RUTRONIK EMBEDDED

TechTalk

Panasonic

Sending Data over Ultra Low Power / Powered on Forever without Maintenance

Chetan Joshi

Michael Spunt

Panasonic
INDUSTRY

Sending data over Ultra Low Power Bluetooth LE

Powered on forever without maintenance

Rutronik Tech Talk
Embedded World
02.03.2021

Presented by:
Chetan JOSHI & Michael SPUNT

Panasonic:
a Short introduction

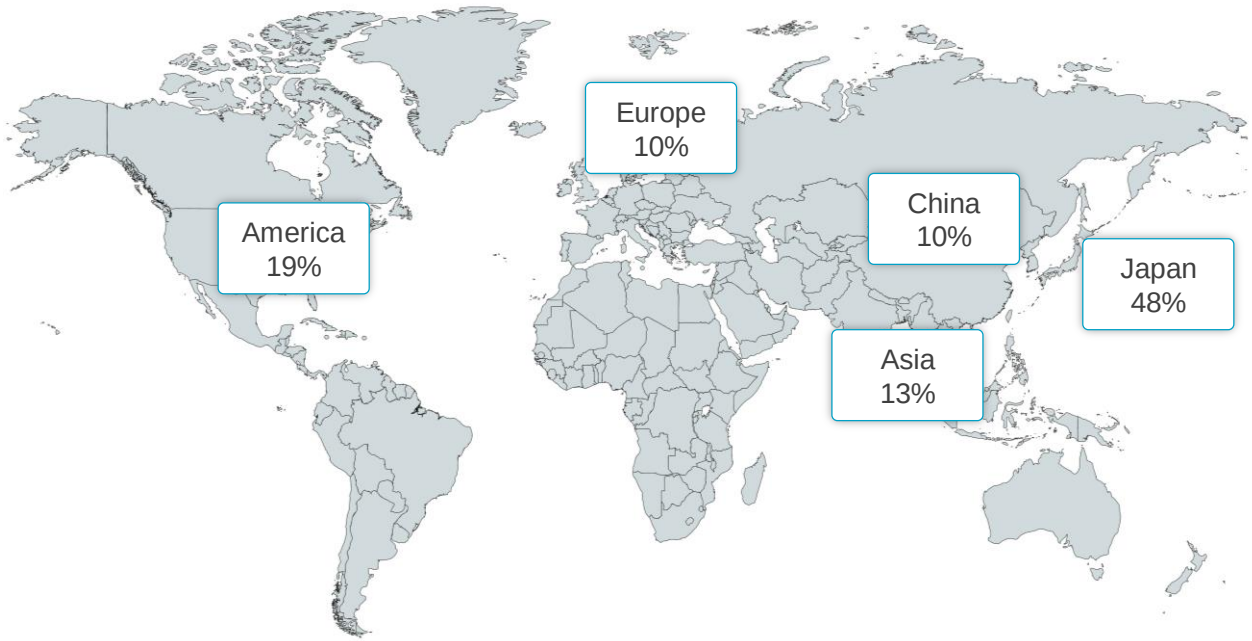
Established in 1918

100

100th Anniversary

in 2018

Excellence in Electronics



€ 61.9 billion
Consolidated sales*

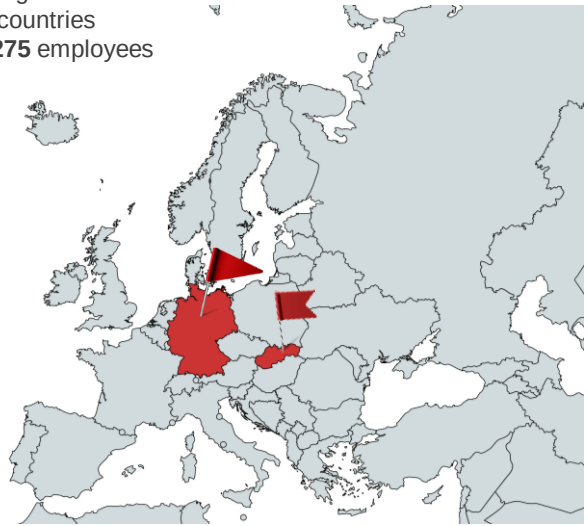
Panasonic is one of the world's leading electronic manufacturers with a century of experience.

259,385 employees work for Panasonic globally.

*Consolidated sales after elimination and adjustments based on average exchange rate 2019: 1 € = 121 JPY

Panasonic Industrial Devices Europe – Company Overview

6 locations
4 legal entities
4 countries
2275 employees



Lüneburg, GER

Established	1984
Head of site	U.Bachsmann, K. Motoyoshi, Y. Ishihara
Employees	345
Functions	HQ, Development, FAE, Marketing

Stara Lubovna,SK

Established	1997
Head of site	R. Sippel, S.Vojtas
Employees	757
Functions	Production
Products	Wireless Modules, Chargers, AMP, DAB tuner

Bluetooth:
a short introduction

The reason to include Bluetooth in your next IoT project?

It is everywhere…

Bluetooth – a history of the standard

Bluetooth Classic

- Started out as cable replacement
- Time critical applications e.g. Audio
- Not suitable for battery operated devices

Bluetooth Low Energy

- Low power operation for battery driven use cases
- Ideal for low throughput communication e.g. Sensors
- Multi year time

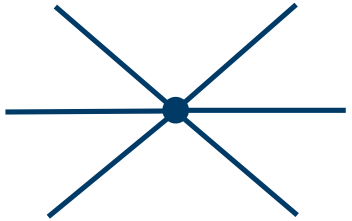
Bluetooth 5.x and the future

- More versatile than ever
- 4 x Range, 2 x Data throughput, Extended Advertising
- Audio over Low Energy, Direction finding
- Increasingly economical designs

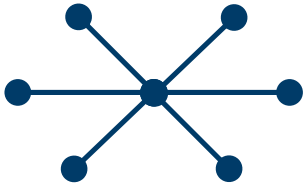
Bluetooth Low Energy – various operation modes

Point to Point

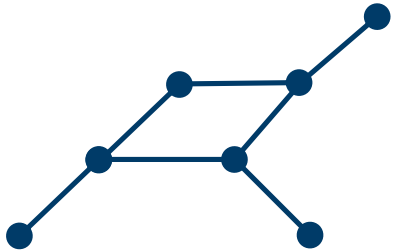
Observer



Broadcast



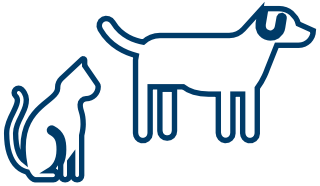
Multiple Simultaneous P2P



Mesh

Panasonic Bluetooth Low Energy Customers by Applications

Panasonic INDUSTRY



Pet trackers

Medical devices

Location Services & Beacons

Smart Home

Smart Building

Smart factory floors

Automotive aftermarket

Agricultural equipment

Power tools and machines

Lighting

Bluetooth in Power Constrained Applications

Basics of Bluetooth Low Energy

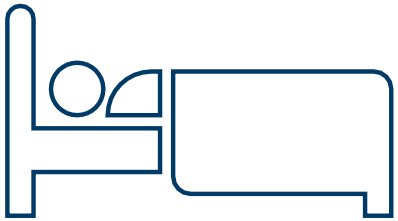
40 Channels on 2.4 GHz ISM Band
Coded/1M/2M PHY

