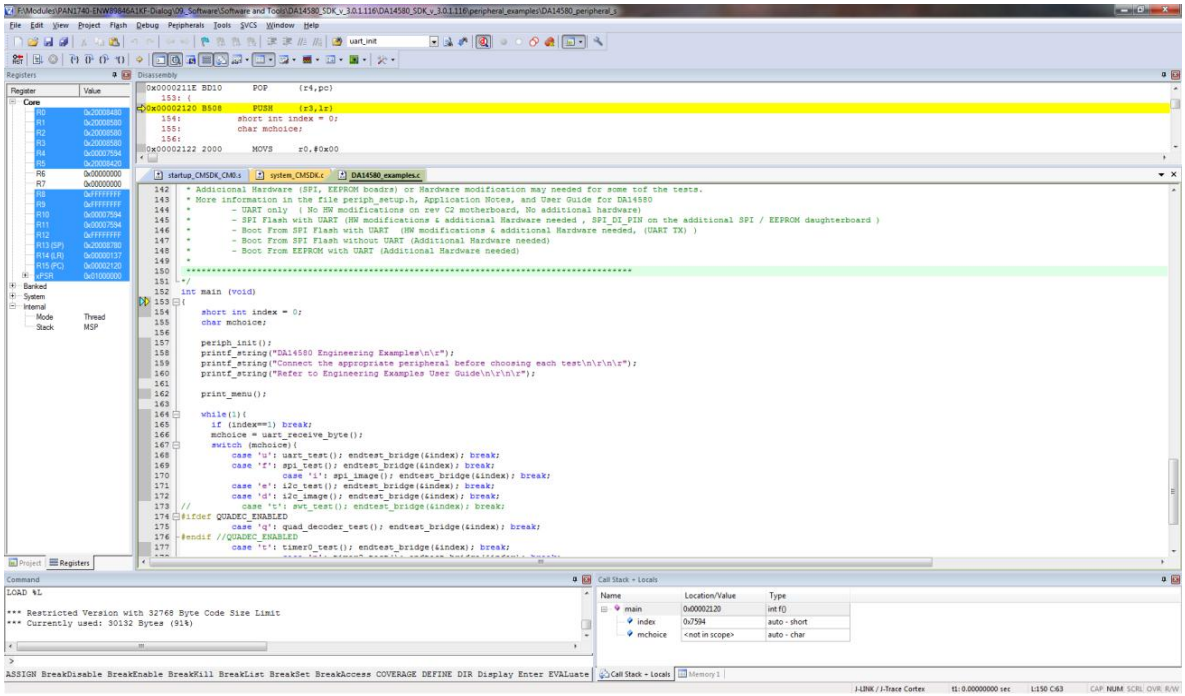
This example uses Dialog's SDK version 3.0.2.1

Receiver Configuration:

Download the proximity/monitor_fe_usb image into the dongle (refer to Section 10 for details):

DA14580_SDK_3.0.2.1\dk_apps\keil_projects\proximity\monitor_fe_usb

Open Keil, compile this project and download the hex file. To download, either start and stop the debug mode or load the hex file with Connection Manager. For debug mode using the Keil complier be sure to check the Configure Flash Tool setting described in section 10.

