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SUBJECT	CLASS 2 BLUETOOTH MODULE Low Energy BT 4.0	PAGE	1 of 17
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## PAN172x Design Guide



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## 1. SCOPE OF THIS DOCUMENT

This Design Guide applies to the Bluetooth development modules PAN1720ETU and PAN1721ETU. Each development module have BLE two stack options – BlueRadios and Texas Instruments. The intention is to enable our customers to easily and quickly integrate Panasonic's PAN1720 module in their product.

This guide describes the Hardware and gives usefull hints.

Please refer to chapter 6 Development of Applications for an overview.

## 2. KEY BENEFITS WHEN USING PAN1720

- Reduced Time to Market
- Easy layout for the customer application with provided CAD data in open source Eagle format.
- 2 Layer PCB with 0.2mm line width possible compared to expensive chip design.
- Optional BlueRadios **nBlue™** stack implementation:
  - AT Command parser with scripting language
  - BlueRadios Serial Profile (BRSP) stack compatible with iPhone 4s
  - Over the air configuration and upgrade entire stack over 2-wire UART, or RF
  - BT certified BLE profiles selectively integrated on request and free of charge
- BT certified and optional BLE profiles for qualified projects
- FCC, IC, CE certified and all other regulatory certifications on request
- Autonomus operation -- Integrated applications executed on the module
- Internal reference clock for ultra low power modes
- Supports UART and USB
- No external components needed
- Free Smartphone sample applications

## 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 PAN1720 fulfills criteria to lable your product as a Bluetooth Smart device.



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#### 4. DESCRIPTION PAN17XX

PAN172xETU (EasyToUse) is a development platform for PAN1720 BLE module to implement Bluetooth functionality into various electronic devices.

The PAN1720ETU is intended for evaluation purpose and can be used together with Texas Instrument's Software Development Kit.

Difference PAN1720 / PAN1721

The PAN1721 is a supplement to the PAN1720 product line. The PAN1721 is designed for applications where the lowest possible power consumption is the primary requirement and range is a secondary factor. The PAN1720 is designed for applications where range has a higher priority.

The PAN1721 is pin-compatible with the PAN1720, with the exception that USB is the hardware communication interface on the PAN1720 and I2C is the hardware communication interface on the PAN1721. Compared to the PAN1720, the PAN1721 provides lower RF current consumption. The PAN1721 does not have the USB interface found on the PAN1720, and provides lower maximum Tx output power.

Module/Function	Range	Power Consumption	Interface
PAN1720	Longer	Higher	USB
PAN1721	Shorter	Lower	I2C

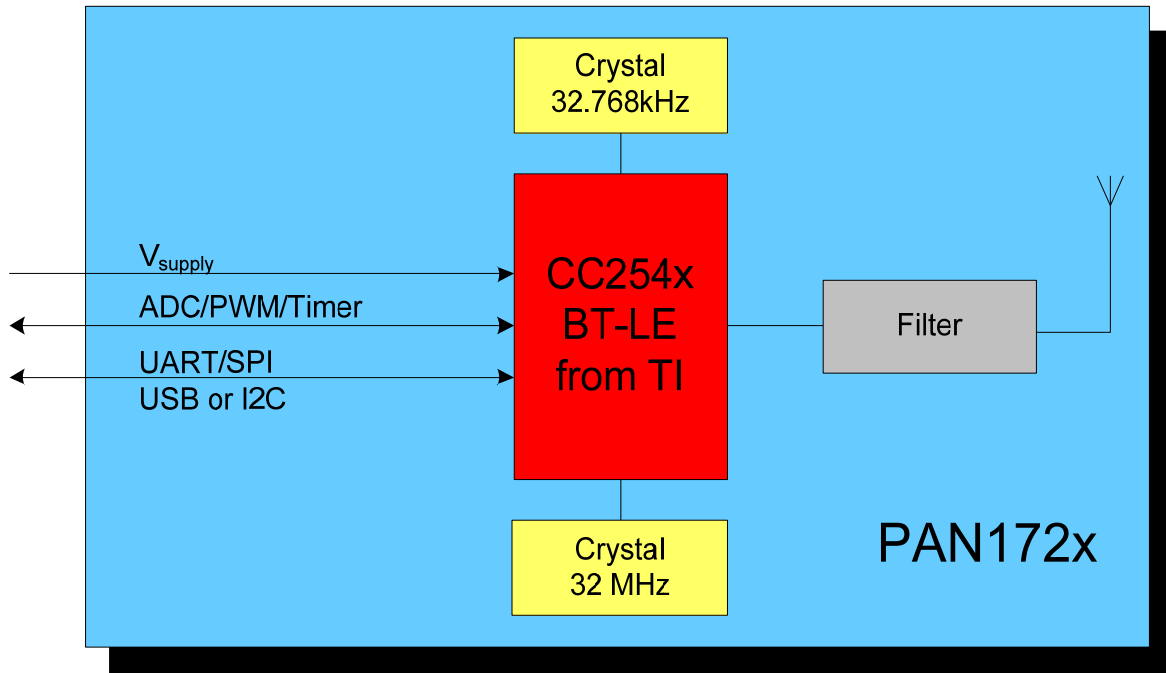
Communication between the module and the host controller is normally carried out via UART, but also USB is supported with this hardware.