Link Layer: Master & Slave

GAP Layer: Central & Peripheral

GATT Layer: Server & Client

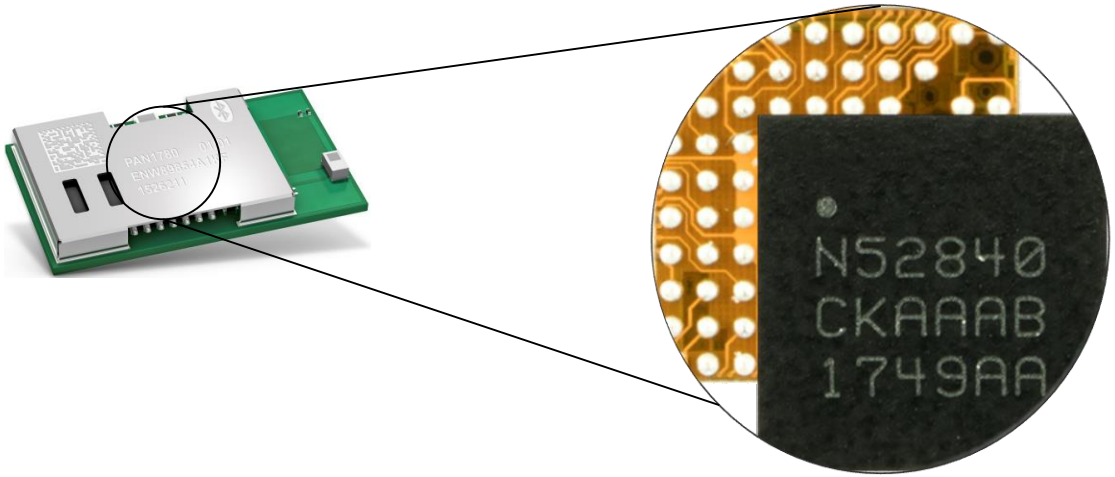
Why is it suitable for low power advertisers?



- Devices spend most of the time sleeping
- Wake up to send out connectable/non-connectable advertising
- Bounded active connection interval

PAN1780 – a Bluetooth platform for power sensitive applications

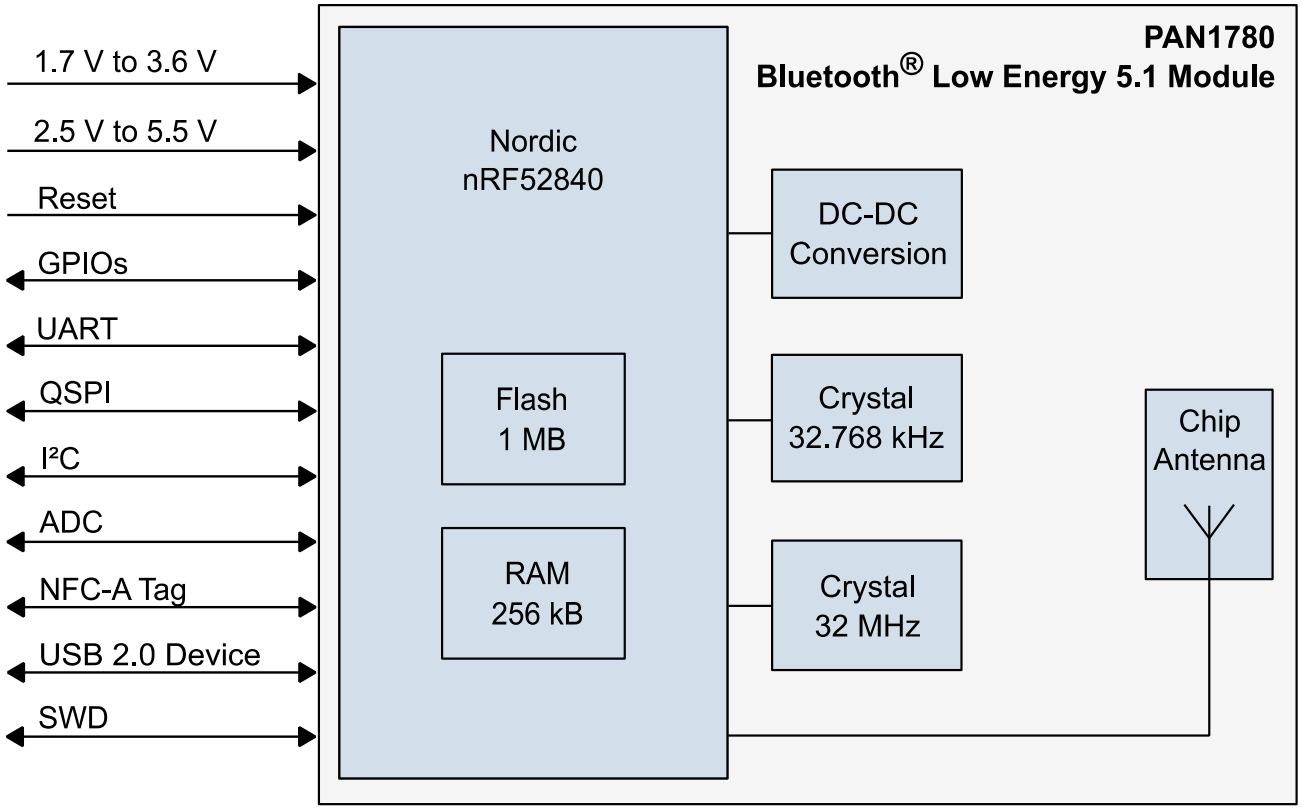
PAN1780 – a versatile 2.4 GHz platform



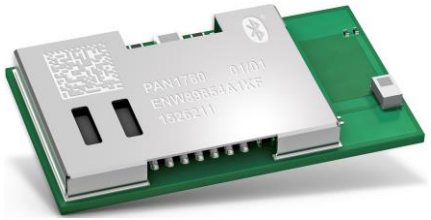
NORDIC SEMICONDUCTOR nRF52840	
Host, Standalone	Nordic SDK
ARM Cortex-M4F	
1 MB *Flash*	256 kB *RAM*
+8 dBm *output power*	-103 dBm *sensitivity*
Chip *antenna*	CE RED, FCC, IC *certifications*
15.6 x 8.7 x 2.1 [mm] *size*	

PAN1780 based on Nordic nRF52840 SoC supports communication over Bluetooth, ANT+, Zigbee, Thread, customer implementation over 802.15.4 or proprietary 2.4 GHz protocol implementations. For more information, get in touch:
wireless.connectivity@eu.panasonic.com

PAN1780 – Block Diagram



PAN1780 – Device Characteristics for low power IoT



- On Chip Power Management Unit (**PMU**)
- Full implementation of DC-DC conversion
- “**System-ON**” & “**System-OFF**” modes
- 1.7 V to 5.5 V supply voltage range
- 32.768 KHz Slow clock crystal