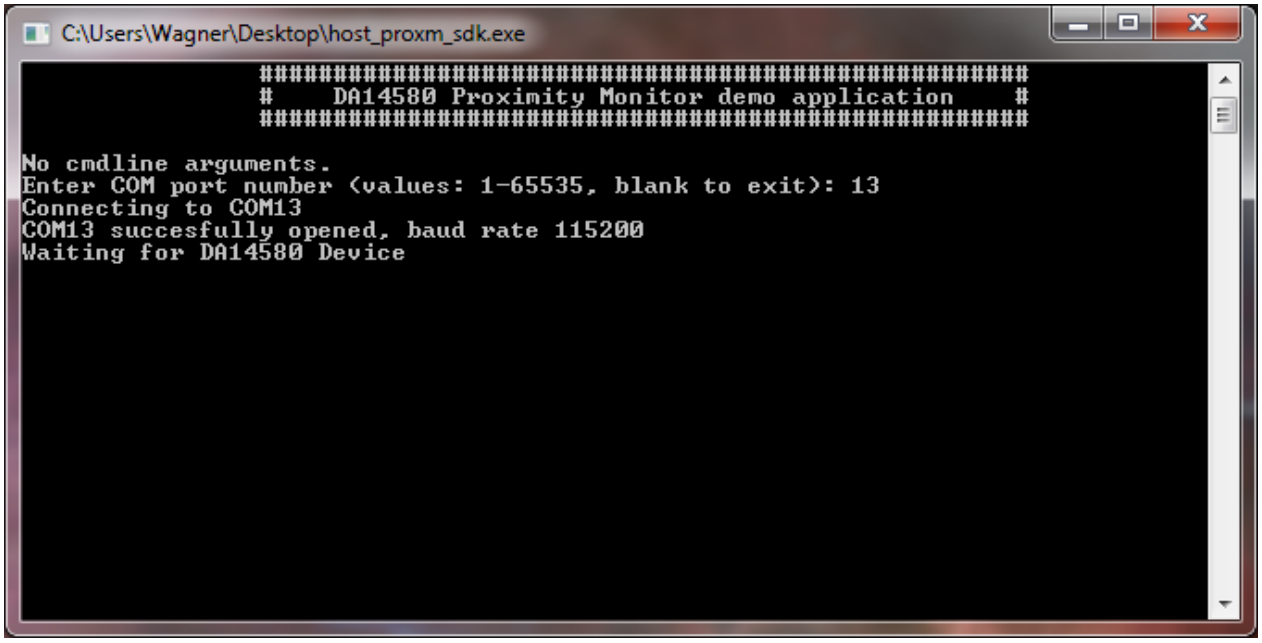


Note: Debug session must be stopped.

Open the Monitor Host Application folder in the SDK.

DA14580_SDK_3.0.2.1\DA14580_SDK_3.0.2.1\host_apps\windows\proximity\monitor

Open the project file "host_proxm.sln" with Microsoft C++ compiler. Compile (Press F7") and run this SW (F5) and determine the correct COM port using Windows Device Manager and enter this port number in the Proximity Host application (DOS window).



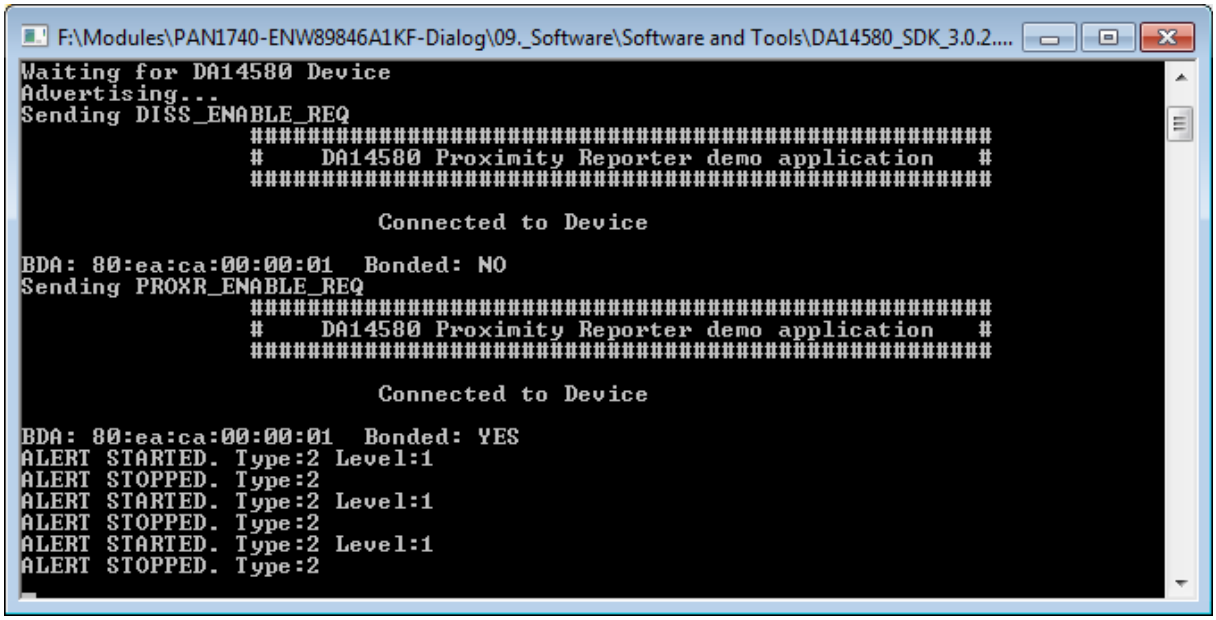
Transmitter Configuration:

Download the proximity/reporter_fe_usb image into the dongle: Open Keil, compile this project and download the hex file. To download, either start and stop the debug mode or load the hex file with Connection Manager.