By using the BlueRadios embedded nBlue firmware no additional tools are needed and customized firmware can be updated via UART or over the AIR.

Please contact your local sales office for further details on additional options and services, by visiting [www.panasonic.com/rfmodules](http://www.panasonic.com/rfmodules) for US and <http://industrial.panasonic.com/eu/> for urope or write an e-mail to [wireless@eu.panasonic.com](mailto:wireless@eu.panasonic.com)

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#### 4.1. BLOCK DIAGRAM PAN172X MODULE

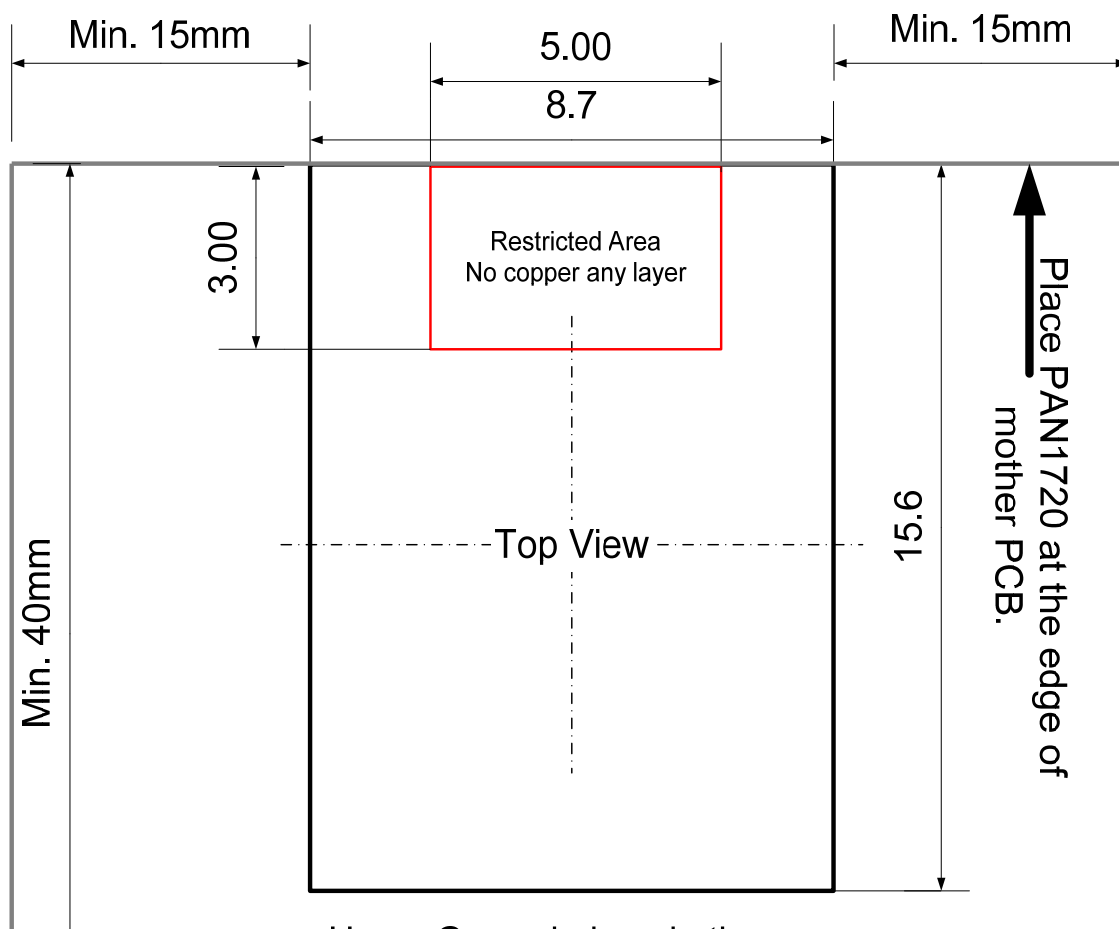


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5. LAYOUT RECOMMENDATION

**PAN1720 WITH ANTENNA  
PLACEMENT**

← If possible place PAN1720 in the center of mother PCB. →



Use a Ground plane in the area surrounding the PAN1720 module wherever possible.

Dimensions are in mm.

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## 6. DEVELOPMENT OF APPLICATIONS

Multiple variants of PAN172x in terms of hardware and software exist for SMD modules and evaluation kits.