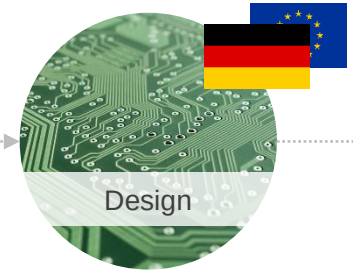
Quality & Certifications

Panasonic Brand Quality Customer Values

Panasonic INDUSTRY

15 years experience in RF technology

Quality focused organizational team structure



- Implemented complete development process
- Panasonic limits exceeding standard values
- Own German based IP‘s
- HW and SW capabilities
- High quality RF specific equipment

- Reliability assurance center at R&D facility
- Including regulatory certification
- Confirmation of all specified values

- Own factories close to design facility
- 2nd production location / Business Continuity Plan
- Flexible capacity planning
- 100% Traceability System
- 100% End-of-Line Testing and documentation
- Incoming, Outgoing Inspection

- Longevity
  (Lifetime, Footprint, Migration Support)
- IN, PCN etc.
- Professional Customer Claim handling
- Service
- Certification Support
- Design Support HW/SW

✓ **Minimize business risk**
customer claims, field rejects etc.

✓ **EU Mindset and Point-of-Contacts**

✓ **Confirmed product specification**

✓ **Conformity to legal requirements**
Environmental & Regulatory

✓ **<1 PPM** (for more than 10 years)*

✓ **Generate trust and increase customer satisfaction**
through reliable products

*as of 01.05.2020

Panasonic Industrial Devices Europe – System Certification

ISO 9001
Certified in 1993


CERTIFICATE

PANASONIC INDUSTRIAL DEVICES SLOVAKIA s.r.o.

ISO 9001:2008

ISO 14001
Certified in 1999


CERTIFICATE

PANASONIC INDUSTRIAL DEVICES SLOVAKIA s.r.o.

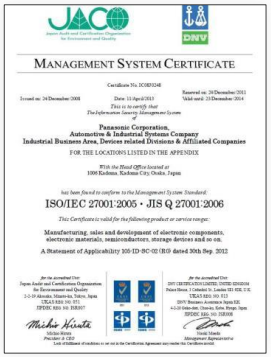
ISO 14001:2004

IATF 16949
Certified in 2018


CERTIFICATE

IATF 16949

ISO/IEC 27001
Certified in 2008


MANAGEMENT SYSTEM CERTIFICATE

Panasonic Corporation,
Automotive & Industrial Systems Company
Industrial Business Area, Devices related Divisions & Affiliated Companies

ISO/IEC 27001:2005 • JIS Q 27001:2006

Product safety Certifications

Module Certifications

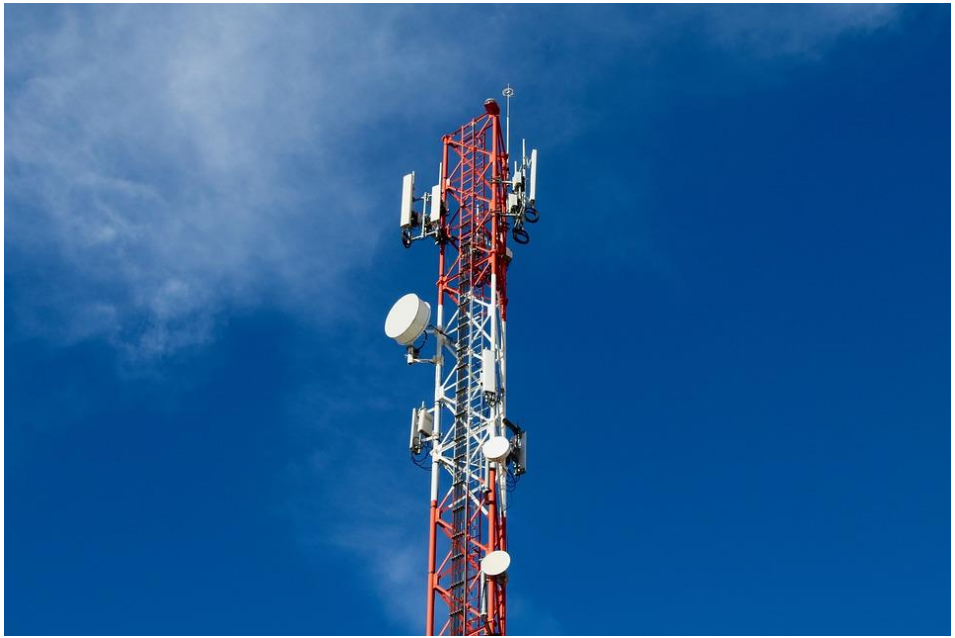
Standard certifications

CE RED | FCC | ISED

Available for dedicated modules

KC | MIC | SRRC

Certificates apply for antenna version only,
conducted test reports for non antenna version available



Other certifications required?
Do not hesitate to talk to us!

Connected by Panasonic Industry

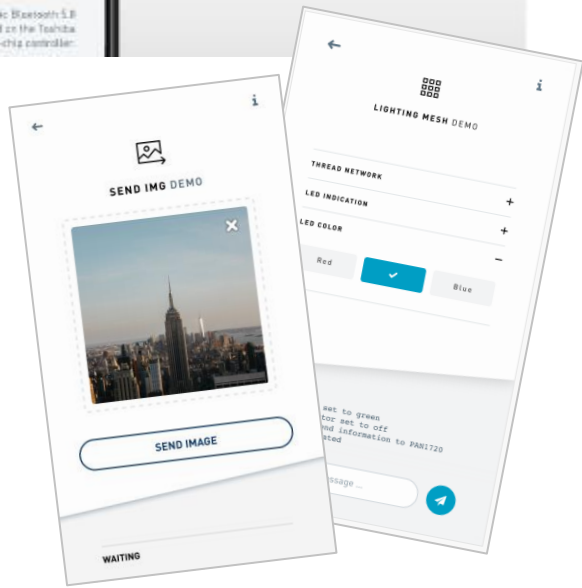
Panasonic INDUSTRY

GET IT ON Google Play

Download on the App Store

NOW AVAILABLE!