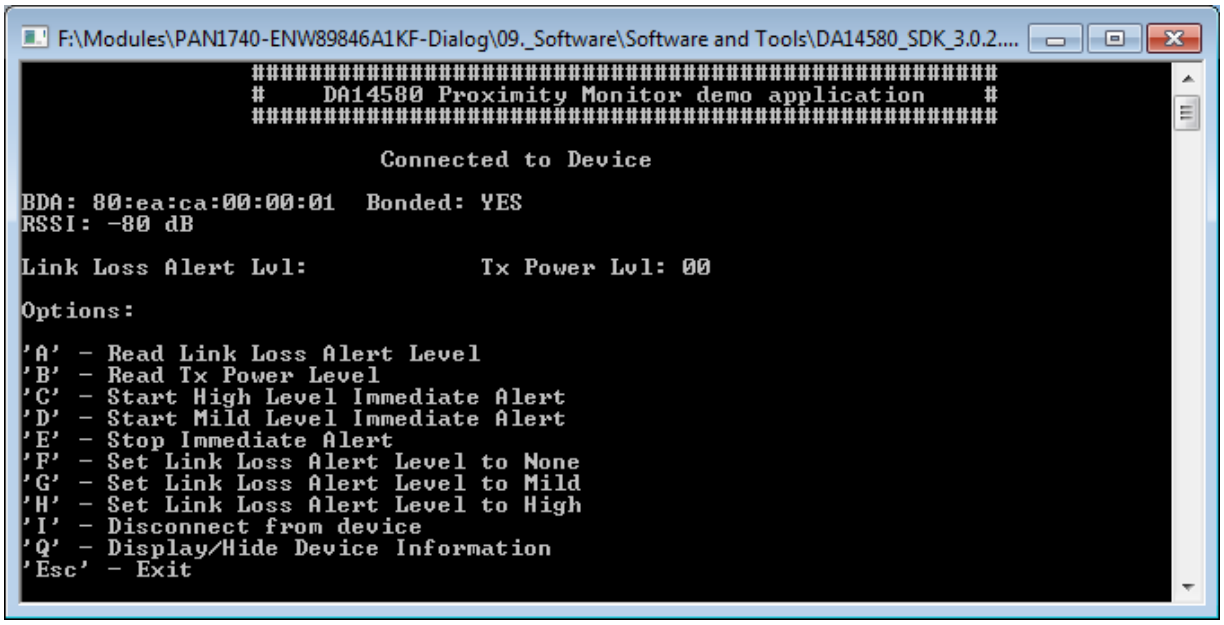
Open the reporter host application

DA14580_SDK_3.0.2.1\DA14580_SDK_3.0.2.1\host_apps\windows\proximity\reporter

Open the project file "host_proxm.sln" with Microsoft C++ compiler. Compile (Press F7") and run this SW (F5) and determine the correct COM port using Windows Device Manager and enter this port number in the proximity host application (DOS window).