	Software Stack: TI-Version <i>"Development environment"</i>	Software Stack: BlueRadios Software Stack <i>"BT LE AT command base"</i>
Bluetooth IC: CC2540	Module: PAN1720-TI ENW89820A1KF Dev.-Kit: PAN1720-TI ETU	Module: PAN1720-BR ENW89820A3KF Dev.-Kit: PAN1720-BR ETU
Bluetooth IC:CC2541	Module: PAN1721-TI ENW89835A1KF Dev.-Kit: PAN1721-TI ETU	not existing, use PAN1720-BR

For most development tools mentioned below, you will need Microsoft .NET framework version 4, which can be downloaded from the Microsoft website.

### 6.1. TOOLS NEEDED TO DEVELOP WITH PAN1720-BR

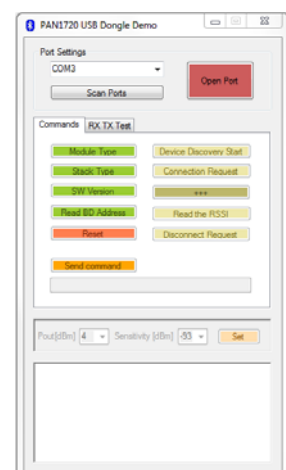
Using the BlueRadios nBlue (BR-SP) option no additional tools are needed. The boot loader including the BR-SP Profile with AT-Commands are pre-flashed on the module. Customized or further firmware options can be programmed via UART or over the air. They can be downloaded from the website or customized on request. All BLE profiles will be supported, but have to be selected on request.

#### 6.1.1. DEVELOPMENT KIT

#### 6.1.2. DEVELOPMENT KIT

The PAN1720ETU contains two USB Sticks. Using the BlueRadios nBlue (BR-SP) option no additional commercial tools are needed.

The PAN1720 USB Dongle Demo application can be used for range and function tests and well as evaluation. It can be downloaded including documentation from Panasonic's website [8].



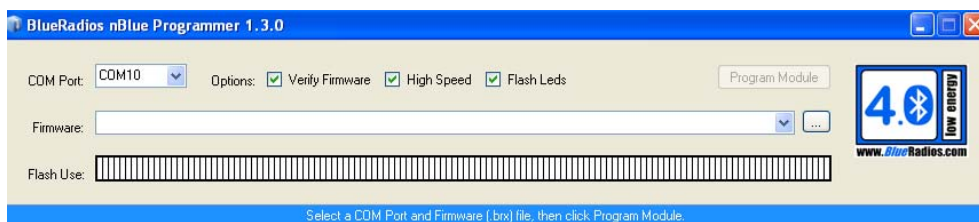
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For integrating the module into a host system, TerraTerm is a recommended tool.

The terminal equivalent on iOS Devices is nBlue Term.  
The nBlue Term app is available in the Apple Store.  
[Search for "nBlue Term" on your iOS device in iTunes]



The BlueRadios Programmer (see picture below) and BlueRadio AT-Commands Guide can be accessed after registration on the website of BlueRadios [6].



A boot loader is including the BR-SP Profile with AT-Commands and pre-flashed on the module. Customized or further firmware options can be programmed via UART or over the air. They can be downloaded from the website or customized on request.

### 6.1.3. BlueRadios Firmware Update Procedure

1. Use BlueRadios nBlue Programmer (Software Tool downloadable in BlueRadios forum)
2. Connect RX,TX,VCC and GND to the module UART
3. Flow control is not used

Firmware updates should only be performed using nBlue Programmer, not a CC Debugger. CC Debugger unlocks the debug interface, erases the entire flash including the module's bootloader and IEEE address, making the module incapable of accepting firmware updates.

The complete firmware upgrade procedure is in Section 4 of the nBlue Module Users Guide v4.2.

#### Considerations:

When using a PC USB port to complete a firmware upgrade a USB to UART converter with level shifting is required. Consider:

1. FTDI's FT232RQ
2. SiLabs CP2104
3. Panasonic's PAN1720ETU-BR – Test pins six and eight



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#### 6.1.4. BlueRadios Software Overview



*Secure, Versatile  
and Award Winning  
Network Radio Devices.*

### Bluetooth® 4.0 Low Energy Single Mode Firmware Options



	<b>AT Commands</b>	<b>BR-API</b>
<b>Language</b>	Simple Scripting	"C" Library w/IAR Compiler
<b>Cost</b>	Free	\$1000 IAR Compiler if Evaluation kit is purchased
<b>Ease of use</b>	Easy - Fast proto-typing	Moderate - Good for using existing "C" application code.
<b>Performance</b>	Cable replacement - BR-SP	Flexible
<b>Architecture</b>	Ext. CPU required for custom application programs, but not for cable replacement	No external CPU required
<b>Power Consumption</b>	Low	Low
<b>Tools</b>	None required	IDE – IAR Systems
<b>Profiles</b>	BRSP, Battery, proximity, etc.	BRI supplied profile libraries
<b>Misc.</b>	N/A	Customer can define profiles
<b>Target Market</b>	Drop in P-to-P solution	Co-locate application in radio – high sensor integration, fast response time
<b>Memory</b>	Application code space	Application code space
<b>RAM</b>	N/A	4Kb
<b>FLASH</b>	N/A	128Kb