- Module Features Overview
- Download section of available Guides etc.
- Demo section for newest products



Product Demo

Outline

Panasonic INDUSTRY

- Components
- Software and Tools
- Primary Cell Example
- Energy Harvesting Example
- Conclusion
- Q&A

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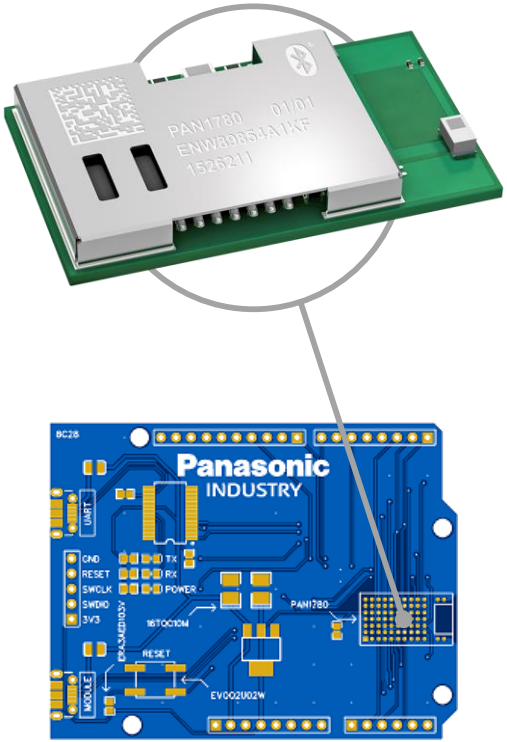
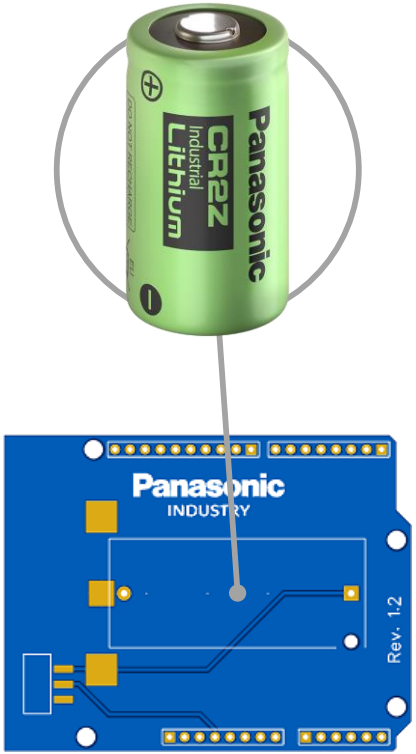
SoC Module – Panasonic PAN1780



Arduino UNO compatible
PAN1780 board

- Bluetooth® 5.0 LE
- Nordic nRF52840, ARM ® Cortex ®-M4F, 64 MHz
- 256 kB RAM, 1 MB Flash
- 15,6 mm × 8,7 mm × 2,0 mm

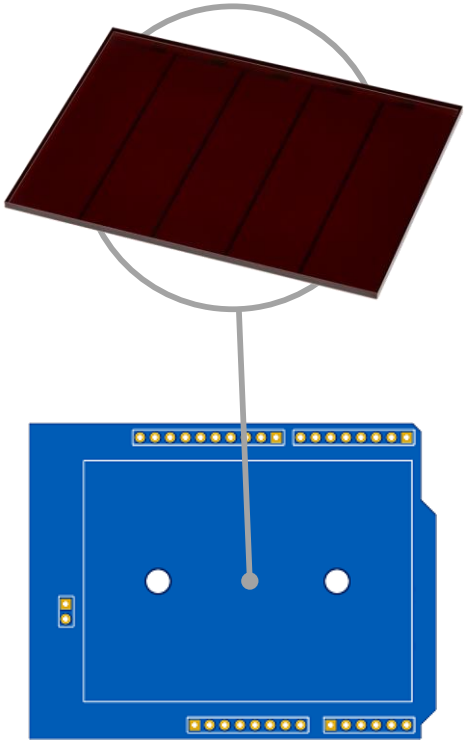
Primary Cell – Panasonic CR-2Z



Arduino UNO compatible battery shield

- Long life Lithium
- Excellent durability under severe conditions
- 3 V, 1.000 mAh
- Ø 15,6 mm × 27,0 mm

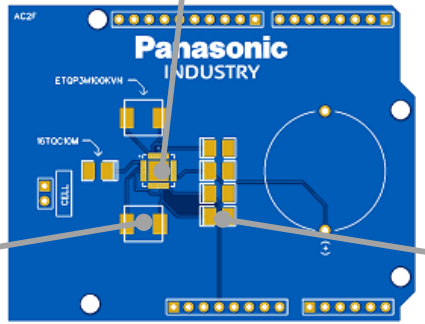
Solar Cell – Panasonic AM-1522



Arduino UNO compatible solar cell shield

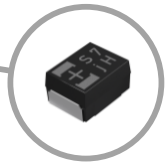
- Optimized for Low Light Conditions
- High Sensitivity in Visible Light Spectrum
- U_{OC} 3,1 V, I_{SC} 62,2 µA at 200 lx
- 55,0 mm × 40,5 mm × 1,1 mm

PMIC – e-Peas AEM10941



Arduino UNO compatible
power management shield

Panasonic industrial
power inductors
(ETQP series)



Panasonic conductive
polymer tantalum solid
capacitors POSCAP

- High Efficiency
- Flexible Energy Storage Management
- Small BOM Possible
- 5 mm × 5mm, QFN 28 Pin

Outline

Components

Software and Tools

Primary Cell Example

Energy Harvesting Example

Conclusion

Q&A

Example Software

- The PAN1780 is fully supported by the SDK provided by Nordic Semiconductors.
- The SDK comes with an extensive set of code and compiled examples.
- Getting started is easy.
- Both examples use a modified ble_app_blinky code.
- https://www.nordicsemi.com/Software-and-Tools/Software/nRF5-SDK/Download

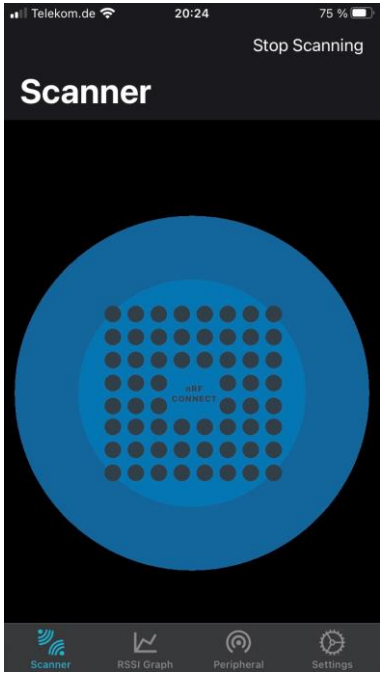
Online Power Profiler

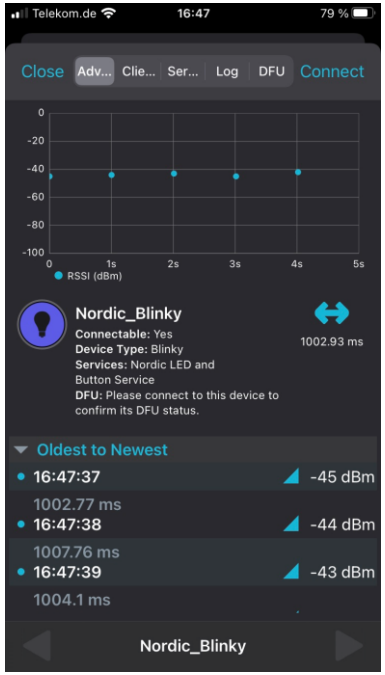
Close to measurement

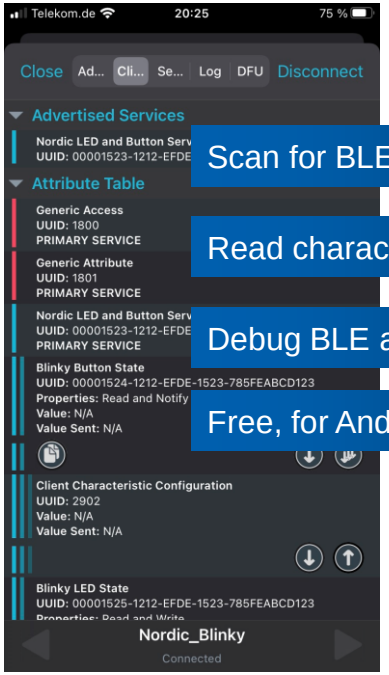
Easy to use

Web application for all platforms

nRF Connect App







- Scan for BLE devices
- Read characteristics
- Debug BLE applications
- Free, for Android and iOS