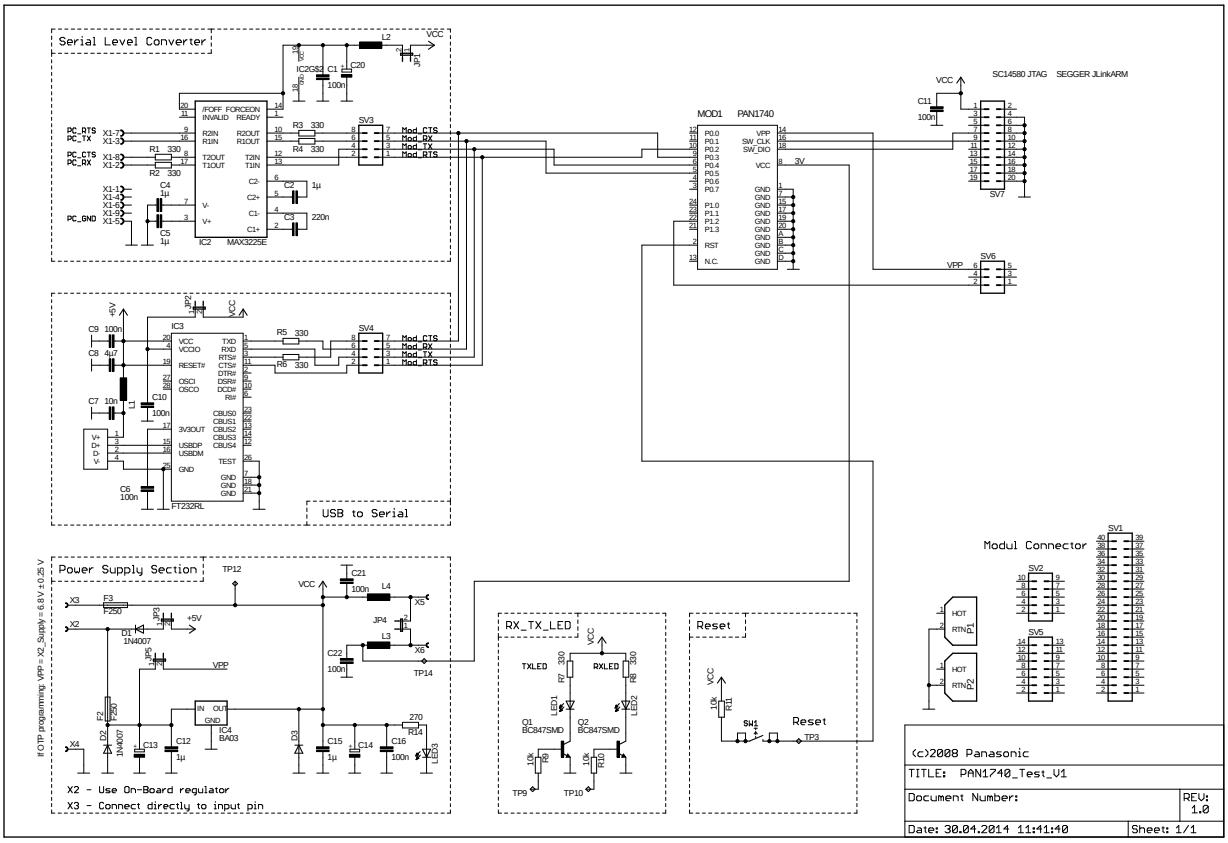
Receiver Side will show connection status



The dongles are now connected with the proximity profile.

12. PRODUCTION TOOLS

To program the PAN1740 in production a J-Link programmer and the 6.8V programming voltage on the VPP input pin is required. Here is an example schematic for a programming jig.



For more details on programming the OTP refer to the Smart Snippets documention and Dialog's programming guide located on Dialog's website.

Note: The crystal frequency register and flag as well as the Bluetooth MAC address is already burned.

13. HISTORY FOR THIS DOCUMENT

Revision	Date	Modification / Remarks
0.1	02.04.2014	Initial Preliminary Release.
1.0	04.06.2014	Added USB dongle and Connection Manager description. Release Version.
1.1	25.06.2014	Added Keil Project example.
1.2	17.07.2014	Added Proximity example for connecting two PAN1740 USB dongles.
1.3	05.09.2014	Added information about production tools.
1.4	26.09.2014	Editoral changes.

14. RELATED DOCUMENTS

[1] PAN1740 Datasheet
http://pideu.panasonic.de/files/Documents/WM%20Documents/PAN1740/PAN1740_Datasheet.pdf

15. GENERAL INFORMATION

Panasonic does not warranty and accepts no liability for the information contained herein. The information contained in this document is subject to change without notice. Modules containing "ES" in the series number are Engineering Samples -- i.e. PANxxxxES. This means, the design of this product is not yet concluded. Engineering Samples may be partially or fully functional, and there may be differences to be published Data Sheet.
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16. FCC WARNING

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.
The FCC and other regulatory certifications for the PAN1740 will be published in the PAN1740 Datasheet.

17. LIFE SUPPORT POLICY

This Panasonic product is not designed for use in life support appliances, devices, or systems where malfunction can reasonably be expected to result in a significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness. Panasonic customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Panasonic for any damages resulting.