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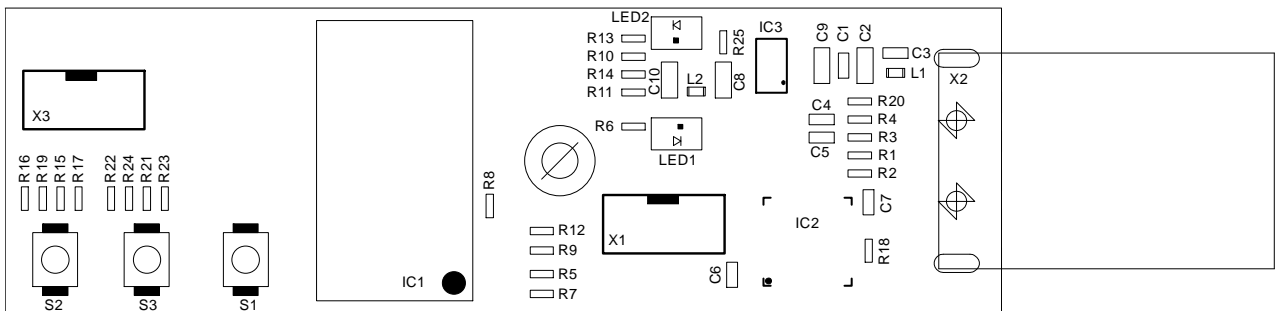
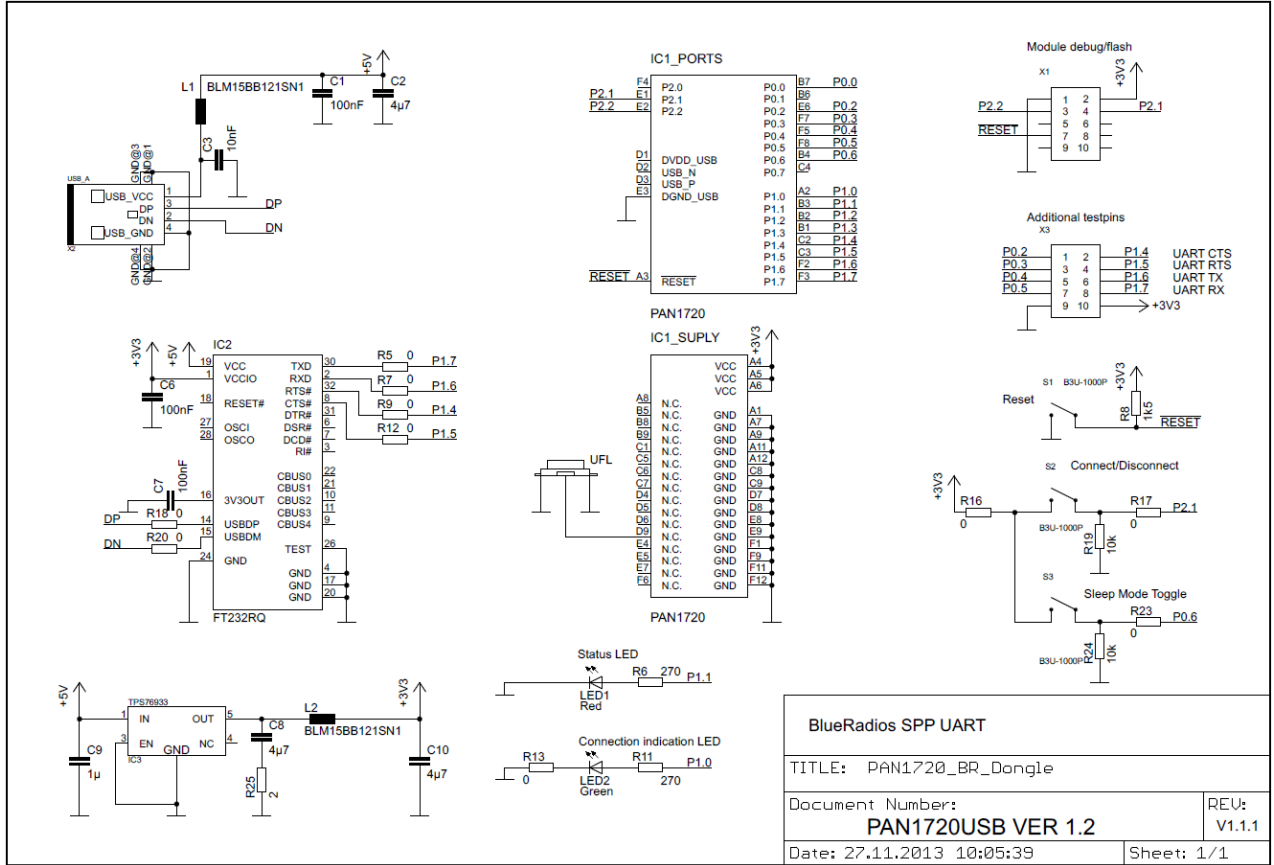
#### 6.1.5. BRSP BLE Data Rates