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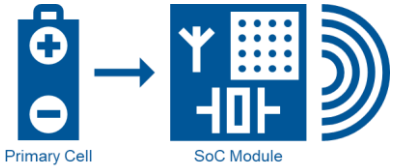
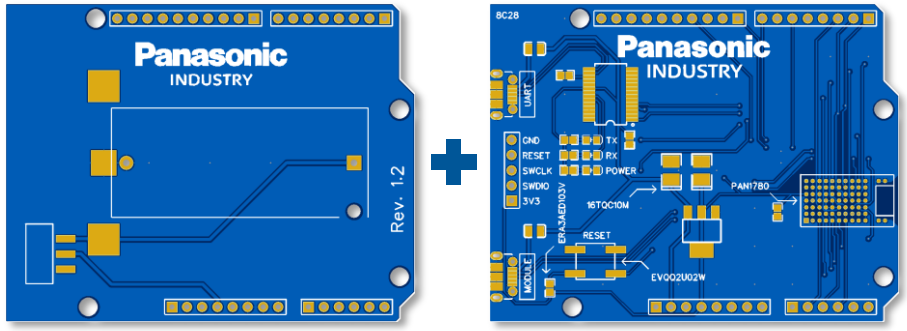
Hardware Architecture

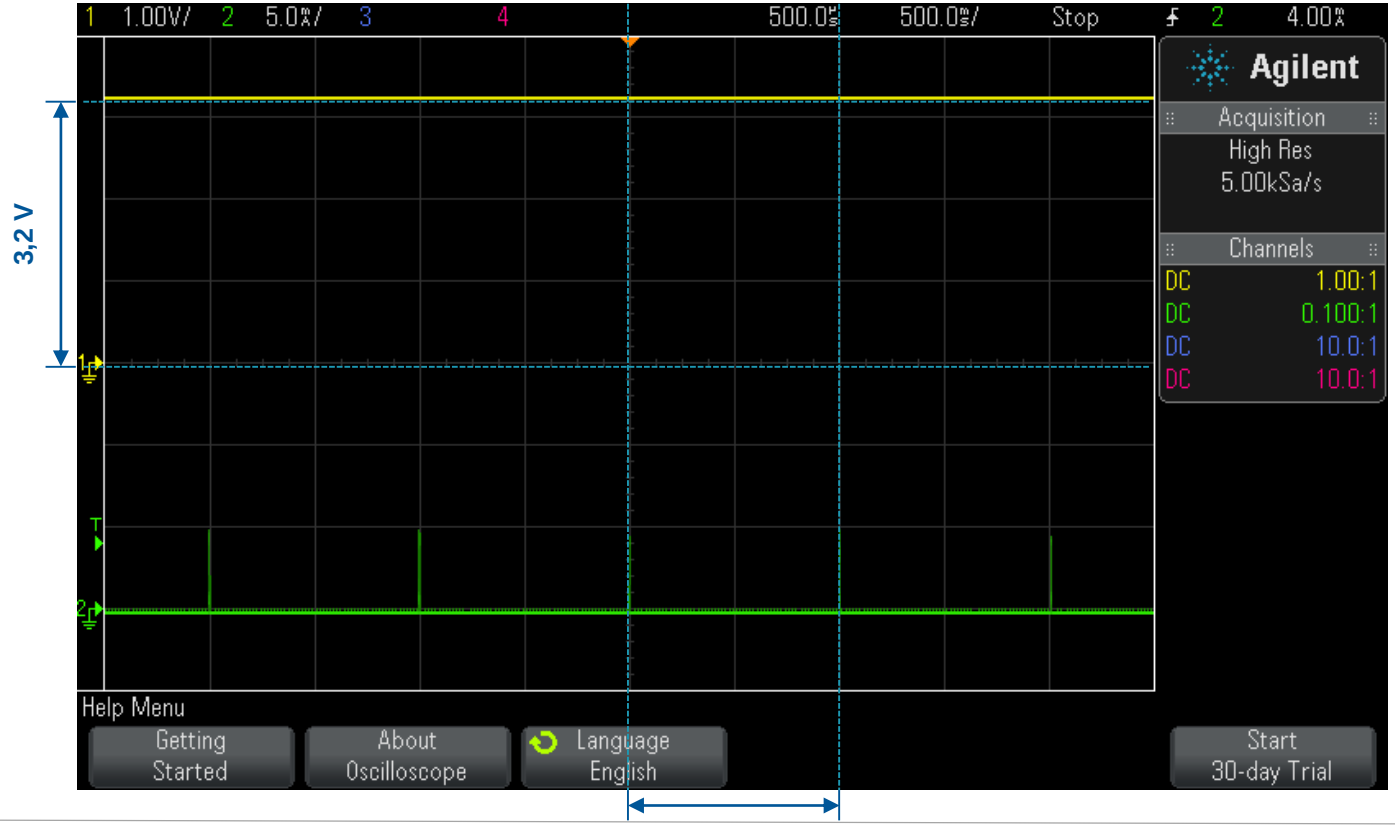


0 dBm



3,0 V

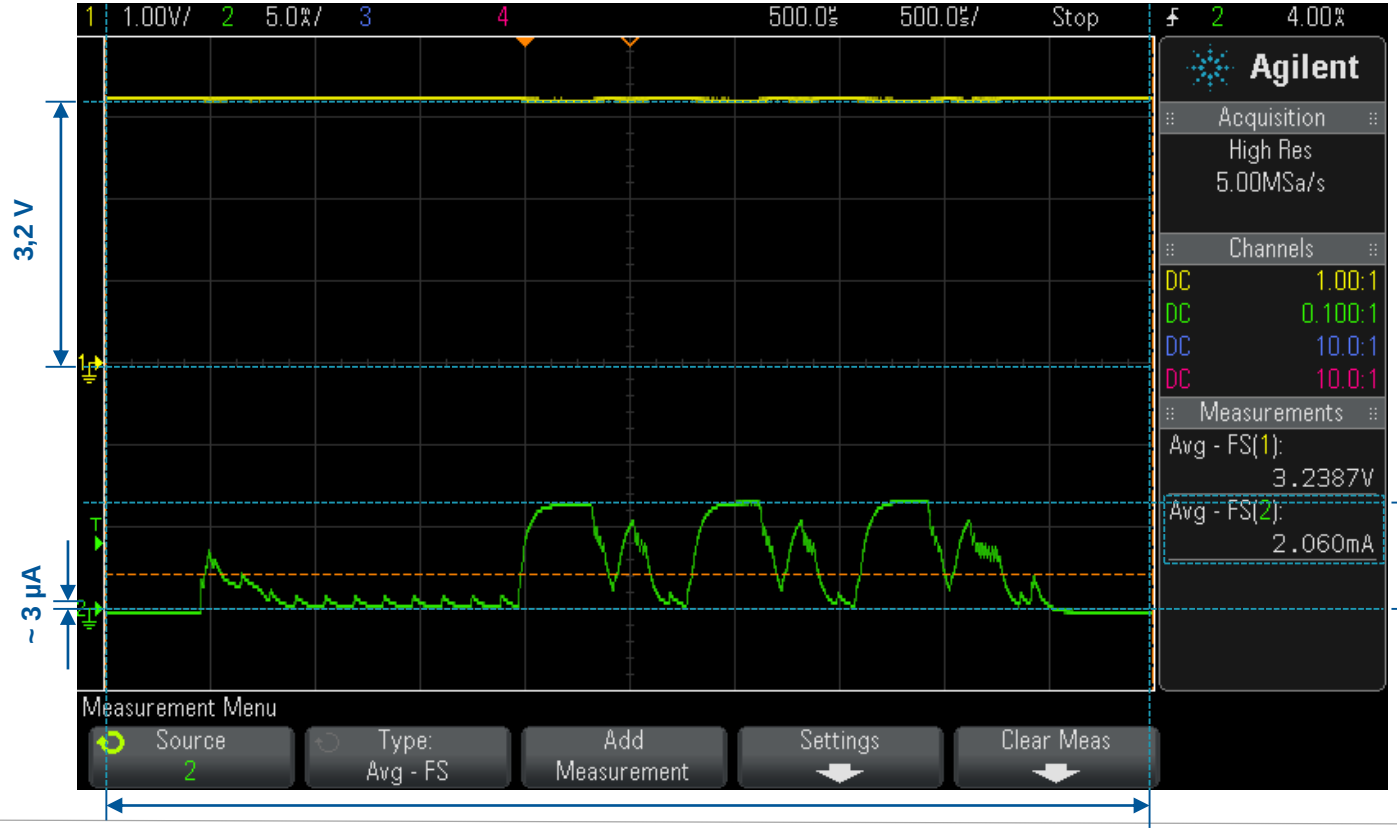
Transceiver Active – Advertising Interval



0 dBm

3,0 V

Transceiver Active – Transmit



0 dBm

3,0 V

- Average transmit current

$$I_{transmit} = 2{,}1\ mA * 5\ ms * 1\ Hz = 10{,}5\ \mu A$$

- Idle mode current

$$I_{idle} = 3{,}0\ \mu A$$

- Average total current

$$\mathbf{I_{total} = 13{,}5\ \mu A}$$

0 dBm

3,0 V

Operating Time

- Battery capacity

$$C = 1.000\ mAh = 1.000.000\ \mu Ah$$

- Average total current

$$I_{total} = 13,5\ \mu A$$

- Nominal run time

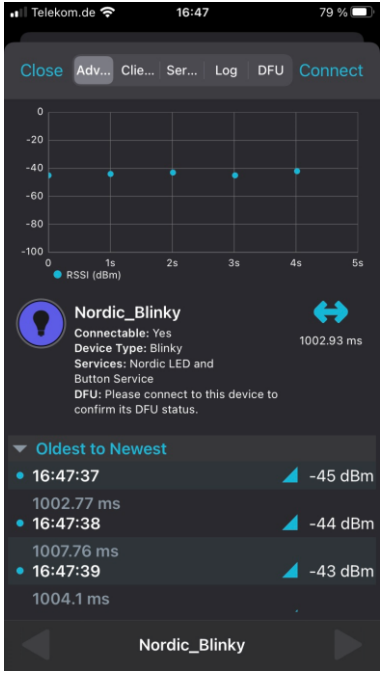
$$t = 1.000.000\ \mu Ah / 13,5\ \mu A$$

t = 8 years

0 dBm

3,0 V

Setup in Action



Output of Nordic nRF Connect iOS app

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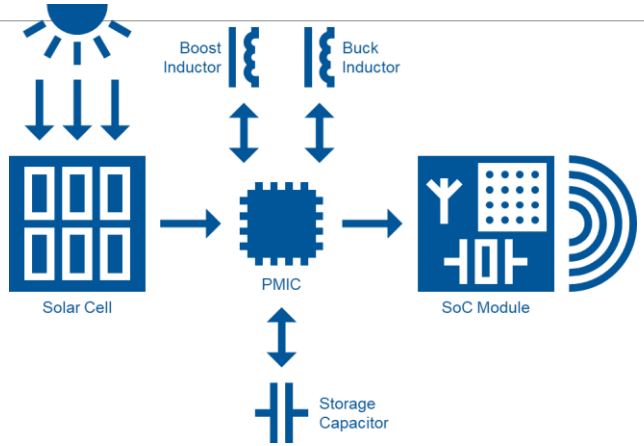
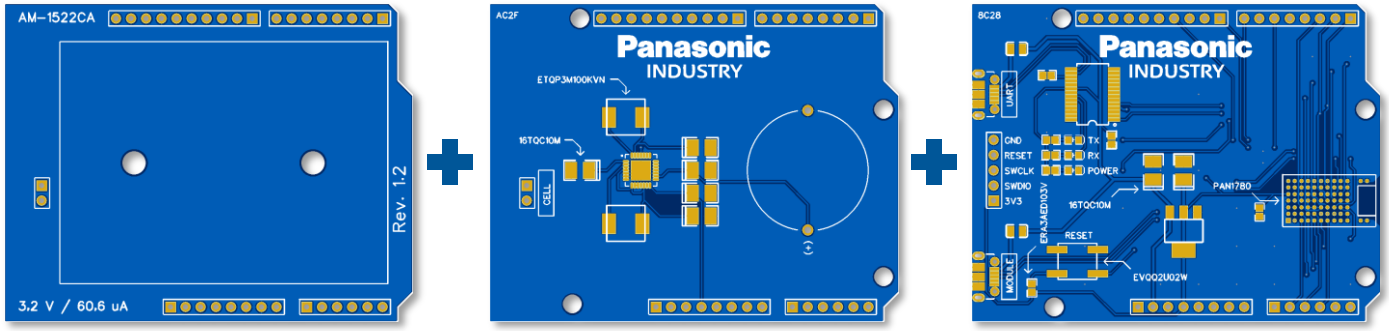
Hardware Architecture