Single mode Bluetooth 4.0 Low Energy is **not** backwards compatible with previous Bluetooth standards. Dual mode Bluetooth 4.0 Low Energy is backwards compatible but is not practical for low power devices, but better suited for to gateway applications.

Throughput over BRSP is currently limited to a theoretical maximum of 1.3kB/s under ideal conditions at the minimum connection interval of 7.5ms (Throughput =  $20000/\text{msConnInterval}$ ). This is a theoretical maximum that could only be achieved if there with no packet retries, in actual use ~1kB/s is more realistic. This is due to the fact that BRSP is currently using GATT Write Requests and Indications to transfer data in order to ensure stability. Write Requests and Indications take two connection intervals to complete, since they require the server to acknowledge the request, and a maximum of 20 bytes of user data can be sent in each request/indication.

In a future release we plan on removing this limitation and using GATT Write With No Response and Notifications to send data, which don't require an acknowledgement from the server, allowing each request to take only 1 connection interval. This would also allow the device to send up to 80 bytes per connection interval, which would lead to a theoretical maximum throughput of 10.6kB/s, although tests have shown ~6kB/s to be more realistic.

6.1.6. SCHEMATIC REFERENCE DESIGN PAN1720-BR

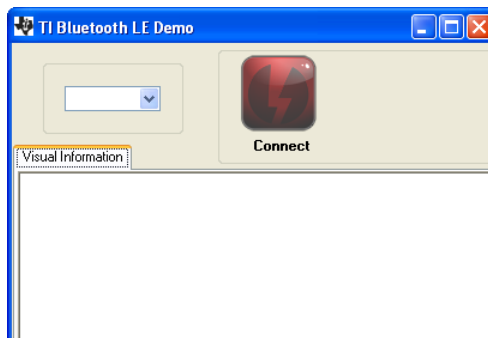


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## 6.2. TOOLS NEEDED TO DEVELOP WITH PAN1720-TI

### 6.2.1. DEVELOPMENT KIT

The PAN1720-TI Development Kit contains two USB Sticks  
Evaluation software for first tests is available on the Panasonic Website.



### 6.2.2. DEVELOPMENT KIT

Using PAN1720 with TI-Software the following tools are needed:

#### Texas Instruments BLE Stack

The Texas Instruments BLE Stack comes in TI's royalty-free BLE software development kit. The kit is a complete software platform for developing single-mode BLE applications.

<http://www.ti.com/tool/ble-stack>

The TI BLE Stack must be installed from a PC. The SDK can be downloaded free of charge. After installation a folder is created with the source code files and also some example profiles such as proximity or temperature profiles. Some byte code files in this package are in .hex format and should be programmed via the above debugger directly in to the PAN1720.

#### Debugger

<http://focus.ti.com/docs/toolsw/folders/print/cc-debugger.html>

#### Software Development Environment – IAR Workbench

<http://www.iar.com>

Application development is begun by downloading the IAR compiler for 8051 devices. There is a free of charge evaluation version available. This version is fully functional for 30days.

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For programming customer specific firmware the debugger must be connected to the debug interface.

Bluetooth software support on the TI Stack is available in the E&E forum from TI.