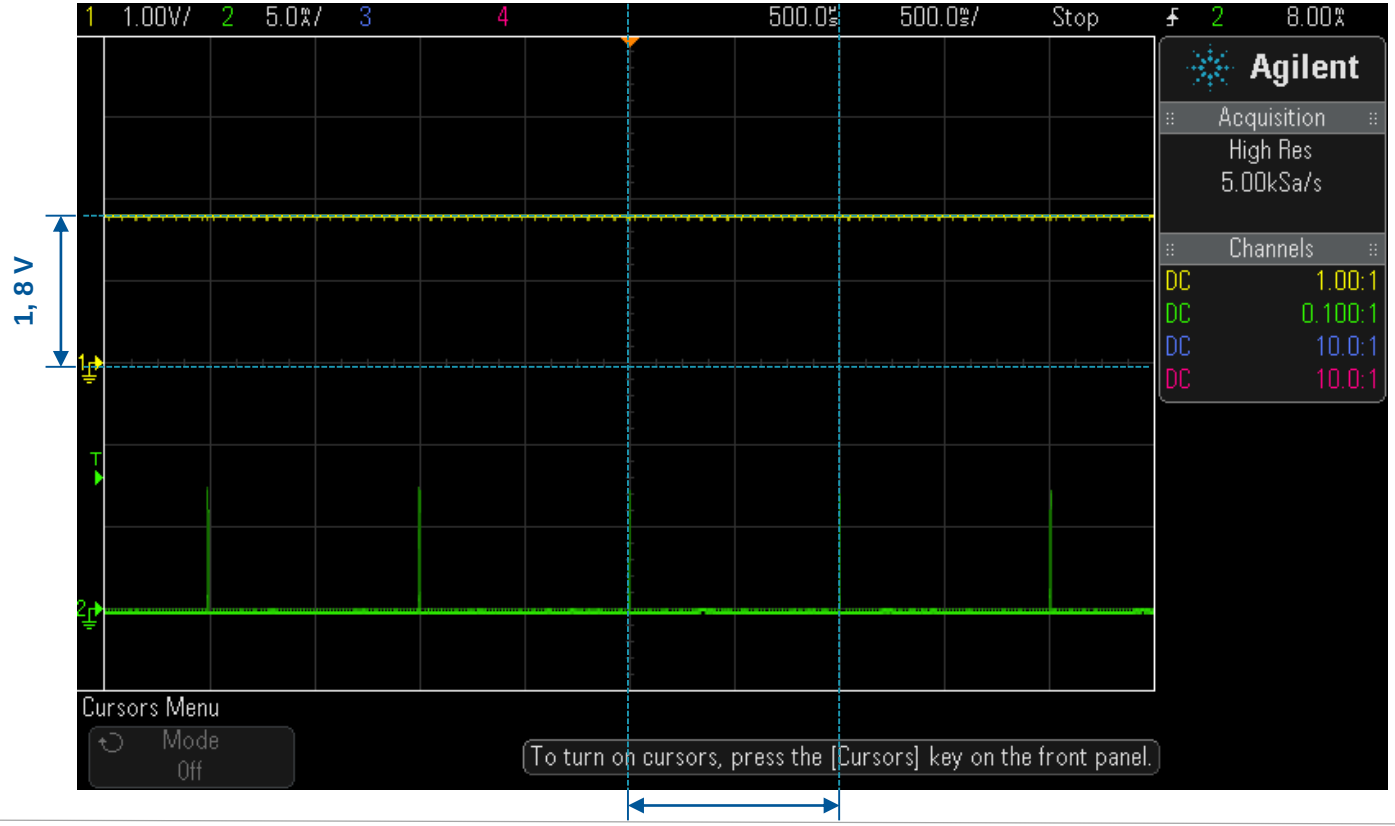


0 dBm



1,8 V

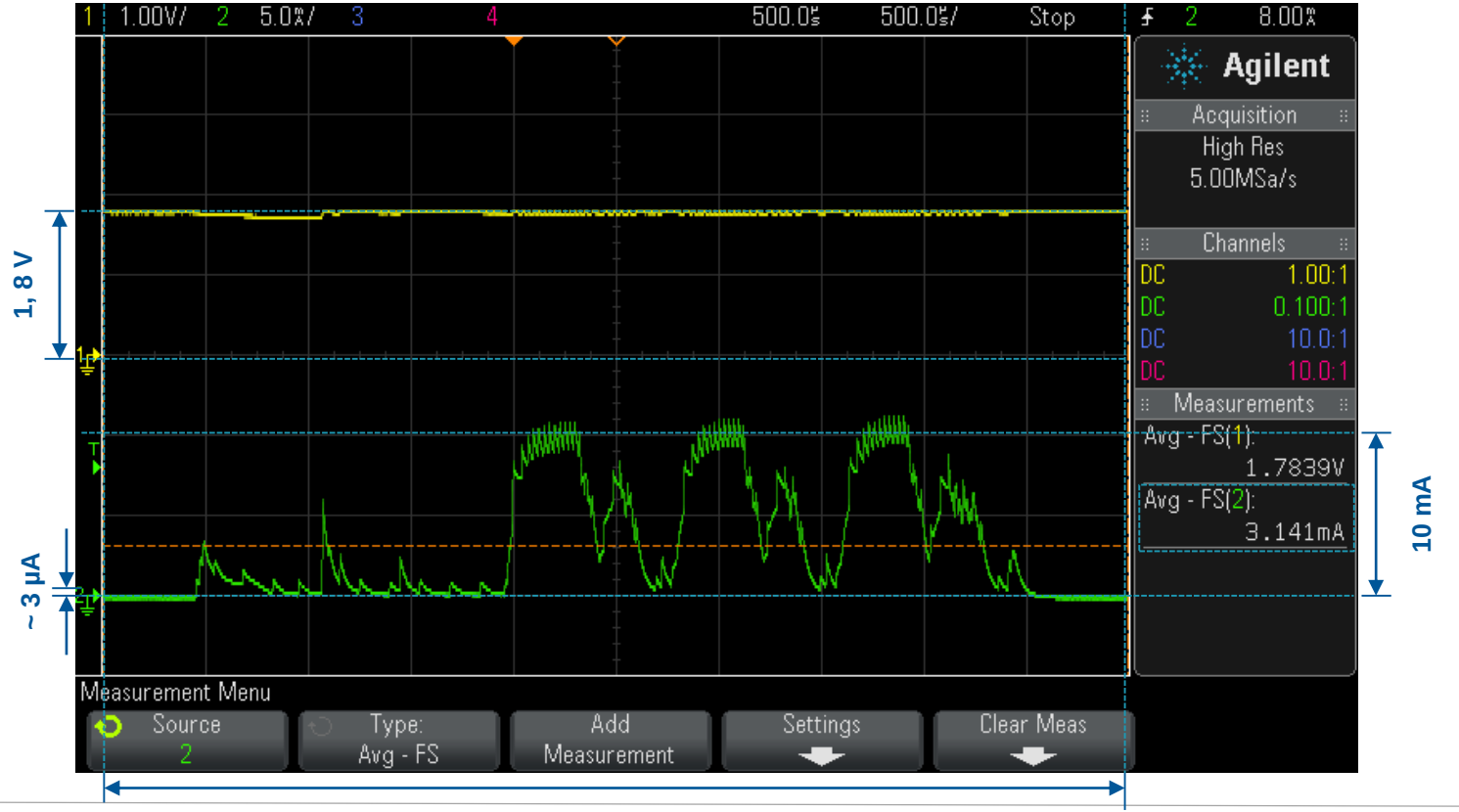
Transceiver Active – Advertising Interval



0 dBm

1,8 V

Transceiver Active – Advertising Interval



0 dBm

1,8 V

- Average transmit current

$$I_{transmit} = 3{,}1\ mA * 5\ ms * 1\ Hz = 15{,}5\ \mu A$$

- Idle mode current

$$I_{idle} = 3{,}0\ \mu A$$

- Average total current

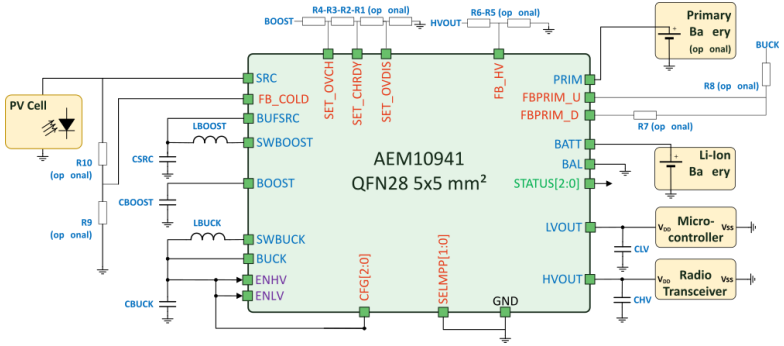
$$\mathbf{I_{total} = 18{,}5\ \mu A}$$

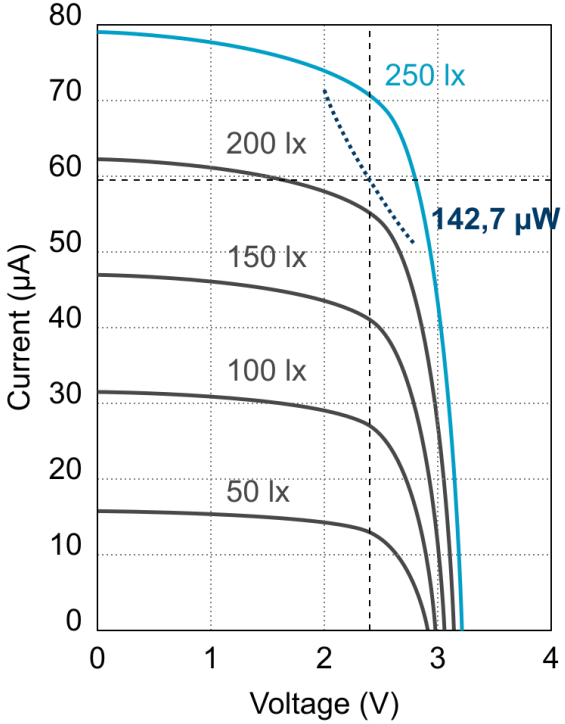
0 dBm

1,8 V

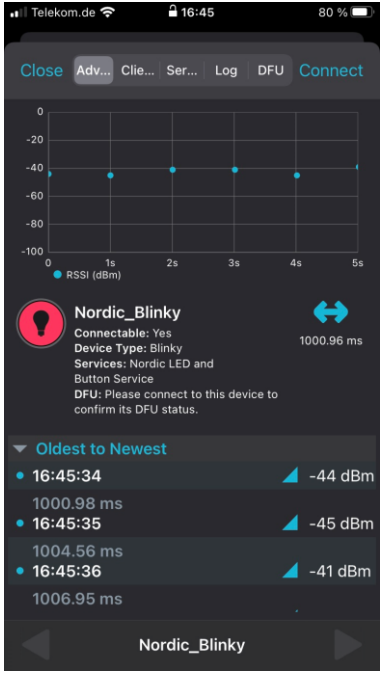
Maximum Power Point

- The minimum recommended illumination for office spaces is 500 lx.
- The AM-1522 provides enough margin between 200 and 250 lx.
- The e-Peas AEM10941 tracks the maximum power point (MPP) of the cell.
- It ensures optimal energy flow between the cell, the storage capacitor and the SoC module.





Setup in Action



Output of Nordic nRF Connect iOS app

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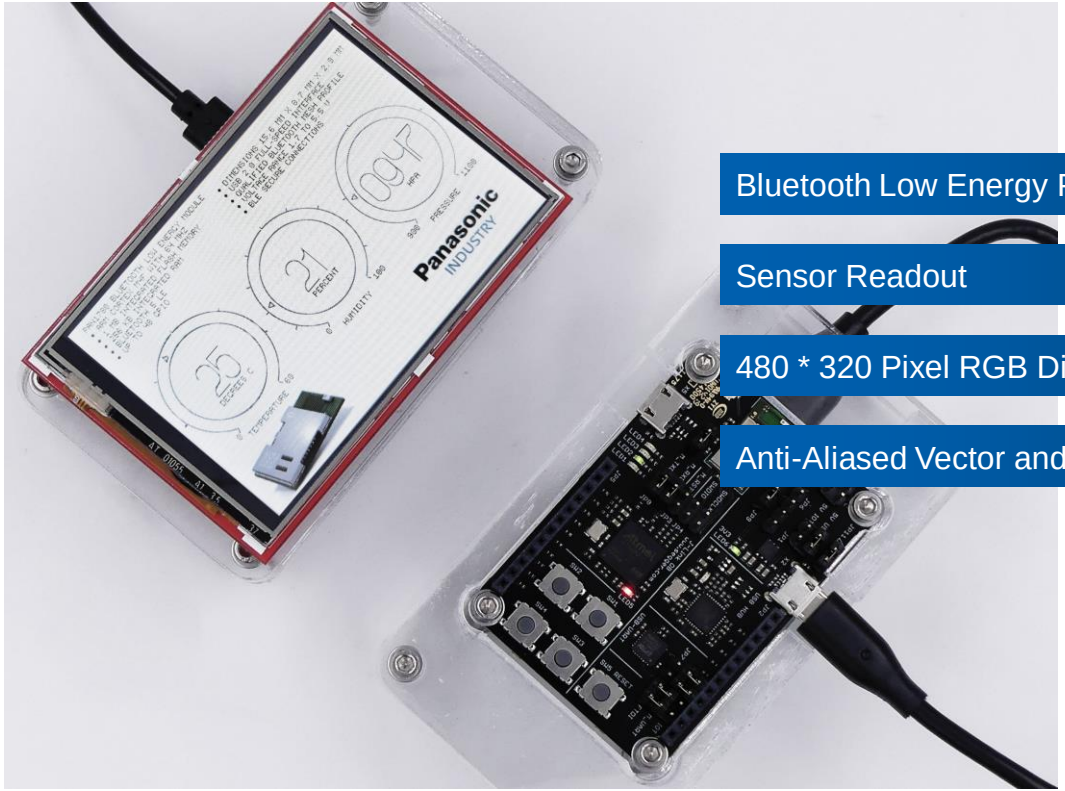
Key Takeaways

- The PAN1780 is a perfect solution for truly low-energy Bluetooth Low Energy applications.
- It is easy to design and optimize IoT products.
- Panasonic Industry components help your R&D to reduce time to market.

Check out other applications which can be built with PAN1780!



- Bluetooth Low Energy Peripheral and Central
- Sensor Readout
- 480 * 320 Pixel RGB Display Control
- Anti-Aliased Vector and Raster Graphics

Thank you!

Q/A