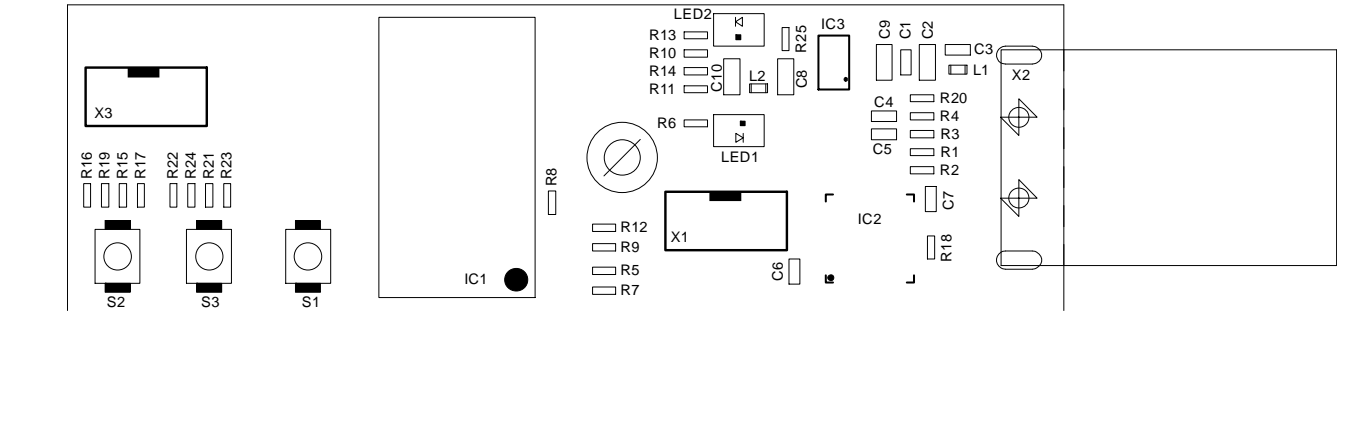
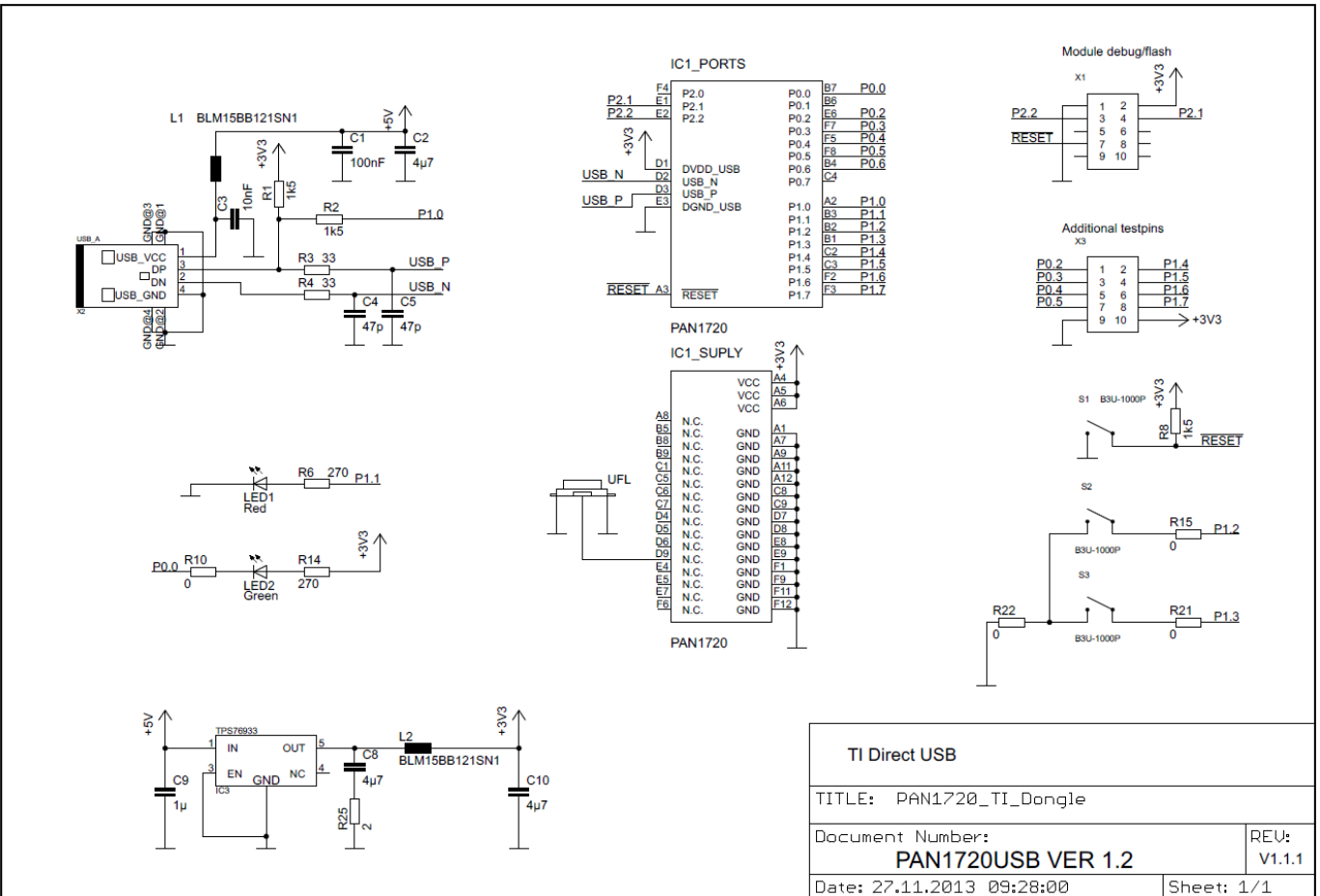
PAN17xx SW available from the TI website:

<http://www.ti.com/blestack>

Applications running on the PAN1720 require IAR Embedded Workbench development platform for 8051 devices:

<http://www.iar.com>

### 6.2.3. SCHEMATIC REFERENCE DESIGN PAN1720-TI



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### 6.3. TOOLS NEEDED TO DEVELOP WITH PAN1721-TI

**The PAN1721-TI contains the CC2541 which does not support USB. USB Dongles must be programmed with customer specific firmware using the CC-Debugger.**

#### 6.3.1. DEVELOPMENT KIT

Using PAN1721 with TI-Software the following tools are needed:

##### Texas Instruments BLE Stack

The Texas Instruments BLE Stack comes in TI's royalty-free BLE software development kit. The kit is a complete software platform for developing single-mode BLE applications.

<http://www.ti.com/tool/ble-stack>

The TI BLE Stack must be installed from a PC. The SDK can be downloaded free of charge. After installation a folder is created with the source code files and also some example profiles such as proximity or temperature profiles. Some byte code files in this package are in .hex format and should be programmed via the above debugger directly in to the PAN1720.

##### Debugger

<http://focus.ti.com/docs/toolsw/folders/print/cc-debugger.html>

##### Software Development Environment – IAR Workbench

<http://www.iar.com>

Application development is begun by downloading the IAR compiler for 8051 devices. There is a free of charge evaluation version available. This version is fully functional for 30days.

For programming customer specific firmware the debugger must be connected to the debug interface.

Bluetooth software support on the TI Stack is available in the E&E forum from TI.

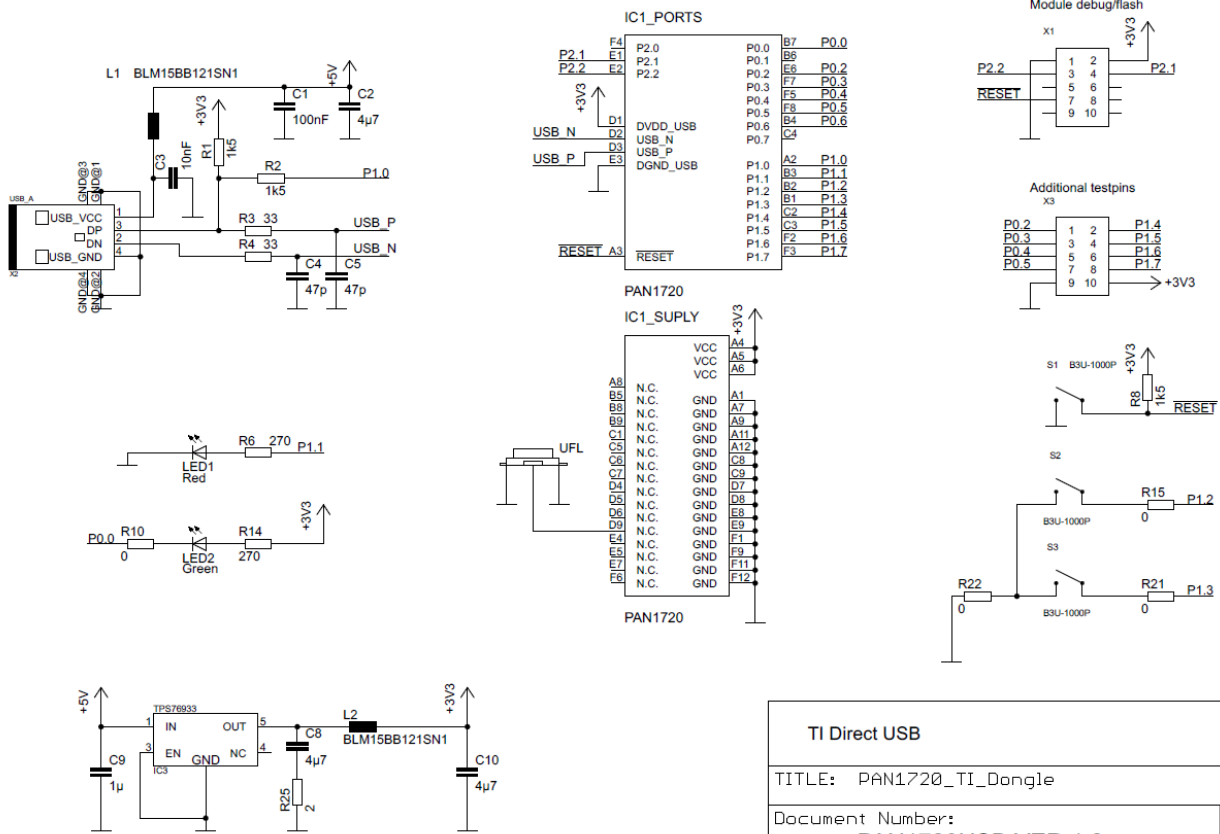
PAN17xx SW available from the TI website:

<http://www.ti.com/blestack>

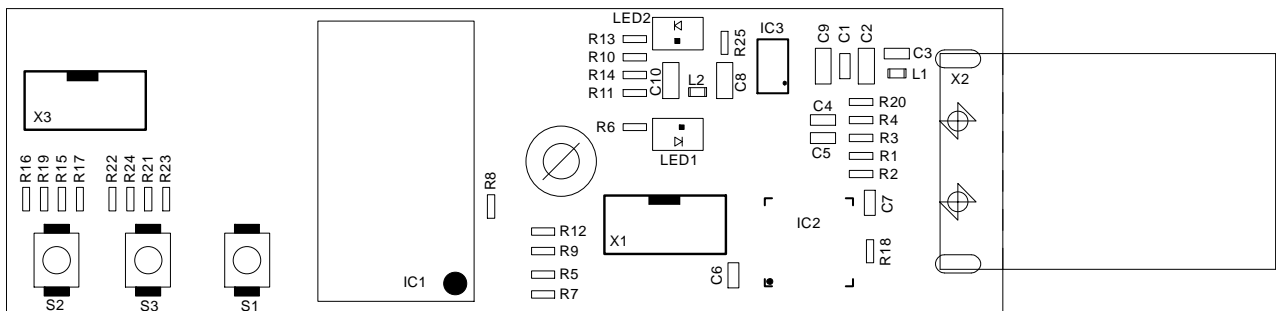
Applications running on the PAN1720 require IAR Embedded Workbench development platform for 8051 devices:

<http://www.iar.com>

6.3.2. SCHEMATIC REFERENCE DESIGN PAN1721-TI



<b>TI Direct USB</b>	
TITLE: PAN1720_TI_Dongle	
Document Number: <b>PAN1720USB VER 1.2</b>	REV: V1.1.1
Date: 27.11.2013 09:28:00	Sheet: 1/1



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## 7. HISTORY FOR THIS DOCUMENT

Revision	Date	Modification / Remarks
1.00	01.04.2012	Released Version.
1.01	31.07.2012	Updated reference schematic.
1.02	01.04.2013	Added BR Firmware update procedure. Editorial changes.
1.03	01.05.2013	Changed ordering information and block diagram.
1.04	02.12.2013	Added information for the PAN1721-TI Kit. Improved chapter about application development.

## 8. RELATED DOCUMENTS

[1] PAN1720 Datasheet

<http://www.pedeu.panasonic.de/pdf/168Datasheet.pdf>

[2] Texas Instruments Bluetooth Low Energy Software Development Kit (SDK)

<http://www.ti.com/tool/ble-stack>

[3] Texas Instruments CC2540 Debugger

<http://focus.ti.com/docs/toolsw/folders/print/cc-debugger.html>

[4] SmartRF Studio

<http://focus.ti.com/docs/toolsw/folders/print/smartrfm-studio.html>

[5] IAR Embedded Workbench for 8051 devices

<http://www.iar.com>

[6] BlueRadios Information

[http://www.blueradios.com/hardware\\_LE4.0-S2.htm](http://www.blueradios.com/hardware_LE4.0-S2.htm)

<http://www.blueradios.com/panasonic/>

[7] nBlue Term

<https://itunes.apple.com/US/app/id516628472?mt=8>

[8] PAN1720 USB Demo for BlueRadios SW

<http://www.pedeu.panasonic.de/pdf/168ext.zip>

[10] PAN1720 USB Demo for TI SW

<http://www.pideu.panasonic.de/pdf/168ext2.zip>



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## 9. GENERAL INFORMATION

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This product description does not lodge the claim to be complete and free of mistakes.

Please contact the related product manager in every case.

If we deliver ES samples to the customer, these samples have the status Engineering Samples. 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.

Engineering Samples are not qualified and are not to be used for reliability testing or series production.

### **Disclaimer:**

Customer acknowledges that samples may deviate from the Data Sheet and may bear defects due to their status of development and the lack of qualification mentioned above.

Panasonic rejects any liability or product warranty for Engineering Samples. In particular, Panasonic disclaims liability for damages caused by

- the use of the Engineering Sample other than for Evaluation Purposes, particularly the installation or integration in an other product to be sold by Customer,
- deviation or lapse in function of Engineering Sample,
- improper use of Engineering Samples.

Panasonic disclaims any liability for consequential and incidental damages.

In case of any questions, please contact your local sales partner or the related product manager.

## 10. 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 PAN1720 will be published in the PAN1720 Datasheet.

## 11. 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.